

Unemployment, Official Economy and the Dimensions of the Shadow Economy: An Empirical Analysis for Sri Lanka using SEM Approach

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Keywords: *Shadow Economy; Unemployment Rate; MIMIC Models; Okun's Law*

Introduction

Economists and policy makers still have a series of issues when accounting all unobserved market fractions in a challenging market economy. These challenges get worse within complex market structures in developing economies. One of the challenges is the expansion of unofficial and hidden economic activities which is generally known as the '*Shadow Economy*' (*SE*). It includes economic activities which fall outside of the government accounting and represents some form of unofficial economy and a part and parcel of criminal and informal transactions.

Schneider (2004) illustrates an increasing trend for the size of shadow economy in Sri Lanka between 1999-2003 periods and it was 45.9% of average. However, Schneider et al. (2010) estimate 43.9 % of SE as an average from 1999 to 2007. Moreover, their results demonstrate a decreasing trend in the relative size of SE over the years. However, the relative proportion of the SE still seems to be a problem in Sri Lanka.

The affiliation between SE and unemployment rate also an identical matter considered by number of researchers. According to Alanon and Antonio (2005), high rates in unemployment encourage more individuals to find a job in the SE. On the other hand there is also a possibility to limit the job opportunities in the SE due to very high unemployment levels. In Dell'Anno and Solomon (2008), there was positive relationship between unemployment rate and the SE for the

countries they use in the study. The empirical results used by Davidescu and Dobre (2012) mention that there is a strong evidence of *uni-directional causality*¹ running from unemployment rate to SE at 1% level for U.S.A. This study basically attempts to estimate the Sri Lankan Shadow Economic activities as a percentage of official estimates by using unemployment rate as a key proxy, while revolving the wheel of non-clarified zones and market functions through overstepping into the traditional official estimates.

Objectives

First objective is to select the appropriate MIMIC models to estimate the SE. Secondly we estimate the size of SE of Sri Lanka using those models. Then we test whether there is a relationship between growth of SE and official economy.

Methodology

This study attempts to estimate the size of the SE by *Multiple Indicator Multiple Cause Model*² (MIMIC). Structural Model includes two kinds of equations, the structural equation and the measurement equation. Equation consists of the relationship between unobserved variable (η) and the causes (X_n).

$$\eta_i = \beta_1(X_{1i}) + \beta_2(X_{2i}) + \beta_3(X_{3i}) + \dots \dots \dots \beta_n(X_n) + \varepsilon_i \quad (1)$$

where, $i = 1 \dots \dots n$. On the other hand, the equations that links indicators (Y) with the unobserved variable (η) is called the measurement model.

$$Y_1 = \alpha_1\eta + \xi_1, Y_2 = \alpha_2\eta + \xi_2, Y_3 = \alpha_3\eta + \xi_3 \dots \dots, Y_i = \alpha_i\eta + \xi_i \quad (2)$$

¹Uni-directional causality is indicated if unemployment rate cause SE, then SE does not cause unemployment rate.

² The Multiple indicator multiple cause model (MIMIC) has its basis from factor analysis of psychometrics and its revelation in economics is through the latent variable models of Zellner and Goldberger in 1970's.

Then the path diagram of the Structural Model has been developed through combining both equations to explain the unobserved variable. The models were estimated using STATA-12 statistical software. The best and structural models were chosen to calculate SE as a percentage of Sri Lankan GDP from benchmark equation.

This equation can be simplify as below,

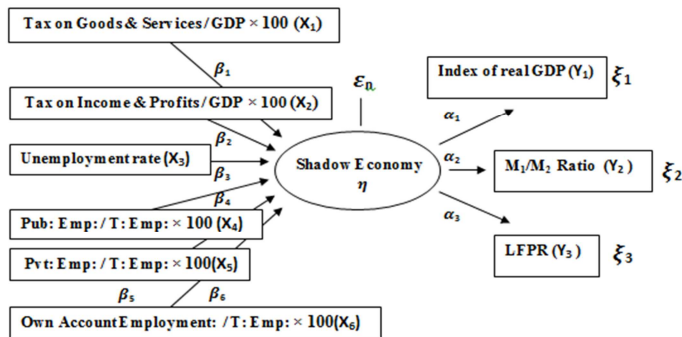
$$[\tilde{\eta}_t \times [\eta^*_{base} / \tilde{\eta}_{base}]] = \hat{\eta}_t \quad (3)$$

where $\tilde{\eta}_t$ for the value of structural calculation as a percentage of GDP from the selected MIMIC model for year t, η^*_{base} for the average size of the previous estimations of SE in the base year (Appendix, Table 1), $\tilde{\eta}_{base}$ for value of the structural calculation from the selected MIMIC model for the base year and $\hat{\eta}_t$ for size of the SE as a percentage of GDP in Sri Lanka. Thereafter, the estimated values will be taken to re-examine the well-known Okun's law through an augmented equation to investigate the structural relationship.

$$g_t^y = \alpha_1 \Delta u_t + \alpha_2 g_t^{ni} + \varepsilon_t \quad (4)$$

Where Δu_t for the change in unemployment rate, g_t^{ni} is the annual growth rate of the estimated SE of i^{th} model and g_t^y is the annual growth rate of the official economy.

Figure: 1: The MIMIC model path diagram with variables and coefficients



Source: Authors' construct

Results and Discussions

This study introduces three MIMIC models through the analysis including MIMIC 5-1-2a (Meaning that five variables on the left and two variables on the right in the above figure), MIMIC 4-1-2b and MIMIC 3-1-3a considering year 2002 as the base year (Appendix, Table 2). Structural Equation (5) is extracted by the coefficients from **MIMIC 5-1-2a**.

$$\tilde{\eta}_t / GDP_{2002} = -0.42 X_{1t} - 0.36 X_{3t} - 0.37 X_{4t} + 0.11 X_{5t} \quad (5)$$

(- 4.34) (- 4.52) (- 2.09) (2.42)

According to MIMIC 5-1-2a in equation 5, the Sri Lankan SE as a percentage of GDP will depend on tax on domestic goods and service, unemployment rate, public employment and private employment. Here, three coefficients negatively affected to the size of the SE in Sri Lanka.

Similarly, **MIMIC 4-1-2b** and **MIMIC 3-1-3a** models estimated and the results are in the appendix (Table 2). According to MIMIC 4-1-2b, the Sri Lankan SE as a percentage of GDP will depend only on unemployment rate and private employment. According to MIMIC 3-1-3a, the Sri Lankan shadow economy will depend on only unemployment rate and private employment.

Then the benchmark calculations for each model derive a series of average values for the Sri Lankan SE from 1990-2012. Calculations for MIMIC 5-1-2a vary between 91% and 32% from 1990 to 2012 with a decreasing trend (Appendix Table 3.1, 3.2 & 3.3). On the other hand, calculations for MIMIC 4-1-2b and MIMIC 3-1-3a demonstrate the average size of SE between 14% and 52% with an increasing trend (Appendix Table 3.1, 3.2 & 3.3). Re-examination for Okun's law for MIMIC 5-1-2a, MIMIC 4-1-2b and MIMIC 3-1-3a demonstrate expected negative relationship between GDP growth rate and change of unemployment rate. However, all three models did not illustrate a significant relationship between the growth of SE and the growth of official GDP.

Conclusion

Based on the results of the structural equations First, strengthening the precision of existing tax structure is required. Pro-active policy is needed to strengthen the public sector employment. Results also revealed the fact that increase in the public employments and increase tax revenue reduces the size of the SE. However, Private sector employment increases the SE. Underemployment situations also enhance SE activities. Finally, the results from re-examination of Okun's law give a hint that, the growth of SE and official economy are not interdependent.

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Appendix

Table 1: Estimates of the size of Sri Lankan Shadow Economy in 2002

Author/Authors	Source/method	Size of Shadow Economy
Schneider (2004)	MIMIC Model	47.2%*
Schneider <i>et al.</i> (2010)	MIMIC Model	44.1%
Average size		45.65%

Note: *(Mean of 2002/3)

Table 2: Estimated Coefficients of the MIMIC models

Models	Taxes on Good and Services	Taxes on income and profits	Unemp. Rate	Public emp.	Private emp.	Own account workers	GDPI	M1/M2	LFPR	χ^2 (p-value)	RMSEA (p-value)	AIC	BIC	Df
	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	Y ₁	Y ₂	Y ₃					
MIMIC 3-1-3a	-	- 0.006 (- 0.01)	- 0.718** (- 2.76)	-	0.48*** (23.76)	-	- 0.41	- 0.12 (- 0.24)	- 0.22*** (- 6.14)	22.91⁺⁺	0.285⁺⁺	193.38	214.95	08
MIMIC 3-1-3b	-	-	0.24* (1.74)	-	0.9*** (3.95)	- 0.41*** (- 4.67)	- 0.447	- 0.036 (- 0.56)	- 0.23	1513.6 ⁺⁺	2.437 ⁺⁺	1754.3	1772.5	11
MIMIC 4-1-3a	-	- 0.42* (- 1.79)	0.75*** (5.22)	0.367 (1.33)	- 0.23*** (- 4.36)	-	- 0.187 (- 0.69)	0.265 (1.2)	0.63*** (8.8)	30.07 ⁺⁺	0.275 ⁺⁺	272.3	299.6	11
MIMIC 4-1-3b	0.99*** (5.03)	-	0.29** (2.69)	0.31 (0.84)	-	0.34 (0.99)	- 0.34* (- 1.65)	- 0.05 (- 0.22)	0.526*** (4.16)	14.09	0.133	254.5	282.8	10
MIMIC 4-1-3c	-	- 0.47* (- 1.74)	0.75*** (3.82)	-	- 0.24 (- 0.68)	0.06 (0.22)	- 0.21 (- 0.68)	0.22 (0.91)	0.62 (6.61)	26.44 ⁺⁺	0.267 ⁺⁺	279.6	307.9	10
MIMIC 4-1-3d	0.71** (2.45)	-	0.61* (1.68)	-	- 0.12*** (- 3.6)	0.1 (0.42)	- 0.24 (- 0.66)	.003 (0.01)	0.67*** (4.32)	18.58 ⁺	0.193	304.7	333.1	10
MIMIC 5-1-3a	0.72** (2.19)	- 0.39* (- 1.79)	0.62*** (3.83)	0.27 (1.16)	- 0.12 (- 0.3)	-	- 0.308 (- 1.01)	0.13 (0.44)	0.71*** (9.41)	31.16 ⁺⁺	0.263 ⁺⁺	309.7	346.1	12
MIMIC 5-1-3b	0.82*** (4.11)	-	0.56*** (3.6)	0.29 (1.1)	- 0.11*** (- 3.87)	0.19 (0.77)	- 0.235 (- 0.91)	- .009 (- 0.04)	0.67*** (7.73)	18.64	0.137	371.78	406.98	13
MIMIC 6-1-2a	0.92 *** (4.44)	- 0.3 (- 1.16)	0.29** (2.09)	0.38 (1.33)	- 0.1*** (- 3.14)	0.133 (0.44)	- 0.123 (- 0.23)	-	0.65*** (5.62)	14.25	0.184	513.3	554.2	08
MIMIC 5-1-2a	- 0.42*** (- 4.34)	-	- 0.36*** (- 4.52)	- 0.37** (- 2.09)	0.11** (2.42)	0.18 (1.00)	0.047*** (5.76)	1	-	56.85⁺⁺	0.515⁺⁺	341.26	371.92	08

Table 2: Estimated Coefficients of the MIMIC models (Cont.)

Models	Taxes on Good and Services	Taxes on income profits and c.	Unemp. Rate	Public emp.	Private emp.	Own account workers	RGDPI	M1/M2	LFPR	χ^2 (p-value)	RMSEA (p-value)	AIC	BIC	Df
	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	Y ₁	Y ₂	Y ₃					
MIMIC 4-1-2a	1.04*** (6.13)	- 0.3 (- 0.96)	0.258*** (2.63)	0.295 (0.85)	-	-	- 0.359* (- 1.75)	-	0.51*** (3.93)	9.68	0.2	308.96	333.94	05
MIMIC 4-1-2b	-	-	0.691** (2.61)	0.299 (0.87)	- 0.467** (- 2.41)	0.11 (0.4)	0.056** (2.47)	0.64*** (4.1)	-	21.7⁺⁺	0.381⁺⁺	268.68	293.66	05
MIMIC 3-1-2a	-	-	- 0.71** (- 2.14)	- 0.24 (- 0.55)	0.45*** (3.43)	-	- 0.4*** (- 3.92)	-	- 0.115*** (- 2.32)	7.12	0.184	373.2	391.3	04

Notes: z – statistics are given in parentheses for each coefficient. Coefficients are significant if | z - statistic | > 1.96 for 95% confidence.

*** Means significance of coefficients under 99% of confidence level. ** for 95% and * for 90 % respectively.

⁺⁺ Means good fitting (p-value > 0.01) where 99% confidence and ⁺ Means good fitting (p-value > 0.05) where 95% confidence.

RMSEA – Root mean squared error of approximation. P-value for test of close fit (RMSEA > 0.05)

AIC – Akaike's information criterion, BIC- Bayesian information criterion.

Df- Degrees of freedom. (Values obtain from the each estimated models)

Model selection Criteria:

- (1) Unemployment rate (X₃) should be significant – Coefficient can be either positive or negative. (Assumption -Theoretical)
- (2) Model should be fitted under either 95% or 99% confidence level. (χ^2 and RMSEA)
- (3) Lowest values of AIC and BIC are the final choice if there are number of fitted models in line with above three conditions.

Table 3.1: New estimate for Sri Lankan shadow economy (1990-1997)

Estimates of SE (% Of GDP)	Year							
	1990	1991	1992	1993	1994	1995	1996	1997
MIMIC 5-1-2a	91	86.3	78.8	70	64.86	63.5	57.29	55.7
MIMIC 4-1-2b	14.79	25.77	26.7	32.47	36.15	37.86	42.18	41.72
MIMIC 3-1-3a	14.45	25.51	26.45	32.27	35.98	37.73	42.1	41.65

Table 3.2: New estimate for Sri Lankan shadow economy (1998-2004)

Estimates of SE (% Of GDP)	Year						
	1998	1999	2000	2001	2002	2003	2004
MIMIC 5-1-2a	51.1	49.53	45.64	46.1	45.65	42.88	42.18
MIMIC 4-1-2b	40	43.4	45.9	47.86	45.65	46.36	49.47
MIMIC 3-1-3a	39.97	43.4	45.93	47.9	45.65	46.37	49.5

Table 3.3: New estimate for Sri Lankan shadow economy (2005-2012)

Estimates of SE (% Of GDP)	Year							
	2005	2006	2007	2008	2009	2010	2011	2012
MIMIC 5-1-2a	42.08	41.09	38.23	38.39	36.07	33.45	32.26	33.62
MIMIC 4-1-2b	50.32	47.1	49	48.15	48.38	49.22	49.7	51.3
MIMIC 3-1-3a	50.37	47.16	49.13	48.25	48.47	49.34	49.84	51.45