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REFLECTS THE HIDDEN: MEASURING SRI LANKAN SHADOW ECONOMY

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ABSTRACT

This study refines both theoretical and pragmatic basis in estimating the size of shadow economy in Sri Lanka. Theoretical investigation had noticed a possibility of use the rate of underemployment as a determinant to measure the size of shadow economy. Further it reveals that the relative magnitudes of job finding rate (f) and devaluation in job separation rate (f*) can change the direction of relationship between the rate of underemployment and the size of shadow economy. Empirical investigation with two fitted MIMIC models; MIMIC 5-1-2a and MIMIC 7-1-2 and Benchmark calculations derive a series of average values for Sri Lankan shadow economy for the period 1990-2015. Calculations for both models tend to decrease from 40-50 percent of GDP. Further comparisons express a strong positive relationship between shadow economy with both underemployment and self-employment.

Contribution/ Originality: This study contributes the first logical analysis to develop a structural relationship between the rate of underemployment and shadow economy. Further it revivals the depth of Sri Lankan shadow economy as an annual estimations from 1990 to 2015 using standard multivariate analytical techniques.

1. INTRODUCTION

Shadow economy includes economic activities which fall outside of the government regulatory. There are two popular approaches to define shadow economy. They are the 'Definitional approach' and the 'Behavioral approach'. According to the Definitional approach, those are simply unrecorded economic activities. Behavioral approach defines shadow economy according to its behavioral characteristics (Schneider and Enste, 2000).

Monitoring the characteristics and deeds of shadow economy is very important for whole social and economic conditions of a country. It generates unofficial income in an economy and it will be a focal issue for any type of government which not reflects their policy planning and strategic perspectives. Generally the creation and improvements in a shadow economy has relations with formal, informal and illegal economic activities. The formal sector of an economy deals officially with the government and pays taxes. It includes large enterprises, the

government, hospitals, universities, foreign investors and etc. Therefore shadow economic activities emerge unfavorably to the formal base of economy. Rigidness of the rules and regulation and the behavioral impacts of the government can induce any improvements in shadow economy.

Impact from taxation and unemployment are key determinants (Dell'Anno and Solomon, 2008; Schneider *et al.*, 2010; Davidescu and Dobre, 2012) which are used to measure the size of shadow economy. In addition to that, this paper uses a series of equations to investigate the nature of relationship between underemployment and shadow economy. With the purpose to identify the empirical significance of the investigated relationship, study estimates the size of Sri Lankan shadow economy for the period 1990-2015. This approach may vital in the South Asian context, because the South Asian economies are generally having issues along with unrevealed economic activities and the underemployment. Moreover, study provides an opportunity for capture the nature of causal relationship among different labour market dynamics. It will provide an inevitable opportunity to examine how features of public finance, public services and official economy may discourage through the impact from unrevealed economic activities in a developing nation like Sri Lanka.

2. LITERATURE REVIEW

The theoretical basis for measuring the labour force was implemented by the 13th International Conference of Labour Statisticians in 1982. Based on the above facts, standards were set to classify people according to their activities during a short reference period, such as a week. This classification describes total population in three categories, the employed population, the unemployed population and the economically inactive population. Those economically inactive populations were considered as the portion of population stay out of the standards of labour force. This framework is widely recognized in the international level and allows each country to completely understand the nature as well as validity of their population. In more detail, according to Karunatilake (2006) labour force is a pool of people and the composition of it may depend on the size and nature of inflows and outflows of economically active portion. Inflows to the labour force may depend upon growth and structure of the population, effectiveness of the education system, nature of available economic activities and social; cultural values as he mentioned. On the other hand, outflows may depend upon the age structure of the population and migration.

The classifying criteria of this labour force framework is used to determine whether a person is employed or unemployed under three benchmarks: (a) to work or to have a job, (b) to be willing to work, and (c) to be available for work. Unemployment, for example, includes people who did not work nor had a job but who were willing to work and were available to work during the reference week. Higher Level of unemployment is considered as a significant obstacle for economic development in a country. According to the International Labour Organization (2013) more than 197 million people or 6 % of the world workforce was without a job in 2012 and now it may be around 5.8% in 2016 according to their forecasts. The affiliation between shadow economy and labour force is vastly discussed upon the relationship with the rate of unemployment. The 'unemployment rate' is the measure of the prevalence of unemployment and it is calculated as a percentage by dividing the number of unemployed individuals by all individuals currently in the labor force. According to Alanon and Antonio (2005) high rates in unemployment instigate more individuals to find a job in the shadow economy. In Dell'Anno and Solomon (2008) there was a significant positive relationship between unemployment rate and the shadow economy. Which means higher the size of shadow economy will intend to increase the level of unemployment rate.

Moreover, Dell'Anno and Solomon (2008) demonstrate that the structural relationship exists between the level of unemployment and shadow economy as below. They have shown a structural relationship between shadow economy and unemployment by adapting the model by Hall (1979). Consider a closed economy with total labour force of L workers and it is constant. The labour force is consists workers who are employed (E) and Unemployed (U).

$$L = U + E \quad (1)$$

Then the rate of unemployment = U/L

If Job separation rate = *s* and job finding rate = *f*

The job separation rate is the rate at which a worker loses a job and becomes unemployed. The job finding rate is the rate at which a worker finds a job and becomes employed (Dell'Anno and Solomon, 2008).

At the steady state, (equilibrium) *s=f*

Then, $fU = sE \quad (2)$

Substitute $E = L - U$ to (2),

$$fU = s(L - U)$$

$$fU = sL - sU$$

Then to obtain the Unemployment Rate, divide the whole equation by L.

$$\frac{fU = sL - sU}{L}$$

$$\frac{fU}{L} = s\left(1 - \frac{U}{L}\right) \quad (3)$$

Solve above equation to U/L ,

$$\frac{fU}{L} = s - \frac{sU}{L}$$

$$s = \frac{fU}{L} + \frac{sU}{L}$$

$$s = \frac{U}{L}(f + s)$$

$$\frac{U}{L} = \frac{s}{(f+s)} \quad (4)$$

Therefore, according to the equation (4), higher the job separation rate (*s*) will increase the unemployment rate and higher the job finding rate (*f*) will decrease the rate of unemployment. Then above derivations can be used to relate the shadow economy to unemployment rate. The structural relationship developed by Dell'Anno and Solomon (2008) according to the above theoretical derivation is demonstrated as a positive relationship between shadow economy and unemployment rate. Further, it explains that an increase in the workers who lose jobs (job separation rate) in formal sector increases the unemployment rate and this cause a rise in shadow economy as a proportion of labour force. This relationship was followed by different researchers to find the size of shadow economy. The empirical results used by Davidescu and Dobre (2012) point out that there is a strong evidence of

uni-directional causality running from unemployment rate to shadow economy at the 1% level of significance. This positive relationship was used as one of the key proxies to estimate the size shadow economy in different economies.

Unemployment is by far the most frequently reported indicator of the labour market in the mass media of virtually every country in the world. Nevertheless, unemployment statistics are often criticized in developed and in developing countries for failing to reflect the true extent of the employment problem (Sengenberger, 2011). New challenges occur through the underutilization and inefficiency matters of current labor market and not because of the usual unemployment issue. It tends to generate underemployment in recent scenarios. The framework given by Wilkins (2004) can be used to identify the verity of labor supply activities in a regular economy.

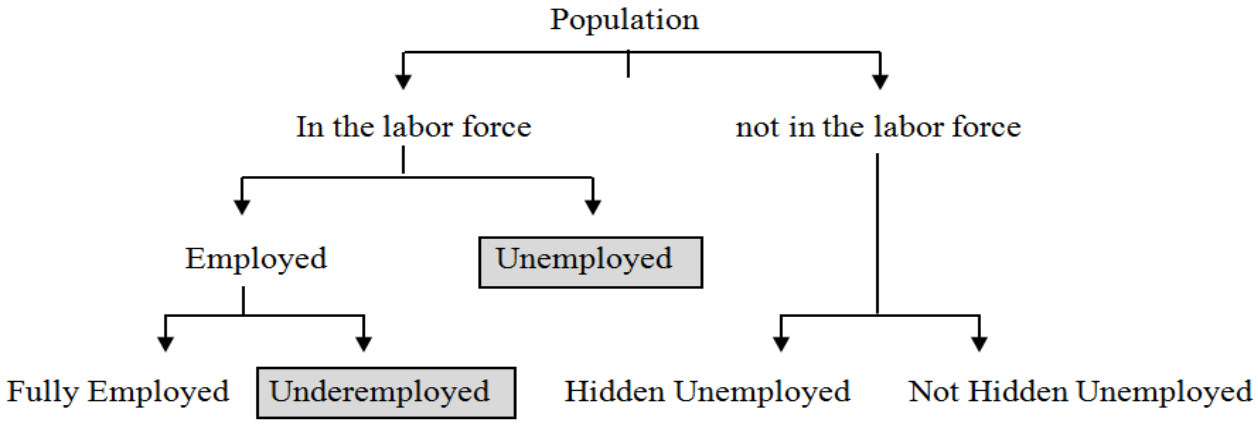

Figure-1. Labor Supply Activity Framework

Source: Wilkins (2004)

According to the above diagram, being unemployed is not the only matter which can undermine the efficiency of labor force. Employed sector of the labor force contains possibility of underutilization of their full capacity. Moreover, inadequate job opportunities tie to the qualification of employee, lack of information at the job market and lack of transparency of institutional or administrative structures are some other reasons to undermine the efficiency of labor force.

Underemployment is a situation where employee works, but not belongs to their actual or exact capacity. Here this 'capacity' will be identified in different prospects such as underutilization, underestimate or undermine the employee skills and capabilities. Underemployment is identify in to two forms namely, visible and invisible underemployment (Labour Force Survey (LFS), 2014). Visible underemployment refers to inefficiency within the employed people. This is also known as the time related underemployment which can be observed in developed countries. On the other hand, invisible underemployment is characterized under the factors such as mismatch of skills, underutilization of skills and low income recipients. According to Walling and Clancy (2010) three different scenarios are used to define the nature of underemployment.

a. A situation where the skills of highly qualified people are under used.

b. A situation where employees are not fully utilized in terms of their productive capacity.

c. A situation where an employee wants to work more hours than he/she usually does with his/her current working surface.

These three scenarios will demonstrate the nature of underemployed matter within the labor market. First two from the above three scenarios are similarly mentioned by the ADB (2005). According to ADB, underemployment can take four forms. They are working less than full time, having higher skills than the job requires, overstaffing issue and having raw labor with few complimentary inputs. Here this overstaffing issue or having raw labor as a usual practice of the institution or firm can create a situation where an employee wants to work more hours than he is usually engaged.

The degree of impact from the above alternatives may differ, on the fact that the labor market belongs to a developed or under developed country. As in Walling and Clancy (2010) developed economies such as United Kingdom (UK) faces the underemployment problem in the situation where an employee wants to work more hours than he does. Therefore the degree of underemployment is highly reflected through the part time workers at the UK labor market. Underemployment issues in under developed countries are highly reflected through the underutilization of qualifications and productive capacity of employees. On the other hand according to Golub and Hayat (2014) underemployment issues in under developed countries such as African nations occur due to lack of demand for labor rather than worker characteristics. Moreover they mention this underemployment issue as a Pervasive matter in Africa to increase informal employment.

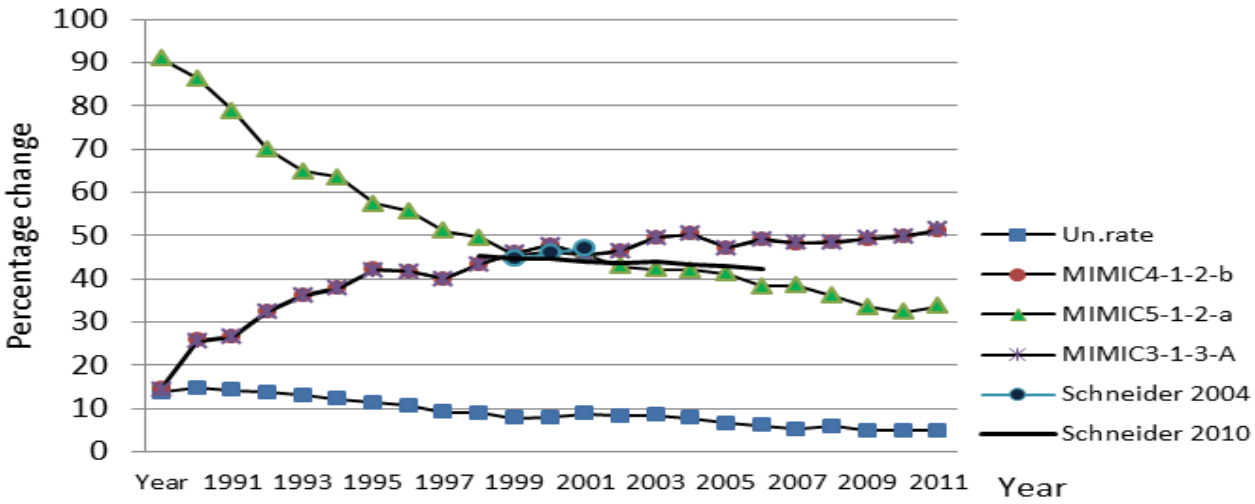

Figure-2. Comparison of Estimated Shadow Economy and Unemployment rate in Sri Lanka
Source: Author's Preparation Using (Schneider, 2004; Schneider *et al.*, 2010; Samaranayake and Dayarathna-Banda, 2015)

In the Sri Lankan context, the first attempt to estimate the size of shadow economy was done by Schneider in 2004. According to his measures, Sri Lankan shadow economy varies from 44.6% to 47.2% while demonstrate an increasing trend over the period from 1999-2003. Then again Schneider *et al.* (2010) measured the size of shadow economy for economies all over the world. Those measurements are from 1999-2007 and vary between 45.2-42.2 percent with a decreasing trend. However they use the same casual and indicator variables in common to measure the average size of shadow economy for either developed or developing economies. Thereafter, Samaranayake and Dayarathna-Banda (2015) measured the size of shadow economy in Sri Lanka while choosing the most appropriate causes and indicators with the nature of Sri Lankan economy. As in their results, three significant models are suggested to identify the size of shadow economy and the estimated sizes vary between 14-50 percent of GDP from 1990-2012.

Then taxation and other type of employment can also be key reason to determine the size of shadow economy as same as the unemployment rate. Moreover, Samaranayake and Dayarathna-Banda (2015) are mention and explain that the underemployment in public sector can be a specific reason to increase shadow economy activities within the Sri Lankan market. However, lack of statistics may create an issue in understanding impact from underemployment rate to the shadow economy. Therefore further interests needed to clarify the nature of factors such as underemployment and shadow economy to identify an exact figure for Sri Lankan market structure.

3. METHODOLOGY

Study uses the structural relationship developed by Dell'Anno and Solomon (2008) between the level of unemployment and shadow economy by adapting the model by Hall (1979) to develop the structural relationship

between the rate of underemployment and the size of shadow economy. Study uses certain assumptions in advance to facilitate the core of the theoretical argument and its rationale.

With regards the empirical methodology, the size of shadow economy cannot be directly observed; hence its magnitudes have to be estimated by a proper approach. This study attempts to estimate the size of the shadow economy by Multiple Indicator Multiple Cause (MIMIC) model under Structural Equation Modeling (SEM) approach. Structural Equation Models are used to obtain statistical relationships among unobserved and observed variables. This method considers shadow economy as an unobserved variable link with a set of observed causal variables and also with a set of observed indicators to reflect the changes in the size of the shadow economy.

These sorts of models include two kinds of equations, 'the structural equation' and the 'measurement equation system'. The equation consists the relationship between unobserved variable (η) and the causes (X_n) is called the 'Structural Equation'. So the size of shadow economy is linearly determined by a set of observable exogenous causes ($X_1, X_2, X_3 \ldots X_n$) and the error term ε_i

$$\eta = \beta_1(X_1) + \beta_2(X_2) + \beta_3(X_3) + \ldots\ldots\ldots\ldots\ldots \beta_n(X_n) + \varepsilon_n \qquad (5)$$

On the other hand, the equations that link indicators (Y_n) with the unobserved variable (η) is called the measurement model. So the shadow economy linearly determines subject to set of observable exogenous indicators ($Y_1, Y_2, Y_3 \ldots . Y_n$) and to error terms ($\xi_1, \xi_2, \xi_3 \ldots . \xi_n$).

$$Y_1 = \alpha_1\eta + \xi_i,\ Y_2 = \alpha_2\eta + \xi_i,\ Y_3 = \alpha_3\eta + \xi_i \ldots\ldots\ldots\ldots,\ Y_i = \alpha_i\eta + \xi_i \qquad (6)$$

Here the structural error term (ε_n) and measurement errors ($\xi_1, \xi_2, \xi_3 \ldots . \xi_n$) are normally distributed, mutually independent and all variables are taken to have zero expectation in line with OLS properties. This study depends only on secondary data and information sources. As determinants of the existence of the shadow economy, the following variables are included in this research. Seven causal variables and two indicators are going to be used to visualize the size of the shadow economy in Sri Lanka using STATA-13 statistical software.

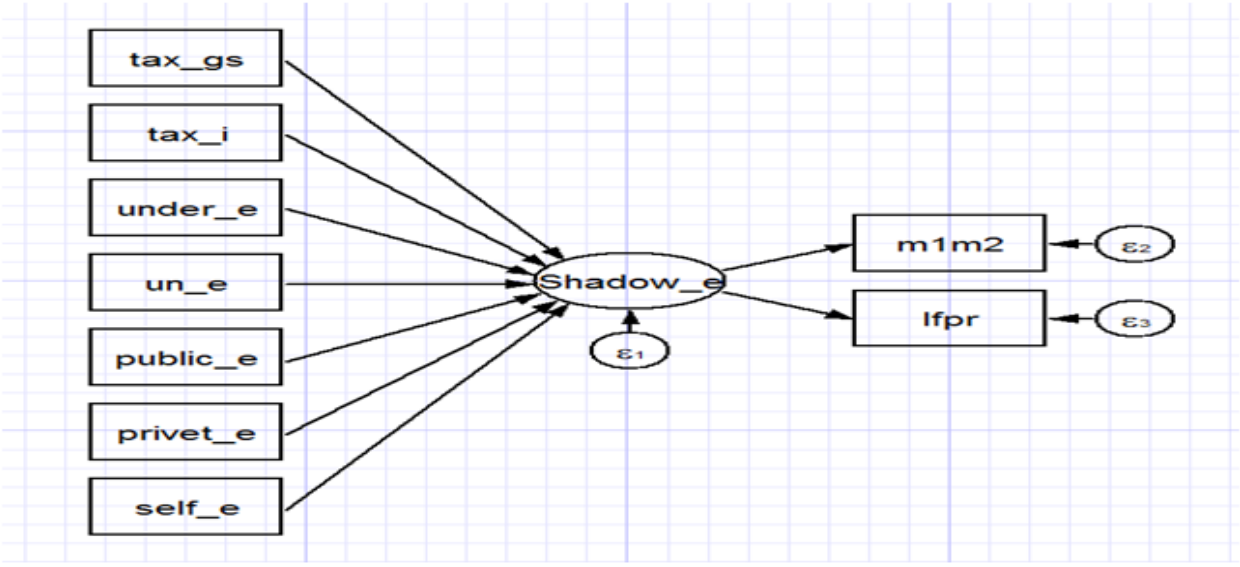

Figure-4. The MIMIC model path diagram with causal variables and indicators

Source: Author Preparation

Each and every possibility at least with three causal variables run in the software and identify the most fitted and suitable MIMIC models according to following criterion.

This study depends only on secondary data and information sources. As determinants of the existence of the shadow economy, the following variables are included in this research. Seven causal variables and two indicators are going to be used to visualize the size of the shadow economy in Sri Lanka using STATA-13 statistical software.

After the structural analyze, we can identify the fitted model with significant coefficients and their signs; which can be used to obtain the size of shadow economy. This study intends to use below benchmark equation to estimate the size of shadow economy as a percentage of the GDP in Sri Lanka..

$$[\tilde{\eta}_t / GDP_{base}] \times [\eta^*_{base} / GDP_{base}] \times [GDP_{base} / \tilde{\eta}_{base}] \times [GDP_{base} / GDP_t] = [\hat{\eta}_t / GDP_t] \quad (7)$$

This equation can be simplified as below,

$$[\tilde{\eta}_t \times [\eta^*_{base} / \tilde{\eta}_{base}] = \hat{\eta}_t \quad (8)$$

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 Shadow Economy in the base year, $\tilde{\eta}_{base}$ for value of the structural calculation from the selected MIMIC model for the base year and $\hat{\eta}_t$ for size of the shadow economy as a percentage of the Gross Domestic Production in Sri Lanka. Therefore, this study requests a base year to estimate the size of shadow economy in Sri Lanka. Then chose year 2002[1] as the base year and use the average size of previous estimates for Sri Lankan Shadow Economy.

Table-2. 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 *et al.* (2010)	MIMIC Model	44.1%
Average size		**45.65%**
Note: *(Mean of 2002/3)		

Source: Adapted from Samaranayake and Dayarathna-Banda (2015)

Then the benchmark equation can be written as below,

$$[\tilde{\eta}_t \times [\eta^*_{2002} / \tilde{\eta}_{2002}] = \hat{\eta}_t$$

In this study, Sri Lankan annual time series data for the period from 1990 – 2015 are used to investigate the nature of relationships that exist between causes or indicators and the shadow economic activities. However this is not a typical time series analysis, and uses special methodology, Structural Equation Modeling due to the impact of 'latent' or unobserved variable in the study. Required data obtained by Annual reports – Central Bank of Sri Lanka, World Bank Data Base and Labor Force Survey Annual Reports – Department of Census and Statistics. More details for data sources are given in appendix.

[1] This year reports two previous estimations for the average size of Sri Lankan SE and also a popular for number of national estimates as the base year.

4. RESULTS AND DISCUSSION

4.1. Structural Relationship between Underemployment and Shadow Economy

Since underemployment reflects a situation where the employee works somewhat lower to their actual or exact capacity, this can be a reason to either encourage or discourage the size of shadow economy. The nature of impact from underemployment to the shadow economy can be different in different types of economies. Within the under developed economies, majority of people who are employed, are not usually having a wage rate which can fulfill all their needs. Therefore this may worsen with underemployed people. In addition to that people may be underemployed within such economies due to lack of job opportunities and vocational skills. Then people with higher educational qualifications will also be engaged in low grade jobs with low salaries. Then this may provide incentives for them to engage with shadow economic activities to earn more.

Therefore above outcomes from Samaranayake and Dayarathna-Banda (2015) indicates some tight spots regarding the nature of Sri Lankan shadow economy. This is an attempt to develop a structural relationship between Underemployment and Shadow Economy while using the above models and pathway. Consider a closed economy model includes an objective of an efficient labor market to let the underemployment (U^*) to zero. This analysis may concern a situation with the presence of underemployment at the economy. If the total labour force of L workers and it is constant. The labour force is consists workers who are employed (E) and Unemployed (U).

$$L = U + E$$

Then the rate of unemployment = U/L

When the job separation rate (s) determines a rate where worker losses a job and becomes unemployed, the job finding rate (s) determines a rate where workers find a job and becomes employed. However, with the presence of underemployment in the economy, job finding rate should be determined with both proper employment and underemployment. Then if we only consider the steady state equilibrium without considering the impact from underemployment, it may give a situation where $s<f$. This means that the presence of underemployment will de-valuate the job separation rate. Because, workers who are underemployed do not prefer their current job but stay their due to lack of proper and suitable job opportunities for his/her skills and preference. Therefore steady state equilibrium can be written as below by using the impact from both proper employment and underemployment to determine f.

At the steady state, (equilibrium) $s + f^* = f$

Where add the damage of job separation rate (f^*) with the presence of underemployment. Here f^* is used as the notation, because the reason to underestimate the job preparation rate is underemployment, a part which improves the job preparation rate. When we consider the stock of workers who are employed (E) and Unemployed (U) with these rates.

From the steady state $s = f - f^*$

Then, $$(f - f^*)U = sE \quad (9)$$

When Under-employment = U^*,

Underemployment is a part of total employment. If the percentage of proper employment $(E^* -$ employees who are not under employed) is 60 per cent of total employment[2], then the underemployment can be recognized as below.

$$E - 0.6E^* = U^*$$

Then, $$E = U^* + 0.6E^* \quad (10)$$

From the equation (9) with the presence of underemployment

$(f\text{-}f^*)\, U = sE$

Then, $$E = \frac{(f-f^*)U}{s}$$

When substitute equation (10) to above,

$$U^* + 0.6E^* = \frac{fU - f^*U}{s}$$

$$U^* = \frac{fU - f^*U}{s} - 0.6E^* \quad (11)$$

When $s = \frac{U}{L}(f + s)$ from equation (4) with the presence of underemployment,

$$S = \frac{U}{L}(f - f^* + s) \quad (12)$$

Then substitute (12) to (11),

$$U^* = \frac{fU - f^*U}{U/L\,(f - f^* + s)} - 0.6E^*$$

$$U^* = \frac{(f - f^*)L}{(f - f^* + s)} - 0.6E^*$$

$$\frac{U^*}{L} = \frac{(f - f^*)}{(f - f^* + s)} - \frac{0.6E^*}{L} \quad (13)$$

If all goods in official economy are produced using only labour and labour is only the stock that are in employment, then output of official economy can be demonstrated as below.

If the output in the official economy = Y_1

Function of Technology = A
Stock of workers who are employed = E

Therefore, $Y_1 = AE$

[2] This is an assumption that 60 per cent of employees from total employees are perfectly employed and rest of 40 percent are under-employed

If technology assumed to be constant, then $\boldsymbol{Y_1 = E}$

Since $L = U + E$, then $L = U + U^* + 0.6E^*$

$$U^* = L - U - 0.6E^*$$

$$\frac{U^*}{L} = \frac{L - U - 0.6E^*}{L}$$

When $U = L - E$

$$\frac{U^*}{L} = \frac{L - (L - E) - 0.6E^*}{L}$$

When $Y_i = E$,

$$\frac{U^*}{L} = \frac{L - (L - Y_i) - 0.6E^*}{L}$$

$$\boldsymbol{\frac{U^*}{L} = \frac{Y_1 - 0.6E^*}{L}} \quad (14)$$

When the total output = Y_T and the output produced in shadow economy = Y_2

$Y_T = Y_1 + Y_2$ and then,

$$\boldsymbol{Y_1 = Y_T - Y_2} \quad (15)$$

Substitute (15) to (14)

$$\frac{U^*}{L} = \frac{(Y_T - Y_2) - 0.6E^*}{L}$$

$$\frac{Y_2}{L} = \frac{Y_T - 0.6E^*}{L} - \frac{U^*}{L}$$

$$\frac{Y_2}{L} = \frac{Y_T}{L} - \frac{U^*}{L} - \frac{0.6E^*}{L}$$

$$\boldsymbol{\frac{Y_2}{L} = \frac{Y_T}{L} - \left(\frac{U^*}{L} + \frac{0.6E^*}{L}\right)} \quad (16)$$

Then substitute (13) to (16)

$$\frac{Y_2}{L} = \frac{Y_T}{L} - \left(\frac{(f - f^*)}{(f - f^* + s)} - \frac{0.6E^*}{L}\right) - \frac{0.6E^*}{L}$$

$$\frac{Y_2}{L} = \frac{Y_T}{L} - \frac{(f - f^*)}{(f - f^* + s)} + \frac{0.6E^*}{L} - \frac{0.6E^*}{L}$$

$$\frac{Y_2}{L} = \frac{Y_T}{L} - \frac{(f - f^*)}{(f - f^* + s)}$$

$$\frac{Y_2}{L} = \frac{Y_T}{L} - \frac{f}{(f - f^* + s)} + \frac{f^*}{(f - f^* + s)} \quad (17)$$

The above equations 16 and 17 represent the nature of relationship between shadow economy, employment and the rate of underemployment. As in equation (16), shadow economy demonstrates a negative relationship with the rate of employment. Employment may comprise both underemployed and properly employed workers. However, further derivations from equation (17) gives further details on this relationship. The above negative relationship will not have a common factor for each and every economy. The increase in the stock of workers who find jobs (*f*) in formal sector increase the employment rate and this cause a decline in shadow economy as a proportion of labour force. Increase in stock of workers who are not properly employed (*f**) will improve the size of shadow economy. Moreover, the rate of proper employment (*f* - *f**) and job separation rates may determine the size of both total and underutilized job finding rates. When *f**=*0*, there will be a perfect negative relationship between underemployment and size of shadow economy. Moreover, the validity of the above outcome can be checked through re-arranging the outcome to observe the nature of the relationship between shadow economy, employment and unemployment.

When $E = U^* + 0.6E^*$, then $E^* = \frac{E - U^*}{0.6}$

Substitute above equation for E^* to equation 14.

$$\frac{Y_2}{L} = \frac{Y_T}{L} - \frac{U^*}{L} - \frac{0.6\left(\frac{E - U^*}{0.6}\right)}{L}$$

$$\frac{Y_2}{L} = \frac{Y_T}{L} - \frac{U^*}{L} - \frac{(E - U^*)}{L}$$

$$\frac{Y_2}{L} = \frac{Y_T}{L} - \frac{U^*}{L} + \frac{U^*}{L} - \frac{E}{L}$$

$$\frac{Y_2}{L} = \frac{Y_T}{L} - \frac{E}{L} \quad (18)$$

According to the equation 18, there is an inverse relationship between shadow economy and employment.

On the other hand, since $E = L - U$

$$\frac{Y_2}{L} = \frac{Y_T}{L} - \frac{(L - U)}{L}$$

$$\frac{Y_2}{L} = \frac{Y_T}{L} - \frac{L}{L} + \frac{U}{L}$$

$$\frac{Y_2}{L} = \frac{Y_T}{L} + \frac{U-L}{L} \qquad (19)$$

The equation 19 demonstrates the positive relationship between shadow economy and unemployment. Therefore the outcome derives an inverse relationship between shadow economy and underemployment rate is present according to the previous theoretical derivations and may be useful to understand the nature of relationship between underemployment and the shadow economy to some extent.

As in the above theoretical outcomes and previous research experience, shadow economy appears to be a critical matter within different economies. It causes a lot of negative consequences such as underestimation of national production of a country, ruin the government revenue and weaken the expected outcome from private and public sector employment. Moreover, this may encourage unemployed people to engage with such underground or informal economic activities and let the strength of actual labour force weaker. On the other hand for developed economies, this issue may eventually arise due to problems with time utilization. In most cases, underemployment in Developed nations occurs due to underutilization of workers production capacity and in a situation where an employee wants to work more hours than he usually does with his current working surface. These employees will have sufficient income for their survival but will use their excess capacity and time for farming, household activities or another part time job will change their job from previous to another higher level job. This may discourage them to work in shadow economy and encourage them to gain more from proper market base. Therefore, this may let f^* towards zero and sharpen the inverse relationship between underemployment and shadow economy. On the other hand, in the developing nation's context, workers capacity and skills will be under used due to lack of proper job opportunities. Then they remain in their underutilized job and engage with shadow economy to improve their level of income or to utilize their capacity. This may occur due to higher values of f^* and generate a positive relationship underemployment and size of shadow economy.

4.2. Empirical Investigation (Estimations for Size of Shadow Economy)

4.2.1. Generate Value for Underemployment

This study introduces underemployment as a determinant (causal variable) to develop path diagram to estimate the size of shadow economy in Sri Lanka. The study uses values for each proposed determinants from 1990-2015. But data for Sri Lanka underemployment was given only from 2006-2014 from the Annual Labour Force Survey (LFS) reports of Department of Census and Statistics. Therefore, data series for underemployment rate is predicted in an average for other time periods (from 1990-2005 and 2015) using simple calculations.

$$\sqrt{\frac{\sum_{i=2006}^{2013}(UNDER\_E_i - UNDER\_E_{i+1})^2}{n}} = \mathbf{D} \qquad (20)$$

$$Estimation\ (E_i) = \begin{cases} UNDER\_E_{i+1} + D \ if \ i < 2006 \\ UNDER\_E_{i-1} - D \ if \ i = 2015 \end{cases}$$

The above equation is used to calculate average estimates for the rate of underemployment as a prediction while using the trend of given values from 2006-2014. Here, E_i for the estimations for missing values of

underemployment where *'i'* represent each year. Within the equation, use 'D' for average for lags of given values over time. *'n'* for the number of lags of given years before the estimations. Therefore, this equation is used to fill 17 units of missing data and use them as an approximate proxy to measure size of shadow economy. Therefore, approximate data set with both estimated and given values for underemployment from 1990-2015 is changing between 14-2 with a decreasing trend due to 0.55 of average (D).

Table-4. Estimated Coefficients of the MIMIC models and Descriptive Statistics

Models	Taxes on Good and Services	Taxes on income and profits	Under-emp. Rate	Unemp. Rate	Public emp.	Private emp.	Self-Employment	M1/M2	LFPR	χ^2 (p-value)	RMSEA (p-value)	TLI	SRMR	Df
	X_1	X_2	X_3	X_4	X_5	X_6	X_7	Y_1	Y_2					
MIMIC 7-1-2	**0.252** (2.13)**	**0.284** (2.42)**	**1.39*** (2.75)**	**0.14* (1.83)**	**0.055 (0.93)**	**0.103 (1.27)**	**1.33*** (2.65)**	**-0.17*** (-2.79)**	**0.76*** (3.35)**	**1428.5^{+++}**	**2.85^{+++}**	**2101.1**	**0.218**	**07**
MIMIC 6-1-2a	0.068 (0.12)	-0.24 (-0.3)	0.55 (0.29)	-0.05 (-0.05)	-0.195 (-0.17)	-0.645 (- 0.29)	-	0.068 (0.44)	0.68 (0.28)	14.05	0.269	-5.101	0.088	05
MIMIC 6-1-2b	0.236** (2.06)	0.312 (1.62)	1.368*** (9.33)	0.146 (1.25)	-	0.084 (0.34)	1.29*** (7.16)	-0.187 (-1.44)	0.737*** (11.17)	1172.3^{+++}	2.413^{+++}	3582.3	0.297	08
MIMIC 6-1-2c	0.352* (1.66)	1.02*** (2.72)	0.906** (2.07)	0.342* (1.79)	-0.373 (-1.23)	-	1.076** (2.4)	-0.29** (-2.47)	0.909*** (4.44)	8.1	0.157	9.778	0.107	05
MIMIC 6-1-2d	0.023 (0.08)	-0.092 (-0.38)	1.153*** (2.73)	-	0.026 (0.05)	-0.023 (-0.04)	0.871 (1.11)	-0.064 (- 0.16)	1*** (3.03)	10.78	0.179	-17.84	0.108	06
MIMIC 5-1-2a	**0.248*** (4.07)**	**0.288*** (3.51)**	**1.288*** (12.81)**	**0.164*** (2.67)**	-	-	**1.288*** (8.13)**	**-0.14*** (-4.18)**	**0.769*** (31.4)**	**1057.1^{+++}**	**2.45^{+++}**	**-294.7**	**0.245**	**07**
MIMIC 5-1-2b	0.31** (2.6)	-0.268*** (-3.36)	0.365 (1.62)	0.589** (2.25)	-	-0.97*** (-4.77)	-	0.263*** (2.9)	0.826*** (36.94)	17.43^{+++}	0.315^{+++}	-1.089	0.125	05
MIMIC 5-1-2c	-0.11 (-1.46)	-0.225* (-1.92)	0.552 (1.24)	-0.197 (-1.26)	0.039 (0.32)	-	-	-0.208 (-1.03)	1** (2.53)	18.95^{+++}	0.387^{+++}	-5.096	0.108	04
MIMIC 5-1-2d	0.136 (1.07)	0.094 (1.17)	1.194*** (10.94)	-	-	0.046 (0.12)	0.914*** (4.32)	-0.193* (-1.88)	1*** (1.9e+16)	23.84^{+++}	0.345^{+++}	-21.22	0.125	06
MIMIC 5-1-2e	- 0.299** (- 2.21)	- 0.149* (- 1.74)	0.432*** (12.88)	-	-0.65*** (-4.76)	-0.27*** (-3.27)	-	-0.076 (-0.74)	1*** (8.3e+16)	13.55^{+}	0.194^{+}	-0.165	0.114	07
MIMIC 5-1-2f	0.245* (1.67)	0.942*** (2.78)	0.791 (0.96)	-	-0.549* (-1.93)	-	0.668 (1.32)	-0.41*** (-3.33)	-0.793*** (12.9)	9.45^{+}	0.189^{+}	-12.15	0.107	05
MIMIC 4-1-2a	0.138 (0.91)	-0.843 (-1.03)	0.387 (0.34)	0.521 (1.16)	-	-	-	0.414 (0.91)	0.459 (0.9)	16.17^{+++}	0.419^{+++}	-2.628	0.153	03
MIMIC 4-1-2b	0.08 (1.58)	-0.141** (-2.30)	0.598*** (3.53)	-	-	-	0.496*** (5.01)	-0.003 (-0.02)	1 (18.35)	14.9^{+++}	0.33^{+++}	-1.975	0.108	04
MIMIC 4-1-2c	-0.107 (-1.56)	-0.168** (-2.02)	0.55*** (4.67)	-	-0.06 (-0.9)	-	-	-0.26** (-2.21)	1*** (4.33)	26.24^{+++}	0.557^{+++}	-4.312	0.141	03
MIMIC 4-1-2d	0.21*** (3.41)	0.3** (2.05)	0.935 (1.48)	-	-	-0.137 (-1.29)	-	-0.95*** (-5.46)	0.718*** (4.89)	30.98^{+++}	0.157^{+++}	-9.683	0.211	03
MIMIC 3-1-2	0.103 (1.52)	0.116 (0.84)	0.357*** (3.64)	-	-	-	-	-0.45*** (-3.11)	0.954*** (3.77)	15.62^{+++}	0.522^{+++}	-6.504	0.103	02

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) TLI – Tucker-Lewis Index, SRMR- Standard Root Mean Squared Residual. Df- Degrees of freedom. (Values obtain from the each estimated models)

4.2.2. Estimated MIMIC Models

MIMIC 5-1-2a and **MIMIC 7-1-2** are two best fitted models which have been selected according to the model selection criterion. Therefore, these two models can use to extract structural equations using estimated coefficients. The Structural Equation (20) is extracted by the coefficients from **MIMIC 5-1-2a.**

$$\tilde{\eta}_t / GDP_{2002} = \underset{(4.07)}{0.248}\, X_{1t} + \underset{(3.51)}{0.288}\, X_{2t} + \underset{(12.81)}{1.288}\, X_{3t} + \underset{(2.67)}{0.164}\, X_{4t} + \underset{(8.13)}{1.288}\, X_{7t} \qquad (21)$$

According to **MIMIC 5-1-2a,** Sri Lankan shadow economy as a percentage of GDP will depend on tax on domestic goods and service, tax on income and profits, underemployment rate, unemployment rate and self-employment. Here, all the coefficients are positively affected to the size of shadow economy in Sri Lanka.

The Structural Equation (21) is extracted by the coefficients from **MIMIC 7-1-2**.

$$\tilde{\eta}_t / GDP_{2002} = \underset{(2.13)}{0.252}\, X_{1t} + \underset{(2.42)}{0.284}\, X_{2t} + \underset{(2.75)}{1.39}\, X_{3t} + \underset{(2.65)}{1.33}\, X_{7t} \qquad (22)$$

According to **MIMIC 7-1-2,** similarly to **MIMIC 5-1-2a** Sri Lankan shadow economy as a percentage of GDP will depend on tax based on domestic goods and service, tax on income and profits, under-employment rate and self-employment. Moreover, all coefficients are positively affected in determining the size of the shadow economy for Sri Lanka. Then these two structural equations are used to perform benchmark calculations to observe values for average size of shadow economy from 19990-2015.

4.2.3. Benchmark Calculations

Estimate coefficients from each estimated model and average base year value for the Shadow economy will be used to measure the average size of shadow economy for Sri Lanka. Those values are the new estimations for size of Sri Lankan shadow economy as a percentage of GDP from 1990 to 2015. Benchmark calculations are performed separately for each model[3] manually. A Summary of the results can be demonstrated as below.

Table-5. New estimate for Sri Lankan shadow economy (1990-1998)

Estimates of SE (% of GDP)	Year								
	1990	1991	1992	1993	1994	1995	1996	1997	1998
MIMIC 5-1-2a	49.2	44.4	45.14	46.04	45.38	45.94	44.96	45.56	47.63
MIMIC 7-1-2	49.18	44.21	45.56	46.04	45.4	45.85	44.92	45.58	47.8

Source: Author Preparation

Table-6. New estimate for Sri Lankan shadow economy (1999-2007)

Estimates of SE (% of GDP)	Year								
	1999	2000	2001	2002	2003	2004	2005	2006	2007
MIMIC 5-1-2a	46.51	47.06	45.4	45.65	45.65	44.88	42.97	44.9	43.5
MIMIC 7-1-2	46.64	47.29	45.55	45.65	44.97	43.42	43	45.11	43.71

Source: Author Preparation

Table-7. New estimate for Sri Lankan shadow economy (2008-2015)

Estimates of SE (% of GDP)	Year							
	2008	2009	2010	2011	2012	2013	2014	2015
MIMIC 5-1-2a	42.84	40.94	41.95	42.35	41.26	43.7	42.38	42.58
MIMIC 7-1-2	43.06	41.06	42.17	42.62	41.54	43.99	42.84	42.80

Source: Author Preparation

[3] All benchmark calculations for relative sizes of SE are shown in appendix

According to **MIMIC 5-1-2a and MIMIC 7-1-2** Sri Lankan shadow economy varies between 40% - 48% of GDP and demonstrates a dynamic pattern of changes over the time period.

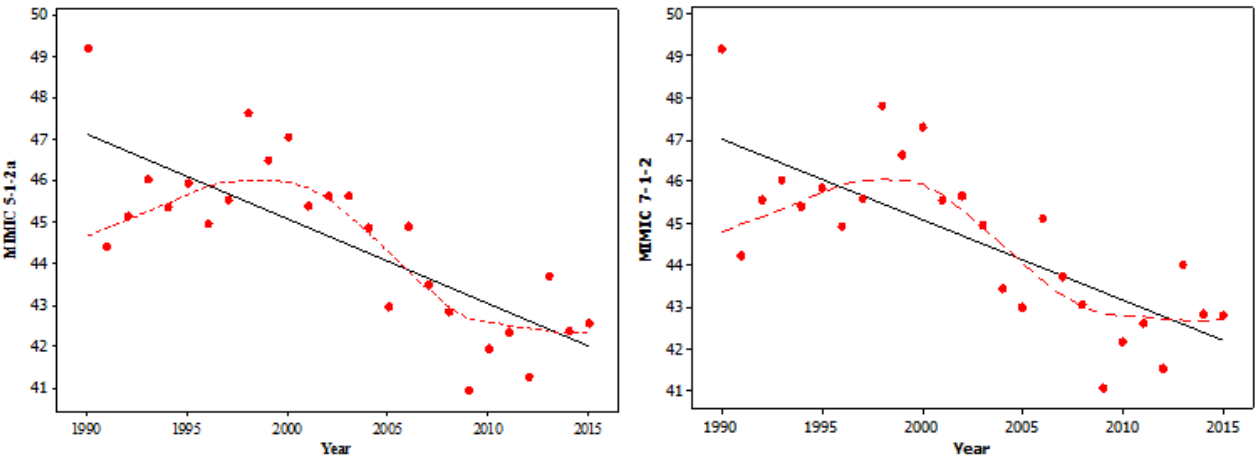

Figure-5. Scatter Plots for MIMIC 5-1-2a and 7-1-2 (1990-2015)
Source: Author Preparation using Minitab-Statistical Software)

The scattered plots clearly demonstrate the nature of the distribution of the estimated values of both models. Both models display similar patterns of distribution while representing negative trends as a whole. Moreover, dash lines within both scatters represent smoothing parameters over 0.5 to identify the distribution of calculated values in more detail. Both curves seem to be similar with improvements of estimation up to the year 2000 and then decrease of values till 2008, thereafter to a stable position as an average.

4.3. Overall Discussion of Results

4.3.1. Taxation and the Size of Shadow Economy

Measurements for the size of shadow economy of Sri Lanka consists a significant positive impact from taxation. Fitted models, MIMIC 5-1-2a and MIMIC 7-1-2 include Taxation on Goods and Services (X_1), Taxation on income and profits (X_2) as a percentage of total tax revenue. Both variables are significant with positive coefficients under 99% of confidence interval for MIMIC 5-1-2a and under 95% of confidence interval for MIMIC 7-1-2. Therefore higher the composition of both X_1 and X_2 of total tax revenue to the government may apply extra burden on people and encourage them to engage with shadow in economy in full time while avoiding official market. On the other hand this burden may also encourage people to engage with shadow economy as a part time activity to increase their level of income to balance the loss from tax burden. However, the estimations for shadow economy with a decreasing trend are given the relationship with both types of taxations as in Figure 6.

The above scatter plots represent the relationship between percentage of Tax on goods and services from the total tax revenue with the estimated values for shadow economy as a percentage of GDP. Lower data series of both graphs which distributed around 40s are estimations for shadow economy. Upper values imply the percentages of taxes. Regression lines for both volumes of values demonstrate a negative trend. This is similar for both MIMIC 5-1-2a and MIMIC 7-1-2 separately. Smooth lines for data series shows more detail of pattern of behaviour, where improvement of values for percentage of taxes on goods and services till 2002 and then to decline is similar with the pattern of estimates from both MIMIC models as previously discussed.

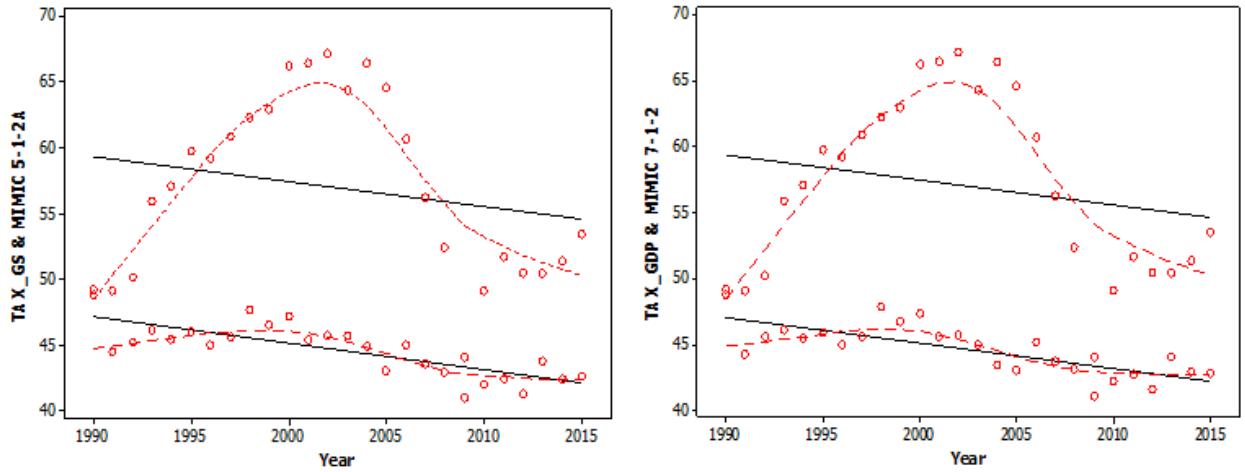

Figure-6. Tax on Goods and Service with estimated MIMIC 5-1-2a and MIMIC 7-1-2
Source: Author Preparation using Minitab-Statistical Software

Therefore, both estimates for shadow economy are proven the theoretical implication; the positive relationship between taxation and shadow economy. As a result of that, taxation on goods and services (it is specially referred to indirect taxes) will make a significant impact on shadow economic activities. Because higher the indirect taxes may decrease the purchasing parity of people and majority of them fail to find alternatives within the official economy to improve their income. Then the burden levied on people throughout indirect taxes will encourage them to improve their financial assistance while engaging with shadow economic activities. Therefore, taxes on goods and services will be one of the focal issues to observe size of shadow economy around 40 per cent of GDP. On the other hand, taxes gained from people who exceed the level of average income are representing from taxation on income and profits. However, in context of Sri Lanka, percentage of taxes on income and profits from total tax revenue tend to be increased but contains only 10-20% of total tax revenue.

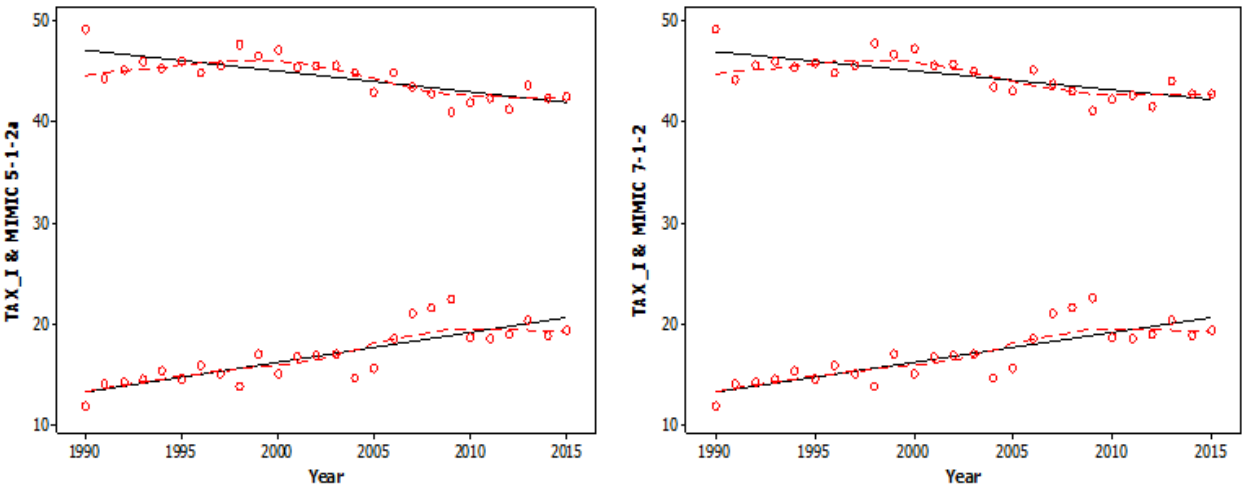

Figure-7. Tax on Income and Profits with estimated MIMIC 5-1-2a and MIMIC 7-1-2
Source: Author Preparation using Minitab-Statistical Software

The above scatter plots represent the relationship between percentage of Tax on income and profits from the total tax revenue with the estimated values for shadow economy as a percentage of GDP. Lower data series of both scatter plots which are distributed around 10-20 are values for X_2 . Upper values implied the estimated sizes of the shadow economy. Regression lines for X_2 in both models demonstrate a positive trend. Since estimated values for

shadow economy demonstrates a negative trend, behaviour of both variables represent opposite relationship. This is similar for both MIMIC 5-1-2a and MIMIC 7-1-2 separately. This is resulted because of a relatively low percentage of revenue as a composition of total taxation. It tends to imply positive impact as a causal variable to determine the size of shadow economy but relatively low in strength to determine the nature of estimated values.

4.3.2. Underemployment and the Size of Shadow Economy

Underemployment is a new causal variable which is introduced from this study as a determined to estimate shadow economy in under developed nations like Sri Lanka. Results of two fitted models (MIMIC 5-1-2a and MIMIC 7-1-2) show very high positive coefficient under the 99% of confidence level. Therefore, the nature of relationship exists between both estimations and the underemployment rate can demonstrate by below scatter plots.

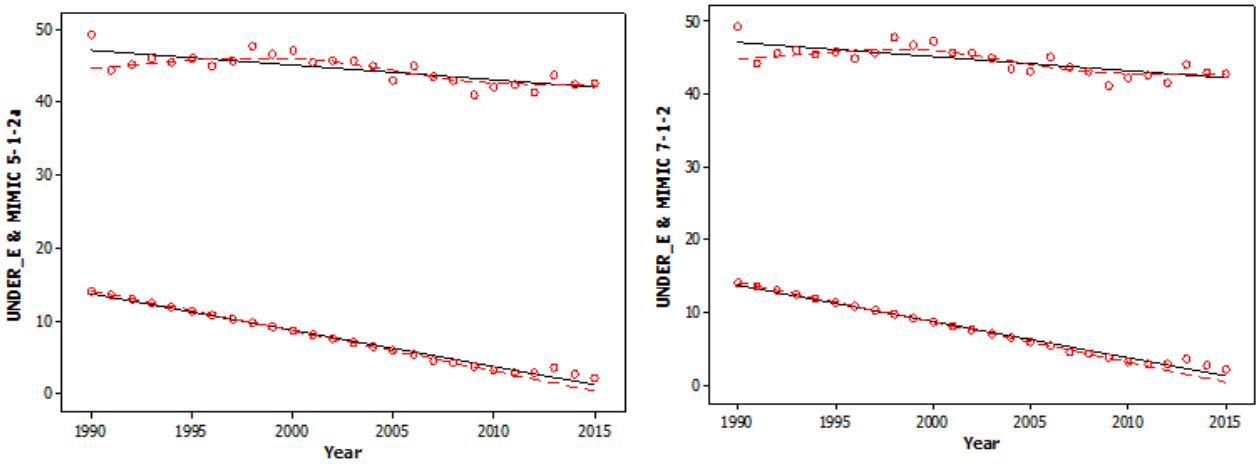

Figure-8. Underemployment with estimated MIMIC 5-1-2a and MIMIC 7-1-2

Source: Author Preparation using Minitab-Statistical Software)

The above scatter plots represent the relationship between the rates of underemployment with the estimated values for shadow economy as a percentage of GDP. Data series at the bottom of both scatter plots represent volume of values for underemployment. The volume of data series at the top of both the scatter plots are the values for estimated values for shadow economy. Regression lines for underemployment rates in both the models demonstrates very steep decreasing trend. Since estimated values for shadow economy demonstrates a negative trend, behaviour of both the variables represent similar trend but with different slopes. This is similar for models, MIMIC 5-1-2a and MIMIC 7-1-2. Therefore, positive impact from underemployment as a causal variable is very higher to determine the size of shadow economy and relatively good in strength (but not at all) to determine the nature of estimated values.

These scatter plots explain the impact from invisible underemployment to size of shadow economy. Where, the coefficients of both models are strengthening the value of f^* and made a positive impact on measurements. Lower range of the estimates for underemployment (14 to 2) is weakening the degree of impact where underemployment can levied on the sizes of shadow economy. However, higher coefficients will reflect the situation, how the under-employment in under developed nations such as mismatch of skills, underutilization of skills and lower level of payments for employees. In practice, this may be a reality when a person who gains lower level of will use other tax avoidable economic activities, especially shadow economic activities to improve their level of income. With the presence of underutilization of and mismatch of skills, workers may use their excess capability with shadow economic activities since it is harder to find another proper economic activity from the official economic activities.

4.3.3. Self-Employment and the Size of Shadow Economy

When an individual engages in an economic activity and manages it on his own, it will be known as the self-employment. Therefore, self-employed people might have the freedom to take decisions about his/her own business and hold a risk on level of income due to difference of each person's ability to sell, invest and to improve the profit margin. According to this study, both fitted models results very high and positive coefficient from self-employment rate to the size of shadow economy. Scatter plots for both estimates of shadow economy can compare with the levels of self-employment as below.

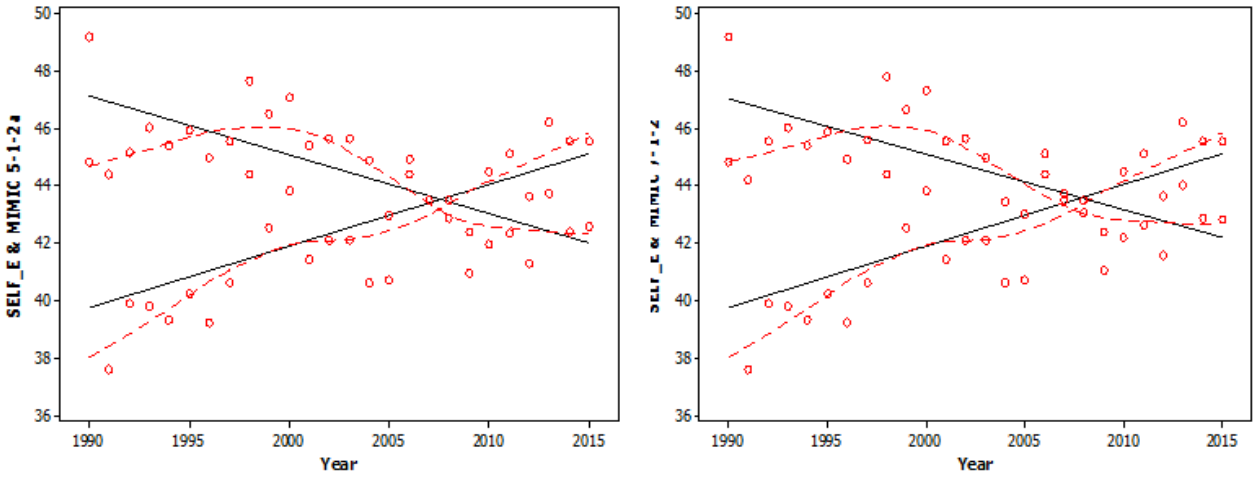

Figure-9. Self-employment with estimated MIMIC 5-1-2a and MIMIC 7-1-2
Source: Author Preparation using Minitab-Statistical Software

The above scatter plots represent the relationship between the rates of self-employment with the estimated values for shadow economy as a percentage of GDP. Data series starts from the bottom of both the scatter plots represent volume of values for self-employment. The volume of data series at the top of both the scatter plots are the values for estimated values for shadow economy. Regression lines for self-employment as a percentage of total employment demonstrate an increasing trend. Since estimated values for shadow economy demonstrates a negative trend, behaviour of both variables represent different trends but with high correlation.

Both underemployment and self-employment displays similar coefficients. But the relative difference between the size of the variables (Self-employment vary between 37- 47 and underemployment vary between 2-14) will change the depth of impact for the behavior of estimated values. Therefore, changes of self-employment are highly correlated with the changes in estimated values. However, trends are different due to impact from other variables to determine the size of shadow economy.

In the context of Sri Lankan labour market, improvement in self-employment does not only reflects an improvement of formal entrepreneurs. Number of pavement sellers, street sellers with small huts also includes within the self-employment representing the informal sector of economy. Those informal self-employed people highly appear within the under developed nations. On the other hand people who utilize their own skills without the assistance of other party (A person who is doing tuition for few students at his own home) are also a kind of self-employment. Therefore, this kind of categories is usually earning money without paying any share of their income for the government tax collectors. This makes the above positive impact from the self-employment true within the third world economies. Moreover, it is noteworthy to identify this relationship where the tax avoidance is also present.

5. CONCLUSIONS

5.1. Theoretical Findings

Initial part of the analysis use series of equations to investigate possibilities of relationship that exists between underemployment and the size of shadow economy. Analysis is done using the model introduced by Hall (1979) and work by Dell'Anno and Solomon (2008) to identify the relationship between the level of unemployment and shadow economy. Findings of these equations are given a possibility to have either positive or negative relationship between two variables. The magnitude of '*f**' can be introduced as the determinant which decide the nature of relationship. With the absence of *f* (if f*=0)* there is a negative relationship between underemployment and shadow economy. On the other hand, higher the magnitude of *f** will turn this relationship in to a positive.

5.2. Empirical Findings

Following part of the analysis has been done to choose suitable and fitted models through Structural Equation Modeling to estimate the size of Sri Lankan shadow economy as a percentage of GDP. 16 different MIMIC models have been run to find the fitted models. Proxies of the model selection criteria are Taxation on goods and services, taxation on income and profits and under-employment. Results were given two fitted models to perform the benchmark calculations at the next stage of the analysis. Both the selected empirical models fulfill each and every requirement given in model selection criterion.

MIMIC 5-1-2a is a model with five causal variables and two indicators which can visualize the existence of the Sri Lankan shadow economy. All causal variable and indicators are significant under 99% of confidence level as in the results. Structural results illustrate strong positive coefficients for underemployment and self-employment. Even both the types of taxation and unemployment demonstrate positive coefficients. On the other hand, shadow economy indicates positive relationship to the indicators LFPR and M_1/M_2 ratio. MIMIC 7-1-2 includes seven causal variables and two indicators. Underemployment and Self-employment are given strong positive coefficients similar to results of MIMIC 5-1-2a. Both types of taxation are given positive coefficients under 95% of confidence level. Unemployment, public employment and private employment are not significant under 95% of confidence level. Therefore, only four causal variables are considered under this model. On the other hand, shadow economy indicates positive relationship with LFPR and negative relationship with the M_1/M_2 ratio.

Then the benchmark calculations obtain three sets of estimations to visualize the average size of the Sri Lankan shadow economy as a percentage of official GDP. Calculations for both MIMIC models are given very similar results with a decreasing trend from 1990-2015. Estimates were distributed around 40s. Then the comparison of estimated values with the size of shadow economy is done separately with two types of taxes, underemployment and self-employment. Both estimates for shadow economy are proven with the theoretical implication; the positive relationship between taxation and shadow economy. As a result of that, taxation on goods and services (indirect taxes) will make a significant impact on shadow economic activities. Because higher the indirect taxes may lower the purchasing parity of people and majority of them fail to find alternatives within the official economy to improve their income. Then the burden levied on people throughout indirect taxes will encourage them to improve their financial assistance while engaging with shadow economic activities. In the context of taxes on goods and services, it tends to implies positive impact as a causal variable to determine the size of shadow economy but relatively low in strength to determine the nature of estimated values. The positive impact from underemployment as a causal variable is very higher to determine the size of shadow economy and relatively good in strength (but not at all) to determine the nature of estimated values. Because, estimated values for shadow economy demonstrates a negative trend, behaviour of both variables represent similar trend but with different slopes. Behaviour of variables, self-employment and the size of shadow economy are represent different trends but with high correlation. Since, high coefficient with positive impact to determine the size of shadow economy describes more of the nature estimated values.

Previous discussions claim that the shadow economic activities are still around 40 per cent of GDP in Sri Lanka. It is quite a high amount which can discourage the official base of an economy. Therefore, government policy and decision makers face a lot of challenging circumstances while maintaining the stability of a strong corporate sector and functioning market systems within the official economy.

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Appendix-1. Target Variables and Data Sources

Measurement	Source
Causal Variables	
X_1=Tax on Domestic Goods and Services	Statistical Appendixes - CBSL annual reports
(As a percentage of total tax revenue)	
X_2=Tax on Net Income and Profits	Statistical Appendixes - CBSL annual reports
(As a percentage of total tax revenue)	
X_3=Under-employment Rate	Labour Force Surveys (DCS)
X_3=Unemployment Rate	Statistical Appendixes - CBSL annual reports
X_4=Public Employment	Statistical Appendixes - CBSL annual reports
(As a percentage of Total Employment)	
X_5=Private Employment	Statistical Appendixes - CBSL annual reports
(As a percentage of Total Employment)	
X_6=Self Employment (Own Account Workers)	World Bank Open Data Base
(As a percentage of Total Employment)	
Indicator Variables	
$Y_2=M_1/M_2$ Ratio	Statistical Appendixes - CBSL annual reports
Y_3=Labour Force Participation Ratio	Labour Force Surveys (DCS)

Source: Authors preparation