SIZE, VICIOUS CYCLE AND ASYMMETRIC EFFECT: AN ANALYSIS ON THE TAX DRIVEN UNDERGROUND ECONOMY IN MALAYSIA

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DECLARATION

We hereby declare that:

(1) This undergraduate research project is the end result of our own work and that due acknowledgement has been given in the references to ALL sources of information be they printed, electronic or personal.

(2) No portion of this research paper has been submitted in support of any application for any other degree or qualification of this, or any other university or institution of learning.

(3) Equal contribution has been made by each group member in completing the research project.

(4) The word count of this research report is 26,125 words.

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LIST OF VARIABLES AND SYMBOLS DESCTIPTION

Variables & Symbols	Name
TR_t	Tax Revenue (in millions) at time t
GDP_t	Nominal Gross Domestic Product (in millions) at time t
$M1_t$	Aggregate Money, M1 (in millions) which includes coins, notes, traveller check, checkable and demand deposit at time t
Θ_t	Average Tax Rate (in ratio) or Marginal Tax Rate (in ratio).
CPI_t	Consumer Price Index (in units) at time t
$RGDP_t$	Real Gross Domestic Product (in millions) at time t
i_t	3 Months Fixed Deposit Rate (in ratio) at time t
UE_t	Size of the Underground Output (in millions) at time t
ATR	$L(1+\Theta_i)$, Average Tax Rate (Chapter 4)
MTR	$L(1+\Theta_i)$, Marginal Tax Rate (Chapter 4)
ATR^+	$\Delta L(1+\Theta_i) > 0$, Average Tax Rate (Chapter 4)
MTR^+	$\Delta L(1+\Theta_i) > 0$, Marginal Tax Rate (Chapter 4)
$UE(ATR)$	Size of the Underground Economy Traced by Average Tax Rate (Chapter 4)
$UE(MTR)$	Size of the Underground Economy Traced by Marginal Tax Rate (Chapter 4)
D	Δ or First Difference
L	Natural Logarithm

Abstract

This study empirically examines the size of the underground economy in Malaysia driven by tax rates (i.e. average and marginal tax rates) using currency demand approach. Secondly, this paper intends to investigate the relationship between tax and underground economy. More specifically, we examine the direction of causality, whether the causality runs from tax rates to the underground economy or the other way round or both are significant in granger causing each other. Lastly, this paper aims to test for asymmetric responses of underground economy to the positive and negative changes of tax rates. We found that the size of the underground economy driven by average tax rates is relatively larger compared to the one driven by marginal tax rates. Besides, we found that there is bi-Granger causality for the case of average tax rate but not for marginal tax rate. This signifies a contradiction to a further exploration by impulse response function which indicates that the vicious cycle does not exist for both cases. Lastly, we found that the responses of the size of the underground economy to an increase or decrease of both average and marginal tax rates is symmetry, which is consistent with the past studies.

Keywords: size of the underground economy, average tax rate, marginal tax rate, vicious cycle, asymmetric hypothesis

CHAPTER 1: RESEARCH OVERVIEW

1.0 Introduction

The issue of existence of underground economy has been of great interest and empirically investigated by previous researchers in their various research topics. In recent IMF working paper by Schneider and Enste (2002), the size of the underground economy follows an upward trend and has become severe in many countries, particularly in the developing countries. However, there is contrary view as to the impact of surging of underground economy to economic growth that we can think of. In light of some analysis by Schneider (2002); Schneider, Braithwaite & Reinhart (2001), an increase in the size of the underground economy has both positive and negative impacts on a country's economic growth rate.

Some researchers argue that an increase in underground economy will suppress economic growth. This is because tax revenue collected will decrease and thus discourage public spending and production capacity in the country. Yet, the opposite view is that income earned in underground sector is transmitted rapidly into the formal sector and this circulation of money supply promotes economic growth. Despite lacking of conclusive theoretical and empirical studies of the effect of increase in underground activities on GDP growth, we take the perspective that the cons of underground activities outweigh the pros of it. This has served as a platform for the government and public all around the world to concern about its adverse effect to the economy and public welfare as a whole because the most crucial thing is that unreliable official statistic will result in ineffective and inappropriate policies implemented by government to resolve problems in the economy.

Underground economy is a natural problem in that no matter how low is the tax rate, the underground economy activities will still persist. It is apparently difficult to have a precise measure of the size of the underground economy because its measurement will be somewhat distorted by its hidden nature.

Although there is no consistent measurement to make global comparison of underground economy, we can contribute our effort to establish the most suitable method to measure its size. More importantly, we find that tax is a major cause among other causes which leads to persistence of the underground economy. This is supported by Schneider in his research about OECD countries in which he found that the OECD countries with the highest relative size of the underground economy are Greece, Italy, Belgium and Sweden with the size of 28.5%, 27%, 21.9% and 19.2%, separately, in the year 1996 had the greatest tax and social security burden which is 72.3%, 72.9%, 76%, and 78.6%, separately. On the other hand, Switzerland and the United States with the lowest relative size of the underground economy, 7.5% and 8.8%, respectively, had the smallest tax and social security burden which is 39.7% and 41.4%, respectively. Despite, the pattern was not faultless and perfect. This can be evidenced by the United Kingdom and Austria had a small underground economy, 13.1% and 8.3%, respectively, but had a relatively high tax and social security burdens of 54.9% and 70.4%, respectively. Still, Schneider concludes that the larger the tax burden and social security burden, the greater the underground economy. Therefore, the investigation of the causality effect between tax rate and underground economy is of great importance and cannot be neglected. Since there are only a few literatures investigating the related issues of underground economy in Malaysia, this has motivated us to examine the increase of underground economy contributed by tax burden.

1.1 Research Background

1.1.1 What is Underground Economy?

The history of civilization is a history of economic duality between a formal economy and an underground economy. They are the *yin* and *yang* aspects of economic balance. Under the Dual Labour Market Theory (Doeringer & Piore, 1971; Saint-Paul, 1997), labour market divides into four categories: primary, secondary, informal and illegal. The primary sector is a highly regulated economy and high wage jobs that are taxed. The secondary sector consists of jobs that have

low wage and is poorly regulated than primary sector. The informal sector encompasses unregulated arrangement or people who are self-employed or people who work for someone else which they work off-the-books or their transactions are based on an exchange of cash only. The illegal sector includes all criminal activity and income generated from this activity is not recorded in official statistics. Formal economy is composed of people who are able to access primary or secondary sector whereas an underground economy is formed by people who are capable of accessing informal or illegal sector (Losby et al., 2002).

At one time, economists were seemed do not consider about the existence of underground economy. Nevertheless, the informal dimensions of organizational life became more and more important and were accepted as a common topic for research in the 1950s and 1960s (Blau & Scott, 1963; Gouldner, 1954). A social anthropologist named Keith Hart (1971, 1973), was the first one to originate the "underground economy" concept in a Third World context. However, the concept of "underground economy" was introduced in the International Labour Organization (ILO) study of urban labour markets in Ghana (Hart, 1973). Later, it was used in ILO reports of labour market terms in other cities of African and by the World Bank in a series of studies of poverty and urbanization throughout the Third World (Sethuraman, 1981; Mazumdar, 1975).

Different names have been used to refer to the "underground economy" in different periods. It has been named the irregular economy (Ferman & Ferman, 1973), the subterranean economy (Gutmann, 1977), the black economy (Dilnot & Morris, 1981), the shadow economy (Frey, Weck & Pommerehne, 1982; Cassel & Cichy, 1986), the underground economy (Simon & Witte, 1982; Houston, 1987), and the informal economy (McCrohan & Smith, 1986). Invisible, hidden, submerged, non-official, unrecorded or clandestine are the terms used by the popular media (U.S Department of Labour, 1992).

Even though there is no universal and precise definition of the underground economy, the works of past researchers aid in giving directions for future research. Many have been written about the definition of the underground economy. However, the most commonly used definition of the underground economy is market-based production of goods and services, whether legal or

illegal, that escapes detection in the official estimates of GDP (Smith, 1994). Table 1.1 below provides detailed information that explains the definition of legal and illegal underground economy. From Table 1.1, we can clearly identify that underground economy includes legal and illegal activities, either from monetary transactions or nonmonetary transactions. Legal activities involve unreported income from the production of legal goods and services with the intention to hide from authorities in order to evade tax. For instance, income earned from a supplementary job in which the payments are made in cash are under-report; businesses which understate the size of their income in order to obtain a much lower taxable income; income earned from second job is not reported and the exchange of services from one professional to another through barter transactions. On the other hand, illegal activities involve the production of illegal goods and services prohibited by laws and regulations and criminal activities such as drug dealing, gambling, smuggling, fraud and prostitution. Regardless of any taxes, these illegal activities will not be reported.

As the definition of underground economy greatly depend on the method chosen to measure the size of the underground economy, in our analysis of the size of the underground economy, we will concentrate on legal value added activities which involves money to be transacted and which escape the taxation by the government. Besides, our analysis will not be focusing on tax evasion or tax avoidance itself but includes all legal activities that can be taxed. Nonmonetary transactions that include barter system, non-market activities such as home production, and illegal market activities will not be included because they will not be taxed.

Table 1.1: A Taxonomy of Types of Underground Economy Activities

	Monetary Transactions		Nonmonetary Transactions	
Illegal Activities	Trade in stolen goods; drug dealing and manufacturing; prostitution; gambling; smuggling and fraud.		Barter: drugs, stolen goods, smuggling etc. Produce or growing drugs for own use. Theft for own use.	
	Tax Evasion	Tax Avoidance	Tax Evasion	Tax Avoidance
Legal Activities	Unreported income from self-employment; wages, salaries and assets from unreported work related to legal services and goods	Employee discounts and fringe benefits	Barter of legal services and goods	All do-it-yourself work and neighbour help

Source: Rolf Mirus and Roger S. Smith (1997, p. 5), with additional remarks.

1.1.2 Underground Economy in Developed and Developing Countries

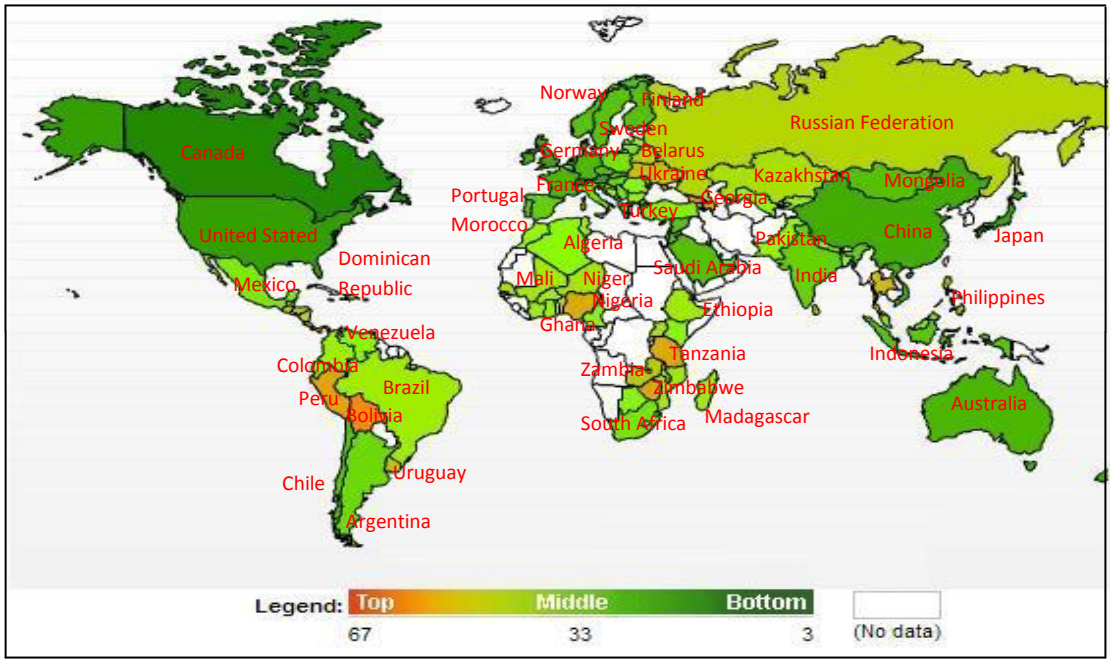
Despite for the differences in defining underground economy, the demonstration on the exact size of the underground economy is also extremely uncertain. Numerous authors have attempted to appraise the size of the underground economy of various countries for different time periods by using different methods and yet there is no consensus as to which of the approach is the most appropriate. Although there are a lot of obstacles to overcome when measuring the size of the underground economy, some progress still can be made. In recent years, many authors such as Schneider, Braithwaite and Reinhart found that underground economy exists in many countries and it is increasing perpetually based on their measurements of the size of the underground economy by using various methods. By referring to Figure 1.1, underground economy exists in almost all the countries. We can see that Bolivia, Nigeria, Tanzania, Zimbabwe, Peru and Georgia which are grouped as less developed countries have high levels of underground economy. On the other hand, countries which are grouped as

developed country such as Japan, Canada, United States, Australia and Sweden have lower levels of underground economy.

There are numerous studies about the underground economy in developing countries and in developed countries. Developed country is a term often used to describe a nation that is rich, with high gross domestic product (GDP) per capita, high level of development and whose citizens are mostly industrial workers while the term of developing country is generally used to describe a country that is poor, with lower gross domestic product (GDP) per capita and low level of material well-being and whose citizens are mainly agricultural workers. Lee (2005), Gerxhani (2003) and Auriol & Warlters (2004) point out that the lower the level of development of a country, the greater and more significant of its underground economy while the higher the level of a country's development, the lower and less important its underground economy.

Of course, there are several reasons to support such evidence. Firstly, the size of the underground economy in developing countries is greater than developed countries because of there are mass poverty and its labours are mainly work in agriculture sector. Labours in developing countries receive lower wages compare with the labours in developed countries. The lower wages will attract the labours to work in the underground economy in order to obtain higher wages. Thus, work force in the underground economy in developing countries is larger than in rich countries. Secondly, low technology and intensive utilization of cheap unskilled labours in developing countries also contribute to similar trend. Thirdly, the low rate of productivity and industrialization will induce the developing countries to have bigger size of the underground economy (Gerxhani, 2003). Moreover, the presence of surplus labours lead to a high level of unemployment in developing countries and for those labours who fail to get their jobs, they may participate in the underground economy (Gerxhani, 2003).

Figure 1.1: World View of the Underground Economy



Source: F. Schneider, A. Buehn & C.E. Montenegro (2010)

As aforementioned, the size of the underground economy in developing nations is larger than developed nations and we have shown the comparisons of geographically and developmentally different countries in Table 1.2 and Table 1.3 below. From Table 1.2, the size and trend of the underground economy of developed countries over the period of 1999 to 2007 shows that the trend of the average of these 20 countries grow moderately over time whereby the size of the underground economy recorded 15.5% of GDP in year 1999 and increased modestly to 16.4% of GDP in year 2007. The three countries with lowest underground economy among these 20 developed countries were Switzerland, United States and Austria, with an average value of 8.6%, 8.8% and 9.8%, respectively. At the higher end is Portugal with the size of 22.5 %, Belgium with 22.5% and Spain with 22.9%.

Table 1.2: Ranking of Developed Countries According to the Size of the Underground Economy

Country	Years									Country Average (% of GDP)	Growth rate (% of GDP)	Average real GDP Growth (%)
	1999	2000	2001	2002	2003	2004	2005	2006	2007			
Switzerland	8.4	8.6	8.6	8.6	8.4	8.7	8.7	8.9	9.1	8.6	1.67	2.07
United States	8.6	8.7	8.7	8.6	8.7	8.8	8.9	8.9	9.0	8.8	0.57	2.84
Austria	9.6	9.8	9.9	9.8	9.8	9.8	9.8	10.0	10.1	9.8	0.63	2.49
Japan	11.0	11.2	11.2	11.1	11.2	11.5	11.7	12.0	12.1	11.4	1.19	1.52
United Kingdom	12.6	12.7	12.8	12.8	12.9	13.0	13.0	13.1	13.2	12.9	0.58	2.83
Netherlands	12.9	13.1	13.1	13.0	12.9	13.0	13.0	13.0	13.2	13.0	0.29	2.49
New Zealand	12.6	12.8	13.0	13.2	13.4	13.6	13.5	13.5	13.6	13.2	0.58	3.59
Australia	14.2	14.3	14.3	14.4	14.7	14.8	14.8	14.9	15.0	14.6	0.69	3.51
France	14.8	15.2	15.4	15.3	15.4	15.5	15.6	15.6	15.7	15.4	0.74	2.26
Ireland	15.7	15.9	15.9	15.9	15.8	16.0	16.2	16.3	16.4	16.0	0.55	6.48
Germany	15.6	16.0	16.1	16.0	15.8	15.9	16.0	16.4	16.7	16.0	0.85	1.62
Iceland	15.8	15.9	16.0	15.8	15.9	16.3	16.7	16.7	16.8	16.2	0.77	4.51
Canada	15.7	16.0	16.1	16.2	16.3	16.4	16.5	16.6	16.6	16.3	0.70	3.16
Finland	17.8	18.1	18.3	18.4	18.5	18.6	18.8	19.1	19.2	18.5	0.95	3.57
Norway	19.0	19.1	19.2	19.2	19.2	19.7	19.7	20.0	20.2	19.5	0.77	2.38
Sweden	18.9	19.2	19.3	19.4	19.6	19.9	19.8	20.2	20.4	19.6	0.95	3.36
Israel	21.2	21.9	21.6	21.1	21.2	21.7	22.0	22.6	23.0	21.8	1.02	3.84
Portugal	22.4	22.7	22.8	22.7	22.4	22.3	22.2	22.2	22.2	22.5	0.06	1.78
Belgium	21.7	22.2	22.3	22.4	22.4	22.6	22.6	22.9	23.1	22.5	0.78	2.31
Spain	22.4	22.7	22.9	23.0	23.0	22.9	23.0	23.0	23.1	22.9	0.38	3.73
Time Average	15.5	15.8	15.9	15.8	15.9	16.0	16.1	16.3	16.4			

Source: F. Schneider, A. Buehn & C. E Montenegro (2010)

In addition, Table 1.3 presents the size and trend of the underground economy in developing countries over the period of 1999 to 2007. We can see that the unweighted average of the underground economy in this sample for the year 1999 was 46.9% of GDP and slowly increased to 51.0% of GDP in the year 2007. Maldives has the smallest underground economy with an average size of 31.1%, followed by Malaysia with the size of 31.3% and Algeria with 35.7%. The largest size in this region is Azerbaijan, Bolivia and Georgia, with an average value of 63.3%, 68.1% and 68.8%, respectively.

Table 1.3: Ranking of Developing Countries According to the Size of the Underground Economy

Country	Years									Country Average (% of GDP)	Growth rate (% of GDP)	Average real GDP growth (%)
	1999	2000	2001	2002	2003	2004	2005	2006	2007			
Maldives	30.3	30.3	30.6	31.2	31.4	31.8	31.0	31.3	32.1	31.1	0.72	6.73
Malaysia	30.1	31.1	30.6	30.7	31.0	31.4	31.7	32.2	32.6	31.3	1.00	5.67
Algeria	34.0	34.1	34.3	34.9	35.8	36.6	37.3	37.3	37.1	35.7	1.09	3.87
Nepal	36.4	36.8	36.9	36.5	36.7	36.8	36.9	37.3	37.5	36.9	0.37	3.80
Madagascar	39.1	39.6	40.4	34.7	36.0	37.7	38.5	39.5	40.6	38.5	0.47	3.74
Brazil	38.8	39.8	39.7	39.7	40.0	40.9	41.1	41.8	43.0	40.5	1.28	3.19
Colombia	38.8	39.1	39.3	39.4	40.4	41.2	42.3	43.4	45.1	41.0	1.88	3.54
Ethiopia	39.9	40.3	41.2	41.0	40.5	42.0	43.1	44.5	45.7	42.0	1.70	7.40
Ghana	41.8	41.9	42.0	42.2	42.5	42.9	44.3	45.3	45.6	43.2	1.09	5.13
Uganda	42.7	43.1	43.3	43.3	43.7	43.8	44.0	45.1	45.8	43.9	0.88	7.10
Philippine	42.7	43.3	43.6	44.1	44.7	45.0	46.6	47.2	48.4	45.1	1.57	4.91
Zambia	48.5	48.9	49.5	49.7	50.4	51.2	51.7	53.1	54.3	50.8	1.41	4.68
Uruguay	51.7	51.1	50.5	48.2	48.6	51.1	53.0	53.7	56.0	51.5	1.00	1.09
Thailand	51.8	52.6	52.8	53.8	55.1	55.8	56.4	56.9	57.2	54.7	1.24	4.97
Ukraine	51.7	52.2	53.0	53.7	55.0	55.9	57.0	57.5	58.1	54.9	1.46	6.61
Tanzania	58.0	58.3	58.9	59.7	60.1	60.6	61.3	61.9	63.0	60.2	1.03	6.53
Peru	59.7	59.9	59.6	60.8	61.2	61.9	62.7	64.2	66.3	61.8	1.31	4.61
Azerbaijan	60.2	60.6	60.9	61.2	62.2	62.7	64.7	67.6	69.6	63.3	1.81	16.26
Bolivia	67.2	67.1	66.6	66.5	66.5	67.3	69.9	71.3	70.7	68.1	0.63	3.11
Georgia	66.2	67.3	67.4	67.4	68.7	69.2	69.5	71.1	72.5	68.8	1.14	7.03
Time Average	46.5	46.9	47.1	46.9	47.5	48.3	49.2	50.1	51.1			

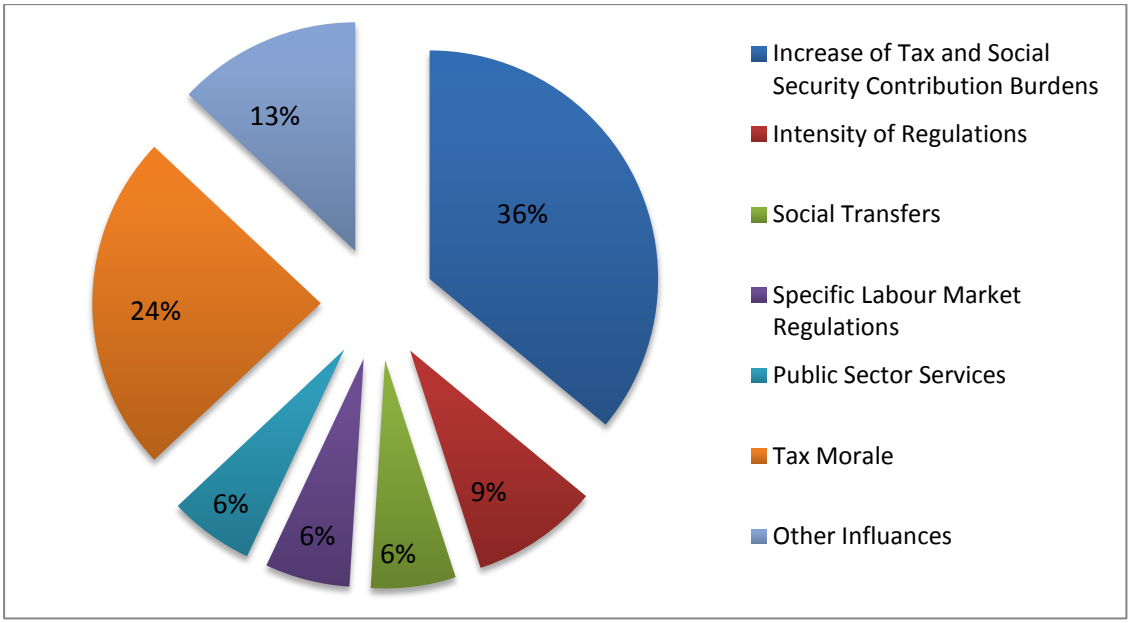
Source: F. Schneider, A. Buehn & C. E Montenegro (2010)

As we compare from Table 1.2 and Table 1.3, the size of the underground economy in developing countries is much higher than size in developed countries. From the year 1999 to 2007, the size of the underground economy in developed countries is only between 15.0% and 16.5% while the size in developing countries is between 46.0% and 51.0%. There is an extremely wide gap between the size in developed and developing countries. Besides, the country with greatest size of the underground economy in developed countries only has 22.9% compare with the developing countries which has 68.8%. In sum one will realize that developing countries have larger size of the underground economy than developed countries. Furthermore, the almost similar extend of growth of underground economy and average real GDP growth in Japan (developed) and Uruguay (developing) countries in which the former country is 1.19% and 1.52% whereas the latter recorded 1% and 1.09%. The growing of underground economy as fast as real GDP growth in these two countries may indicate that there is serious understatement of real GDP and there is a bad erosion of tax that could keep the government in a serious overspending situation.

1.1.3 What Drives the Underground Participation?

The causes of underground economy are also the basis for our study. According to the research by Schneider (2006), there were six main causes of underground economy: 1) Increase of tax and social security contribution burdens; 2) Intensity of regulations; 3) Social transfers; 4) Specific labour market regulations; 5) Public sector services; 6) Tax morale. In Figure 1.2, tax and social security contribution burdens was the greatest cause among the six factors, which possessed an influence of 36% followed by tax morale with 24% influence on underground economy. Intensity of regulations is the third major cause of increased in the underground economy. Besides, social transfers, labour market regulations and public sector services have similar percentage of influence which was 6% while other influences have an effect of 13% on underground economy.

Figure 1.2: Main Causes For the Increase of Underground Economic Activities



Source: F. Schneider (2006)

1.1.4 The Relationship between Tax Rate and Underground Economy

Studies of tax rates have played an important role in the perceptions of the changing size of the underground economy because tax is a compulsory payment of income collected by government. Schneider & Johnson (1994) and Kaufmann & Zoido-Lobaton (1998) found strong evidence for the common effect of taxation on the underground economy. Taxation lowers the ability of consumers to consume and the ability to invest thus lead to significant influence on the growth of the underground economy (Greenidge, 2009). There is a positive relationship between tax rates and underground economy. As tax rates increase, the size of the underground economy increases. This is because a rising burden of taxation provides a strong incentive to participate in the underground economy. Based on Cebula (1997), 1% increase in the tax will lead to 1.4% increase in the underground economy.

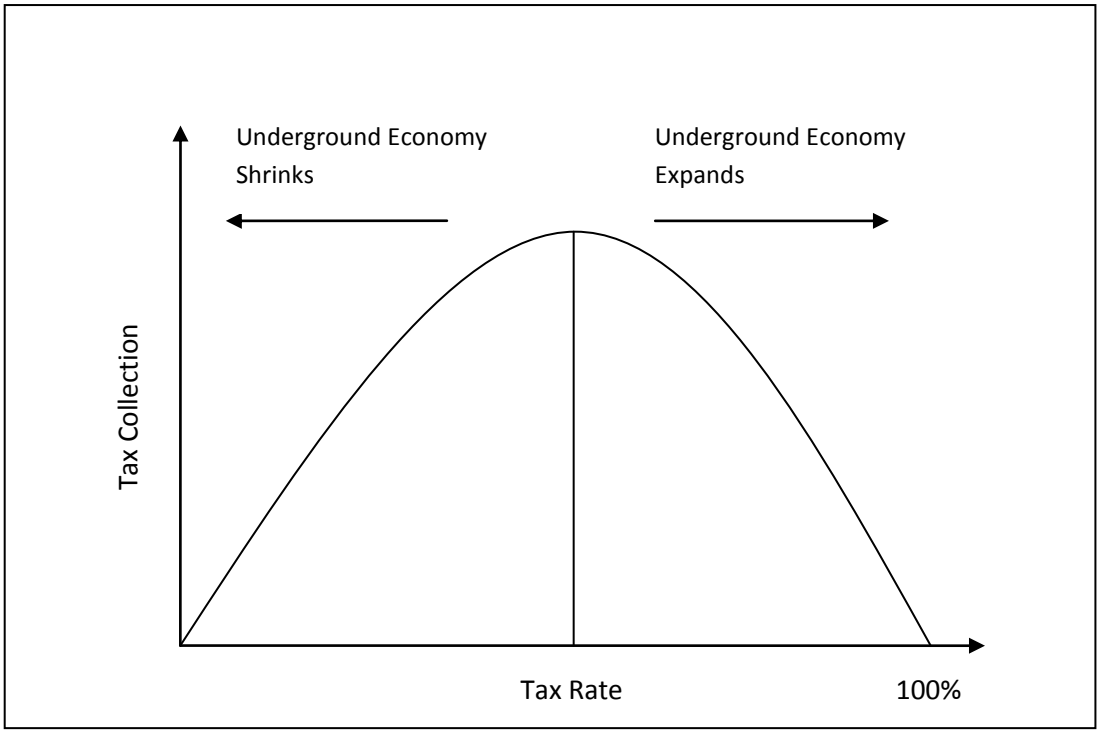
The role of tax in underground economy is an important issue to explore, not only because the burden of tax itself is an important aspect of economic

imbalance, but also because it is closely related to labour participation in the official labour market. Having refraining from meeting certain labour market standards or regulation such as minimum wage law, maximum working hours, etc., the share of underground economy is at increasing trend. Moreover, taxes indeed affect labour-leisure choices and stimulate labour market activities in underground economy. A rise in marginal tax rate will cause substitution effects and distortion of the labour-leisure decision to become greater (Schneider, 2002). As a matter of fact, labour-leisure choices are sensitive to the changes in tax rate. The decline in marginal utility of productive labour resulting from an increase in the tax rates and hence, it makes taxpayers to prefer leisure compared to working in formal economy (Schneider, 2002). This will suppress the labour participation in formal economy while causing labour supply in the underground economy to be stimulated. This is evidenced by the fact that the bigger the difference between the total cost of labour and the after-tax earnings in formal economy, the greater is the incentive to attract labour to move from formal economy to underground economy (Schneider, 2002). In addition, a reduced tax base will raise the gap between returns to factors in formal economy and underground economy (Frey & Schneider, 2000). Furthermore, diminishing efficiency of the economy will arise because of the reallocation from more efficient and productive businesses in formal economy to less efficient business in underground economy (Mirus, Smith & Karoleff, 1994). This will benefit the underground businesses but restrain the profitability of formal businesses.

On the other hand, Lemieux, Fortin, and Fréchette (1994), provide Laffer curve to support the study of tax rates. The Laffer curve presents the relationship between tax rates and tax revenue. It is used to demonstrate the concept of taxable income elasticity in which taxable income will change as tax rate change. Figure 1.3 shows the amount of tax revenue increase at the extreme tax rates of 0% and 100% are considered. We can clearly see that a 0% tax rate generates no revenue, but a 100% tax rate also raises no revenue because a rational taxpayer does not has incentive to earn income. If both a 0% tax rate and 100% tax rate create no revenue, it reflects that at least one rate between 0% rate and 100% rate of taxation would maximize the tax revenue. The Laffer curve suggests that a rise in marginal tax rate will cause tax revenue decrease when tax rate is high (Schneider,

2002). This is to say that as tax rates increase, tax revenue of government will increase up to a maximum and then declines as the tax rates rise beyond the optimum. Indeed, higher tax rates reflect higher underground economy. From the Laffer curve, we know that underground economy shrinks when tax rates increase from low level to high level thus causing tax revenue collected by government to increases. In other words, it also signifies that the expansion of underground economy resulting from a rising tax rates from the highest point of tax collection cause tax revenue collected by government to decline.

Figure 1.3: Laffer's Curve and the Underground Economy



Source: M.E. Sharpe (2007)

Apart from that, if a growing underground economy is caused principally by a rise in tax rates from high level, this may lead to an erosion of the tax and eventually to a decrease in tax receipts (Schneider, 2002). Low tax receipts exert pressure to raise tax rates on the formal sector and this will strengthen the incentives to participate in the underground economy. As a result, vicious cycle arises as further increases in budget deficits or further increases in tax rates with

the consequence of continuing growth of the underground economy and so on (Schneider, 2002). On the other hand, if a reduction in the underground economy is caused primarily by an increase in tax rates from low level, tax revenue collected by government may increases and thus to a further decline in the budget deficit or to a further decline of tax rates. This, in turn, diminishes the incentive to move into the underground economy, leading to a virtue cycle. Vicious cycle refers to a situation in which an attempt to resolve one problem in a chain of circumstances creates a new problem and raises the difficulty of solving the original problem. The growth of the underground economy can be seen as a reaction by individuals who feel overburdened by government activities and who choose the "exit option" rather than the "voice option" to show their dissatisfaction (Bajada & Schneider, 2005). This phenomenon raises public concerns and becomes one of the important reasons why politicians and public sector workers should be particularly worried about the increase in the underground economy.

1.1.5 Tax Morale, Tax Evasion and Underground Economy

There are many researchers who supported tax morality as one of the main causes for high level of underground economy. Tax morale measures individual attitude while tax evasion measures individual behaviour. Tax morale can be described as a moral obligation to pay taxes, a belief in contributing to society by paying taxes (Torgler & Schneider, 2007). Additionally, tax morale is also linked to what have been termed as taxpayer ethics, "the norms of behaviour governing citizens as taxpayers in their relationship with the government" (Torgler & Schneider, 2007). The intrinsic motivation to pay taxes, sometimes refers to tax morale, may differ across countries. The differences in tax morale across countries are indicated that these countries have different real or observed behaviours. A decrease in tax morale diminishes the moral costs of behaving illegally and strengthens the incentive to work in the underground economy (Alm & Martinez-Vazquez, 2007). Therefore, we anticipate that tax morale has such effects on the size of the underground economy.

The degree of tax morale also affects the real behaviour of tax payers, thus, affecting the size of the underground economy. For instance, a rise in tax morale leads to a reduction in the underground economy and countries with high tax morale reflect a clear tendency to have a small underground economy (Alm & Torgler, 2006). Otherwise, many researchers have argued that tax morale can assist in illustrating the high degree of tax compliance. A higher degree of tax morale lead to higher motivation to pay taxes, then, lower the size of the underground economy (Alm & Torgler, 2006). Torgler (2005) found that tax morale is significantly low if people perceive that others obey the law and avoid taxes. Tax morality tends to be lower if there is an increase in the tax rates in which it will encourage individuals to work in underground economy in order to avoid tax payments (Schneider, 2002). Alm & Martinez-Vazquez (2007) argue that tax morale is negatively correlated with the size of the underground economy and this negative correlation reflects that both the individuals' revealed actions and their attitudes are co-related about paying taxes. According to Torgler (2005), individuals who are older, married, high salaries and heads of household tend to have greater tax morale.

1.1.6 Who Engages in the Underground Economy?

In another investigation of tax rates, tax evasion behaviour varies according to occupation group, income type, levels of education, family status, age and other personal characteristics (Mirus et al., 1994). Participants of underground economy activities who are most likely to evade taxes are more likely to be young taxpayers who do not comply with the laws, while under-reporting of taxable income is most common among small and self-employed businesses (Mirus et al., 1994. The adoption of underground activity by businesses alters across occupations. A massive amount of labour participation rate in underground economy happens in occupations that are low paying, require limited skills and usually avoided by non-immigrant job-seekers (Losby et al., 2002). These occupations that commonly utilizing underground workers include private household services, machine operators, farm workers, construction workers, cleaners, food service and other handlers. Whereas, occupations such as teachers,

administrators, secretaries, engineers, police, architects and scientists represent a low level of work force in underground economy.

Next, the association between the level of income of a person and the likelihood that person will evade taxes and participate in underground economy is uncertain. Campell, Spenser and Amonker (1993) found that people who are less unlikely to engage in the underground economy are people whose families have access to income in formal economy. Additionally, people who tend to evade taxes are more likely to be lower-income people (Losby et al., 2002). Besides, connection between level of education and participation in underground economy is certain. According to Losby et al. (2002), people with less education are more likely to take part in the occupations that are low paying and have high percentage of labour participation in the underground economy.

On the other hand, Lobsy et al. (2002) found that people who have high probabilities to work in the formal economy are people who have highest level of education while those with lowest level of education are more likely to evade taxes and can be found in the underground economy. Furthermore, people who tend to evade taxes and engage in underground economy are more likely to be man compare with woman (Losby et al., 2002). Moreover, taxpayers will perceive other personal characteristics on tax evasion (Mirus et al., 1994). For instance, taxpayers are likely to avoid taxes if they perceive that other is dishonest.

1.2 Problem Statement

Over the past decades, many authors have tried to apply an effective method for the measurement of underground economy in many countries, but they did not found any appropriate method as each method has their advantages and disadvantages. Besides, there are few literatures and researches about the methods to assess the size and relevance of the underground economy. Due to the debatable measurement, it is difficult to get accurate information about the underground economy activities. In consequence, it is hard to implement effective policies to counteract the growth of underground economy. The existence of the underground economy will cause many negative impacts to a country. This includes an

increase in poverty, corruption and budget deficit; a decrease in welfare, government revenue and employment in formal economy; instability of politics, inefficient policy, economic crisis and degradation of society moral (Startiene & Trimonis, 2010).

Besides, the issue about the contribution of tax in explaining the presence of underground economy has been examined and explained in quite a detail in U.S and in many OECD countries as well as in transition countries, yet virtually no rigorous studies of underground economy in Malaysia. As a result of relatively few studies and notification about this issue, this offer a bleak picture as to the importance of tackling the underground economy for good policy decision making. Furthermore, this paper is one of the first attempts to provide statistical estimation and to see the influence of tax on the size of the underground economy in Malaysia.

1.3 Research Objectives

1.3.1 General Objectives

The main purposes of our study are:

1. To estimate the size of the underground economy for the case of Malaysia.
2. To investigate the direction of causality between tax rate and underground economy or in other words whether there is a vicious cycle between tax rate and underground economy.
3. To observe the asymmetric effects of the positive and negative effect of the tax rates to the size of the underground economy.

1.3.2 Specific Objectives

More specifically, our study intends:

1. To trace out marginal tax rate and average tax rate.

2. To apply marginal tax rate and average tax rates in observing whether there is co-integration between tax rate and underground economy in the long run.
3. To test for bidirectional causality between underground economy and tax rates by using marginal tax rate and average tax rate.
4. To see whether marginal tax rate incurs larger estimated size of the underground economy compare with average tax rate.

1.4 Research Questions

In our study, we have few common questions to raise:

1. How large is the size of the underground economy in Malaysia?
2. Does the underground economy driven by tax rates?
3. Does the relationship between tax rates and underground economy self-reinforcing?
4. Is there any asymmetric effect of the positive and negative impact of the tax rates to the size of the underground economy?

It is worth noting that the causality effect between tax rate and underground economy is still in a debate stage because of inadequate literature to support. However, the studies by Giles and Caragata (2001) support that there is causality effect between tax rate and underground economy.

1.5 Hypothesis of the Study

In our research, we hypothesized that the effect of tax rate is significant in affecting the underground economy and the relationship between this two variables is a bidirectional long run relationship. As we all know that underground economy has brought substantial effect to our national welfare. This will distort government macroeconomic policy making process thus leads to incorrect estimates of economic variables, and eventually a reduction in the effectiveness of both fiscal and monetary policies implemented by regulatory authority. An increase in tax rate may indicate a greater underground economy, which will then

induce government to increase tax rate in order to reduce government deficit. This may trigger a more serious problem of underground economy and thus bring about vicious cycle in the economy which will worsen underground economy rather than reducing it. Besides, we also hypothesized that the responses of underground economy to an increase or decrease in either average or marginal tax rate is symmetry.

1.6 Significance of the Study

By estimating the variables in our currency demand approach and by referring to our policy recommendation, we can give a clear picture to the Malaysia government so as to evaluate the positive effect and negative effect of underground economy on economic growth. This will serve as a cautionary reminder to the government to give attention and to take serious account of the consequences of underground economy that may impede or promote the economic growth in Malaysia. It is commonly known that the administrative official in majority of Malaysia often place less emphasis on regulatory control and there is a large loophole in regulating the irregular activities which will eventually erode the tax bases and social security burden which lead to bad equilibrium. Knowing that tax rate contributes to greater portion of underground economy, we have decided to tackle the vicious cycle problem that may result from the basis of tax. According to Schneider and Enste (2000) estimation by using the physical input and currency demand approach, the shadow economy in Thailand is among the highest, recorded 70% of GDP averaging from year 1990-1993, while Philippines and Malaysia underground activities were about 38% and 40% to GDP respectively. In our research, we hope to provide a framework and to serve as a basis for cultivating further research in area of estimating underground economy in Malaysia. Furthermore, our study may provide indication of whether tax is an appropriate instrument to control the increasing trend of the size of the underground economy in the case of Malaysia.

1.7 Chapter Layout

The following sections are organized as follow: Chapter 2 demonstrates review of literature by other researchers. Chapter 3 presents theoretical and empirical modelling of the estimate of size of the underground economy using currency demand approach. Chapter 4 describes about the data and discussion of our findings. Finally, Chapter 5 concludes with the discussion of main results, recommendations and conclusions.

CHAPTER 2: LITERATURE REVIEW

In this chapter, we will review the definition of the underground economy given by several authors and then figure out the definition applicable to our research. Next, we will discuss the various methods employed to measure the size of the underground economy as well as the choice of tax rates in determining the size of the underground economy. After that, we will study the causality effect between underground economy and tax rates, and whether will this effect lead to vicious cycle. Lastly, we will discuss the asymmetric responses of underground economy to tax changes.

2.0 Definition of Underground Economy

Underground Economy has been a hot topic to many researchers in the recent decades. Its effects and consequences have alarmed all players in the economy including firms, consumers as well as the government. The initial problem of researchers into this topic is the definition and thorough understanding of exactly what underground economy is. Although they are all referred to the same thing, there are synonymous terms used to mean "underground economy" namely black economy, shadow economy, unofficial economy, etc. Hence, the definition of underground economy slightly varies from one author to another. For instance, Macias and Cazzavillan (2009) defined informal economy as all the income generating activities that are unregulated by institutions.

On the other hand, Fethi, Fethi & Katircioglu (2006) defined underground economy as legitimate activities resulting in transactions which are not taxed or concealed from the tax authorities and should be included in national statistics. Apparently, it is impossible to select the best standard definition because the adequacy of taxonomy used must be related to the need to employ a definition and respect the specifications of the econometric models (Anno, Gomez-Antonia, and Pardo, 2007). Thus, Table 2.1 may be useful in developing a common consensus definition of underground economy.

According to Feige (1990), there are many omnipresent underground economies that exist in market oriented and centrally planned nations, whether developing or developed. Clearly from Table 2.1, the total economy is made up of the official economy (which follows all laws and regulations and is recorded by national authorities) and a fraction of unofficial economy that is neither recorded nor estimated by authorities (Asaminew, 2010). According to Schneider (2008), underground economy includes only all legal and market-based production of goods and services that are deliberately concealed from governments for the following reasons:

1. To avoid payment of income, value added or other taxes,
2. To avoid payment of social security contributions,
3. To avoid having to meet certain legal labour market standards like minimum wages, minimum working hours, safety standards, etc and
4. To avoid complying with certain administrative procedure such as completing statistical questionnaires or other administrative forms.

In our research, underground economy is defined as legal value added activities involving monetary transactions that circumvent taxation by the government. Because we will be using currency demand approach to estimate the size of the underground economy, our analysis includes only all legal taxable activities.

Table 2.1 A Taxonomy of the Types of Underground Economic Activities

	Monetary Transactions		Nonmonetary Transactions	
Illegal Activities	Trade in stolen goods; drug dealing and manufacturing; prostitution; gambling; smuggling and fraud.		Barter: drugs, stolen goods, smuggling etc. Produce or growing drugs for own use. Theft for own use.	
	Tax Evasion	Tax Avoidance	Tax Evasion	Tax Avoidance
Legal Activities	Unreported income from self-employment; wages, salaries and assets from unreported work related to legal services and goods	Employee discounts and fringe benefits	Barter of legal services and goods	All do-it-yourself work and neighbour help

Source: Rolf Mirus and Roger S. Smith (1997, p. 5), with additional remarks.

2.1 Measurement of the Size of the Underground Economy

2.1.1 Direct Approach

There are several methods that can be used to examine the size of the underground economy depending on the research objective(s). Generally, there are four common methods used to measure the size of the underground economy which are direct approaches, indirect approaches, multiple indicators multiple causes (MIMIC) model and monetary approaches. Direct approaches, which are also known as microeconomic approaches that involve surveys and samples based on voluntary responses and tax auditing, and other questionnaire methods. The advantage of these approaches is based on the use of correct detailed information and sensitive formulation of the questionnaire. However, the conclusions may be misleading if the respondents do not respond to the questions correctly (Fethi et al., 2006). Besides, these approaches only lead to point estimates because it is unlikely that they capture all of the underground activities. Furthermore, they are

incapable of providing estimates for the growth of underground economy overtime (Schneider & Hofreither, 1987; Schneider, 1986).

2.1.2 Indirect Approach

On the other hand, indirect approaches or indicator approaches or macroeconomic approaches use many different economic indicators that contain information about the development of the underground economy over time (Schneider, 1986; Schneider & Hofreither, 1987). These approaches work at macro level and there are four macroeconomic indicators that leave some signs of the development of the underground economy:

(a) The GNP or GDP discrepancy approach

The Gross Domestic Product (GDP) can be computed using three different methods namely production, income and expenditure. If any excess exists in the measure of GDP between the income or production method and the expenditure method, the excess amount can be used as an indicator to represent underground economy. Nonetheless, there are criticisms that this approach leads researchers to arrive at an unreliable conclusion, caused by the discrepancy between the two methods which reflects errors and omissions in the recorded statistics and underground economy activities (Fethi et al., 2006).

(b) The employment discrepancy approach

Assuming total labor force participation is constant over time and other variables held constant, a decline in labor force participation in the formal economy can be observed as an indication of an increase in the activity in the underground economy. Meanwhile, a decrease in the ratio of employment to population in the registered economy assumes an increase in the employment in the underground economy when labor force participation rate is held constant. Nevertheless, this approach has been criticized for the negligence of the fact that people can work in both full time (i.e. official economy) and part time employment (i.e. underground economy). Apart from that, Schneider (1986), Schneider & Hofreither (1987) and Fethi et al. (2006) stated that the differences in the rate of participation might have other causes such as

demographic developments (i.e. increasing number of women in employment or increasing rate of employment from rural to urban areas).

(c) Tax auditing approach

This approach has been frequently used over the last three decades in many countries. Taxpayers who report their income level to the tax authorities may give incorrect information to evade tax. Therefore, tax officers find out individual's taxable income by auditing taxpayers. Thus, if any under declared income has been detected by the officers, the amount of money can be used as an indicator of the extent of underground economy (Fethi et al., 2006).

(d) Physical input or electricity consumption approach

This approach estimates both unregistered GDP and unregistered consumption in order to find out the extent of underground economic activities by computing the difference between the growth of official GDP and the growth of electricity consumption to indicate the growth of the underground economy. A major weakness of this approach is that underground economic activity is considered to occur only in the household sector by using substantial amount of electricity rather than any other energy source such as oil, gas, etc. (Fethi et al., 2006).

2.1.3 Model Approach

The third method of measuring the size of the underground economy is the model approach or commonly known as Multiple Indicators Multiple Causes (MIMIC) model. This model considers multiple causes of the existence, growth and multiple effects of the underground economy. It is based on the statistical theory of the unobserved variables which considers multiple causes and multiple indicators of the phenomenon to be measured (Schneider, 1986; Schneider & Hofreither, 1987). In general, this model consists of two parts which are the measurement and the structural equation model. The former links the unobserved variables to observed indicators whereas the latter specifies causal relationships among the unobserved variables. This approach, however, has two major weaknesses. First, the estimation procedure does not allow for a pure time series

analysis. Second, when this approach is applied to European countries, it is difficult to obtain reliable data for the cause series other than the tax burden.

2.1.4 Monetary Approach

Earlier, we have discussed the numerous non-monetary approaches to estimate the size of the underground economy. Now, we will examine the various monetary approaches which have been so far the most popular and widely used method in assessing the extent of underground economic activities. This is because the transactions in the underground economy are largely determined by cash, and the monetary official data are readily available in any country (Fethi et al., 2006).

There are three types of monetary approaches which are simple currency ratio (SCR) approach, transaction approach and currency demand approach. The former approach is the ratio of currency in circulation held by public to demand deposit in which this ratio is often referred to as the currency ratio. According to this approach, an increase in currency stock and payment can be an indicator of transactions which are not reported to government authorities. On the other hand, the transaction approach is based on the relationship between the total value of transactions and the recorded income in an economy.

The currency demand approach assumes that underground transactions are undertaken in the form of cash payments in order to avoid detectable traces for government authorities. Hence, an increase in the underground economy will increase the demand for currency (Schneider, 1986).

As explained by Fethi et al. (2006), the evolution of the currency demand approach begin with Cagan (1958), the pioneer in estimating the size of the underground economy during World War II, who calculated a correlation between currency demand and tax pressure for the United States economy. The disadvantage of this model as pointed out by Giles (1999) came from its three main assumptions: all unreported transactions are in the form of currency, the ratio of currency to demand deposits is constant over time in the formal economy, and the income velocities of currency are the same in both formal and informal

economy.

The second assumption is especially problematic with the invention of electronic banking transactions. Cagan's model was then modified by Gutmann (1977) who estimated the size of the underground economy by estimating the amount of currency that could be reasonably attributed to ordinary and traditional business purposes, the amount of currency required for underground economy purposes and the underground economy output that was lubricated by this currency. In other words, the size of the underground economy can be measured by examining the composition of the stock of money, M1 that consists of two components, currency and demand deposits.

In Gutmann (1980), the author found that his previous estimation was conservative because he did not consider the part of underground output that was produced using payments other than currency. Thus, both barter and those transactions executed with the use of cheques made out to cash or with other cheques were not specifically included. In spite of that, Thomas (1990) gave credit to Gutmann's cash-deposit ratio method (also known as SCR method) as the procedure for measuring the size of the underground economy was simple to apply. Besides, the estimates of the size of the underground economy it produced were dramatic and well publicized.

Tanzi (1983) further developed Cagan's model by investigating the size of the underground economy in the United States using a variant monetary approach which specifies a demand-for-currency equation that is able to infer the effect of a change in the tax level on that demand. The two important assumptions are, first, that underground economic activities are the direct consequence of high taxes. Second, currency is used mainly for carrying out such transactions or for storing wealth. The equation was formed such that the ratio of currency holdings to money (M2) is a function of real per capita income, the rate of interest paid on time deposits, the ratio of wages and salaries in national income and income tax variable. Then, this equation was estimated and was utilized to estimate currency holdings by assuming that the tax variable assumes a value of zero. Hence, the extent of the underground economy can be determined by multiplying excessive currency by the income velocity of money.

Although Tanzi's model is an enhancement on the simple currency demand approach, it still suffers from several drawbacks. Giles (1999), Schneider (2000) and Fethi et al. (2006) argued that not all transactions in the underground economy are paid in cash. Apart from that, most studies only consider tax burden as a cause of the underground economy. Other causes like the impact of regulation, tax morality, the complexity of the tax system, etc are not considered because time series data of these variables is not available for most countries. Another disagreement is the velocity of money in both types of economy is assumed the same. Lastly, the U.S. dollar is used as an international currency, and therefore Tanzi should have considered the amount of U.S. dollars held in cash abroad.

The most recent currency demand model derived by Ahumada (2008) is mainly to resolve the problem of "initial situation" by Gutmann (1977) and Feige (1979). Based on their model, the assumptions that the underground economy does not exist in the based year and all the currency transactions are made for legitimate purposes. In other words, all the currency transactions that take place are purely in the official economy. This assumption is unrealistic because it is impossible that there is no underground economy for any country. As for the Tanzi model, this assumption is not needed. However, when the lagged dependent variables are added to improve the model, the "initial situation" will arise and hence the unrealistic assumptions have to be made. In contrast, Ahumada's model does not require any lagged dependent variables because it is a long-run regression model and thus these assumptions are not necessary.

2.2 The Choice of Tax Rates

It is incontrovertible that tax is one of the most crucial determinants of underground economy. Giles and Caragata (2001), Schneider (2002) and Startiene and Trimonis (2010) agreed that a rising tax burden promotes greater underground economic activities and more tax evasion. Hence, a positive sign for the parameter associated to this variable is to be expected since an increase in the tax burden gives a strong incentive to work in the underground economy (Anno et al., 2007). Therefore, a rise in the overall tax may lead to an erosion of the tax and finally to a decrease in tax revenue, and to a further increase in the budget deficit or to a further increase of tax rates with the consequence of an additional increase in the underground economy, and so on (Schneider, 2002). Although it is certain that tax is definitely a significant variable in the estimation of underground economy, the problem lies in choosing the appropriate tax because it is not clear on either theoretical or empirical grounds. Generally, tax rates can be classified into average tax rates and marginal tax rates.

2.2.1 Average Tax Rate

Average tax rates represent the institution effect and can be reasonably well captured by their ratio of total tax revenue, i.e. the tax ratio (Lee, 2005). A study by Hill and Kabir (1996) revealed that Cagan (1958) and Macesich (1962) were the early researchers who used average tax rates. They defined average tax rates as the ratio of personal income tax revenues to personal incomes. Cagan further explained that this series presumes the amount of tax evasion depends directly on the rewards and believed that changes in taxes affect currency holdings with some lag because it took some time for people to begin attempts to escape them.

In an intriguing study by Tanzi (1982), the author noted that average tax rates could play a role: “if the average tax rate is also high, there could be an income effect that might reinforce the taxpayers’ propensity to evade tax.” In his examination of an average personal income tax, given by personal income taxes divided by personal income net of transfers, he argued for the removal of transfer

income because it is largely non-taxable. Only if all the taxes paid from transfer payment were taken away from the numerator should all transfers be removed from the denominator.

2.2.2 Marginal Tax Rate

Marginal tax rates, including statutory tax rates, aggregate effective marginal rates and tax ratio, represent the incentive effect but measures for these tax rates are not readily available (Lee, 2005). The author also indicated that there is a need to generate a weighted average of various statutory tax rates since there are vast of taxes in any economy, namely personal income tax, corporate income tax, commodity taxes, etc. Nevertheless, this process involves strong assumptions and approximations which cause the loss of many observations.

In view of this, Koester and Koremendi (1989) suggested a simple method to estimate aggregate effective marginal tax rates. The tax revenue was regressed on GDP for each country and the estimated coefficient of tax revenues was utilized as a measure of effective aggregate marginal tax rates. However, one can estimate only one aggregate effective marginal tax rate as it will cause loss within-country variations in tax rates. Moreover, these effective aggregate marginal tax rates are not noticeably different from the tax ratio, which is an average tax rate that can also work as a proxy for weighted average of numerous marginal tax rates. According to Schneider (2002), the higher the marginal tax rate, the larger is the substitution effect and the greater the distortion of the labour-leisure decision.

2.2.3 The Tax Mix

In practice, it is often that only average direct tax is used to explain currency holdings. Hence, the assumption is being made that a change in the tax mix involving a decline in direct taxes and an increase in indirect taxes (i.e. provincial retail sales taxes and value-added taxes) will decrease tax evasion and related currency demand. An objection against this view by Kesselman (1993) was that if tax evasion is concentrated in particular industries and if those who

evade income taxes also evade to a similar degree the indirect taxes on the value of what they sell, then a change in the direct-indirect tax mix is likely to have small effect on the degree of tax evasion.

In lieu of average direct tax, some researchers employed a single broad tax rate consisting of average direct and indirect tax revenues as a percentage of personal income. They believed that a change in the direct-indirect tax mix (overall tax revenues remained unchanged) would have no effect on tax evasion and currency demand. In a past research, Schneider (1994) examined measures of direct and indirect taxes concurrently which allowed for tax-induced changes in the underground economy to be divided up into those owing to changes in direct and indirect taxes. Hill and Kabir (1996) provided a variety of tax rate measures that have been used by other researchers, as shown in Table 2.2. It showed the wide variation in the definitions of tax rates used. Whether marginal tax rates or average tax rates should be chosen, the best tax rate should be the most influential in the decisions of those who participate in the underground economy.

2.3 Bidirectional Causality between Underground Economy and Tax Rates

The increasing trend of the underground economy has caught the attention of the many researchers in examining the possible reasons and causes to it. Indeed, they found out that tax is the main determinant of underground economy and its changes have significant impact on underground economy. Giles, Werkneh and Johnson (2001), agreed that there is a relationship between taxes and the amount of tax evasion, or the size of the underground economy.

More importantly, Fethi, Fethi and Katircioglu (2004) confirmed the presence of a long run relationship between underground economy and tax rates. In addition, they found that the direction of causality runs from the measured GDP and tax rates to the underground economy and tax evasion. Besides, they also indicated bidirectional causality between tax rates and underground economy in both long run and short run periods. Hence, they concluded that significant

underground economic activities and changes in the tax rates in many countries might stimulate greater loss of tax revenue with larger budget deficits and slower economic growth.

From the past literatures, we know that there is causality between underground economy tax rates, at least to some extent in some countries. The direction of causality is particularly important for policy implementation because it signals the appropriate policy to be implemented. For instance, if it is found that tax rate affects underground economy, then fiscal policy to control tax rates may bring desired outcome. However, if the direction of causality is found to be the other way round, then controlling the tax rate may not improve the situation. Our concern is will this causality effect lead to vicious cycle?

2.4 Does Vicious Cycle Exist?

Schneider and Enste (2000) said, once the people feel overburden by tax and social security, they will begin to join shadow economy. Then, the incresed share to underground economy will result in erosion of tax revenue and social securities base. Subsequently, the government are forced to increase tax rate or budget deficit and thus the vicious cycle engine begins. In relation to this, Johnson, Kaufmann, Shleifer (1997) proposed a graph as shown in Figure 2.1, to examine the equilibrium of the underground economy. From Figure 2.1, if the public good provision increases, it will attract individuals to join the official economy, economies of scale will exist and the return to official economy begins to increase higher than the underground economy. Thus, the tax revenue collected by government will also increase, and the provision of public goods increases.

According to the Laffer curve (as shown in Figure 2.2), once government begins to increase the tax rate beyond the threshold (revenue maximizing point), the tax revenue will start to drop. Relating this to Figure 2.1, the equilibrium point will begin to move down until it finally reaches the bad equilibrium point. In short, the increase in tax rates beyond the threshold will initiate decreasing tax revenue that drives the whole economy into high tax rate and underground economy with low tax revenue and public good provision. However, there are also

Table 2.2: Selected Studies of Currency Demand and Tax Rate

Study	Country	Currency measure	Currency velocity	Tax rate (S) Used
Cagan, 1958	USA, 1919-1955	C/M 2	n.a.	PIT as percentage of personal income.
Macesich, 1962	Canada, 1924-1958	C/M 2	n.a.	PIT as percentage of personal income.
Tanzi, 1980	USA, 1929-1976	C/M 2	Legal M1	1) PIT / personal income net of transfers. 2) Top statutory marginal PIT rate. 3) Average tax rate on interest income.
Mirus & Smith, 1981	Canada, 1936-1976	C/DD	M1	PIT / personal income net of transfers.
Klovland, 1984	Sweden, Norway, 1953-1982	Real currency	Between 2 and 7	1) Average of marginal PIT rates. 2) [Peak] average marginal direct tax rate. 3) Total marginal (direct + indirect) tax rate.
Ethier, 1985	Canada, 1968-1981	C/M 2	Legal M1	1) Federal PIT / personal income net of transfers. 2) Federal PIT / declared income. 3) Marginal PIT rate of average tax filer 4) Maximum federal plus provincial PIT

				rate.
Schneider, 1986	Denmark, 1955-1982	Real per capita currency	Legal M1	1) Marginal PIT rate for those with average taxable income. 2) Marginal PIT rate for the upper range of average taxable income. 3) Average direct taxes / taxable income. 4) Average direct taxes / gross income. 5) (Direct + indirect taxes) / GDP.
Mirus & Smith, 1989	Canada, 1960-1982	Real per capita currency	NA	PIT / personal income net of transfers.
Schneider, 1994	Austria	Real per capita currency	Legal M1	1) Average + marginal direct taxes 2) Indirect taxes / GDP net of indirect taxes. 3) Index of complexity of tax system
Mirus, Smith, & Karoleff, 1994	Canada, 1939-1990	C/DD; C/M2	M2	1) PIT / personal income net of transfers 2) (Direct + indirect taxes) / GNP.
Spiro, 1994	Canada, 1950-1993	C	5 (M1, 1926-1959)	Direct taxes + provincial sales tax +GST revenue as shares of personal income.

Source: Hill and Kabir (1996)

C = nominal currency. DD = demand deposits. GDP = gross domestic product. GNP = gross national product. GST = goods and services tax. M1 = currency + demand deposits. M2 = M1 + time deposits. PIT = personal income tax.
Sources: Phillip Cagan, " The Demand for Currency Relative to the Total Money Supply" (August 1958), 66 The journal of Political Economy 303-28; Mireille Ethier, ' The Underground Economy: A review of the Economic Literature and New Estimates for Canada," in Francois Vaillancourt, research coordinator, *Income distribution and Economic Security in Canada*, Collected Research Studies of the Royal Commission on the Economic Union and Development Prospects for Canada, vol. 1 (Toronta: University of Toronto Press, 1985), 77-109; Jan Tore Klovland. ' tax Evasion and the Demand for Currency in Norway and Sweden; Is There a Hidden Relationship" (1984), 86 *Scandanavian Journal of Economics* 423-39; George Macesich, ' Demand for Money and Taxation in Canada" (July 1962), 29 *The Southern Economic Journal* 33-38; Rolf Mirus and Roger S. Smith, "Canada's Irregular Economy' (September 1981), 7 *Canadian Public* 444-53; Rolf Mirus and Roger S. Smith, 'Canada's Underground Economy," in Edgar L. Feige, ed., *The Underground Economies: Tax Evasion and Information Distortion* (New York: Cambridge University Press, 1989), 267-80; Rolf Mirus, Roger S. Smith, wand Valdimir Karoleff, " Canada's Underground Economy Revisited: Update and Critique" (September 1994), 20 *Canadian Public Policy* 235-52; Friedrich Schneider, " Estimating the Size of the Danish Shadow Economy Using the Currency Demand Approach: An Attempt" (1986), 88 *Scandinavian Journal of Economics* 643-68; Friedrich Schneider, " Can the Shadow Economy Be Reduced Through Major Tax Reforms? An Empirical Investigation of Austria' (1994), vol. 49, *supplement Public Finance* 137-52; Peter S. Spiro, "Estimating the Underground Economy: A Critical Evaluation of the Monetary Approach" (1994), vol. 42, no. 4 *Canadian Tax Journal* 1059-81; and Vito Tanzi, " Underground Economy and Tax Evasion in the United States: Estimates and Implications," in Vito Tanzi, ed., *The Underground Economy in the United States and Abroad* (Lexington, Mass.: Lexington Books, 1982), 69-92.

Source: Hill and Kabir (1996)

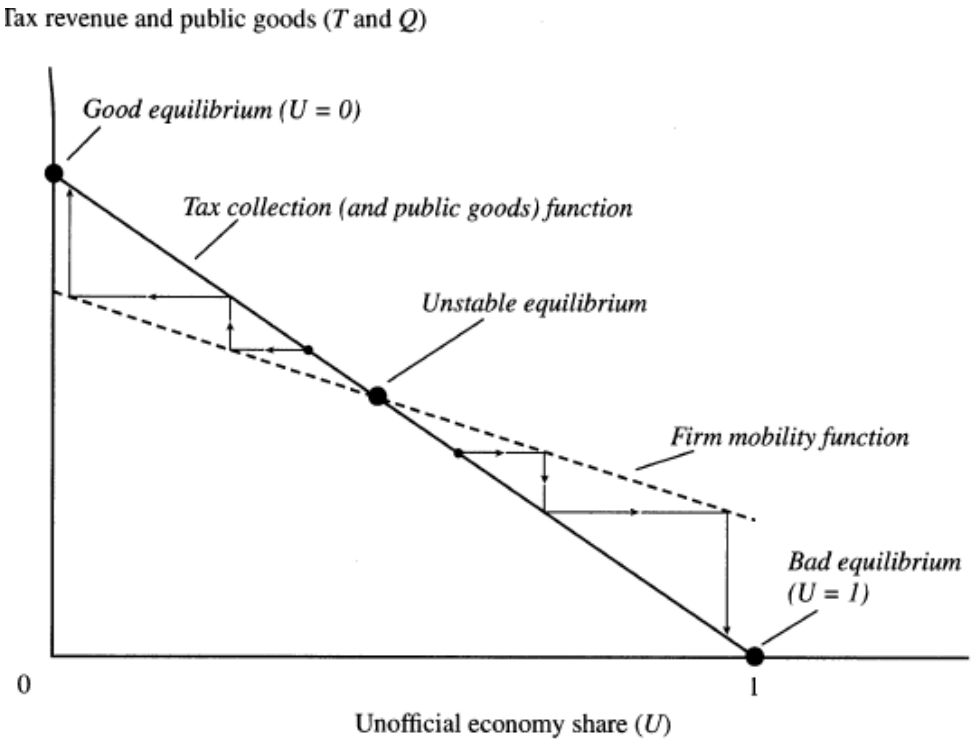
findings about the absence of vicious cycle. Giles et al. (2001) found out that effective tax rate will have effect on the underground economy, but did not indicate the reverse causal effect. This shows that there is no bi-causality effect which also implies the absence of vicious cycle.

2.5 Asymmetric Responses of Underground Economy to Tax Changes

If the vicious cycle is relevant, then reversing the cycle by decreasing tax may be a good idea to bring the economy to its desirable equilibrium level. In simple understanding, asymmetric effect takes place when the response of the underground economy to an increase in taxes is different as its response to a decrease in taxes. Christopoulos (2001) supported the symmetry hypothesis in a study of symmetrical response of underground economy to direct and indirect tax for the case of Greece. Even though, Giles et al. (2001) did not find asymmetric effect of underground economy to upward and downward movement in the effective tax rate, there were marked differences in the point elasticities associated with upward and downward changes in the tax rates.

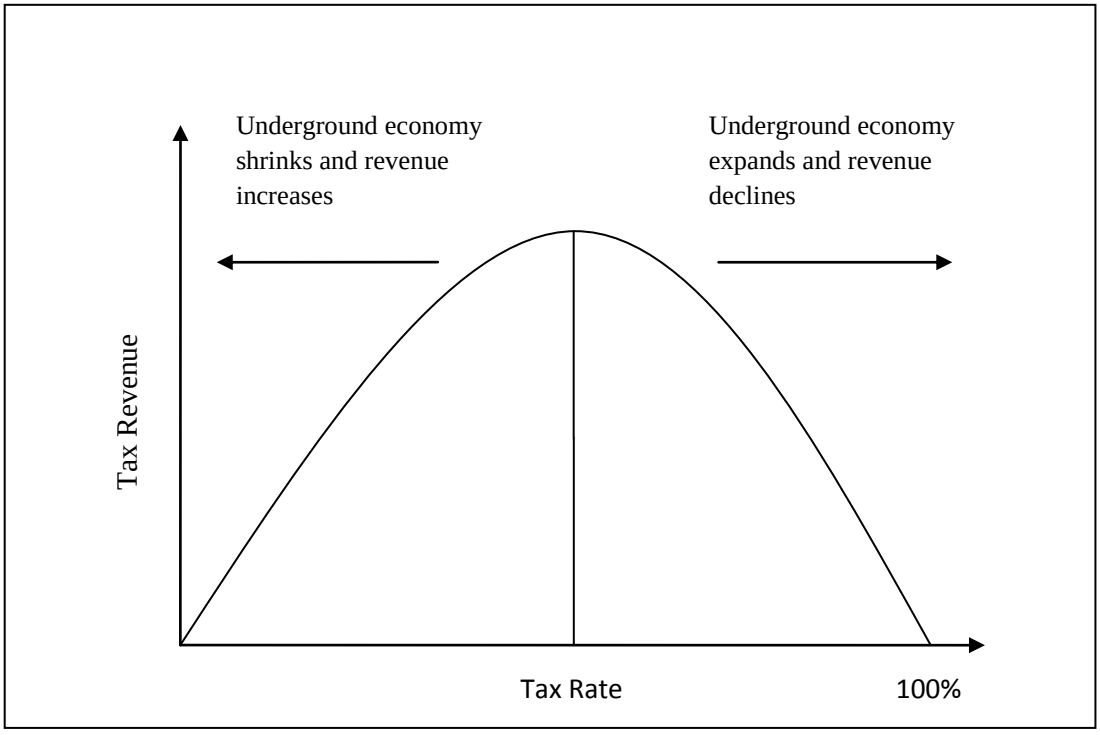
Another study by Schneider (1998) showed that a tax reform such as direct tax decrease does not lead to decrease in the size of the underground economy. The decrease in direct tax only helped to stabilize the size of the underground economy but not reduce it. If the asymmetric hypothesis holds, it will become difficult for the government to use tax reformation as a means to improve the underground economy problem. Therefore, the government might have to source for other tools.

Figure 2.1: The Unofficial Economy and the Collapse of Public Finances



Source: Johnson, Kaufmann, and Shleifer (1997)

Figure 2.2: Laffer's Curve and the Underground Economy



Source: M.E. Sharpe (2007)

2.6 Conclusion

From the discussion above, we are aware that there are two main tax rates used to estimate underground economy which are marginal tax rates and average tax rates. Both these tax rates have their own functions, advantages and disadvantages. In our study, we choose to use both marginal and average tax rates despite of a lack of data for marginal tax rates. The reason is because we want to observe the different dimensions of tax burden and the effects of these two tax rates on the size of the underground economy. After some insights into the methods of measurement, we have decided to employ currency demand approach because it assumes that underground economy is majorly driven by tax burden. Besides, it is quite consistent with our objectives of examining the size of the underground economy driven by tax, investigating the causality effect between tax rates and underground economy. Furthermore, this approach is easy and powerful in comparison to other methods. The subsequent chapter defines the theoretical model and provides detailed procedures for the estimation of the size of the underground economy using currency demand approach. With the estimated size we will further explore the bidirectional causality between underground economy and tax rates and asymmetric responses of underground economy to positive and negative changes of tax rates. Next, Chapter 4 provides the estimation and interpretation of output and Chapter 5 gives an overall conclusion and recommendations of our research.

CHAPTER 3: METHODOLOGY

3.0 Introduction

In our research, we focus our examination of the size of the underground economy, vicious cycle and asymmetric responses on Malaysia, which is one of the developing countries in South-East Asia. We believe that Malaysia data are well suited to examinations because of the lacking of extensive studies regarding tax-driven underground economy in Malaysia. Second, it may bring meaningful implications to the government regarding the policy implementation. In this chapter, we will first describe the data and variables used for estimations, detailing the sources and nature of the data and variables as well as derivation of certain variable (i.e. marginal tax rate). In addition, rolling regression which is performed to trace out the marginal tax rate will also be discussed under this section. Next, we will present the theoretical framework of the procedures to determine the size of the underground economy which involves currency demand approach and two transformation approaches. Third, we will discuss the empirical framework that consists of three main parts, which are the size of the underground economy, vicious cycle and asymmetric hypothesis. Under this section, various statistical tools will be employed to study each objective specifically, and the implications of the expected result will also be discussed. Lastly, we will briefly discuss the pre-test and diagnostic test.

3.1 Data and Variables Description

This research is conducted by using secondary, quantitative and time series data. The data is an annual data from the year 1970 to 2010 that are obtained from the Bank Negara Malaysia (BNM), International Monetary Fund (IMF), World Bank and also Asian Development Bank. Several data including tax revenue, Consumer Prices Index (CPI), Gross Domestic Product (GDP), 3 months fixed deposit rate, and aggregate money (M1) are retrieved to form the variables as below:

1. Aggregate money, M1 (in millions), is the total amount of currency (coins and notes) in circulation, traveller's check, checkable and demand deposit in bank at a particular point in time. M1 consists of money that used for transaction either in official or unofficial. Our purpose is to trace out the aggregate money that is used for underground transactions. In our case, it is used as endogenous variable in our currency demand approach.
2. Average tax rate, ATR (in ratio), is expressed as the total tax revenue divided by Gross Domestic Product (GDP) at a particular point in time. Tax revenue, TR (in millions), is the income gained by the government through taxation including direct taxes, indirect taxes, and non-taxed revenue. Nominal Gross Domestic Product, GDP (in millions), is the market value of all goods and services produced within a country in a given period which is also considered as a standard of living in a country.
3. Marginal tax rate, MTR (in ratio), is traced out using rolling regression (will be discussed under section 3.1.1). The data involved is the same as average tax rate. Both average and marginal tax rate measure the tax burden that induces agents in the official economy to evade tax and subsequently involve in underground economic activities.
4. Consumer Prices Index, CPI (in unit), is the weighted average price of goods and services that consumer paid for their private consumption.
5. Real Gross Domestic Product, RGDP (in millions), is given by the nominal GDP divided by CPI. It is a scale variable that captures the nation real income level.
6. Interest rate, *i* (in ratio), is 3 months nominal interest rate on fixed deposit in Malaysia. It measures the opportunity cost of holding currency or checkable deposit. The original data is in percentage form, so we divide it by 100 to transform it into ratio form.

These three variables (CPI, real GDP and *i*) are exogenous variables for original money demand model.

3.1.1 Computation of Marginal Tax Rate Using Rolling Regression

As discussed earlier in the literature review, marginal tax rate captures the incentive effect that drives official economy to go underground, because it measures the additional burden of people to stay at official economy. However, marginal tax rate cannot be determined easily, so we used rolling regression to obtain the marginal tax rate. Zivot and Wang (2006) stated that rolling analysis of a time series model is often used to assess the model's stability over time as the rolling window can capture instability such as changing economic environment that leads to inconsistency to the model's parameters over the time. It appears to be a creative approach for us to determine the marginal tax rate. The rationale of rolling regression is splitting the total sample into sub-samples, say five years per sub-sample, and then run each sub-sample individually to compute the coefficients. In short, rolling regression can help us to obtain multiple coefficients instead of only one coefficient throughout the whole sample. Thus, marginal tax rate, β_1, can be interpreted as an additional one unit change of income, on average will lead to β_1 unit change of tax revenue.

The rolling regression is run using Ordinary Least Square, OLS is as below:

$$TR_t = \beta_0 + \beta_1 GDP_t + \varepsilon_t \qquad (3.1)$$

TR_t : Tax Revenue (million) at time t

GDP_t : Nominal GDP (million) at time t

μ_t : Error term at time t

β_1 is a positive parameter and is less than 1.

The rolling regression is regressed using OLS regression method with a five-year window size (period for each sub-sample recursively). As a result, the first four observations will be lost and the series will start from 1974. In our case, we do not transform TR and GDP into natural logarithm form, because the β_1s computed may have the possibility of more than one and negatively signed. This is unreasonable to have percentage change of TR more than the percentage change of GDP marginally.

3.2 Theoretical Framework

We adopt currency demand approach by Ahumada et al. (2007) as our referenced framework.

$$C_{Tt} = A(1 + \Theta_t)^{\alpha} Y_{Tt}^{\beta} (1 + i_t)^{\gamma} \quad (3.2)$$

C_{Tt} : Real observed currency at time t.

Θ_t : Variable that drives agents into underground.

Y_t : Real GDP

i_t : Opportunity cost of cash holding

A,α,β are positive parameters, γ is negative parameter.

The Equation 3.2 is the derivation of money demand model. The variable, tax rate, served as a proxy to the tax burden of people to stay in the official economy. It captures the currency demanded in the underground economy. The details of this model will be discussed again under the empirical framework. After the currency demand model is formed, the following equations show the procedures to trace out underground's currency demand and derived the formulas that calculate the size of the underground economy. There are two transformation approaches, which are Pickhardt & Sarda (2006) approach, and Ahumada (2007) approach.

3.2.1 Pickhardt & Sarda Transformation Approach

Total currency, C_{Tt}, is equal to the currency used for transactions in the recorded economy, C_{Rt}, and hidden economy, C_{Ht}.

$$C_{Tt} = C_{Rt} + C_{Ht} \quad (3.3)$$

Each money demand model for recorded and underground is as follows:

$$C_{Rt} = A(Y_{Rt})^{\beta} (1 + i_t)^{\gamma} \quad (3.4)$$

$$C_{Ut} = A(Y_{Ut})^{\beta} (1 + i_t)^{\gamma} \quad (3.5)$$

Equations (3.4) and (3.5) can be combined and rewritten as follows:

$$C_{Tt} = A(Y_{Rt})^{\beta} (1 + i_t)^{\gamma} + A(Y_{Ut})^{\beta} (1 + i_t)^{\gamma} \quad (3.6)$$

modifying Equation (3.2) into linear form by converting it into natural logarithm form:

$$logC_{Tt} = logA + \alpha \log(1 + \Theta_t) + \beta logY_{Rt} + \gamma log(1 + i_t) \quad (3.7)$$

since the total observable money demand model is given by:

$$C_{Tt} = A(1 + \Theta_t)^{\alpha}(Y_{Rt})^{\beta}(1 + i_t)^{\gamma} \quad (3.8)$$

and principally, Equations (3.6) and (3.8) are identical because both represent total money demand.

$$A(Y_{Rt})^{\beta}(1 + i_t)^{\alpha_2} + \alpha_0(Y_{Ut})^{\beta}(1 + i_t)^{\gamma} = A(1 + \Theta_t)^{\alpha}(Y_{Rt})^{\beta}(1 + i_t)^{\gamma} \quad (3.9)$$

Therefore, it can be simplified and rewritten as:

$$A(1 + i_t)^{\gamma}\left((Y_{Rt})^{\beta} + (Y_{Ut})^{\beta}\right) = A(1 + \Theta_t)^{\alpha}(Y_{Rt})^{\beta}(1 + i_t)^{\gamma}$$

$$\Rightarrow (Y_{Rt})^{\beta} + (Y_{Ut})^{\beta} = (1 + \Theta_t)^{\alpha}(Y_{Rt})^{\beta}$$

$$\Rightarrow 1 + \left(\frac{Y_{Ut}}{Y_{Rt}}\right)^{\beta} = (1 + \Theta_t)^{\alpha}$$

then, the final formula for the relative size of the underground economy is as follows:

$$\frac{Y_{Ut}}{Y_{Rt}} = ((1 + \Theta_t)^{\alpha} - 1)^{\frac{1}{\beta}} \quad (3.10)$$

3.2.2 Ahumada's Transformation Approach

Observed currency, C_{ot}, is equal to the total currency, C_{Tt}, in the economy. It is also equal to currency used for transactions in the recorded economy, C_{Rt}, and hidden economy, C_{Ht}.

$$C_{ot} = C_{Tt} = C_{Rt} + C_{Ht} \quad (3.11)$$

Based on the equation above, the assumption of Y_{Rt} is independent to $\frac{Y_{Ht}}{Y_{Rt}}$ has to be made (Cagan, 1958).

$$C_{Tt} = AY_{Rt}^{\beta} \exp(-\gamma i_t) + AY_{Ht}^{\beta} \exp(-\gamma i_t)$$

$$= AY_{Rt}^{\beta} \exp(-\gamma i_t) \left(1 + \left(\frac{Y_{Ht}}{Y_{Rt}}\right)^{\beta}\right) \quad (3.12)$$

Total GDP is equal to the observed or recorded GDP plus hidden GDP.

$$Y_{Tt} = Y_{Ot} + Y_{Ht} = Y_{Rt} + Y_{Ht} \quad (3.13)$$

The currency demand for official economy or recorded economy can be obtained by setting Θ to zero,

$$\hat{C}_{Rt} = \hat{A}\hat{Y}_{Ot}^{\hat{\beta}} \exp(-\hat{\gamma} i_t)$$

(3.14)

then, subtracting $\hat{C}_{Rt}$ from C_{Tt}, will give the currency demand for hidden economy.

$$C_{Ht} = C_{Tt} - \hat{C}_{Rt} \quad (3.15)$$

Hence, the Y_{Ht} can be traced out, given $\hat{C}_{Rt}, \hat{C}_{Ht}, Y_{Rt}$ and $\hat{\beta}$.

$$\frac{C_{Ht}}{C_{Rt}} = \frac{AY_{Ht}^{\beta} \exp(-\gamma i_t)}{AY_{Rt}^{\beta} \exp(-\gamma i_t)} = \left(\frac{Y_{Ht}}{Y_{Rt}}\right)^{\beta}$$

Thus, the final formula for Ahumada to trace out the relative size of the underground economy is as follows:

$$\frac{Y_{Ht}}{Y_{Rt}} = \left(\frac{C_{Ht}}{C_{Rt}}\right)^{\frac{1}{\beta}} \quad (3.16)$$

After tracing out the relative size of the underground economy, real absolute form can be obtained by multiplying it with RGDP.

3.3 Empirical model

3.3.1 The Size of the Underground Economy

The currency demand model is a model to trace out the money demand for underground economy. The procedures to determine the size of the underground economy are identical to the theoretical framework discussed above. The model after natural logarithm transformation is as below:

$$LM1_t = \beta_0 + \beta_1 L(1 + \Theta_t) + \beta_2 LCPI_t + \beta_3 LRGDP_t + \beta_4 L(1 + i_t) + \varepsilon_t \quad (3.17)$$

$M1_t$: Aggregate Money, M1 (million) at time t.

Θ_t : Average tax rate (ratio) or marginal tax rate (ratio) at time t.

CPI_t : Consumer Price Index (unit) at time t.

$RGDP_t$: Real Gross Domestic Product (million) at time t.

i_t : 3 months fixed deposit rate (ratio) at time t.

L : Natural Logarithm

ε_t : Error term

$\beta_1, \beta_2, \beta_3$ are expected to have positive sign, while β_4 is expected to have negative sign.

We have four series of the size of the underground economy. The first two series are generated using Pickhardt and Sarda (2006) transformation approach with average and marginal tax rate. Likewise, the other two series are generated using Ahumada (2007) transformation approach with average and marginal tax rate. From Figure 3.1, the curve represented the time plot of the ratio of nominal currency to M1 in Malaysia. The trend showed that the ratio is decreasing over time starting from 1975 where individuals and firms used lesser and lesser cash for their transactions. This may be due to the rapid advancement of the payment system, like electronic payment system, debit and credit card services and other possible factors. Based on this fact, we used M1 in lieu of currency in circulation as independent variable to track the money used for underground transactions.

The expected sign for the CPI variable is positive because the higher the price level of goods and services, the more M1 people need to hold regardless of

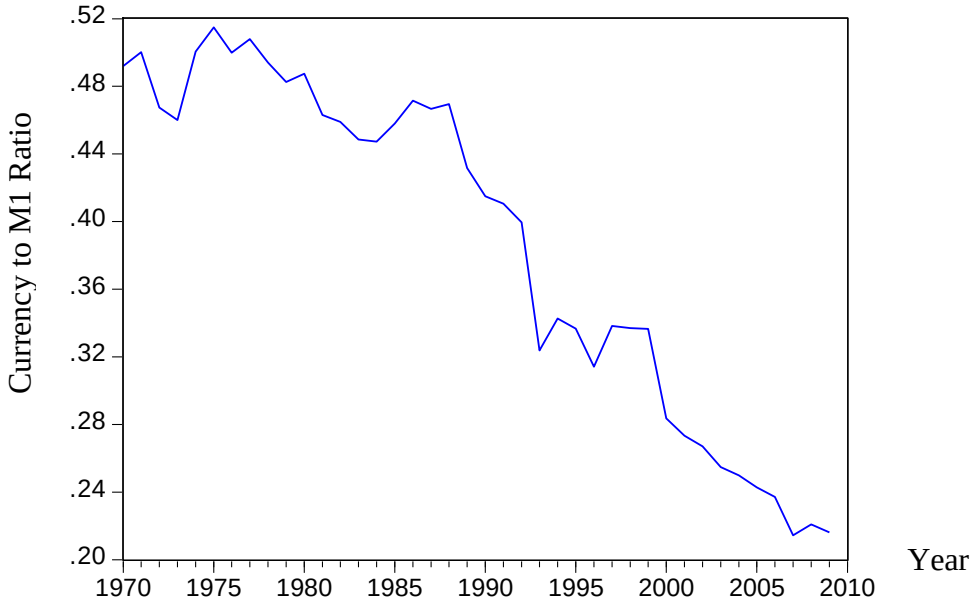
in hand or at bank for daily transactions. RGDP measures the purchasing power or the income that takes into account the inflation. The expected sign for RGDP is positive because the absolute demand for M1 will increase as income increases; given the proportion of holding M1 against longer term interest generated assets remain unchanged. The 3-months fixed deposit rate, *i*, captures the opportunity cost of holding non-interest generated assets like cash and transactional-purpose balance at bank. The expected sign is negative because the higher the 3 months fixed deposit rate, the more incline people convert cash or liquid assets into fixed deposit as the opportunity of holding non-interest bearing assets increases.

The proxy in the money demand model, Θ, is to capture the burden of tax rate on people that work in the official economy. The expected sign is positive because the higher the tax rate, the higher the burden on those who work in the official economy. Consequently, it gives incentive to people to avoid tax payment in two forms. First, they avoid direct tax through tax evasion and tax avoidance activities. These evaded or avoided taxes will eventually be spent and thus can be reflected in the currency demand. Second, people avoid indirect tax by purchasing goods and services produced in the underground economy. This is the variation of tax evasion activities that indirectly evades the tax payment.

We attempt to use average tax rate and marginal tax rate to determine the size of the underground economy, and to examine whether there is a difference between these two tax rates. Marginal tax rate is interpreted as the proportion of income that is used to pay tax when there is an increase of RM1 in income. The reaction of human behaviour to an increment of tax burden shows the incentives effect. When we look from the perspective of average tax rate, we find that it indicates a small portion of human behaviour and despite of this, it also tends to signify institutional effect. For example, when the tax evasion detection effectiveness increase, individuals and firms may find it difficult to evade tax, hence they will comply with the tax payment. The increase of punishment for tax evasion's and effectiveness in tax collection show similar result. Besides, the increase of average tax rate also indicates that the increase in productivity of existing labour force will move up the income bracket as their income increase. For our study, there is no single tax rate that is superior or more suitable than another. Marginal tax rate measures the reaction of human behaviour; hence it will

be more relevant to be used as a proxy to measure the tax burden. For the case of average tax rate, although it does not purely reflect the impact of tax burden, but it is commonly used by previous researchers, so it is useful for results comparison.

Figure 3.1: Currency to M1 ratio



3.3.2 Vicious Cycle

To examine the presence of vicious cycle, Vector Autoregressive (VAR) model is adopted and the model is expressed as:

$$LUE_t = \beta_{10} + \beta_{11}LUE_{t-1} + \cdots + \beta_{1p}LUE_{t-p} + \alpha_{11}L(1+\Theta_{t-1}) + \cdots + \alpha_{1p}L(1+\Theta_{t-}) + \varepsilon_t \quad (3.18)$$

$$L(1+\Theta_t) = \beta_{20} + \beta_{21}LUE_{t-1} + \cdots + \beta_{2p}LUE_{t-p} + \alpha_{21}L(1+\Theta_{t-1}) + \cdots + \alpha_{2p}L(1+\Theta_{t-p}) + \varepsilon_{2t} \quad (3.19)$$

UE_t : The size of the underground output (in millions) at time t

Θ_t : Average tax rate (ratio) or marginal tax rate (ratio) at time t.

L : Natural logarithm

ε_t : Error term

Vicious cycle occurred when the tax rate increases, the size of the underground economy increases. Then, the increased size of the underground

economy will again lead to an increase in the tax rate and this mechanism will continue until equilibrium is achieved. The reason to evident the presence of vicious cycle is to provide explanation to the increasing trend of the size of the underground economy. On one hand, if the vicious cycle indicates an upward trend, it will eventually achieve bad equilibrium, which is high tax rate but low tax revenue. On the other hand, if it indicates a downward trend, it will eventually achieve good equilibrium, which is low tax rate but high tax revenue. The rationale of the impact of increased tax rate has been discussed earlier in section 3.3.1. The increased size of the underground economy will deteriorate the tax base and hence lead to a drop in the tax revenue collected by the government. Subsequently, government are forced to increase tax rate in order to finance public expenditures.

To examine the existence of vicious cycle statistically, bi-causality test is carried out. Simultaneous equation is one of the best tools, but due to lack of other instrument variables, we have decided to opt for another alternative, which is bi-Granger causality and long run relationship. Granger causality means that the lags of one variable affect the other variable (Granger, 1969). The existence of bi-Granger causality implies that the vicious cycle does exist. In other words, the lags of tax rate affect size of the underground economy and the lags of the size of the underground economy affect tax rate.

Even though, the bi-Granger causality is significant, we cannot confirm the existence of vicious cycle because vicious cycle does not solely depend on bi-Granger causality which indicates short run relationship, it also takes into account the long run relationship. Long run relationship means that these two variables will converge to each other or achieve equilibrium in the long run. In our case, the long run and short run relationship can be examined together by utilizing the Vector Error Correction Model, VECM, if the series are I(1) and co-integrated, depending on the nature of the data and relevant criterions which will be discussed under section 3.4. The short run relationship can also be examined using impulse response function.

The vicious cycle has two different interpretations. First, the vicious cycle is initiated by tax rate such as inefficient tax rate designed by government. Second,

the vicious cycle is caused by other factors, for example, high corruption in a country. High corruption may dampen long run economic growth because government revenue is not wisely utilized to promote economic development, for instance, building infrastructures which may improve the productivity of the official economy. If corruption is high, people will find that the "reward" of their tax compliance is very low since the taxes paid were not contributed back to the society. Thus, people will decide to avoid paying taxes. In this case, corruption is the "culprit" that impacted the size of the underground economy which then led to the rise of vicious cycle. The former interpretation is more direct but is only partially pictured whereas the latter interpretation involves general equilibrium view that considers other variables. Nevertheless, it is relatively indirect and it is hard to examine each possible variable that affects the size. In our study, we are only interested to find out the existence of vicious cycle between tax rate and underground economy. This may serve as a preliminary but an important step for future research.

3.3.3 Asymmetric Hypothesis

The following model is to test asymmetric hypothesis.

$$\Delta LUE_t = \beta_0 + \sum \beta_i \, \Delta L(1 + \Theta_i) + \sum \beta_j^+ \, DUM\Delta L\left(1 + \Theta_j^+\right) + \varepsilon_t \qquad (3.20)$$

UE_t : Size of underground output (in millions) at time t.

Θ_t : Average tax rate (ratio) or marginal tax rate (ratio) at time t.

L : Natural logarithm

Δ : First difference form

ε_t : Error term

$DUM\Delta L(1 + \Theta_t^+)$: Interactive term

DUM =1, if $\Delta L(1 + \Theta_t) > 0$,

DUM =0, if $\Delta L(1 + \Theta_t) < 0$.

Asymmetric hypothesis means that the increased in the size of the underground economy due to the increased in tax rate is higher than the decreased of the size of the underground economy due to the decreased in tax rate. The

purpose to test this hypothesis is to examine whether the upward vicious cycle could be reversed by decreasing tax rate. To examine this hypothesis statistically, we run the model using OLS. The expected sign of the interactive term should be positive and statistically significant at 5%. If it is found to be true, it means that the elasticity of positive changes is greater than negative changes and hence asymmetric hypothesis holds. This implies that upward vicious cycle cannot be reversed by controlling tax rate.

Asymmetric hypothesis may consist of a few implications. One of the possible implications is the opportunity cost of participating in the underground economy. To stay in the official economy, people are required to pay taxes. However, these taxes will be "rewarded" back to the citizens in the form of infrastructures, rules and regulations, nation safety, subsidies and other benefits. If people go underground, they can avoid paying tax, but will have to forgo the benefits stated above. The benefits are the opportunity cost of participating in the underground economy. A plausible explanation of asymmetric hypothesis is, if the opportunity cost is low, rational tax payers that have decided to go underground will not go back to the official economy since they are not required to pay tax in the underground economy. In contrast, if the opportunity cost is high, participants in the underground economy will move back to the official economy once the burden or tax rate is reduced, as they can enjoy the benefits in the official economy. This helps to explain the symmetric hypothesis.

3.4 Pre-test and Diagnostic tests

3.4.1 Unit Root & Stationary Tests

Pre-test refers to stationarity and co-integration checking whereas post-test refers to the various diagnostic checking. Stationarity checking is important before we could begin to regress a model. A model's variables that are statistically significant, well specified and have high R squared do not mean that they have relationship. The model may suffer from spurious regression problem if the variables are not stationary because they may just merely share the same trend or have autocorrelation problem.

First, we have to check the stationarity of the series by using Augmented Dickey-Fuller, ADF test and Philip-Perron, PP test in which the null hypothesis is unit root, and KPSS test in which the null hypothesis is stationary, to determine whether the series is I(0) or I(1). Each test must be presented with the intercept and intercept plus trend, to capture the constant and trend in the series. The combination of these two different null hypotheses is to confirm the result. If both tests indicate the same decision, the result is reliable, but if it they are different, the stationarity of the series will be questioned. Throughout the stationary test, if the series are I(0), then we can proceed to regress model in level form. But if the series are I(1), we have to proceed with cointegration test which will be discussed in next section. If have cointegration, we can proceed to run the model in level form, if do not have cointegration, we have to first differentiate the series by examining their short-run relationship.

3.4.2 Cointegration Test

Granger (1987) said if the series are I(1) but have cointegration or long run relationship, we can proceed to level regression and this model will be super-consistent which means that it will coverage to equilibrium at a faster rate than first difference equation. Besides, the endogeneity and dynamic problems can be ignored. To test for co-integration or long run relationship, we adopted Engle-Granger cointegration test and Johanson cointegration test (1988). Engle-Granger cointegration test is suitable for bi-variate model and the procedure is to first, regress a two-variable model by using OLS. Second, the stationarity of the residual is examined. If the residual is stationary in level with no intercept and trend, the two variables are said to have a co-movement (movement of these variables are similar). Thus, we performed Engle-Granger cointegration test on marginal tax rate and vicious cycle, since it only involves these two series.

Johansen co-integration test is suitable for multivariate model as it can examine multiple long-run relationships concurrently. If the model is found to have at least one and maximum k-1 long run relationships, the model is said to have long run relationship and we can proceed to regress the model in level form

or Error Correction model (ECM) or VECM which can capture long run and short run relationship simultaneously. In conclusion, Johansen cointegration test is adopted for model 3.17 which is the currency demand approach, as it involves multiple variables.

3.4.3 Diagnostic Tests

Various diagnostic checking will be performed after each model is run. Basically, it involves four major diagnostic checking which are autocorrelation, heteroscedasticity, non-normality and model misspecification. Autocorrelation, heteroscedasticity and model misspecification (irrelevant variables) problems will produce misleading t-test and F-test results because the standard errors are bias. Model misspecification like omitted variables and incorrect functional form will cause the coefficient to become bias, which also signals that the model is unreliable and meaningless. Autocorrelation problem can be examined using Breusch-Godfrey series correlation Lagrange Multiplier test in which the model is asymptotically chi-square distributed with the null hypothesis as no autocorrelation. Next, the heteroscedasticity problem can be detected using Autoregressive Conditional Heteroscedasticity, ARCH, test in which the model is asymptotically chi-square distributed with the null hypothesis as no heteroscedasticity. Non-normality can be investigated using Jarque-Bera test with the null hypothesis as normally distributed. Lastly, the model misspecification can be examined using Ramsey RESET test in which the model is asymptotically chi-square distributed with the null hypothesis that the model is not mis-specified.

In conclusion, there are three main objectives being examined. First, we estimate the size of the underground economy in Malaysia. Second, we examine the vicious cycle and lastly, we test the asymmetric hypothesis. The following chapter will present and discuss the results based on these three objectives.

CHAPTER 4: DATA ANALYSIS

4.0 Introduction

This section reveals our empirical findings. First, we estimated the size of Malaysia's underground economy by using Pickhardt and Sarda (2006) and Ahumada (2007) currency demand approach for the period 1970 to 2010. Two different types of tax rate which are average tax rate and marginal tax rate are used to examine the size of the underground economy. Next, vicious cycle is examined by using Vector Autoregressive, VAR Granger causality to observe whether there is an occurrence of vicious cycle due to the bidirectional causality between underground economy and tax rate. Lastly, we examined the asymmetric hypothesis due to the ambiguous response of underground economy to an increase and decrease in tax rates.

4.1 Estimating Size of the Underground Economy

We estimated the size of the underground economy using average tax rate and marginal tax rate and then compared both results. As discussed in Chapter 3, since the data for marginal tax rate is not readily available, we have decided to employ rolling regression to trace out the marginal tax rate which is then used to estimate the size of the underground economy in Malaysia. After that, stationary test and unit root test are performed on the variables. Next, if long run relationship is found between the variables, we began to estimate the relative size of the underground economy using Pickhardt and Sarda (2006), and Ahumada (2007) currency demand approach.

4.1.1 Computation of Marginal Tax Rate

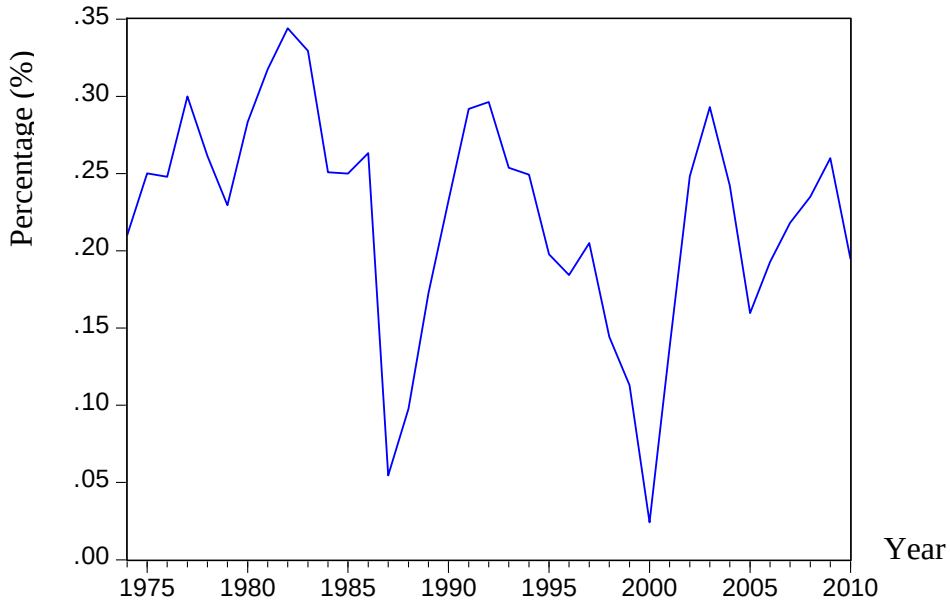
Before running the rolling regression, stationary and unit root tests are performed on Gross Domestic Product, GDP and Total Revenue, TR. In Table 4.1, GDP is not stationary at level or first difference in ADF test. However, PP test shows that GDP and TR are significant at 1% in first difference whereas KPSS test indicate that GDP and TR, both with constant and trend are significant at 5% in first difference. From these three methods, we conclude that GDP and TR are stationary at first difference. Next, we employed rolling regression to obtain marginal tax rate. The first four years observations are lost and hence the observation began from 1974 to 2010. Figure 4.1 illustrates the results of marginal tax rate and there are four years (1987, 1999, 2000, and 2001) that are insignificant at any level. This may be due to the unreliable data or the deviation of data from the boundary.

Table 4.1: Unit Root and Stationary Test

	ADF		PP		KPSS	
	τ_μ	τ_T	τ_μ	τ_T	η_u	η_t
Level						
GDP	3.055 (9)	2.388 (9)	7.197	1.102	0.717	0.205
	[1.000]	[1.000]	[1.000]	[0.999]		
TR	4.131 (9)	-0.068 (9)	-2.324	-2.419	0.722	0.197
	[1.000]	[0.9937]	[0.169]	[0.365]		
First Difference						
GDP	0.468 (9)	-1.808 (9)	-6.303	-8.945	0.725	0.112**
	[0.983]	[0.675]	[0.000]***	[0.000]***		
TR	-4.116	-5.041	-4.964	-4.143	0.622	0.101**
	[0.003]***	[0.001]***	[0.001]***	[0.002]***		

Notes: GDP is defined as gross domestic product. TR denotes total revenue. τ_T represents the most general model with a drift and trend; τ_μ is the model with a drift and without trend. Numbers in brackets are lag lengths used in ADF test (as determined by AIC) to remove serial correlation in the residuals or bandwidth in Philip-Perron test of unit root. Critical values are τ_μ= -2.93 and τ_T = -3.52 at the 5% significance level respectively (ADF & PP). η_u represent drift without trend and η_t represent drift and trend in the model with the critical values 0.463 and 0.146 at 5% significance level respectively (KPSS). *, **and *** denote significance level at 1%, 5% and 10% respectively. p value use to compare with significant level where p value are displayed in [ ].

Figure 4.1: Marginal Tax Rate



4.1.2 Unit Root & Stationary Tests

Prior to the model estimation, unit root and stationary tests are performed to examine the stationarity of all the variables including logged of money supply (LM1), logged of average tax rate (ATR), logged of marginal tax rate (MTR), logged of consumer price index (LCPI), logged of real gross domestic product (LRGDP), logged of interest rate [L(1+ i_t)]. From Table 4.2, the results show that all the variables are significant at 5% and are integrated of order I(1) except interest rate and MTR, both with constant and trend in the KPSS test. In addition, ADF and KPSS tests show that MTR is significant in level and LCPI with constant is not stationary in first difference. On the contrary, PP test show that all the variables are stationary at first difference and LCPI with constant is stationary in level. From the results, we concluded that all the variables can be considered as integrated of order I(1).

Table 4.2 Results of Unit Root and Stationary Tests on Variables

	ADF		PP		KPSS	
	τ_μ	τ_T	τ_μ	τ_T	η_u	η_t
Level						
LM1	-1.269 (9) [0.635]	-2.689 (9) [0.246]	-1.286 [0.627]	-2.639 [0.266]	0.798	0.098**
LCPI	-1.944 (9) [0.309]	-3.166 (9) [0.106]	-4.089 [0.003]**	-1.969 [0.599]	0.784	0.181
LRGDP	-0.940 (9) [0.765]	-2.927 (9) [0.165]	-1.043 [0.729]	-3.007 [0.143]	0.793	0.067**
L(1+ i_t)	-1.835 (9) [0.359]	-3.173 (9) [0.105]	-2.003 [0.284]	-2.439 [0.355]	0.420**	0.141**
L1 + Θ_t (ATR)	-2.489 (9) [0.126]	-2.589 (9) [0.287]	-2.419 [0.169]	-2.324 [0.365]	0.186**	0.173
L1 + Θ_t (MTR)	-3.359 (9) [0.019]**	-3.678 (9) [0.037]**	-2.734 [0.078]*	-2.827 [0.198]	0.257**	0.082**
First Difference						
LM1	-6.135 [0.000] ***	-6.327 [0.000] ***	-6.135 [0.000] ***	-6.333 [0.000] ***	0.172**	0.059**
LCPI	-1.177 [0.673]	-3.687 [0.039] **	-3.620 [0.009] ***	-4.437 [0.006] ***	0.508	0.079**
LRGDP	-5.741 [0.000] ***	-5.782 [0.000] ***	-6.529 [0.000] ***	-6.531 [0.000] ***	0.106**	0.055**
L(1+ i_t)	-5.176 [0.000] ***	-5.143 [0.000] ***	-5.762 [0.000] ***	-6.379 [0.000] ***	0.197**	0.149
L1 + Θ_t (ATR)	-8.459 [0.000] ***	-8.542 [0.000] ***	-9.355 [0.000] ***	-8.778 [0.000] ***	0.186**	0.101**
L1 + Θ_t (MTR)	-5.301 [0.000] ***	-5.219 [0.000] ***	-6.937 [0.000] ***	-6.736 [0.000] ***	0.194**	0.184

Notes: τ_T represents the most general model with a drift and trend; τ_μ is the model with a drift and without trend. Numbers in brackets are lag lengths used in ADF test (as determined by AIC) to remove serial correlation in the residuals or bandwidth in Philip-Perron test of unit root. Critical values are τ_μ= -2.93 and τ_T = -3.52 at the 5% significance level respectively (ADF & PP). η_u represent drift without trend and η_t represent drift and trend in the model with the critical values 0.463 and 0.146 at 5% significance level respectively (KPSS). *, **and ***denote significance level at 1%, 5% and 10% respectively. p value use to compare with significant level where p value are displayed in [ ].

4.1.3 Cointegration Test

After stationary checking, we used Johansen and Juselius approach which depends on the choice of lag length criteria to determine any possible long run relationship among the variables. We performed cointegration tests on two models, Model 1 which included LM1, LCPI, L(1+ i_t), LRGDP and ATR, and Model 2 which included the same variables but used MTR instead of ATR. Table 4.3 and Table 4.4 show the results of cointegration test on Model 1 and Model 2. Both tests give consistent result, suggesting that there are at least four co-integrating relationships. In other words, there are four long run equilibrium relationships between these variables. The existence of long run relationships enables us to perform OLS regression in level form.

Table 4.3: Johansen and Juselius Test for Model 1

H_0	H_1	Intercept without trend		Intercept and trend	
		λ_{trace}	C.V at 5%	λ_{trace}	C.V at 5%
$r \leq 0$	$r \leq 1$	159.908	69.819	244.951	88.804
$r \leq 1$	$r \leq 2$	88.668	47.856	132.054	63.876
$r \leq 2$	$r \leq 3$	38.232	29.797	73.439	42.915
$r \leq 3$	$r \leq 4$	12.796	15.495	28.683	25.872
$r \leq 4$	$r = 5$	0.100	3.842	8.392	12.518

Note: r indicates the number of co-integrating relationships, λ_{trace} is the trace statistics. VAR 5 based on both Akaike Information Criterion (AIC) and Schwartz Criteria (SC) are used to select the number of lag required in the cointegration test.

Table 4.4: Johansen and Juselius Test for Model 2

H_0	H_1	Intercept without trend		Intercept and trend	
		λ_{trace}	C.V at 5%	λ_{trace}	C.V at 5%
$r \leq 0$	$r \leq 1$	264.803	69.819	355.310	88.804
$r \leq 1$	$r \leq 2$	115.746	47.856	168.408	63.876
$r \leq 2$	$r \leq 3$	55.838	29.797	89.267	42.915
$r \leq 3$	$r \leq 4$	26.934	15.495	37.171	25.872
$r \leq 4$	$r = 5$	2.407	3.842	9.123	12.518

Note: r indicates the number of co-integrating relationships, λ_{trace} is the trace statistics. VAR 5 based on both Akaike Information Criterion (AIC) and Schwartz Criteria (SC) are used to select the number of lag required in the co-integration test.

4.1.4 Estimation of the Relative Size of the Underground Economy

Before we estimate the relative size of the underground economy, we have to first estimate the money demand model. The OLS regression result for money demand model shown in Table 4.5 is remarkably good. The expected sign for both models are consistent with the theoretical framework. Besides, from Model 1 and Model 2, all the variables are significant at 5% significance level. In addition, the added variables for Model 1 namely DUM 1 and DUM 2, and DUM1 for Model 2 are also significant at 5% level. The additional variables are used to capture structural break such as oil price crisis and economic recession. In our case, we assigned the value one to DUM 1 and DUM 2 in year 1973 and 1975 respectively for Model 1. As for Model 2, we assigned the value one to DUM 1 in 1975. Apart from that, both models have high adjusted R squared which is 0.9977 and 0.9972 for Model 1 and Model 2 respectively. The Durbin Watson statistics and all diagnostic tests results are also at satisfactory level. From the diagnostic test, both models are normally distributed, without heteroscedasticity, autocorrelation and misspecification problems.

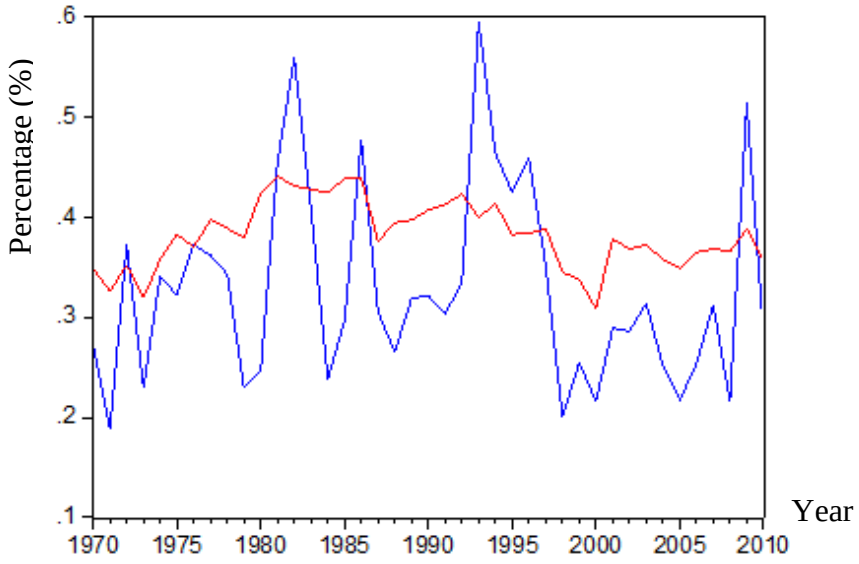
Next, we proceed to estimate the relative size of the underground economy using Equations 3.10 and 3.16 in Chapter 3 which are proposed by Pickhardt and Sarda (2006), and Ahumada (2007). Both methods using average tax rate to trace out the relative size of the underground economy are shown in Figure 4.2. The figure shows that there are huge fluctuations in the relative size of the underground economy using Ahumada (2007) method which is insensible and illogical. For example, in year 1980, the relative size of the underground economy in Malaysia is 24.62%. For the subsequent four years, the relative size of the underground economy increased to 55.90% in 1982 and then dropped to 23.84% in 1984. The huge fluctuations in the relative size of the underground economy may be either due to a huge increased or decreased in hidden or recorded GDP which is not reasonable. Therefore, we have decided to drop the Ahumada (2007) method and to continue our estimation using Pickhardt and Sarda (2006) approach. The following discussions are based on Pickhardt and Sarda (2006) approach.

Table 4.5: OLS Estimation of Money Demand with Different Tax Rates

Variables	Malaysia	
	Model 1	Model 2
Constant(β_0)	-8.810	-8.019
	(-18.754)***	(-21.59)***
Log CPI (β_1)	0.684	1.037
	(4.348)***	(5.879)***
Log RGDP (β_2)	1.312	1.140
	(15.326)***	(13.02)***
Log(1+ i_t) (β_3)	-1.680	-2.010
	(-2.299)**	(-2.420)**
Log $1 + \Theta_t$ (β_4)	1.212	0.483
	(2.232)**	(2.514)**
DUM 1	0.126	0.108
	(6.070)***	(5.982)***
DUM 2	0.131	-
	(6.275)***	
Diagnostic tests		
R^2	0.998	0.998
Adjusted R^2	0.998	0.997
F-statistic	[0.000]***	[0.000]***
Jarque-Bera	1.864	1.721
	[0.394]	[0.423]
LM(1)	0.191	0.316
	[1.011]	[1.608]
ARCH(1)	0.032	0.108
	[0.224]	[0.872]
RESET	0.014	0.006
	[1.027]	[0.483]

Note: Estimation with Newey-West correction for heteroskedasticity consistent coefficient covariance. The dummy variables are used to deal with problem of non-normality of residual. Malaysia: DUM 1= 1973 DUM 2= 1975 (model 1) and DUM 1=1975 (model 2). *, **and *** denote significance level at 1%, 5% and 10% respectively. p value use to compare with significant level where p value are displayed in [ ].

Figure 4.2: Relative Size of the Underground Economy with Different Methods



Relative size of the underground economy using Pickhardt and Sarda (2006) method (average tax rate)

Relative size of the underground economy using Ahumada (2007) method (average tax rate)

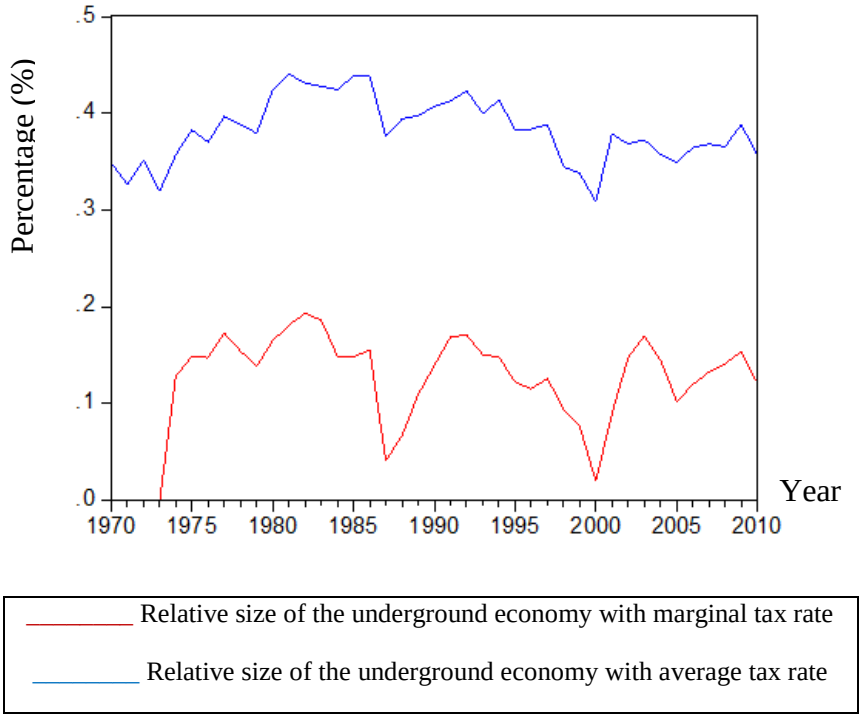
By adopting the Equation 3.10, the result of the relative size of the underground economy using both marginal and average tax rates is shown in Figure 4.3. As discussed in section 4.1.1, the relative size of the underground economy using marginal tax rate began from year 1974. The figure shows that the relative size of the underground economy computed using marginal tax rate is much smaller than the one using average tax rate. This is because the increased in official economic activities will lead to an increase in total revenue. Thus, the average tax rate given by total revenue divided by RGDP will also increase. Subsequently, the estimated size of the underground economy is also high because high tax rate gives incentive to people to go underground. A study by Zilberfarb (1986) indicated that the relative size of the underground economy in United States using marginal tax rate is smaller than the one using average tax rate whereby the difference between these two estimates was 11% on average.

From Figure 4.3, both tax rates show that the relative size of the underground economy in Malaysia is considerably larger from 1980 to 1986. The

largest relative size of the underground economy using average tax rate falls in the year 1981 with 44.09%. As for marginal tax rate, the size is largest in 1982 with 19.33%. High underground economy in 1980s may due to the implementation of new policy "New Economic Policy" (NEP) in which the government spent a lot of money to restructure the society, increase the productivity and living standards of the rural areas. Thus, government imposed higher taxes to generate more income to execute the NEP. Consequently, higher taxes and increased tax burden encouraged people to go underground and caused the relative size of the underground economy to increase.

The smallest relative size of the underground economy for both average and marginal tax rates falls in year 2000 with 30.88% and 2% respectively. This may due to the recession in developed countries that diverted investors' attention to invest in countries like Malaysia. This in return helped to boost the Malaysia economy and increased the GDP of the country. The relative size of the underground economy in Malaysia using average and marginal tax rates fluctuate at an average of 32.27% and 13.34% respectively. Marginal tax rate represents the human behaviour interest in underground economic activities which may be more accurate in estimating the size of the underground economy.

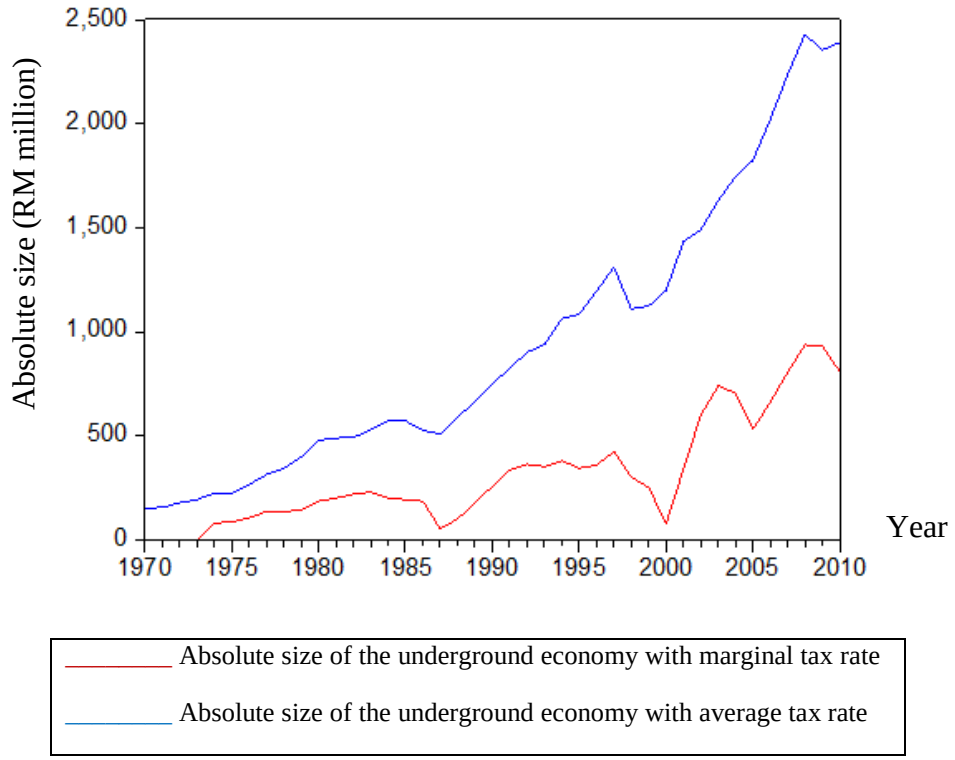
Figure 4.3: Relative Size of the Underground Economy in Malaysia



4.1.5 Absolute Size of the Underground Economy in Malaysia

After examining the relative size of the underground economy, we then traced out the absolute size of the underground economy in Malaysia as shown in Figure 4.4. From Figure 4.4, we observed that the size of the underground economy in Malaysia keep increasing most of the time which may be due to rising Real Gross Domestic Product, RGDP in Malaysia. In 1987, Malaysia has small absolute size of the underground economy using marginal tax rate which is RM5520.01 million. This result is unreliable because the marginal tax rate traced out using rolling regression for this particular year is insignificant. The insignificance of marginal tax rate may due to the unreliable data or deviation of data from the boundaries. In year 2000, the absolute size of the underground economy is also small. This may due to increased foreign investments in Malaysia that generated more revenue to the government and increased involvement in the official activities which brought more formal businesses into Malaysia. Generally, the size of the underground economy follows an increasing trend over the years.

Figure 4.4: Absolute Size of the Underground Economy in Malaysia



4.2 Vector Autoregression (VAR) Estimation of Vicious Cycle for Tax Driven Underground Economy

VAR in level form will not be used in our study due to the constraint in consequence of the way the relative size of the underground economy is derived in that it is derived contemporaneously from the dynamic of tax rate. Hence, although there is cointegration, granger causality between both average and marginal tax rate and size of the underground economy as a share of GDP either unidirectional or bidirectional by definition is certainly proved to be absent. Moreover, the results of cointegrated but independence between both average and marginal tax rate and relative size of the underground economy as a share of GDP may indicate that there may be cyclical movement in the underground economy that coincide with movement in tax rate which cause the two variables to have co-movement. This is shown in Table 4.6 and Table 4.7 in which the correlation between relative size of the underground economy and log of average as well as marginal tax rate is 0.999.

Table 4.6: Correlation between Relative Size of the Underground Economy and Log of Average Tax Rate

Correlation	Relative size of the underground economy	Log of average tax rate
Relative size of the underground economy	1.000	0.999
Log of average tax rate	0.999	1.000

Table 4.7: Correlation between Relative Size of the Underground Economy and Log of Marginal Tax Rate

Correlation	Relative size of the underground economy	Log of marginal tax rate
Relative size of the underground economy	1.000	0.999
Log of marginal tax rate	0.999	1.000

4.2.1 Granger Causality Test for the Case of Average Tax Rate

The results as shown in Table 4.8 insists that we conclude in favour of first difference of both log of average tax rate and log of absolute size of the underground economy after conducting unit root testing. This is evidenced by repeating the unit root testing until we reject $H_{0.}$ The p value of 0.000 (with drift and trend) and also 0.000 (with drift but without trend) for size of the underground economy as well as for average tax rate using both Philip-Perron and ADF test restate our decision in concluding level of differencing as mentioned above. This motivates us to test for cointegration in deciding whether to model in level form or first difference form. However, the results of cointegration in Table 4.9 shows that we do not reject H_0 at p value of 0.490 and conclude that there is no cointegration between log absolute size of the underground economy and the % change in average tax rate. Our findings are also inconsistent with the evidence existing in the studies by Fethi et al. (2004) in which they found a long run relationship between underground economy and average tax rate in Cyprus. The

indication of first difference stationary for both log absolute size of the underground economy and log of average tax rate as well as with the absence of cointegration between them may motivate us into a second stage of estimation of studying the relationship between growth rate of log absolute size of the underground economy and the % change in average tax rate. This is because the absence of cointegration between the pair variables does not allow us to model them in level form.

Therefore, the results of regressing using first difference of the two variables suggested that either the first difference or growth rate of log absolute size of the underground economy and % change in average tax rate is in level stationary. In other words, we construct a first differenced Vector Autoregressive model to determine the presence and hence the direction of causality. The results as shown in Table 4.10 concluded in favour of bidirectional causality between absolute size of the underground economy and average tax rate at log difference which is in the short run. The p value of granger causality from the latter to the former and from the former to the latter variable is 0.000. This allows us to reject H_0 of no granger causality between growth rate log of absolute size of the underground economy and % change in average tax rate.

Table 4.8: Unit Root Test in the Case of Average Tax Rate

	ADF		PP	
	τ_μ	τ_T	τ_μ	τ_T
Level				
LUE(ATR)	-1.547(0)	-2.834(1)	-1.555(4)	-2.109(3)
	[0.499]	[0.194]	[0.495]	[0.525]
ATR	-2.489(0)	-2.588(0)	-2.324(1)	-2.419(1)
	[0.125]	[0.287]	[0.169]	[0.364]
First Difference				
LUE(ATR)	-5.216(0)	-5.432(0)	-5.192(3)	-5.499(4)
	[0.000]***	[0.000]***	[0.000]***	[0.000]***
ATR	-8.459(0)	-8.541(0)	-8.778(4)	-9.355(7)
	[0.000]***	[0.000]***	[0.000]***	[0.000]***

Notes: LUE (ATR) is defined as the log of the size of the underground economy computed using average tax rate whereby ATR is defined as the log of average tax rate. τ_μ is the model with a drift but without trend; τ_T represents the most general model with a drift and trend. The above value is t statistics and p value in [ ]. Numbers in brackets ( ) are lag lengths used in ADF test (as determined by AIC) to remove serial correlation in the residuals or bandwidth in Philip-Perron test of unit root. Critical values are τ_μ= -2.93 and τ_T= -3.52 at the 5% significance level respectively (ADF & PP). ***, **, * denotes statistical significance at 1%, 5% and 10% respectively.

Table 4.9: Pairwise Cointegration Results

Null Hypothesis:	Lag length	Prob
There is no cointegration between LUE(ATR) and ATR	0	0.490
There is no cointegration between LUE(MTR) and MTR	0	0.644

Notes: LUE (ATR) is defined as the log of the size of the underground economy computed using average tax rate whereby ATR is defined as the log of average tax rate. LUE (MTR) is defined as the log of the size of the underground economy computed using marginal tax rate whereby MTR is defined as the log of marginal tax rate. ***, **, * denotes statistical significance at 1%, 5% and 10% respectively.

Table 4.10: VAR Granger Causality/Block Exogeneity Wald Tests for Changes in Log of Average Tax Rate (DATR)

Dependent variable: DLUE(ATR)	df	Prob
DATR	1	0.000***

Dependent variable: DATR	df	Prob
DLUE(ATR)	1	0.000***

Notes: DLUE (ATR) is defined as the growth rate log of the size of the underground economy computed using average tax rate whereby DATR is defined as the % change in average tax rate. ***, **, * denotes statistical significance at 1%, 5% and 10% respectively.

4.2.2 Granger Causality Test for the Case of Marginal Tax Rate

Besides, the results of modelling log absolute size of the underground economy and log of marginal tax rate also showed similar outcome as regression on log of average tax rate in that the log of marginal tax rate indicate a first difference stationary (using Philip Perron test) and no cointegration towards log absolute size of the underground economy as shown in Table 4.9 and Table 4.11. The results of no cointegration is shown in Table 4.9 in which we do not reject H_0 at p value of 0.644 and conclude that there is no cointegration between log absolute size of the underground economy and log marginal tax rate. However, the results of level stationarity for log of marginal tax rate computed using Augmented Dickey Fuller (ADF) gives a contradicting result. This is evidenced by p value of log marginal tax rate using ADF test which recorded 0.037(with drift and trend) and 0.019 (with drift only). We reject H_0 of first difference stationary and concluded in favour of level stationary. On the other hand, Philip-Perron test suggested first difference stationary for log marginal tax rate in that p value of 0.000 (both with drift and trend and with drift only) indicates we reject H_0 of unit root in the first difference and conclude that log marginal tax rate is stationary after differencing by one time.

However, if we regress the growth rate of absolute log size of the underground economy with changes in log of marginal tax rate, VAR granger causality evokes that the absolute size of the underground economy and marginal tax rate have no effect of Granger causation to each other at log difference which is in the short run. This is shown by p value of 0.993 when we evaluate the granger causality from growth rate log of size of the underground economy to the % change in marginal tax rate whereas the granger causality of the reverse procedure recorded a p value of 0.469. This can be seen as in Table 4.12. Hence, we do not reject H_0 of no granger causality. Whereas, if we perform analysis towards log of marginal tax rate in its level form as in Table 4.13, the result leads us to an outcome of bilateral causality between growth rate log absolute size of the underground economy and log of marginal tax rate. In other words, they exhibit feedback effect towards each other. This is shown by p value of 0.012 for the causality from log of marginal tax rate to growth rate log of size of the underground economy computed using marginal tax rate significant at 5%, and p

value of 0.054 for directional relationship from growth rate log of size of the underground economy computed using marginal tax rate to log of marginal tax rate which is significant at 10%.

Table 4.11: Unit Root Test in the Case of Marginal Tax Rate

	ADF		PP	
	τ_μ	τ_τ	τ_μ	τ_τ
Level				
LUE(MTR)	-1.868(0)	-3.264(0)	-1.694(5)	-3.090(5)
	[0.353]	[0.088]*	[0.425]	[0.123]
MTR	-3.358(1)	-3.678(1)	-2.733(4)	-2.826(5)
	[0.019]**	[0.037]**	[0.078]*	[0.197]
First Difference				
LUE(MTR)	-6.287(0)	-6.190(0)	-9.501(16)	-9.195(16)
	[0.000]***	[0.000]***	[0.000]***	[0.000]***
MTR	-5.300(0)	-5.218(0)	-6.936(15)	-6.735(15)
	[0.000]***	[0.000]***	[0.000]***	[0.000]***

Notes: LUE (MTR) is defined as the log of the size of the underground economy computed using marginal tax rate whereby MTR is defined as the log of marginal tax rate. τ_μ is the model with a drift but without trend; τ_τ represents the most general model with a drift and trend. The above value is t statistics and p value in [ ]. Numbers in brackets ( ) are lag lengths used in ADF test (as determined by AIC) to remove serial correlation in the residuals or bandwidth in Philip-Perron test of unit root. Critical values are τ_μ= -2.93 and τ_τ= -3.52 at the 5% significance level respectively (ADF & PP). ***, **, * denotes statistical significance at 1%, 5% and 10% respectively.

Table 4.12: VAR Granger Causality for Changes in Log Marginal Tax Rate (DMTR)

Null Hypothesis:	df	Prob
DLUE(MTR) does not granger cause DMTR	1	0.993
DMTR does not granger cause DLUE(MTR)	1	0.469

Notes: DLUE (MTR) is defined as the growth rate log of the size of the underground economy computed using marginal tax rate whereby DMTR is defined as the % change in marginal tax rate. ***, **, * denotes statistical significance at 1%, 5% and 10% respectively.

Table 4.13: VAR Granger Causality for Log of Marginal Tax Rate (MTR)

Null Hypothesis:	df	Prob
DLUE(MTR) does not granger cause MTR	1	0.054*
MTR does not granger cause DLUE(MTR)	1	0.012**

Notes: DLUE (MTR) is defined as the growth rate log of the size of the underground economy computed using marginal tax rate whereby MTR is defined as the log of marginal tax rate. ***, **, * denotes statistical significance at 1%, 5% and 10% respectively.

Hence, in order to conclude for this section, we should say that the presence of bidirectional causality between growth rate of log absolute size of the underground economy and % change in average tax rate as well as between growth rate of log absolute size of the underground economy and log of marginal tax rate should not be the only criteria to conclude whether there exist a vicious cycle between tax rate and size of the underground economy. As a matter of fact, there are another two criteria that constitute to our conclusion about vicious cycle which we could not examine; this comprises the bi-causes and long run relationship between the variables. The simultaneous equation cannot be used in our case to determine the causality between current value of the variables because instrumental variables that is necessary in the regression by indirect least square or two stage least square is certain to be absent in our case.

Besides, the results of no cointegration between log of absolute size of the underground economy and both log of average tax rate and log of marginal tax rate also break down our analysis of vicious cycle in that we can only examine the possibility of short run vicious cycle. Vicious cycle should be a long run effect rather than a short run effect. In other words, we can take the perspective that there is a symptom of the presence of vicious cycle but cannot be sure of the presence of vicious cycle in Malaysia. This issue of vicious cycle might need further investigation by examining the appropriate instrumental variables that is not correlated with the disturbance to be included in the analysis of the possibility of vicious cycle in future studies.

4.2.3 Impulse Response Functions (IRFs) for the Case of Average Tax Rate

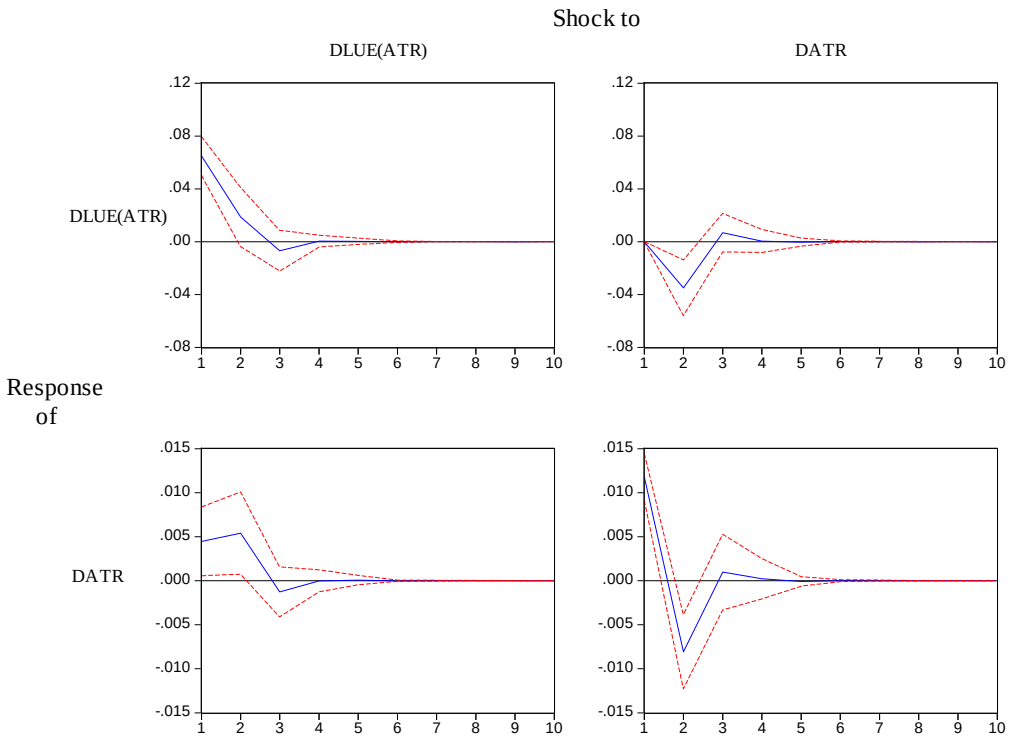
From the impulse responses plotted in Figure 4.5, we can deduce several implications. Firstly, there is a clear indication that average tax rate and size of the underground economy are mutually dependent but the causality last for a longer period than for the case of marginal tax rate: the size of the underground economy is not responsive to the first unit of shock in average tax rate but the response is about 3.422% in the year 2 in which it yields a negative response before there is a sharp turning point in year 3. Year 3 yields a positive response of 0.664% only before it fades out quickly to a zero response in year 5.

Secondly, we can see that average tax rate and size of the underground economy exhibit an incoherent response to each other's impulse in which they exhibit opposite movement in response to each other's shock. Despite, they converge to zero value at about the same speed which is approximately at year 5.

Thirdly, initial shock of a unit of size of the underground economy or average tax rate also yield different response to each other in that size of the underground economy is yield a zero response to a shock in average tax rate whereby average tax rate is very responsive to a unit of shock of in size of the underground economy initially at +0.432%, before the effect started to diminish in year 3.

In conclusion, the results depicted in Figure 4.5 emphasize the absence of any vicious cycle between average tax rate and size of the underground economy. This is because they exhibit opposite responses to each other's shocks and thus does not demonstrate an explosive trend or at least a short period of upward and continued by constant responses to each other's shocks.

Figure 4.5: Impulse Response (Cholesky One Standard Innovation) of a Shock in Average Tax Rate on Size of the Underground Economy



4.2.4 Impulse Response Functions (IRFs) for the Case of Marginal Tax Rate

From the impulse responses plotted in Figure 4.6, several observations emerge. Firstly, there is a clear indication that marginal tax rate and size of the underground economy does granger cause each other but the causality is weak and temporal: the size of the underground economy is not responsive to the first unit of shock in marginal tax rate but the response is about 6.412% in the year 2 in which it yield a negative response before there is a sharp turning point in year 3. Year 3 yields a less negative response of 3.822% only before it fades out quickly.

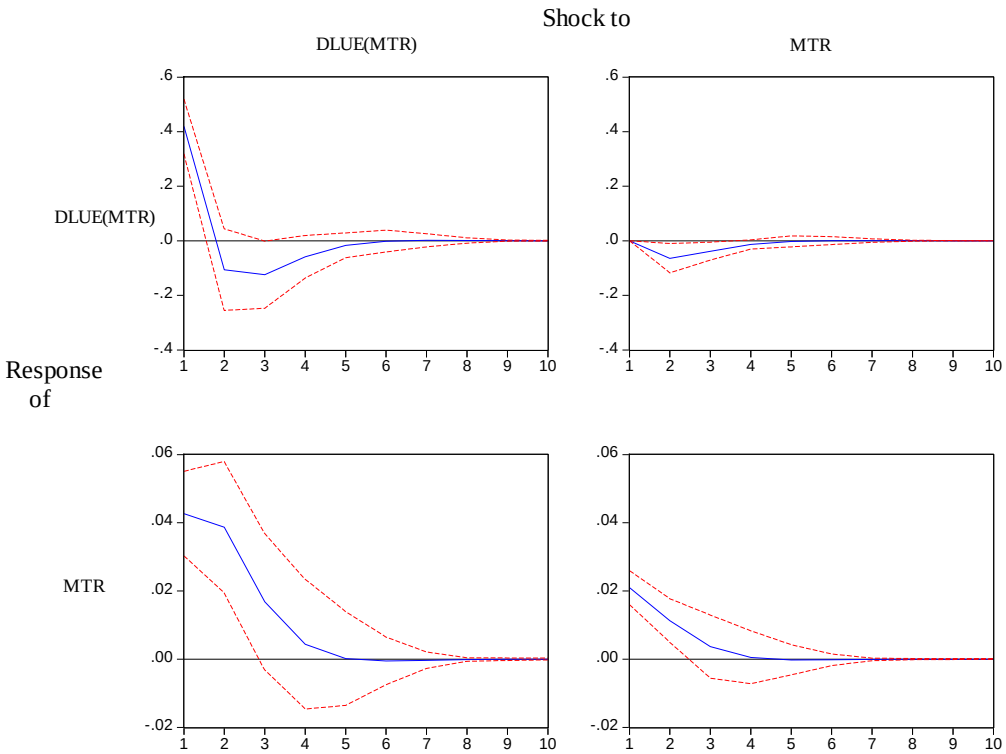
Secondly, we can see that marginal tax rate and size of the underground economy exhibit an incoherent response to each other's shocks. Despite, they converge to zero value at about the same speed which is approximately at year 4.

Thirdly, an impulse in marginal tax rate leads to a temporary abrupt decrease in the size of the underground economy and the time path dies away more rapidly compare to response of marginal tax rate to a shock in size of the

underground economy. Initial shock of a unit of size of the underground economy or marginal tax rate also yield different response to each other in that size of the underground economy is yield a zero response whereby marginal tax rate is very responsive initially at +4.266%, before the effect diminished gradually.

In conclusion, the results depicted in Figure 4.6 emphasize the absence of any vicious cycle between marginal tax rate and size of the underground economy. This is because they exhibit opposite responses to each other's shocks until the shocks in year 2 and thus does not demonstrate a continuous same upward pattern in response to each other's shocks.

Figure 4.6: Impulse Response (Cholesky One Standard Innovation) of a Shock in Marginal Tax Rate on Size of the Underground Economy



Based on the results of IRFs, the responses of tax rate to size of the underground economy are as our postulation. However, the responses of size of the underground economy to tax rate exhibit another interesting implication which we do not concern before: the lagged negative responses of size of the

underground economy to shock of tax rate as the expected responses should be positive. As we know, taxes collected by government are used to fund for public expenditures, either to provide public goods, subsidies or other goods and services that promote economy welfare. If those benefits of economy welfare only can be reaped in official economy, people may retain in official economy even though the tax burden increase as the benefits outweigh the costs in official economy. In this case, it could explain why our lagged impact of underground economy is negative responded to the shock of tax rate in both cases. However, the impact may vary to different countries as it depends on the efficiency and effectiveness of government to utilize the tax revenue to promote economy welfare.

Furthermore, these results may raise another interesting issue: the threshold of the tax rate to size of the underground economy. This has to be related to extent that people can tolerate the tax burden and start to move into underground economy. Based on the Figure 2.2, after the tax rate exceeds the threshold (revenue maximizing point), underground economy will begin to expand. However, if tax rate do not exceed the threshold level, not only the underground economy do react, but the tax revenue increase at the same time. The increased revenue can be funded to promote economy welfare in official economy in that it helps to control or even draw the people out from underground activities. Is Malaysia government utilizing the tax revenue wisely? Statistically, in both cases the results of IRFs do support our argument, but it is just a preliminary study. Our explanations may be just one of the possible answers.

4.3 Asymmetric Responses of Size of the Underground Economy to Changes in Tax Rates

In dealing with asymmetric testing of responses of size of the underground economy to positive and negative changes in tax rates, we have modeled both the % change in average tax rate as well as % change in marginal tax rate in our regression.

4.3.1 Analysis for the Case of Average Tax Rate

The results in Table 4.14 show that the stability test of Ramsey Reset test does not reject H_0 of no model misspecification at p value of 0.693(p value > 0.05)

and this allows us to conclude that the model is well-specified. However, the autocorrelation test and heteroscedasticity do not signifies a rejection of H_0 at p value of 0.108 and 0.915, this indicates that these two problems have been corrected by Newey-West HAC Standard Errors & Covariance as well as White heteroscedascity corrected standard error and covariance test respectively. However, both of the % change in log of marginal tax rate and % change in log of average tax rate violate the normality assumption of the error term of u_i for all i, where i≠j. Overall, these stability tests indicate that our estimated model is quite well specified although there is frailness in the residual test that yields less satisfactory results.

In accepting the model specification, the results depicted in Table 4.14 imply that for the % change in average tax rate, the positive changes (p value=0.635) is not significant at 5% significance level, so we do not reject the null hypothesis of symmetry. However, the expected coefficient sign of -0.877 in relation to positive side of % change in average tax rate in our finding seems contradict with our hypothesis that the positive changes in average tax rate should yield positive sign in its relation in estimating the size of the underground economy. A negative sign implies that positive changes in average tax rate will trigger a negative growth rate in the absolute size of the underground economy. Nevertheless, this variable is statistically insignificant in explaining the growth rate in underground economy.

4.3.2 Analysis for the Case of Marginal Tax Rate

The reliability tests for marginal tax rate are also shown in Table 4.14 such that the Ramsey Reset test shows a p value of 0.559; in this case, we do not reject null hypothesis and conclude that the model is well specified. However, the model also suffers from heteroscedasticity problem (at p value=0.007) and autocorrelation problem (at p value=0.039) in which we reject H_0 at 5% significance level even after we corrected for it.

By referring to the same table, we can see that for positive side of the % change in marginal tax rate, its p value of 0.397 is greater than the 5% significance level in explaining the growth rate log size of the underground economy. Thus, the result has served the basis of not to reject the null hypothesis,

this enable us to conclude in favor of symmetry. For sign of the coefficient of positive side of % change in marginal tax rate, we found that the expected sign of the coefficient indicate a positive value of +1.501 in which it complies with the theoretical sign. If there is 1% increase in the change of marginal tax rate, the growth rate of underground economy will increase by 1.501% in the short run, *ceteris paribus*.

Symmetry responses signify that taxpayer move into the underground economy as fast as they depart from it when there is an increase or decrease in either average tax rate or marginal tax rate. We do not have enough evidence to conclude that the effect of upward movement in vicious cycle is greater than the downward movement in vicious cycle. Taxpayers in Malaysia may be fear of being detected by tax authority and thus tend to depart from underground activities and moving towards official economy when tax rates are reduced (substitution effect). The income effect that keeps the people in the underground economy has been overridden by the substitution effect. If we see the symmetry effect from the perspective of opportunity cost, we can deduce that the opportunity of going to underground economy may be is too high for Malaysian, hence they will move back to official economy as long as there is decrease in tax rate, both average and marginal. When there is an increase in tax rate, they may have the incentive to evade tax by going underground, but the opportunity cost of not being able to enjoy the institutional benefit when operating in official economy may dominate the incentive effect when there is a decrease in tax rate. As for the results of reliability testing, we should be more cautious in interpreting the sign, significance, and size of the coefficient because the robustness of the results may be somewhat distorted by the effect of non-normality of error term and some problematic diagnostic checking as evidenced by the case of marginal tax rate. All of these cannot be avoided in statistical modeling.

Table 4.14: Robustness Analysis for the Case of Average Tax Rate and Marginal Tax Rate

	ATR	MTR
Variables		
C	0.073(4.832)	0.036(0.886)
	[0.000]***	[0.381]
DTR	3.094 (2.314)	6.707(7.973)
	[0.026]**	[0.000]***
DTR+	-0.877 (-0.478)	1.501(0.858)
	[0.635]	[0.397]
Diagnostic tests		
RESET	0.693	0.559
LM(1)	0.108	0.039**
ARCH(1)	0.915	0.007***
Jargue-Bera	0.009***	0.003***

Notes: ATR denotes average tax rate. MTR denotes marginal tax rate. DTR denotes % change in tax rate. DTR+ is defined as positive side of % changes in tax rate. The above value is coefficient, t statistics in ( ) and p value in [ ], while for diagnostic testing, the above values are in p value. ***, **, * denotes statistical significance at 1%, 5% and 10% respectively.

CHAPTER 5: CONCLUSION AND RECOMMENDATION

In our study, we first estimated the size (i.e. relative and absolute) of the underground economy in Malaysia using currency demand model by Pickhardt and Sarda (2006), and Ahumada (2007). Then, we proceed with examining the bidirectional causality between underground economy and tax rates. Lastly, we tested for the responses of underground economy to positive or negative tax changes. Experiment results show that the changes of the relative size of the underground economy quantified by utilizing Ahumada (2007) model using average tax rates is huge. Therefore, we have decided to drop this model as it is not sensible and realistic. Hence, we concentrate on the size of the underground economy derived from Pickhardt and Sarda (2006) model. The results indicate that the relative size of the underground economy using average tax rates fluctuate around an average of 32.27%. From 1980 to 1986, the size of the underground economy is considerably larger and peaks at 1981 with 44.09%. When marginal tax rate is used, the size of the underground economy is largest in 1982 with 19.33%. On the contrary, both average and marginal tax rates indicate that the size of the underground economy is smallest in 2000 with 13.88% and 2.0% respectively. Besides, these two tax rates show that the absolute size of the underground economy follows an increasing trend.

Subsequently, when we tested for bidirectional causality between underground economy and tax rates, we find that there is cointegration between the relative size of the underground economy and tax rates. However, there is no granger causality between them because the relative size of the underground economy is exactly derived by the current tax rates only for both average and marginal tax rates. Thus, we opted to examine the subject using the growth rate of the underground economy and changes of tax rates. The results prove that there is bi-granger causality between these variables in that both the changes of average tax rates and growth rate of the underground economy affect each other at 5% significance level. In contrast, the changes in marginal tax rates do not granger

cause the growth rate of underground economy, instead it is the marginal tax rates that granger cause the growth rate of the underground economy. However, from another perspective, the growth rate of the underground economy only weakly granger causes the marginal tax rate. From the Granger causality test, we suspect that there is vicious cycle. However, the impulse response function, IRF indicates otherwise. The expected sign is incorrect and the responses to the shock die off in a short period. This signifies the absence of long run effect. Thus, we may conclude that there is no vicious cycle in Malaysia but at the same time it raise up another two important issues: negative impact of tax rate to underground economy and indication of the possibility of threshold level. Last, the asymmetric test shows that the responses of the growth rate of underground economy to an increase or decrease of both average and marginal tax rates is symmetry, which are consistent with the past studies.

5.0 Limitations

In relation to our research, the transactions involve in the underground economic activities are cash and bank. For instance, a clerk who is employed in the official economy received wages from a supplementary work in which the payments in cash are not reported to the tax authority. However, underground activities not only involve cash and bank transactions, but also involve barter transactions. For example, the exchange of services between a doctor and a lawyer are made through barter transactions. Besides, the size of the underground economy is purely affected by tax rates in our research. In the realistic world, the size of the underground economy can be influenced by other variables such as corruption, intensity of regulation and social transfer. In our research, we used annual data due to the unavailability data of monthly data. As a result, the rolling regression has only five observations in a five-year window size in order to obtain an estimate. Consequently, four observations are lost and the accuracy of the estimates is affected.

5.1 Recommendations

Our recommendations are based on our limitations mentioned earlier. The underground economic activities not only involve cash and banking transactions, but also barter transactions. Therefore, currency demand model might not be adequate to capture the size of the underground economy. We suggest future researchers to consider the MIMIC model because it generates index for underground economy which includes the impact of all the variables. Besides, it contemplates more variables, for example, real output growth, male labour participation rate, etc. Since underground economy is not purely driven by tax, other variables (i.e. institutional effect, intensity of regulation, corruption effect, etc.) should be considered. In addition, future researchers can contemplate broader definition of money instead of restricting the definition of money to M1 as in our research. Apart from that, monthly data are preferable compared to annual data in order for the rolling regression to produce a more accurate estimate for marginal tax rates.

In terms of policy implication, policy makers will be in a good position to control the underground economy. This is evidenced by the results in Table 4.10 as well as Table 4.13 in that Granger causality runs from tax rate to underground economy. Policy makers can always make sure the utilization of tax revenue is always in efficient and effective manner to ensure the negative relationship. Otherwise, increases of tax rate will tend to purely increase the net tax burden of Malaysian. As discussed in section 4.2, the negative response arouses the attention to find out the possible relationship between tax rate and underground economy. We want to ask whether it is consistent with common literature reviews or it constitutes a negative value in our case. Besides, the threshold for tax rate is also another interesting topic for future researchers or even policy makers. It is useful to government or policy makers to determine the optimal tax rate that will maximize the tax revenue with a lower size of the underground economy.

5.2 Conclusion

In the past, there is no research done regarding this topic in relation to Malaysia. We do not just end our research after examining the size of the underground economy, but rather we proceed further to find out the answers to the questions we raised in our literature which are: the presence of vicious cycle due to bidirectional causality between underground economy and tax rates; and asymmetric responses of underground economy to positive and negative changes of tax rates. Although our research may suffer from several limitations, it serves as a framework or guideline for future researchers with similar area of interest.

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APPENDICES

Appendix 1: Results of Marginal Tax Rate.

Year	Marginal tax rate	Standard Error	t-statistic
1974	0.210	0.027	(7.674)***
1975	0.250	0.039	(6.351)***
1976	0.248	0.035	(7.144)***
1977	0.300	0.019	(15.410)***
1978	0.261	0.007	(36.651)***
1979	0.229	0.009	(24.779)***
1980	0.283	0.023	(12.493)***
1981	0.318	0.031	(10.396)***
1982	0.344	0.021	(16.609)***
1983	0.329	0.040	(8.189)***
1984	0.251	0.010	(24.042)***
1985	0.250	0.012	(21.583)***
1986	0.263	0.014	(18.295)***
1987	0.055	0.166	(0.328)
1988	0.098	0.037	(2.671)*
1989	0.173	0.039	(4.475)**
1990	0.232	0.031	(7.382)***
1991	0.292	0.003	(104.681)***
1992	0.296	0.005	(55.956)***
1993	0.254	0.020	(12.445)***
1994	0.249	0.010	(25.629)***
1995	0.198	0.015	(13.472)***
1996	0.184	0.005	(35.577)***
1997	0.205	0.012	(17.271)***
1998	0.144	0.034	(4.195)**
1999	0.113	0.051	(2.214)
2000	0.024	0.011	(2.278)
2001	0.137	0.065	(2.121)
2002	0.248	0.051	(4.906)**
2003	0.293	0.017	(17.09)***
2004	0.242	0.047	(5.103)**
2005	0.160	0.007	(24.306)***
2006	0.193	0.016	(11.705)***
2007	0.218	0.020	(11.026)***
2008	0.235	0.007	(31.705)***
2009	0.260	0.026	(9.946)***
2010	0.194	0.035	(5.513)**