A RE-EXAMINATION OF THE U.S. UNDERGROUND ECONOMY: SIZE, ESTIMATION, AND POLICY IMPLICATIONS

Jung-Suk Yu*, M. Kabir Hassan**

Abstract

We re-examine the size of the underground economy in the U.S. between 1972 and 2006 after properly adjusting for several statistical issues relating to its estimation. The dynamic error-correction-based currency demand approach confirms that income tax rates have no contemporaneous effect on currency demand, but they have positive and significant effects with a one-period lag. In addition, we observe that the size of the underground economy in the U.S. has grown considerably during the post-1990 period from $148.7 billion (3.4% of official GDP) in 1973 to $691.2 billion (6.0% of official GDP) in 2006. We also find that misspecified models have a propensity for overstating the size of the underground economy. During recessionary periods, the underground and official economies move in a same direction, although the growth rates of the underground economy are more unpredictable than those of the official economy.

Keywords: Underground economy, currency demand method, error correction model, non-stationarity with unit roots, serial correlations

**The Global Studies Department, Samsung Economic Research Institute, Seoul 137-072, Korea*
Email: jungsuk.yu@gmail.com
***Corresponding Author, Department of Economics and Finance, University of New Orleans, New Orleans, LA 70148*
Phone: (504) 280-6163
Fax: (504) 280-6397
Email: mhassan@uno.edu

I. Introduction

During the past few decades, there has been increased interest in the informal, shadow, unofficial or underground economy. The presence of a large underground economy undermines government revenue collection, while increasing the cost of providing public services. The underground economy can also lead to misguided policy decisions because it can potentially distort economic statistics and information. Therefore, it is essential that accurate measurement be made of the part of the economy that is not captured by official means. Despite its importance, there is still disagreement on the definition of the underground economy. For this paper, it will be defined as unreported income from the production of goods and services to avoid paying income taxes.[29]

Furthermore, although none of the available theoretical or empirical models provides a perfect explanation, most previous studies on the underground economy have concentrated on the following issues: measurement, the general characteristics (size, causes, scope, trends, major actors, etc.) of the underground economy, the impact of the underground economy on the formal economy, policy design to adequately address the sources and outcomes of the underground economy (See Schneider and Enste, 2000).

In this paper, we focus on the following measurement issues based on currency demand models to estimate the size of the underground economy. First, most of previous studies on the underground economy have a tendency to overlook the importance of the so-called 'spurious regression problem', mainly resulting from the non-stationarity with unit roots, stochastic trends, and serial correlations prevalent in time-series variables used in the estimation of currency demand models.

Second, a consensus seldom exists regarding accurate model specifications. For example, Tanzi (1980, 1983) uses the ratio of currency to M2 as a dependent variable, but in a closely related research,

[29] There exist various illegal and forbidden activities of economic agents (such as organized crimes, drug dealing, trafficking of human beings, smuggling of goods, loan-sharking, prostitution, bribing of officials, fencing of stolen goods, etc), which are not tax-induced as they would exist even in the absence of taxation. Therefore, this definition may be disputed by some, but the focus of this paper is to measure the size of the underground economy rather than perfect the definition (For a detailed discussion on the definition of the underground economy, see Schneider and Enste, 2000).

Feige (1986) uses the ratio of currency to bank deposit as a dependent variable. Spiro (1996) uses currency, real currency per capita, M1 excluding currency, or M2 excluding currency as a dependent variable. Therefore, researchers have serious disagreement with the choice of explanatory variables because currency holding decision could be determined by numerous economic factors such as tax rates, wages, interest rates, incomes, financial innovations, unemployment, consumption, and many other aspects (see Tanzi, 1999; Bhattacharyya, 1999; Giles, 1999; Thomas, 1999).

Consequently, the choice of relevant dependent and explanatory variables is, unavoidably, at researchers' discretion. In addition, to deal with non-stationarity, trends, and serial correlations, researchers have additional flexibility to select one of the alternative approaches such as detrending, ARMA, differencing, and error correction models. In this regard, it would be more meaningful to investigate the sensitivity of the sizes of the underground economy depending on the model specifications and variables selections, rather than to find the single best model specification.

We summarize the major findings as follows. First, a dynamic error-correction-based currency demand model outperforms other alternative specifications once non-stationarity and serial correlations are properly dealt with. Second, we observe that the underground economy grew from about $148.7 billion (3.4% of official GDP) in 1973 to about $676.6 billion (6.0% of official GDP) in 2006. The size of the underground economy in the U.S. has grown the most distinctly since the 1990s mainly due to increase in currency holding, growth in the private services sector, the burdensome procedure to obtain business licenses and pay taxes, and a higher perceived level of corruption in public sectors. Third, we find that the sizes of the underground economy are relatively robust without regard to currency demand model specifications. Misspecified currency demand models would not make dramatic changes in the estimation results, even though they tend to overstate the size of the underground economy. Finally, although the growth rates of the underground economy have fluctuated more over the periods than those of the official economy, the underground and official economies appear to move in the same direction. During the recessionary periods, the underground economic activities in the U.S. also experience recession, but they tend to rebound once official economy recovers.

In Section II, we analyze the U.S. time-series of currency holdings and monetary bases. In addition, we also investigate the profile for the non-U.S. citizen population, business environment, regulation, and the perceived level of corruption to surmise the trend of the underground economy. Section III provides a detailed explanation of currency demand models, estimation issues, and research methods to estimate the size of the underground economy. Section IV gives the empirical results of the econometric testing, including the estimated size of the underground economy for the years from 1972 to 2006. Section V describes the policy implications of the existence of a substantial underground economy and Section VI provides conclusions.

II. Currency Holdings, Employment, Business Environments, and the Level of Corruption in the U.S.

The time-series patterns (Figure 1) of currency holdings and monetary bases during 1959-2006 in the U.S. provide serious challenge to both researchers and policy makers. Although the U.S. tends to be headed toward a cashless society fueled by financial innovations including the rapid growth of credit cards, electronic bank transfers from savings to checking accounts, and automatic teller machines (Porter et al., 1979), real per capita currency outside banks has been exploding from $160 in 1959 to $2,489 in 2006. As a result, the volume of currency peaked (2.45) relative to demand deposits (C/DD) in 2006.[30] Similar to the ratio of currency to M2 (C/M2), the remarkable drops in the ratio of currency to private consumption expenditure (C/PCE) from 71% in 1959 to 40% ended in 1986, and then this ratio increased up to 69% in 2006.

We also marked recessionary periods (1960, 1970, 1974, 1980, 1981-2, 1990, and 2001) in Figure 1 (See Appendix A). Before 1990, with a few exceptions, C/PCE and C/M2 ratios jumped to higher levels during recession periods. However, since 1990, the ratios dramatically increased without adjustments. In absolute terms, bank deposits experienced the most noticeable increases during the periods between 1959 and 2006. As a result, M2 reached $7027.3 billions in 2006 starting from $297.8 billions in 1959.

Figure 2 depicts employment levels by occupations and sectors in the U.S. Unemployment rates have been relatively stable across the periods except slightly higher levels during the recessionary periods. Income tax rates, calculated as total income tax payments as a percentage of personal incomes, ranged between 12.52% and 21.14%. However, we observe that unlike (agricultural and non-agricultural) self-employed workers, private service-providing sectors, prone to underreport incomes taxes, have been rapidly expanding across periods from 40% in 1959 to 63% in 2006. In contrast, the amount of wage and

[30] Gutmann (1977) mentions that currency in circulation has been growing more rapidly than demand deposits, which shows a reflection of growth in the underground economy. However, Garcia (1978) argues that a shortfall in demand deposits, rather than an increase in holdings of cash, has caused the ratio of currency in circulation to demand deposits (C/DD) to rise because of recent rapid financial innovations and the proliferation of money-saving opportunities over the past decades. Thus, Garcia points out that increases in the currency ratio provide no information from which to estimate the magnitude of the underground economy.

salary relative to national incomes shows consistently decreasing patterns from 54% in 1965 to 36% in 2006.

We also report profile for the non-U.S. citizen population in Table 1 from U.S. Census Bureau. It is well-known that a good number of U.S. residents without work permits are tempted to make a living in the underground economy. Recent years have seen a rise in the number of immigrants. The period of U.S. entry between 1990 and 2000 comprises 61.5% (11,418,890) of the total population (18,565,265) of the non-U.S. citizens by 2000, more than twice as much as those who entered 1980 to 1989. This number includes people born outside the U.S. who have not received U.S. citizenship, such as lawful permanent residents, students, refugees, and people illegally present in the United States. More worrisome is the fact that the non-U.S. citizens and newly-arrived immigrants are amongst those most active in small and medium-sized companies with low wages, that largely avoid paying taxes and benefits, and thus involve substantial underground economic activity (Mirus et al., 1994). Tables 2 summarizes the business environment in the U.S as of 2006. The Ease of Doing Business indicators in the World Bank Group provide objective measures of business regulations and their enforcement, which are comparable across 175 economies.[31] These measures help us identify the causes and sources of working in the underground economy. For example, starting a business in the U.S. proves to be quite convenient and is ranked 3 out of 175 countries, together with overall ease of doing business rank. However, we find that the procedures to deal with licenses and pay taxes are rather complicated and burdensome compared to those in other geographic regions. U.S. workers need 18 procedures, on average, to deal with licenses and have to spend about 325 hours in preparing, filing, and paying taxes, which are higher than OECD averages (14 procedures to deal with licenses and 202.9 hours in paying taxes). The U.S. profit tax rate (26.6%) is also considered the highest compared to those of other geographic regions including OECD countries.

Transparency International Global Corruption Barometer in Table 3 also suggests extensive underground activity among national institutions and sectors. Unlike the common belief, the perceived level of corruption is not significantly lower in the U.S. than other emerging economies. Furthermore, almost 43% of participants in the 2005 survey agreed that the level of corruption increased a lot in the past 3 years and 30% of participants expected the level of corruption in the next 3 years to increase a lot, while only a few participants were optimistic about the direction of corruption levels. In sum, there is no doubt that the sizable underground economic activity exists in the U.S. from the various perspectives including currency holdings, employment, business environments, and the perceived level of corruption.

III. Description of Methods

A. The Econometric Analysis to Estimate the Size of the Underground Economy

In measuring the size of the underground economy, the currency demand approach has been the most widely used. It estimates the size of the underground economy from the demand for cash, based on the assumption that informal transactions are undertaken in cash and that an increase in the underground economy will raise demand for cash.[32] There are several different models that have been used to estimate the size of the underground economy. These include Cagan (1958), who analyzed the demand for currency specifying expected real income, expected interest rates, and tax rates as explanatory variables. Gutmann (1977, 1979) assumes a stable relation between the ratio of currency to demand deposits and 'legal activities' and argues that a rise in the ratio indicates an increase in the size of the underground economy. Feige (1979) assumes a constant ratio of total transactions to nominal GNP and argues that given that the money supply (Ml) and its transaction velocity are known then, in the absence of the underground economy, the derived GNP should equal the official GNP and any discrepancy would measure the underground GNP. Gutmann's approach is criticized for not considering the effect of financial innovations on the currency to demand deposit ratio while Feige's approach is criticized for its reliance on ratios that are assumed constant over long periods.

[31] The 'Starting a Business' indicator measures the challenges of launching a business and includes the number of steps entrepreneurs can expect to go through to launch, the time it takes on average, and the cost and minimum capital required as a percentage of gross national income (GNI) per capita. The 'Dealing with Licenses' indicator reports the procedures, time, and costs to build a warehouse, including obtaining necessary licenses and permits, completing required notifications and inspections, and obtaining utility connections. The 'Paying Taxes' indicator shows the tax that a medium-size company must pay or withhold in a given year, as well as measures of the administrative burden in paying taxes. This indicator includes the number of payments an entrepreneur must make; the number of hours spent preparing, filing, and paying; and the percentage of their profits they must pay in taxes.

[32] More recently, the latent variable / MIMIC (Multiple Indicators, Multiple Causes) approach estimates the size of the underground economy as a function of observed variables that are assumed to influence the underground economy – for example, the burden of taxation, the burden of government regulation – and of variables where informal economic activities leave traces, like cash, official working time, and unemployment. This latent variable method considers multiple causes and effects simultaneously and assumes that a change in the size of the underground economy may be reflected in a change in monetary indicators, labor market participation rates and working hours, and national output statistics (For a survey of other alternative approaches together with more technical details on MIMIC model, see Schneider and Enste, 2000; Chaudhuri et al., 2006).

Tanzi (1980, 1983) modified Cagan's approach by estimating a currency demand function for the United States for 1930-1980. In his approach, the influence of the underground economy on currency demand, proxied by tax rates to indicate the incentive to avoid taxes and participate in a cash-based underground economy, was estimated directly in the regression equation linking currency demand and tax rates. The approach to measuring the underground economy consists of specifying a demand-for-currency equation to infer the effect of a change in the tax level on that demand. The key assumptions are as follows: 1) the underground economy activities are the direct consequence of high taxes and, 2) the transactions are made using mainly currency.

More formally, the long-run demand-for-currency equation can be written as $\ln(C) = \boldsymbol{\beta}'\mathbf{Z} + \gamma T$, where $\mathbf{Z}$ is the vector of all explanatory variables except the tax variable *T*, $\boldsymbol{\beta}'$ is the associated vector of coefficients on $\mathbf{Z}$ and γ is the coefficient on *T*. The explanatory variables in Tanzi's model include real per capita income (Y), rate of interest on time deposits (R), the ratio of wages and salaries to national income (WS/NI), and income taxes (T). Accordingly, the estimated value of currency in year *t* is $\tilde{C}_t = \exp\left(\tilde{\boldsymbol{\beta}}'\mathbf{Z}_t + \tilde{\gamma}T_t\right)$. However, if there were no taxation, by assumption, since participants in the underground economy do not pay income taxes, currency holdings in year *t* would have been predicted to be $\tilde{C}_t^0 = \exp\left(\tilde{\boldsymbol{\beta}}'\mathbf{Z}_t\right)$. The change in currency demand motivated by taxation is then computed as $C_t^{UE} = \tilde{C}_t - \tilde{C}_t^0$ where C_t^{UE} is the amount of currency needed to fuel the underground economy. The income velocity of money (M2) in the underground economy, V_t^{UE}, is not readily observable. Therefore, assuming that the underground income velocity (V_t^{UE}), is the same as the observed velocity in the formal sector (V_t^{OE}), the income generated in the underground economy is then calculated as $Y_t^{UE} = C_t^{UE} \cdot V_t^{OE}$ to estimate the size of the underground economy as a percentage of GDP.

B. Estimation Issues and Model Specifications

Most recent currency demand methods including Tanzi's (1980, 1983) original model are built upon the regression model with multiple time series variables. However, we find that the majority of the time-series data used as dependent and independent variables are non-stationary with unit roots. Therefore, much care must be taken to precisely estimate currency demand models, which requires more formal procedures involving detrending, differencing, corrections of serial correlations, or cointegration tests depending on the properties of time-series data.

The Tanzi-type currency demand models will only become valid when the sample is large enough, the explanatory variables are exogenous, and both the dependent and the explanatory variables are stationary or cointegrated, and the random error term has certain distributional properties (Granger and Newbold, 1974; Dickey and Fuller, 1979). Unless the above-mentioned time-series properties are properly corrected, 'nonsense correlations' (seemingly significant correlations) or 'spurious regression' (seemingly significant effects) problems arise and regression results will often indicate a significant relationship, even though non-stationary time-series variables are not closely related (Granger and Newbold, 1974). Similarly, serial correlations should be also addressed by including ARMA terms within regression models due to the inertia properties of macroeconomic time-series data.[33]

Table 4 reports Dickey-Fuller unit root tests. From these tests, we find that not all of the variables are stationary, and become stationary after differencing. Cointegration tests among $(C, T, WS/NI, R, \text{ and } Y)$ are therefore not feasible because the variables have different orders of non-stationarity (Dickey et al., 1991; Johansen, 1991). For this reason, we estimate dynamic error-correction-based currency demand model, which appropriately adjusts the non-stationarity of time-series data with unit roots (Klovland 1984; Faal, 2003). For comprehensiveness, we estimate the following five alternative currency demand models to estimate the size of the underground economy.

Model [1]: Spurious regression

$$\ln(C_t) = \alpha + \beta_1 \ln(T_t) + \beta_2 \ln(R_t) + \beta_3 \ln(Y_t) + \varepsilon_t \quad (1)$$

Model [2]: Detrending

$$\ln(C_t) = \alpha + \beta_1 \ln(T_t) + \beta_2 \ln(R_t) + \beta_3 \ln(Y_t) + \beta_4 \ln(WS/NI_t) + \beta_5 Time + \varepsilon_t \quad (2)$$

Model [3]: ARMA

$$\ln(C_t) = \alpha + \beta_1 \ln(T_t) + \beta_2 \ln(R_t) + \beta_3 \ln(Y_t) + \beta_4 \ln(WS/NI_t) + \phi \ln(C_{t-1}) + \varepsilon_t + \theta\varepsilon_{t-1} \quad (3)$$

Model [4]: Differencing

$$\Delta \ln(C_t) = \alpha + \beta_1 \Delta \ln(T_t) + \beta_2 \Delta \ln(R_t) + \beta_3 \Delta \ln(Y_t) + \beta_4 \Delta \ln(WS/NI_t) + \varepsilon_t \quad (4)$$

Model [5]: Dynamic error correction model

$$\begin{aligned}\Delta \ln(C_t) = {} & \alpha + \beta_1 \Delta \ln(T_t) + \beta_2 \Delta \ln(R_t) + \beta_3 \Delta \ln(Y_t) + \beta_4 \Delta \ln(WS/NI_t) \\ & + \beta_5 \ln(T_{t-1}) + \beta_6 \ln(R_{t-1}) + \beta_7 \ln(Y_{t-1}) + \beta_8 \ln(WS/NI_{t-1}) \\ & + \beta_9 \ln(C_{t-1}) + \varepsilon_t\end{aligned} \quad (5)$$

where ε_t is an error term.

[33] For example, Tanzi's (1983) currency demand model is corrected with a first-order Cochrane-Orcutt correction for serial correlation.

In the above equations, the dependent variable is the currency holding, $\ln(C_t)$, for Models [1]-[3] and the log difference, $\Delta \ln(C_t)$, for Models [4]-[5]. The independent variables are real per capita income $\ln(Y_t)$, the rate of interest paid on time deposits $\ln(R_t)$, the ratio of wages and salaries in national income $\ln(WS/NI_t)$, and a variable measuring income taxes $\ln(T)$ to be consistent with Tanzi (1983). Once the above equations have been estimated for the years 1972-2006 due to the availability of reliable income tax data, it can be utilized to estimate currency holdings by making the assumption that the tax variable assumes a value of zero. Once currency holdings at zero taxes are estimated, they can be used to determine the extent of the underground economy by multiplying excessive currency by the income velocity of money.

We admit that the estimates derived from currency alone may exaggerate the degree of the U.S. underground economic activity because of difficulties in accounting for overseas holdings of the U.S. currency (Pozo, 2006). Therefore, we also carried out experiments with 1) other functional forms, 2) the ratio of currency holdings to other forms of liquidity, not the absolute level of currency, for a dependent variable such as C/DD, C/BD, $C/M1$, and $C/M2$, 3) other empirical combinations of T, Y, R, WS/NI, unemployment rate, and private consumption expenditure, 4) changes in the estimation period, and 5) alteration of the dynamic specification with different lags for robustness check. These additional estimation efforts did not alter our main conclusions. The detailed sources of data used in this study are presented in Appendix B, which covers the period 1959-2006 except tax rates (1972-2006), with currency and other relevant variables based on December 31 of each year. Income tax rate, T, is total income tax[34] payments as a percentage of personal incomes and we use 3-month CD rates for the rates of interest paid on time and savings deposits, R.

IV. Results

A. The Estimation Results of Currency Demand Models

From the theoretical viewpoints, the expected sign for both per capita income and the interest rate is negative, while the expected sign for both taxes and the ratio of wages and salaries in national income is positive. As the level of taxation rises, individuals are tempted to take part in tax-evading activities that are performed using currency so that the use of currency increases. Because wages are often paid in currency for daily informal workers, and other types of income (interest, dividends, etc.) are almost always paid by check, an increase in the ratio of wages in total income paid will require more currency. On the other hand, economic development, as proxied by per capita real income, is assumed to lead to the replacement of currency by checks, which leads to a fall in currency holding relative to deposits, but not absolutely. In addition, currency holding and the time-deposit rate can be expected to be negatively correlated because as the rate of interest increases the opportunity cost of holding currency increases.

Indeed, the estimation results of Model [1] in Table 5 show high degree of fit, as measured by a very high value of R^2 (0.9878), implying that most of the variation in $\ln(C_t)$ is explained by the estimated equation. In every case, the *t*-values for the coefficients are significant at the 5 percent level. The signs are as expected - positive for the tax variable and negative for the rate of interest. An exception is the coefficient of real per capita income, which is positive at the 1 percent level. However, Durbin-Watson statistic (d) is 0.7214, implying the existence of positive autocorrelation in the residuals of the estimated equation. The Breusch-Godfrey *LM* test (F = 16.4446) also strongly rejects the null hypothesis of no serial correlation at the 1 percent significance level. Therefore, Model [1] specification is a typical example of spurious regression with high R^2 and low Durbin-Watson statistic values. If uncorrected, serial correlation in the residuals will lead to incorrect estimates of the standard errors, and invalid statistical inference for the coefficients of the equation unless the variables are cointegrated (Dickey et al., 1991).

Empirical interpretations become more subtle and complicated once currency demand models are modified to address non-stationarity, trends, and serial correlations as in Models [2]-[5]. In Model [2], we examine if currency holding has a deterministic trend by incorporating linear *Time* variable within the model specification. We find that although both tax rates and a *Time* coefficient are significant at the conventional statistical levels, Model [2] still suffers high R^2 values (0.9981) with low Durbin-Watson statistic (0.6030), indicating positive autocorrelations. Breusch-Godfrey *LM* test (F = 10.9913) also strongly supports the existence of serial correlations. Detrending method also generates heteroskedasticity remaining in residuals in Model [2] from ARCH test. Therefore, we figure out that upward or downward trends in variables used in currency demand models show stochastic trends mainly coming from non-stationarity with unit roots. For this reason, the detrending method to remove a deterministic trend is not very satisfactory.

[34] We only consider income taxes, but other types of taxes are also avoided in underground activites.

For Models [3]-[4], we consistently obtain the non-significant relationship between tax rates and currency holding for ARMA (1, 1) structure (Model [3]) and first- differencing method (Model [4]). Importantly, Models [3]-[4] produce negative and insignificant coefficient values on tax rates although both model specifications correct serial correlations based on Durbin-Watson and Breusch-Godfrey statistics. In addition, the estimation results in Model [3] verify that although all of the independent variables $(T,\ R,\ Y,\ \text{and}\ WS/NI)$, except a constant and AR (1) coefficients, are not statistically different from zero, R^2 provides extremely high value of 0.9994. This result strongly suggests that the significant coefficients in Model [1] is spurious and serial correlations need to be appropriately dealt with.

In Model [4], we observe that the first-differenced independent variables lose their explanatory powers on $\Delta \ln(C_t)$, resulting in the extremely low value of R^2 (0.0235). Since the differencing method tends to eliminate non-stationarity and serial correlations, we question whether there exists a dynamic relationship with different time lags between currency holding and other independent variables, rather than a static or contemporaneous 'Tax–Currency' relationship.

Finally, the error-correction-based currency demand model in Model [5] takes the form of an autoregressive distributed lag model (ADL). One advantage is that dynamic error correction model (ECM) can capture both the short-run dynamics and the long-run equilibrium of the time-series variables. For the estimation results, we find that the estimation results of Model [5] outperform other model specifications. Although contemporaneous changes in T, R, Y, and WS/NI are not significant, the coefficients have the expected signs and indicate that in the long run, the demand for currency is driven by taxes (*t-stat* = 0.2463, *p-value* = 0.0211) and interest rates (*t-stat* = -0.0355, *p-value* = 0.0162). The results suggest that the tax variable has no contemporaneous effect on currency demand but has important effects with a one-period lag. Compared to other model specifications, R^2 has a more credible value (0.4272). The diagnostic tests also show that Durbin-Watson (*d* = 2.2362), Breusch-Godfrey (*F* = 0.2184), and ARCH (*F* = 0.2795) tests indicate no evidence of serial correlations or heteroskedastic disturbances.

B. The Size of the Underground Economy in the U.S., 1972-2006

The first step in determining the magnitude of the underground economy is to solve Models [1], [2] and [5]. The estimates of the underground economy are derived as follows. For each year, the predicted level of the currency, *C**, can be calculated by using the preceding regression equations. Next, the equations are solved in the same way, assuming that the tax variable is zero while the coefficients of the other variables remain the same. The resulting value of currency is then defined as *C***. The difference between *C* and *C** gives an indication of the accuracy of fit of the equations. The difference between *C** and *C*** gives the estimation of how much currency holding is tax induced; in other words, it indicates by how much taxes induce people to hold larger amounts of currency - presumably because of their attempt to evade taxes.

The difference between predicted currency holdings (*C**) and the currency holdings predicted from the equation under the assumption of zero taxes (*C***) yields an estimation of 'illegal money'. The difference between M2 and the estimated illegal money yields 'legal money' used for transaction purposes. Dividing GDP by legal money gives an estimate of the income velocity of legal money. Assuming that the velocity of illegal money is the same as that of legal money, an estimate of the underground economy can be obtained by multiplying illegal money by the velocity of money.

Therefore, positive and significant coefficient values on tax variables are required to estimate the size of underground economy using monetary approach. For example, if tax coefficient is negative, predicted currency without tax (*C***) will become larger than that with tax (*C**), which makes the size of the underground economy less than zero. In addition, if tax coefficient is insignificant, the difference (illegal money) between *C** and *C*** will not be statistically significant. Therefore, for comparison, we estimate the size of the underground economy based on Models [1], [2], and [5], which have positive coefficients on tax rates. Considering that the error-correction-based currency demand model provides the best performance as well as effectively deals with non-stationarity and serial correlation, we provide detailed intermediate procedures for Model [5] in Table 6.

Table 6 reports 1) actual currency holdings (C) for the period 1972-2006, 2) currency holdings (*C**) predicted by Model [5], 3) currency holdings (*C***), when taxes are assumed to be zero, predicted by Model [5], 4) the difference between *C* and *C**, and 5) the difference between *C** and *C***. The yearly estimates of the underground economy are shown in columns (8)-(9) in Table 3. Multiplying column (5) by column (7) produces the estimates of the underground economy, shown in column (8). These estimates are also given as proportions of GDP in column (9).

Table 6 indicates that the underground economy grew from about $148.7 billion in 1973 to about $676.6 billion in 2006. As a percent of GDP, the underground economy averaged 4.50% during the period from 1973 through 2006. This level of the size of underground economy[35] in the U.S. is relatively low

[35] As Klovland (1984) points out, the income velocity of money in the underground economy is even harder to estimate with a reasonable degree of confidence. Besides, Ahumada et al. (2006) show that the monetary method only

in comparison to other industrialized countries and much lower in comparison to developing countries (Klovland, 1984; Mirus et al., 1994; Shabsigh, 1995; Schneider and Enste, 2000; Faal 2003; Chaudhuri et al., 2006).

However, there is a disturbing trend taking shape. The level of the underground economy as a percent of GDP has been slowly but steadily increasing since 1972. In fact, the percentage increased from 3.40% in 1973 to 6.00% in 2006. While the federal tax rates have gone up, come down and gone back up during this period due to the U.S. tax reforms, the underground economy as a percentage of GDP has consistently gone up in small increments. Possible explanations for the increase include a growing level of sophistication by operators of underground businesses and the increasing use of technology and communications to successfully operate underground enterprises. As technology improved, it gives the underground entrepreneurs a larger set of tools with which to operate a business while avoiding official detection.

As expected from the trends of currency holdings, employment, business environments, and the perceived level of corruption in Section II, the size of the underground economy in the U.S. have grown the most noticeably during the 1990s (5.15%) and 2000s (5.71%). More importantly, the sizes of the underground economy are less susceptible to specific currency demand model specifications. Although the estimation results based on spurious regression (Model [1]) tend to over-emphasize the size of the underground economy, the detrending method provides very similar (slightly higher) estimation results even though detrending fails to correct serial correlations. Therefore, researchers have some flexibility to choose dependent and explanatory variables since the sizes of the underground economy are not very sensitive to specific model selections.

We also illustrate the size and growth rate of the underground economy based on dynamic error-correction-based currency demand model in Figure 3. It is clear that the underground economic activity in the U.S. has increased significantly since the 1990s. The growth rates of the underground economy also have fluctuated more than those of the official economy represented by annual GDP growth. Furthermore, right after the recessions, the underground economy gains momentums. For example, the underground economy experienced 15.7% growth in 1978, 10.7% in 1987, 10.4-11.4% during 1992-1994, and 7-8% during 2004-2005.

It is well-known that impoverishment and unemployment represent the main motives for people to get involved in the informal sector (Belev, 2003). However, during the recessionary periods, underground economic activities also tend to be sluggish together with official growth rates. Therefore, although the informal sector offers income-earning opportunities to large numbers of disadvantaged people who have no access to more formal avenues of income and employment (Nurul Amin, 1987), it is unlikely that the growth of the underground sector in the U.S. protects the poor to survive during the periods of economic decline.[36] Indeed, informal sector could exacerbate poverty, either directly or indirectly, through increasing inequality in the access to services and opportunities, increased vulnerability, and human abuse (Marc and Kudatgobilik, 2003).

V. Policy Designs, the U.S. Tax Reforms, and Taxpayer Compliance

If the underground economy continues to grow, it will have vital implications for the U.S. government. Primarily, as a greater percentage of the economy goes underground, a smaller percentage must bear the total tax burden. As both the underground businesses and its employees avoid paying taxes, the businesses and employees of the legitimate economy are forced to pay more than their share of taxes. This leads to bitterness over unjust tax rates and provides a greater incentive for others to join the underground economy.

In addition, any governmental decisions regarding fiscal and monetary policy are being made based on incomplete and inaccurate information. In other words, the data describing the national income, employment, spending, etc. are being understated. This makes it very difficult for the government to make informed decisions in its implementation of economic policy. One good example is that the failure to take account of the underground economic activity overstates the official unemployment rate and the government estimate of families who live in poverty. Therefore, it encourages the federal government to focus more attention on unemployment, rather than inflation although a significant percentage of the officially unemployed are in reality working 'off the books,' being paid in cash suitable for transactions that go unrecorded and untaxed (Gutmann, 1978).

According to the recent estimate of The Internal Revenue Service (IRS), between one and two million Americans are using tax havens to deposit money, which they then withdraw on their credit cards, and that offshore tax evasion is reducing U.S. tax revenue by US$70 billion a year. In addition, the October 2004

produces coherent estimates if the income-elasticity of the demand for currency is one and suggests a way to correct the estimated size of the underground economy when such elasticity is not one. Therefore, we admit that the overall estimation results of the size of the underground economy could be affected depending on the assumption of the unobservable income velocity of illegal money.

[36] With respect to the role of the informal sector on alleviating poverty by redistributing income towards the poorer group, Bennett (1995) also concludes that the growth of the informal sector did little to protect the poor in Guyana and Jamaica from overall economic decline between 1977 and 1989.

tax reform included a number of incentives for companies to repatriate funds held overseas since growing number of companies have moved their head offices to tax havens to reduce their tax burden. Moreover, the liberalization of financial markets, particularly for cross-border capital flows, promotes money laundering. Money laundering activities can corrupt parts of the financial system and undermine governance of banks (Quirk, 1996, 1997; Morris-Cotterill, 2001).

Therefore, the U.S. government needs to make further efforts to penalize 'tax evasion' in the form of the use of offshore tax havens and money laundering. There is considerable synergy in improving both tax collection and anti-laundering systems because laundered income from crime is also subject to tax evasion. In this regard, it is possible that much of the U.S. federal deficit could have been eliminated if taxes on unreported income had been paid.

Importantly, recent studies (Johnson et al., 1998, 1999; Scheneider and Enste, 2002; Sennholz, 2003; Schneider, 2006; Pozo, 2006) demonstrate that there exists no positive correlation between tax rates and the size of the underground economy using data in a sample of countries from around world (so-called 'the tax paradox'). They argue that the perceived corruption, ineffectual and discretionary application of the tax system and regulations by governments are directly related to the demise of respect for government, a disregard for laws and regulations, and the rise of underground economic activity.

As a result, the underground economy is expected to be thriving wherever, in the judgment of taxpayers, the government exactions are exorbitant and unjust. On the contrary, smaller underground economies appear in countries with higher tax revenues that are achieved by lower tax rates (resulting in a high degree of taxpayer compliance), fewer laws and regulations combined with consistent enforcement, and less bribery facing companies. For example, although President Bush's series of ambitious tax cuts over recent years have been the subject of hot debate, the administration argues that tax revenues have actually risen and the economy has been stimulated. Enste (2003) also mentions that due to underground economic activities, the tax revenue might reach the negatively sloped part of the Laffer Curve where higher tax rates result in a lower tax yield.

V. Conclusions

This paper presents the yearly estimates of the underground economy for the period from 1972-2006. The estimates were made based primarily on dynamic error-correction-based currency demand methodology to correct non-stationarity and serial correlations prevalent in macro time-series variables. Our calculations show that the underground economy as a percent of GDP has fluctuated from a low of 3.40% to a high of 6.05%. These estimates are considered very low, even in comparison with other industrialized countries, where the underground economy is estimated to be approximately 8-10% of GDP. It is a far smaller percentage than in developing countries, where the unofficial economy is believed to make up anywhere from 20% to 68% of the total economy (Schneider and Enste, 2000; Schneider, 2006).

However, the percent has been steadily increasing, especially since the 1990s, which indicates that the underground economy may further increase in its importance in the future. We also observe that although the distortions of estimation results are in acceptable ranges, the misspecifications in currency demand models such as a spurious regression or detrending method tend to over-emphasize the sizes of the underground economy in the U.S. For policy suggestions, the government should consider not only the current level of the underground economy but also its potential size in the future to identify the extent of the problems caused by the underground economy in determining its implications for economic policy.

References

1. Ahumada, H., F. Alvaredo, and A. Canavese, 2006, The Demand for Currency Approach and the Size of the Shadow Economy: A Critical Assessment, Berkeley Program in Law & Economics, Working Paper Series, University of California, Berkeley, 1-19.
2. Belev, B., 2003, The Informal Economy in Central and Eastern Europe - Obstacle to European Integration or Bridge Between the EU Member State and the Accession Countries?, Center for the Study of Democracy, 3-20.
3. Bennett, K., 1995, Economic Decline and the Growth of the Informal Sector: The Guyana and Jamaica Experience, *Journal of International Development* 7, 229-242.
4. Bhattacharyya, D., 1999, On the Economic Rationale of Estimating the Hidden Economy, *The Economic Journal* 109, F348-F359.
5. Cagan, P., 1958, The Demand for Currency Relative to Total Money Supply, *Journal of Political Economy* 66, 303-328.
6. Chaudhuri, K., F. Schneider, and S. Chattopadhyay, 2006, The Size and Development of the Shadow Economy: An Empirical Investigation from States of India, *Journal of Development Economics* 80, 428-443.
7. Dickey, D., and W. Fuller, 1979, Distribution of the Estimators for Autoregressive Time Series with a Unit Root, *Journal of the American Statistical Association* 74, 427-431.
8. Dickey, D., D. Janson, and D. Thornton, 1991, A Primer on Cointegration with an Application to Money and Income, Federal Reserve Bank of St. Louis, 58-78.
9. Enste, D., 2003, Shadow Economy and Institutional Change in Transition Countries, Center for the Study of Democracy, 81-113.
10. Faal, E., 2003, Currency Demand, thte Underground Economy, and Tax Evasion: The Case of Guyana, *International Monetary Fund Staff Papers* WP/03/7, 1-30.
11. Feige, 1979, How Big is the Irregular Economy?, *Challenge* 22, 5-14.
12. Feige, E., 1986, A Re-examination of the "Underground Economy" in the United States: A

Comment on Tanzi, *International Monetary Fund Staff Papers* 33, 768-781.
13. Garcia, G., 1978, The Currency Ratio and the Subterranean Economy, *Financial Analyst Journal* 69, 64-66.
14. Giles, D., 1999, Measuring the Hidden Economy: Implications for Econometric Modelling, *The Economic Journal* 109, F370-F380.
15. Granger, C. W. J., and P. Newbold, 1974, Spurious Regressions in Econometrics, *Journal of Econometrics* 2, 111-120.
16. Gutmann, P., 1977, The Subterranean Economy, *Financial Analyst Journal* 26-27, 34.
17. Gutmann, P., 1978, Are the Unemployed, Unemployed?, *Financial Analyst Journal* 34, 26-29.
18. Gutmann, P., 1979, Taxes and the Supply of National Output, *Financial Analyst Journal* 64-66.
19. Johansen, S., 1991, Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models, *Econometrica* 59, 1551-1580.
20. Johnson, S., D. Kaufmann, and P. Zoido-Lobaton, 1998, Regulatory Discretion and the Unofficial Economy, *The American Economic Review* 88, 387-392.
21. Johnson, S., D. Kaufmann, and P. Zoido-Lobaton, 1999, Corruption, Public Finances, and the Unofficial Economy, *The World Bank Policy Research Working Paper* WPS2169, 1-51.
22. Klovland, J., 1984, Tax Evasion and the Demand for Currency in Norway and Sweden. Is there a Hidden Relationship?, *The Scandinavian Journal of Economics* 86, 423-439.
23. Marc, A., and Z. Kudatgobilik, 2003, Poverty and Informality in Southeast Europe, Center for the Study of Democracy, 115-136.
24. Mirus, R., R. Smith, and V. Karoleff, 1994, Canada's Underground Economy Revisited: Update and Critique, *Canadian Public Policy* 20, 235-252.
25. Morris-Cotterill, N., 2001, Money Laundering, *Foreign Policy* 124, 16-20, 22.
26. Nurul-Amin, A. T. M., 1987, The Role of the Informal Sector in Economic Development: Some Evidence from Dhaka, Bangladesh, *International Labor Review* 126, 611-623.
27. Porter, R., T. Simpson, and E. Mauskopf, 1979, Financial Innovation and the Monetary Aggregates, *Brookings Papers on Economic Activity* 1979, 213-229.
28. Pozo, S., 2006, Below the Surface: Underground Economic Activity, *Harvard International Review* 27, 58-61.
29. Quirk, P., 1996, Macroeconomic Implications of Money Laundering, *International Monetary Fund Staff Papers* WP/96/66, 1-33.
30. Quirk, P., 1997, Money Laundering: Muddying the Macroeconomy, *Finance & Development* 7-9.
31. Schneider, F., 2006, Shadow Economies and Corruption All Over the World: What Do We Really Know?, IZA DP No. 2315, 1-65.
32. Schneider, F., and D. Enste, 2000, Shadow Economies: Sizes, Causes, and Consequences, *Journal of Economic Literature* 38, 77-114.
33. Schneider, F., and D. Enste, 2002, Hiding in the Shadows: The Growth of the Underground Economy, *Economic Issues* 30.
34. Sennholz, H., 2003, The Underground Economy, The Ludwig von Mises Institute, 1-27.
35. Shabsigh, G., 1995, The Underground Economy: Estimation, and Economic and Policy Implications - The Case of Pakistan, *International Monetary Fund Staff Papers* WP/95/101, 1-20.
36. Spiro, P., 1996, Monetary Estimates of the Underground Economy: A Critical Evaluation, *The Canadian Journal of Economics* 29, S171-S175.
37. Tanzi, V., 1980, The Underground Economy of the United States: Estimates and Implications, *Banca Nazionale del Lavoro Quarterly Review* 135, 427-453.
38. Tanzi, V., 1983, The Underground Economy in the United States: Annual Estimates, 1930-80, *International Monetary Fund Staff Papers* 30, 283-305.
39. Tanzi, V., 1999, Uses and Abuses of Estimates of the Underground Economy, *The Economic Journal* 109, F338-F347.
40. Thomas, J., 1999, Quantifying the Black Economy: 'Measurement without Theory' Yet Again?, *The Economic Journal* 109, F381 – F389.

Appendices

Appendix A: Recessionary Periods between 1959 and 2006

Peak month	Year	Trough month	Year
April	1960	February	1961
December	1969	November	1970
November	1973	March	1975
January	1980	July	1980
July	1981	November	1982
July	1990	March	1991
March	2001	November	2001

Source: U.S. Census Bureau, Current Population Survey, 1960 to 2006 Annual Social and Economic Supplements / National Bureau of Economic Research, Inc.

Appendix B: Databases and Sources for Macroeconomic Time-Series Data

1. Currency, M1, M2 and GDP: The Federal Reserve at St. Louis through EconoMagic
   - Currency: Currency Component of M1: Billions of Dollars: Seasonally Adjusted (SA)
   - BD (Bank Deposit) = M2 – Currency = Demand Deposit + Time Deposit
   - M1: Currency Component of M1 Plus Demand Deposits: Billions of Dollars: SA
   - M2: M2 Money Stock: Billions of Dollars: SA
   - VELOCITY: Velocity of Circulation: GDP divided by M2
   - Real GDP per capita ($ Thousands) = Real GDP / Total Population

2. Income Taxes: Urban Institute, Brookings Institution and IRS
   - 1972-1976: Our own calculation
   - 1977-2004: State & Local Government Finance Data Query System. The Urban Institute - Brookings Institution Tax Policy Center. Data from U.S. Census Bureau, Annual Survey of State and Local Government Finances, Government Finances, Volume 4, and Census of Governments (Years).
   - 2005-2006: SOI (Statistics of Income) Tax Stats - IRS Data Book: Internal Revenue Collections and Refunds, by Type of Tax, Fiscal Years 2005 and 2006

3. WS/NI: Economic Report of the President
   - The Wage and Salary / National Income = [Average weekly earnings, total private □ 52 □ the Employees on nonagricultural payrolls, by major industry + Total Farm income] / National Income)

4. Interest rates for time deposits: 3-month CD Rate (Secondary Market) though Federal Reserve, Board of Governors

5. Unemployment rate: The St. Louis Federal Reserve Bank

6. Employment levels by occupations and sectors: Bureau of Labor Statistics (BLS)
   - PS: Private service - providing: Total Employment (thousands), SA
   - ASE: Employment level, Agriculture and related industries, self-employed workers; (Thousands): SA
   - NASE: Employment level, Nonagricultural, self-employed workers; (Thousands): SA

7. Inflation rate: Consumer Price Index from Federal Reserve Bank of Minneapolis

8. Corruption index: Transparency International Global Corruption Barometer 2005

9. Regulation index: The World Bank Group (Doing Business)

10. Profile for the non-US citizen population: U.S. Census Bureau

Table 1. Profile for the Non-U.S. Citizen Population

Subject	Number	Percent
Total population	18,565,265	100.0
PERIOD OF U.S. ENTRY		
Entered 1990 to 2000	11,418,890	61.5
Entered 1980 to 1989	4,687,305	25.2
Entered before 1980	2,459,065	13.2

Note: Non-U.S. citizen population includes people born outside the U.S. who have not been conferred U.S. citizenship, such as lawful permanent residents, students, refugees, and people illegally present in the United States.

Source: U.S. Census Bureau, Census 2000 Special Tabulations (STP-159)

Table 2. The Ease of Doing Business Environment in the U.S.

As of 2006 (Year)		East Asia & Pacific	Europe & Central Asia	Latin America & Caribbean	Middle East & North Africa	OECD	South Asia	Sub-Saharan Africa	U.S.
Ease of Doing Business Rank									3
Starting a Business	Rank								3
	Procedures (number)	8.2	9.4	10.2	10.3	6.2	7.9	11.1	5
	Time (days)	46.3	32	73.3	40.9	16.6	32.5	61.8	5
	Cost (% of income per capita)	42.8	14.1	48.1	74.5	5.3	46.6	162.8	0.7
	Min. capital (% of income per capita)	60.3	53.9	18.1	744.5	36.1	0.8	209.9	0
Dealing with Licenses	Rank								22
	Procedures (number)	17.6	21.4	15.4	19.9	14	16.1	17.7	18
	Time (days)	147.4	242.5	198.7	206.9	149.5	226.6	230.2	69
	Cost (% of income per capita)	207.2	564.9	246.2	499.9	72	375.7	1,024.5	16
Paying Taxes	Rank								62
	Payments (number)	29.8	50	41.3	28.9	15.3	30.1	41	10
	Time (hours)	290.4	423	430.5	236.6	202.9	304.6	336.4	325
	Profit tax (%)	19.7	11.7	22.8	16.7	20.7	20.3	24.2	26.6
	Labor tax and contributions (%)	10.9	30.6	14.5	18.7	23.7	8	14	10
	Other taxes (%)	11.6	13.7	11.8	5.5	3.5	16.8	33	9.4
	Total tax rate (% profit)	42.2	56	49.1	40.8	47.8	45.1	71.2	46

Source: The World Bank Group, The Doing Business database

Table 3. The Perceived Level of Corruption in the U.S.

National institutions and sectors, corrupt or clean?															
To what extent do you perceive the following sectors in this country/territory to be affected by corruption? (1: not at all corrupt, … 5: extremely corrupt)	Political parties	Parliament / Legislature	Police	Legal system / Judiciary	Tax revenue	Business / private sector	Customs	Medical services	Media	Education system	Utilities	Registry and permit services	The military	NGOs	Religious bodies
ASIA - average	4.2	3.9	3.9	3.4	3.5	3.3	3.4	3.3	3	3.1	3.1	2.9	2.9	2.8	2.9
AFRICA - average	4.2	3.8	4.4	3.7	3.5	3.1	4	3	2.7	3.4	3.4	3.3	3.2	2.5	2.2
W. EUROPE - average	3.7	3.3	2.7	2.9	2.9	3.3	2.7	2.7	3.3	2.3	2.6	2.5	2.5	2.5	2.5
CE EUROPE-average	4	3.9	4	3.9	3.5	3.7	3.7	3.7	3.2	3.5	2.9	3.4	3.1	2.7	2.3
LAC - average	4.5	4.4	4.3	4.3	3.7	3.5	4	3.2	3.3	3.2	3.5	3.7	3.3	3.1	2.8
U.S.	3.9	3.5	3.1	3.5	3.4	3.2	3	3.1	3.5	3	3	2.5	2.9	3	2.8
Total	4	3.7	3.6	3.5	3.4	3.4	3.3	3.2	3.2	3	3	2.9	2.9	2.8	2.6

How have corruption levels increased or decreased over the past three years?					
In the past 3 years, how has the level of corruption in this country changed?	% Increase a lot	% Increase a little	% Stay the same	% Decrease a little	% Decrease a lot	% Don't know / no answer
U.S.	43	22	23	7	4	2
Total	35	22	27	9	2	5

Expectations: will corruption levels increase or decrease over the next three years?						
Do you expect the level of corruption in the next 3 years to change?	% Increase a lot	% Increase a little	% Stay the same	% Decrease a little	% Decrease a lot	% Don't know / no answer
U.S.	30	26	28	10	4	2
Total	23	21	30	14	5	7

Source: Transparency International Global Corruption Barometer 2005

Table 4. Augmented Dickey-Fuller Tests for a Unit Root

Levels	Constant			Constant and Linear Trend		
	t-statistic	*p*-value	Lag length	*t*-statistic	*p*-value	Lag length
$\ln(C)$	-2.9266	[0.0527]	0	0.1672	[0.9967]	0
$\ln(T)$	-3.3896	[0.0194]*	4	-3.2332	[0.0966]	3
$\ln(R)$	-1.9223	[0.3185]	0	-3.5064	[0.0556]	2
$\ln(Y)$	-0.1066	[0.9408]	0	-4.3123	[0.0091]**	2
$\ln(WS/NI)$	-0.4026	[0.8976]	0	-2.0427	[0.5578]	0

First Differences	Constant			Constant and Linear Trend		
	t-statistic	*p*-value	Lag length	*t*-statistic	*p*-value	Lag length
$\Delta\ln(C)$	-4.7708	[0.0005]**	0	-6.1301	[0.0001]**	0
$\Delta\ln(T)$	-	-	-	-3.2987	[0.0858]	3
$\Delta\ln(R)$	-4.5234	[0.0010]**	0	-4.4361	[0.0066]**	0
$\Delta\ln(Y)$	-4.7470	[0.0006]**	0	-	-	-
$\Delta\ln(WS/NI)$	-5.9592	[0.0000]**	0	-5.3534	[0.0007]**	1

Second Differences	Constant			Constant and Linear Trend		
	t-statistic	*p*-value	Lag length	*t*-statistic	*p*-value	Lag length
$\Delta^2\ln(T)$	-	-	-	-8.1135	[0.0000]**	1

Note: The optimal lag length is based on Schwarz Information Criterion (SIC) with maximum 8 lags. MacKinnon one-sided *p*-values are reported in square brackets. *(**) indicates statistical significance at the 5% (1%) level, respectively.

Table 5. The Estimation of Demand for Currency in the U.S.

Models	[1] Spurious	[2] Detrending	[3] ARMA	[4] Differencing	[5] Error Correction
Dependent Variable	$\ln(C)$	$\ln(C)$	$\ln(C)$	$\Delta\ln(C)$	$\Delta\ln(C)$
Explanatory Variables					
Const.	-7.3017	3.8699	11.2600	0.0749	-1.5278
	[0.0000]**	[0.0376]*	[0.0000]**	[0.0000]**	[0.1759]
$\ln(T)$	0.6261	0.2849	-0.0521		
	[0.0257]*	[0.0376]*	[0.4775]		
$\ln(R)$	-0.1050	-0.0134	-0.0041		
	[0.0156]*	[0.4939]	[0.7018]		
$\ln(Y)$	3.3572	-0.1791	0.0687		
	[0.0000]**	[0.5558]	[0.7246]		
$\ln(WS/NI)$		-0.0127	-0.0892		
		[0.9640]	[0.6376]		
Time		0.0776			
		[0.0000]**			
$\Delta\ln(T)$				-0.0248	0.0385
				[0.7431]	[0.6445]
$\Delta\ln(R)$				-0.0018	-0.0234
				[0.8785]	[0.0807]
$\Delta\ln(Y)$				-0.0011	-0.0129
				[0.9957]	[0.9549]
$\Delta\ln(WS/NI)$				-0.1446	-0.1027
				[0.4855]	[0.6241]
$\ln(T)_{-1}$					0.2463
					[0.0211]*
$\ln(R)_{-1}$					-0.0355
					[0.0162]*
$\ln(Y)_{-1}$					0.1620
					[0.3866]
$\ln(WS/NI)_{-1}$					0.2181
					[0.2306]
$\ln(C)_{-1}$					-0.0740
					[0.1387]
AR (1)			0.9866		
			[0.0000]**		
MA (1)			-0.1491		
			[0.4866]		
Models	[1] Spurious	[2] Detrending	[3] ARMA	[4] Differencing	[5] Error Correction
R^2	0.9878	0.9981	0.9994	0.0235	0.4272

Durbin-Watson	0.7214	0.6030	1.9082	1.6498	2.2362
Breusch-Godfrey	16.4446	10.9913	0.0438	0.6294	0.2184
	[0.0000]**	[0.0003]**	[0.9572]	[0.5405]	[0.8055]
ARCH	4.0205	14.4445	1.3846	6.6000	0.2795
	[0.0535]	[0.0006]**	[0.2483]	[0.0152]*	[0.6008]

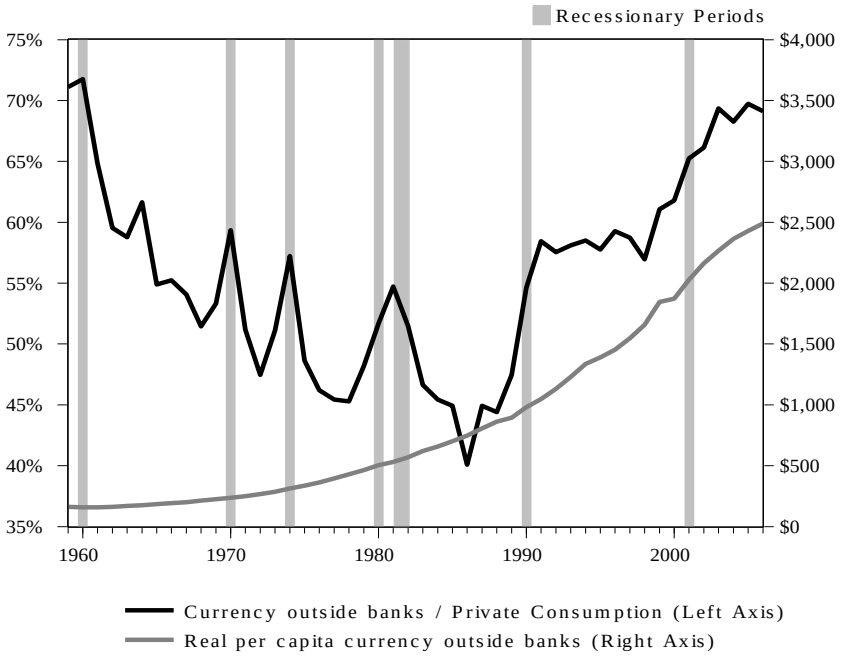
Note: The *p*-values are reported in square brackets. *(**) indicates statistical significance at the 5% (1%) level, respectively.

Table 6. The Size of the Underground Economy in the U.S., 1972-2006

	Error-Correction-Based Currency Demand Model									Spurious Regression		Detrending	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)				
	Actual	Predicted	Predicted	Difference	Illegal	Legal	Income	UE	UE/GDP				
	($Billion)	(with Tax)	(w/o tax)	($Billion)	Money	Money	Velocity	($Billion)	(%)	UE ($Billion)	UE/GDP (%)	UE ($Billion)	UE/GDP (%)
Year	*C*	*C**	*C***	*C*-*C**	*C**-*C***	M2-(5)	GDP/(6)	(5)□(7)	(8)/GDP				
1972	56.2	-	-	-	-	-	-	-	-	299.1	7.12%	161.5	3.85%
1973	60.8	60.6	32.5	0.2	28.1	827.4	5.3	148.9	3.40%	316.0	7.23%	172.2	3.94%
1974	67.0	66.0	35.0	1.0	31.0	871.1	4.9	151.9	3.56%	273.7	6.38%	178.7	4.17%
1975	72.8	73.1	38.4	-0.3	34.6	981.6	4.5	155.7	3.53%	265.7	6.04%	172.5	3.92%
1976	79.5	79.1	41.9	0.4	37.2	1114.8	4.1	152.5	3.33%	283.3	6.18%	172.4	3.76%
1977	87.4	86.4	45.2	1.0	41.2	1229.1	3.9	160.6	3.35%	354.2	7.36%	199.6	4.14%
1978	96.0	96.6	48.2	-0.6	48.4	1317.6	3.9	188.8	3.68%	395.2	7.69%	207.6	4.04%
1979	104.8	106.4	53.4	-1.6	53.0	1420.7	3.7	196.1	3.73%	354.2	6.80%	206.9	3.98%
1980	115.3	115.5	58.3	-0.2	57.2	1542.6	3.4	194.5	3.71%	300.0	5.77%	205.3	3.95%
1981	122.5	123.8	62.5	-1.3	61.3	1694.1	3.1	190.0	3.62%	291.4	5.54%	206.2	3.92%
1982	132.5	134.4	67.7	-1.9	66.8	1843.5	2.8	187.0	3.62%	257.8	4.97%	207.4	4.00%
1983	146.2	146.2	73.1	0.0	73.2	2053.3	2.7	197.6	3.56%	314.7	5.63%	216.6	3.88%
1984	156.1	157.8	78.5	-1.7	79.3	2230.7	2.6	206.1	3.56%	360.3	6.10%	225.2	3.82%
1985	167.8	170.2	84.7	-2.4	85.6	2410.1	2.6	222.5	3.55%	401.2	6.53%	237.6	3.86%
1986	180.4	186.0	91.8	-5.6	94.2	2638.2	2.4	226.0	3.57%	422.9	6.69%	245.4	3.88%
1987	196.7	203.3	99.6	-6.6	103.7	2727.7	2.4	248.9	3.80%	478.3	7.24%	268.9	4.07%
1988	212.0	219.5	107.0	-7.5	112.5	2882.0	2.4	270.0	3.90%	494.0	7.21%	279.5	4.08%
1989	222.3	233.3	114.3	-11.0	119.0	3039.5	2.3	273.7	3.91%	515.4	7.33%	293.9	4.18%
1990	246.5	250.4	122.6	-3.9	127.8	3150.8	2.2	281.1	4.06%	496.6	7.02%	311.9	4.41%
1991	267.1	271.7	132.6	-4.6	139.1	3240.0	2.2	306.0	4.29%	513.7	7.18%	334.2	4.67%
1992	292.2	295.9	144.2	-3.7	151.7	3280.8	2.3	348.9	4.62%	608.5	8.17%	376.1	5.05%
1993	321.6	322.2	156.1	-0.6	166.1	3317.9	2.3	382.0	5.01%	658.1	8.62%	416.2	5.45%
1994	354.0	345.6	166.7	8.4	178.9	3318.6	2.4	429.4	5.39%	696.6	8.76%	459.2	5.77%
1995	372.2	367.8	177.7	4.4	190.1	3450.3	2.4	456.2	5.51%	716.7	8.83%	490.5	6.05%
1996	394.1	392.3	189.0	1.8	203.3	3614.7	2.3	467.6	5.62%	808.4	9.54%	530.0	6.26%
1997	424.5	418.4	200.8	6.1	217.5	3818.8	2.3	500.2	5.70%	889.4	10.06%	565.7	6.40%
1998	459.8	448.3	214.7	11.5	233.5	4150.8	2.2	513.7	5.63%	967.7	10.48%	584.1	6.32%

1999	517.8	478.8	229.7	39.0	249.2	4394.8	2.2	548.3	5.67%	1051.2	10.87%	615.6	6.36%
2000	531.2	506.7	243.6	24.5	263.1	4660.5	2.1	552.5	5.65%	1044.9	10.57%	641.3	6.49%
2001	581.1	550.0	265.1	31.1	284.8	5152.1	1.9	572.7	5.53%	986.0	9.95%	611.6	6.17%
2002	626.3	596.3	293.8	30.0	302.5	5478.6	1.8	544.5	5.52%	930.5	9.22%	602.9	5.97%
2003	662.7	635.7	318.3	27.0	317.4	5750.1	1.8	571.3	5.52%	1119.2	10.69%	681.8	6.51%
2004	697.9	678.9	330.9	19.0	348.0	6066.7	1.8	626.4	5.74%	1203.0	11.12%	763.1	7.05%
2005	724.5	723.6	343.2	0.9	380.4	6292.5	1.8	684.7	6.05%	1186.1	10.62%	804.2	7.20%
2006	749.6	758.0	360.0	-8.4	398.0	6629.3	1.7	676.6	6.00%	1258.1	10.93%	862.8	7.49%
Average													
72-79	78.1	81.2	42.1	0.0	39.1	1108.9	4.3	164.8	3.51%	317.7	6.85%	183.9	3.97%
80-89	165.2	169.0	83.7	-3.8	85.3	2306.2	2.7	221.8	3.68%	383.6	6.30%	238.6	3.96%
90-99	365.0	359.1	173.4	5.9	185.7	3573.7	2.3	424.5	5.15%	740.7	8.95%	468.4	5.67%
00-06	653.3	635.6	307.9	17.7	327.7	5718.5	1.9	604.0	5.71%	1104.0	10.44%	709.7	6.70%
72-06	300.0	302.9	147.7	4.2	155.2	3135.0	2.7	348.4	4.50%	614.6	8.01%	386.0	5.00%

Figure 1. Currency Holdings and Time Series of Monetary Bases in the U.S., 1959-2006



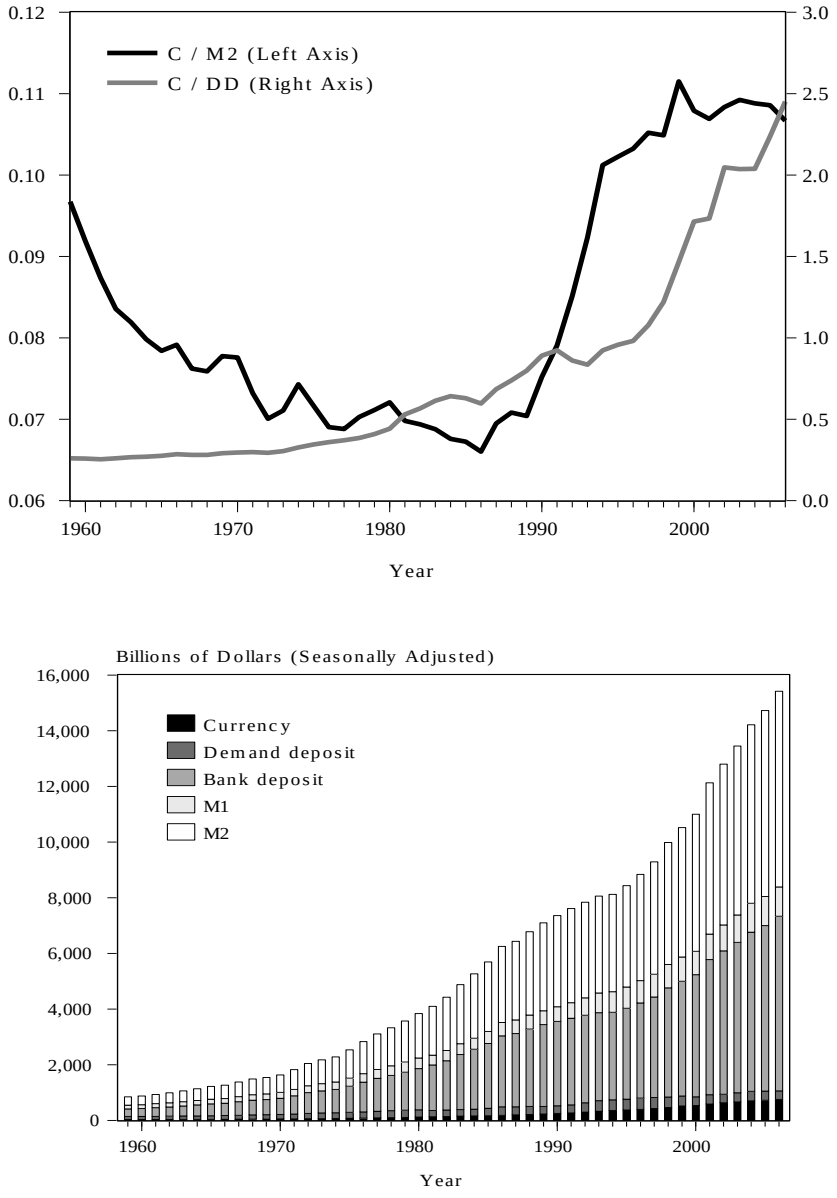
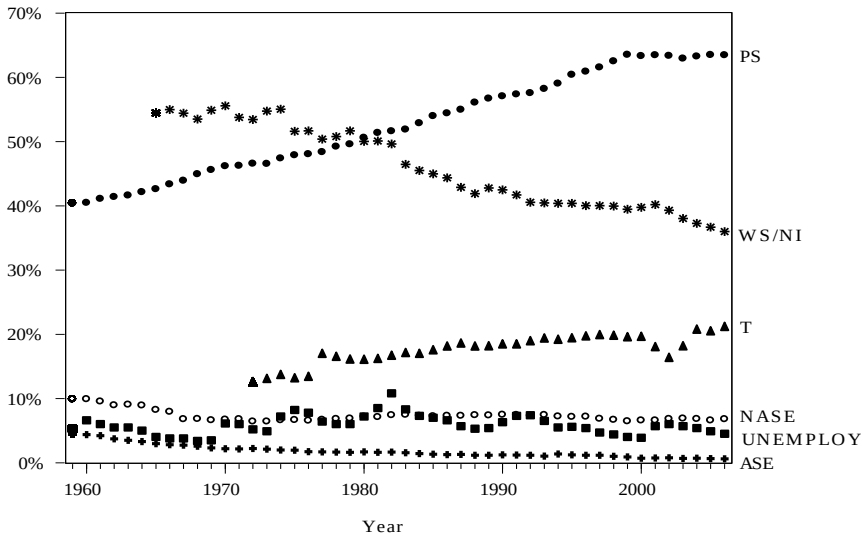


Figure 2. Employment Levels by Occupations and Sectors in the U.S., 1959-2006



Note: Abbreviations of Legends

- PS: Private Service-Providing / Total Employment
- WS/NI: The Wage and Salary / National Income
- T: Total Income Tax Payments / Personal Income
- NASE: Nonagricultural, Self-Employed Workers / Total Employment
- UNEMPLOY: Unemployment Rate
- ASE: Agriculture and Related Industries, Self-Employed Workers / Total Employment

Sources: Refer to Appendix B.

Figure 3. The Size and Growth Rate of the Underground Economy in the U.S., 1972-2006