Economic Issues, Vol. 13, Part 1, 2008

Estimating the Black Economy through a Monetary Approach: A Case Study of Pakistan

Qazi Masood Ahmed and M. Haider Hussain[1]

ABSTRACT

In recent years, the black economy has held enormous appeal for policy makers. Presence of black economy creates critical misrepresentation of macroeconomic variables in official estimates that lead to the false determination and delusional impact of economic policies. Similarly, black economy represents the unrecorded potential of the economy vis-à-vis resource generation and mobilization. The Economy of Pakistan underwent several minor tax reforms since 1960's. However, the tax and tariff reform of 1990's, committed under international pressure, was the first comprehensive exercise and therefore it becomes highly desirable to gauge its impact on the black economy and tax evasion practices. This paper, with some modifications, uses the standard monetary approach to obtain the latest estimates of the size of black economy and its macroeconomic implications thereof.

1. INTRODUCTION

AN OBLIVIOUS PART OF ECONOMIC ACTIVITIES takes place outside of official or recorded economy all over the world, in general, and in developing world in particular. At least three major concerns can be identified with the existence of the unrecorded economy. First, the ignorance of the existence and extent of the black economy creates biases in appraising economic policies and then leads to biases in designing the economic policies. Second, a loss of tax revenue stemming from the black economy compels the respective government to shrink economic activities, especially in social sectors. Third, the presence of the black economy creates an uncongenial relationship between the government and economic agents[2] especially producers, and the hidden resources can be used to promote illegal and immoral activities in society, in general, and in government in particular. If the underground economy is large

and significant, then there is a clear evidence of market distortions, poor governance and administrative loopholes.

Although there is a consensus on the presence of the underground economy, the phenomenon has been discussed and defined in the literature under many different names such as unofficial, informal, unregistered, unobserved, shadow, subterranean, parallel, hidden, invisible and irregular. Nevertheless, the purpose behind all these definitions is to link the underground economy to official national income so as to compare and add these figures to GNP. Conceptually, there are four classifications of underground economy made according to the particular institutional rules they violate. These are, illegal Economy, unreported Economy, unrecorded Economy and informal Economy.[3] Moreover, as Schneider and Frey (2001) point out, the notion of the underground or black economy should not only be identified with illegality. Most of the activities are perfectly legal but the taxes are evaded for different reasons and loopholes.

This is exactly what we want to address in this paper. The present work addresses the issue of the size of the unreported economy in Pakistan and estimates the resources that are lost due to tax evasion. For this we use, with some modifications, the methodology of Tanzi (1983), adopted previously by Ahmed and Ahmed (1995) for the Pakistan economy. Revisiting this issue is of critical importance, especially taking into account the tax reform exercise started in early 90s under the influence of IMF and strengthened in late 90s. The series of economic reforms implemented in Pakistan in the 1990s were no different from the reforms in developing countries taking place in the same period. One of the important ingredients of the reform agenda was to introduce tax reforms, which included a drastic reduction in tax rates to minimise tax evasion and improve trade and investment. In Pakistan, following this agenda, the effective import duty was reduced from more than 65 per cent in 1990 to less than 10 per cent in 2005. Similarly the income tax slabs have been reduced and average tax rate fallen from 35 per cent to less than 15 per cent. Several other measures have also been taken to reduce the burden of taxation, to broaden tax base and encourage people to pay their share of taxation. Whether such important and significant tax reforms have any impact on tax declaration is an important issue and is analysed in this paper.

The paper is organised as follows: Section 2 presents the review of selected literature, section 3 illustrates the methodology, section 4 elucidates the results and finally section 5 concludes the discussion with some policy implications.

2. Review of selected literature

The pioneering efforts in the area of the monetary approach are of Gutmann (1977), Feige (1979) and Tanzi (1983). Gutmann (1977), without using any statistical procedure, estimated the black economy by computing the ratio of currency to demand deposits over the period 1937-76. Feige (1979), using the

quantity theory of money, formulated that the total value of transactions is given by the stock of demand deposits multiplied by the velocity of demand deposits plus the stock of currency multiplied by the velocity of currency. This total value of transactions is then used to obtain derived GNP. The difference between derived and actual GNP is assumed to the represent underground economy. Tanzi (1980, 1983) formulated his methodology based on Cagen's (1958) work. According to Cagen (1958), higher tax rates induce people to use currency for transactions to avoid tax reporting. Tanzi (1980) re-hypothesised the same link to obtain the alternative estimates of US black economy. He postulated the currency in circulation to money supply ratio as a function of the top bracket statutory tax rate, the weighted average rate on interest income, the ratio of personal income tax to personal income net of transfers, the share of wages and salaries in national income, the interest rate and per capita income. According to him, economic development in the country - measured by per capita income - is assumed to lead to the replacement of currency by cheques, thus causing a fall in currency-money supply ratio. Higher interest rates encourage people to invest in deposits, which reduce the volume of currency in circulation.

On the other hand, higher taxes motivate people to use currency in transactions instead of cheques etc. Moreover, as the wages are paid in currency, especially of daily workers, an increase in wages will require more currency. Thomas (1999) criticised estimating such a currency demand equation on the grounds that there is no precise discussion of underlying economic theory. He added that concentrating on black economy size without providing the theoretical background of its determinants and structure is of limited value for policy makers. Bhattacharyya (1999, p.351), however, argues that the literature on tax evasion indicates that the 'tools and concepts used in different branches of economic theory are sufficient to analyze the phenomena of the hidden economy'. He, using the functions of government expenditure and demand for durable goods, shows that the estimates of the hidden economy still has a lot to offer for policy advice — for instance, the effect of changes in the VAT on the marginal propensity to consume from the hidden economy. Tanzi (1982) also estimated the extent of evaded taxes by multiplying the underground economy by the tax to GNP ratio.

In Pakistan, Tanzi's approach was used in almost all studies to estimate black economy. Shabsigh (1995) formulated the ratio of currency in circulation to demand deposits as a function of real per capita income, real interest rate, per capita banking services, tax on imports, exports and domestic services. He concluded that the size of the black economy was 21 per cent of GDP in 1975, declining slightly to 20.4 per cent in 1990. Ahmed and Ahmed (1995) came up with the result that this size declined from 52 per cent in 1960 to 35 per cent in 1990. However, we re-estimated a similar model and the CUSUM test (Brown *et al* 1975) shows that the model is fairly unstable, which makes the inference less reliable.[4] Iqbal *et al* (1998) used the ratio of

currency in circulation to M2 as a function of the domestic tax to GDP ratio, international taxes to GDP ratio, real interest rate, real per capita income growth, banking services and a dummy to capture the effect of structural adjustment programme during 1988 and 1996. They concluded that the underground economy has increased from 20 per cent of GDP in 1973 to 51 per cent in 1996.

Aslam (1998) introduced currency in circulation plus the foreign currency accounts to M2 ratio as a function of the total tax revenue to GDP ratio, interest rate on time deposits, growth rate of real GDP and a dummy for the period 1991 onwards to capture the effect of introduction of the foreign currency accounts in 1991. He finds that the underground economy increased from 29 per cent of GDP in 1960 to 44 per cent in 1990. Kemal's (2003) model is similar to Aslam (1998), except for the use of a lagged dependant variable. His results suggested that the underground economy increased from 20 percent of GDP in 1974 to 37 per cent in 2002. Interestingly, the sign of real GDP growth in Kemal (2003) is negative as against in Aslam (1998). This variable, however, turned out to be insignificant in both studies. Kemal's (2003) use of the *h*-statistics to detect serial correlation might be questionable as Durbin's *h* test follows a normal distribution asymptotically. Furthermore, the lagged dependent variable in his model shows a highly significant positive coefficient, revealing that inertia is capturing most of the increase in the black economy. A comparison of these studies in the context of Pakistan reveals different estimates of the black economy. Econometrically, the basis of these alternative results may include (i) different model specifications (ii) choice of the different estimation periods and (iii) Short run fluctuations in the selected macroeconomic variables.

3. Data and estimation methodology

Our estimation model is based on the methodology of Ahmed and Ahmed (1995). They use a dummy for the 1960-1971 period, based on the separation of Bangladesh (former East Pakistan) in 1971, which is replaced by the tax reform dummy in the present exercise. We formulate

$$Lncm2 = \beta_0 + \beta_1 Ln(1+tgr) + \beta_2 Lnr + \beta_4 d_{97} + e \qquad (1)$$

where *cm*2 is the ratio of currency in circulation to money supply M2, *tgr* is the overall tax to GDP ratio, *r* is a weighted average rate of return on deposits and *d*97 is the tax reform dummy, taking the value of 1 from 1997 onwards. We hypothesise a positive link between the tax to GDP ratio and currency to M2. An increase in the tax rate stimulates people to evade taxes through using currency transactions instead of cheques. On the other hand, an increase in the rate of return would induce people to invest in deposits and thereby reduce the currency-money supply ratio.

Besides the currency ratio equation, another dependent variable is used in a separate regression with the same explanatory variables. This dependent variable includes bearer bonds along with currency in circulation. Bearer bonds were introduced in the mid 80's to enhance savings and investment in the economy. These bonds were particularly attractive for black money since they can be obtained in unlimited quantities and without any cumbersome procedure. Since they are easily convertible into cash at any time, they can serve as currency themselves. Therefore, the second regression is

$$Lncbm2 = \beta_0 + \beta_1 Ln(1+tgr) + \beta_2 Lnr + \beta_4 d_{97} + e \qquad (2)$$

where *cbm*2 is (currency + bearer bonds' value)/(M2 + bearer bonds' value). Moreover, as mentioned above, most of the macroeconomic variables are subject to short run fluctuations with large variances, which may affect the significance of estimators. To cope with this problem, we use the HP filter (Hodrick and Prescott, 1997) to remove cyclical variations from independent variables. More specifically, let y_t be a series composed of two components: a cyclical component (c_t) and a trend component (τ_t). The HP filter isolates c_t from τ_t by minimising the variance of y_t. To do this, the HP filter uses a penalty parameter λ to control the smoothness of the series τ_t. The larger the value of λ, the smoother the series and τ_t becomes a perfect linear trend as $\lambda \to \infty$. There are various critiques on the use of the HP filter for smoothing a series and researchers point out some of the undesirable properties associated with it (Ahumada and Garegnani, 1999; Ravn and Uhlig, 1997). Ravn and Uhlig (1997, p.1), nonetheless, suggest that 'none of these shortcomings and undesirable properties are particularly compelling: HP filter has withstood the test of the time and the fire of discussion remarkably well'. Likewise, Ahumada and Garegnani (1999, p.18) conclude that the criticised drawbacks of the HP filter 'do not appear to have had great effects on its wide use in empirical research'. Figures 1(a), 1(b) and 1(c) compare the actual and filtered series used in the regression. Different values of the smoothing penalty λ are chosen for different variables depending upon empirical practice.[5]

Figure 1(a): *tgr* series in Equation 2

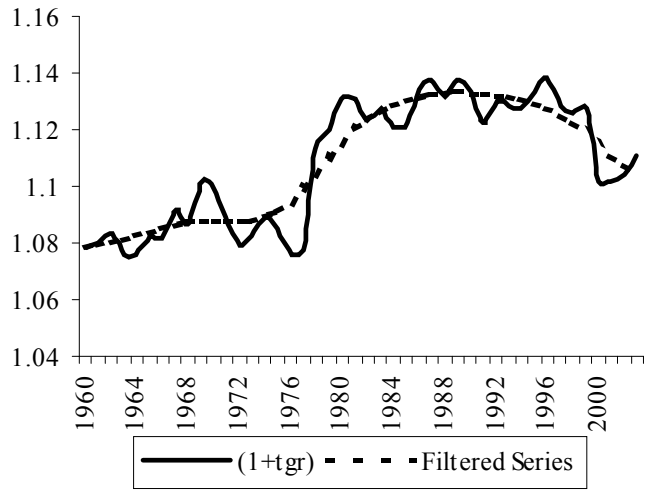
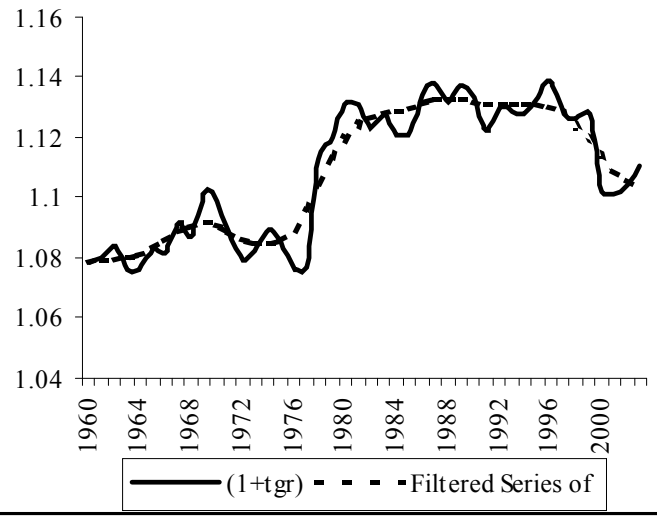


Figure 1(a): *tgr* series in Equation 3



The rest of the analysis follows the typical path. From equation 1, the predicted value of ratio *cm2* is computed for each year first with tax variable ($cm2_t$) and then without tax variable ($cm2w_t$). The difference between the tax and without tax ratio gives us an indication of the level of currency holdings stimulated by taxes. This difference is multiplied by M2 to obtain the level of illegal money. Mathematically:

$$\text{Illegal Money (IM)} = (cm2t - cm2w_t) \text{ . M2} \tag{3}$$

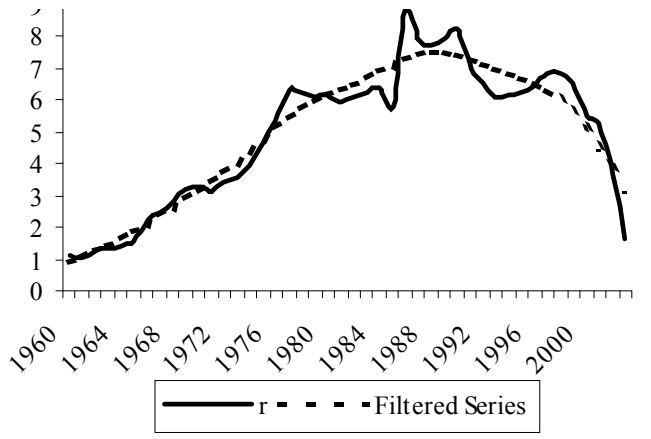
The size of the Black economy can be obtained by multiplying illegal money by velocity of money. Velocity of money equals the ratio of GNP to legal money. Moreover, total money in the economy can either be legal or illegal. Therefore, legal money is computed by taking the difference between total money supply and illegal money. Mathematically:

$$\text{Legal Money (LM)} = \text{M2} - \text{IM} \tag{4}$$

$$\text{Velocity of Money,} \quad v = \frac{GNP}{LM} \tag{5}$$

$$\text{Black Economy (BE)} = \text{IM}.v \tag{6}$$

Figure 1(c): r series in Equation 2 and 3



Finally, the level of tax evasion is obtained by multiplying the size of the black economy by the ratio of tax-to-GNP.

$$\text{Tax Evasion} = BE.\left(\frac{Taxes}{GNP}\right) \tag{7}$$

The same process is applied for equation 2. Furthermore, we assume that the velocity of money is the same for both illegal and legal money. Rationally, when black money is used in regular markets for transactions, it should behave in the same manner as white money in order to appear regular and trustful.

The data for our analysis covers the period 1960 to 2003 and are obtained from various issues of the *Pakistan Economic Survey* and the State Bank of Pakistan's *Annual Reports*.

4. Estimation Results

Table 1 shows the results from regression 3 and 4. All variables are highly significant and the model fit and overall significance poses no problem. Tests for model stability, heteroskedasticity and serial correlation are reported in Appendix A. Residuals are found to be homoskedastic and serially uncorrelated. Moreover, we checked the stability of the models with and without dummies. The CUSUM test (Brown *et al*, 1975) indicates instability in the without-dummy version of equation 1 during 1998 and 2003. However, the dummy-included model reveals that the model is stable during this period. Equation 2 is found to be stable for both with- and without-dummy specifications6. In both regressions, the tax-to-GDP ratio (*tgr*) possesses the positive sign confirming the hypothesis of increasing currency-money supply ratio with increasing tax rates. The sign of the weighted average rate of return (*r*) is negative, which also confirms our hypothesis that the higher the rates of returns on deposits, the higher the savings and the lower the currency-M2 ratio. The dummy variable for tax reforms (*d*97) is also highly significant and negative. The tax reform exercise reached its peak in 1997 when several important steps were taken. These included a substantial decrease in the personal income tax rate to 20 per cent, a reduction in the corporate tax rate, the withdrawal of turnover tax and some of withholding taxes, the strengthening the tax administration and improvements in documentation. The negative sign on the dummy in both equations implies that these exercises were significant in reducing the *cm*2 and *cbm*2 ratios, and thus contracting the size of the black economy.

Following this estimation, we obtained the size of black economy explained by equations 3 to 7. The results are shown in Tables 2 and 3. The black economy in Pakistan turns out to be highest in early 60s when the corporate and personal income tax rates were high. The Corporate income tax rate was 30 per cent and a super tax of 30 per cent. This (aggregate corporate income and super tax) rate was dropped to 40 per cent in the later part of 80s. Likewise, the maximum personal income tax rate was 75 per cent during 1960-64 causing the black economy to remain well above 30 per cent of GDP during this period. The Black economy kept declining during 1965-75 when this rate was brought down in between 60 and 70 per cent (Qureshi, 1989,

pp.23). Furthermore this rate, 56 percent during 1980-1986, was brought down to 39 per cent in 1988 and to 28 per cent in 1993 — the effect of which is subsequently reflected by the squeezing of the black economy in the periods under review.

Table 1: Regression results

	Equation 2 *Currency ratio (cm2)*			*Equation 3* *Currency and bond ratio (cm2)*		
	Coefficient	Standard error	*p*-value	Coefficient	Standard error	*p*-value
Constant	-1.100	0.170	0.0000	-1.229	0.162	0.0000
tgr	8.805	2.496	0.0011	10.311	2.346	0.0001
r	-0.597	0.075	0.0000	-0.584	0.072	0.0000
d_{97}	-0.344	0.057	0.0000	-0.233	0.059	0.0003
N	44			44		
R^2	0.88			0.85		
dw-statistic	1.77			1.70		
F-statistic	77.90			57.44		

It is also interesting to note that Kemal (2003) reports an increasing trend in the black economy between 1995 and 1998 — contrary to our results. Reasons could legally be the tax reform capture, which was absent in Kemal (2003). Furthermore, the results of Kemal (2003) are based on a special specification where a lagged dependent variable is used as the explanatory variable with a high positive coefficient. In our results, the impact of tax reforms dominates, evident from Tables 2 and 3. The Black economy as a percentage of GDP declined by 35 percent in the case of the currency ratio equation, and by 27 per cent in the case of the currency bearer bond equation during 1996 and 1997. The corresponding decline in tax evasion as a percentage of GDP was 39 per cent and 32 per cent respectively.

The inclusion of bearer bonds with currency in circulation, as Table-2 shows, does not alter the direction of outcomes. It is, however, central to increases in the magnitude of the black economy as a percentage of GDP. This suggests that bearer bonds are a reliable medium of exchange in the underground economy alongside currency. Roughly, it can be seen that the inclusion of bearer bond increases the black economy as a percentage of GDP, on average, by 5 percentage points each year. It is quite interesting to note that the annual compound growth rate of currency in circulation and bearer bonds during the last two decades remained almost the same, at 12 per cent. Moreover, note also that the size of the black economy has increased slightly from 2000. This is due, perhaps, to the reduction of the rate of return on deposits, which fell by more than 30 per cent between 2000 and 2003, reveal-

ing the loose stance of monetary policy. On the other hand, the effective coverage of indirect as well as direct taxes increased during the same period. This brought some of the untaxed sectors into the tax net, causing the tax to GDP ratio to increase slightly, by 0.26 per cent, during the same period.

5. Conclusion and Policy Implications

In this paper, we have tried to estimate the size of the tax induced unreported part of the economy. One of the main focuses of the paper has been to gauge the impact of taxation reforms on the extent of the black economy. These reforms, part of overall economic reform, was one of the main features of the Pakistan economy in the last fifteen years, given the objective of increasing the tax base and tax collection along with the overall efficiency of the economy. All the results are shown to accord with economic intuition. They show the black economy as a percentage of GDP is decreasing over time especially after the rigorous period of tax reforms from 1997. This indicates that the tax reforms involving rationalisation of tax rates, several exemptions and allowances coupled with the decrease in direct tax rates have, to some extent, achieved their desired goals.

The inclusion in the analysis of bearer bonds, frequently used as a medium of exchange, significantly increases the size of the black economy. After their inception in mid 80's, the volume of bearer bonds has grown almost at the same pace as currency in circulation. Despite the fact that the black economy as a percentage of GDP has decreased, the annual compound growth rate of the black economy during the sample period remained more than 11 per cent. During the 1960s the initial level of the black economy was very high and therefore, its growth rate was low, around 2 per cent. The growth rate was 17 per cent during the 70's, 15 per cent during the 80s and 13 per cent during the 90s and afterwards (see Table 3). This shows that despite the huge reduction in tax rates, the growth of the black economy and tax evasion is still high.

This implies that in societies where other types of corruption and bad governance are pervasive, the tax-induced component of black economy cannot be rectified only through tax measures but requires rigorous administrative measures and stringent implementation. Therefore the tax administration responsible for the detection and tackling of tax evasion should be improved. The tax system must be simple, convenient and transparent. The system loopholes and prevailing corruption among the tax collection authorities cannot be neglected and the inefficiencies must be dealt accordingly in order to curb the tax evasion. Moreover, due to the strong underlying assumptions of Tanzi (1980, 1983), the estimates of the black economy cannot be taken as precise measures. They can, nevertheless, be used to formulate appropriate policy to mitigate its impact. Lastly, despite the fact that reducing tax rate is a well received prescription for reducing the black economy, it cannot be adopted in isolation and should be used in conjunction with appropriate administrative measures. Otherwise reduction in tax revenue due to reduced tax rates may have an adverse impact on the economic welfare of society.

Table 2: Estimates of the Black Economy via Equation 2

Year	Illegal Money (MillionRs.)	Legal Money (MillionRs.)	Velocity of Money	Black Economy (Million Rs.)	Black Economy as % of GDP	Tax Evasion (MillionRs.)	Tax evasion as % GDP
1960	1,994	3,862	4.6	9,206	51.6	722	4.0
1961	1,820	4,058	4.8	8,784	44.8	705	3.6
1962	1,745	4,360	4.7	8,207	40.0	687	3.3
1963	1,863	5,124	4.3	8,000	36.3	611	2.8
1964	1,990	5,950	4.2	8,276	33.4	628	2.5
1965	2,043	6,578	4.3	8,752	31.0	726	2.6
1966	3,152	10,852	2.9	9,061	29.0	740	2.4
1967	3,355	12,279	2.9	9,698	27.3	894	2.5
1968	3,436	13,349	2.9	9,945	25.7	864	2.2
1969	3,599	14,849	2.8	10,015	24.2	1,019	2.5
1970	3,787	16,653	2.9	10,860	22.7	1,077	2.3
1971	3,845	18,068	2.8	10,792	21.2	960	1.9
1972	3,864	19,339	2.8	10,943	20.0	869	1.6
1973	4,313	22,755	3.0	12,879	18.8	1,072	1.6
1974	4,738	25,941	3.4	16,205	18.3	1,451	1.6
1975	5,035	28,039	4.0	20,173	18.1	1,705	1.5
1976	6,382	35,269	3.8	24,132	18.4	1,801	1.4
1977	8,163	43,610	3.6	29,057	19.3	2,174	1.4
1978	10,508	53,151	3.5	37,280	21.0	3,962	2.2
1979	13,658	64,954	3.2	44,083	22.5	4,936	2.5
1980	16,837	75,587	3.3	56,315	24.0	6,844	2.9
1981	19,790	84,831	3.5	70,193	25.2	8,517	3.1
1982	22,621	93,889	3.7	83,649	25.8	9,621	3.0
1983	28,812	117,213	3.4	99,254	27.2	11,424	3.1
1984	32,486	130,781	3.5	114,113	27.2	12,580	3.0
1985	36,733	147,172	3.5	127,409	27.0	14,457	3.1
1986	42,223	168,888	3.3	138,974	27.0	17,227	3.3
1987	48,057	191,966	3.2	152,420	26.6	19,764	3.5
1988	54,021	215,493	3.3	176,604	26.1	22,300	3.3
1989	58,338	232,119	3.4	200,262	26.0	26,519	3.4
1990	68,775	272,477	3.3	224,810	26.3	28,775	3.4
1991	81,192	319,452	3.3	264,487	26.0	31,595	3.1
1992	103,197	402,372	3.0	312,317	25.9	40,222	3.3
1993	122,315	473,075	2.8	347,238	26.0	44,336	3.3
1994	145,027	558,371	2.8	406,505	26.0	51,844	3.3
1995	169,971	654,761	2.9	488,024	26.2	64,394	3.5
1996	192,455	746,225	2.8	544,964	25.7	75,802	3.6
1997	151,794	901,439	2.7	405,646	16.7	52,316	2.2
1998	172,373	1,033,947	2.6	442,339	16.5	56,356	2.1
1999	182,318	1,098,228	2.7	483,563	16.5	62,267	2.1
2000	200,718	1,199,914	3.1	626,533	16.5	64,703	1.7
2001	223,955	1,302,089	3.2	706,590	17.0	72,668	1.7
2002	270,627	1,490,743	3.0	803,375	18.3	83,381	1.9
2003	342,507	1,736,262	2.9	981,029	20.3	105,340	2.2

Table 3: Estimates of the Black Economy via Equation 3

Year	Illegal Money (MillionRs.)	Legal Money (MillionRs.)	Velocity of Money	Black Economy (Million Rs.)	Black Economy as % of GDP	Tax Evasion (MillionRs.)	Tax evasion as % GDP
1960	2,202	3,654	4.9	10,743	60.2	843	4.7
1961	1,996	3,883	5.0	10,066	51.3	808	4.1
1962	1,899	4,206	4.9	9,258	45.1	775	3.8
1963	2,014	4,972	4.4	8,912	40.4	681	3.1
1964	2,157	5,783	4.3	9,231	37.2	700	2.8
1965	2,247	6,374	4.4	9,935	35.2	824	2.9
1966	3,545	10,460	3.0	10,572	33.8	863	2.8
1967	3,871	11,763	3.0	11,681	32.9	1,077	3.0
1968	4,045	12,741	3.0	12,264	31.7	1,066	2.8
1969	4,278	14,170	2.9	12,476	30.2	1,270	3.1
1970	4,456	15,984	3.0	13,313	27.9	1,320	2.8
1971	4,397	17,516	2.9	12,730	25.1	1,133	2.2
1972	4,263	18,940	2.9	12,327	22.5	979	1.8
1973	4,612	22,456	3.0	13,957	20.4	1,162	1.7
1974	4,954	25,725	3.4	17,085	19.3	1,530	1.7
1975	5,201	27,873	4.0	20,958	18.8	1,771	1.6
1976	6,641	35,010	3.8	25,294	19.3	1,888	1.4
1977	8,800	42,973	3.6	31,789	21.1	2,378	1.6
1978	11,967	51,692	3.6	43,651	24.6	4,639	2.6
1979	16,304	62,308	3.4	54,854	28.0	6,142	3.1
1980	20,658	71,766	3.5	72,774	31.0	8,844	3.8
1981	24,386	80,235	3.8	91,451	32.9	11,096	4.0
1982	27,530	88,980	3.9	107,421	33.1	12,355	3.8
1983	34,463	111,562	3.6	124,733	34.2	14,357	3.9
1984	38,284	124,983	3.7	140,721	33.5	15,513	3.7
1985	43,058	140,847	3.6	156,056	33.1	17,707	3.8
1986	49,645	161,466	3.4	170,918	33.2	21,187	4.1
1987	56,702	183,321	3.3	188,322	32.9	24,419	4.3
1988	63,679	205,835	3.4	217,946	32.3	27,521	4.1
1989	68,464	221,993	3.6	245,742	32.0	32,542	4.2
1990	80,064	261,188	3.4	273,025	32.0	34,947	4.1
1991	93,873	306,771	3.4	318,436	31.3	38,040	3.7
1992	119,473	386,096	3.2	376,814	31.3	48,529	4.0
1993	142,737	452,653	3.0	423,494	31.8	54,073	4.1
1994	171,428	531,970	2.9	504,352	32.3	64,323	4.1
1995	203,738	620,994	3.0	616,788	33.1	81,384	4.4
1996	232,542	706,138	3.0	695,855	32.8	96,791	4.6
1997	204,086	849,147	2.8	578,976	23.8	74,670	3.1
1998	228,704	977,616	2.7	620,712	23.2	79,082	3.0
1999	236,883	1,043,663	2.8	661,133	22.5	85,132	2.9
2000	254,500	1,146,132	3.3	831,687	21.9	85,889	2.3
2001	280,262	1,245,782	3.3	924,212	22.2	95,049	2.3
2002	339,024	1,422,346	3.1	1,054,809	24.0	109,477	2.5
2003	433,071	1,645,698	3.0	1,308,692	27.1	140,524	2.9

Accepted for publication: 2 February 2007

APPENDIX

Testing for Heteroskedasticity in the Model: White (1980) Test

Equation 1

F-statistic	1.143	*p*-Value	0.355
Obs*R^2	5.751	*p*-Value	0.331

White Test Equation
Dependant Variable: residual^2

Variable	Coeff.	S.E.	*t*-Stat.	Prob.
Constant	0.431	0.265	1.623	0.113
tgr	-8.997	5.542	-1.623	0.113
tgr^2	43.792	26.915	1.627	0.112
r	0.062	0.031	2.020	0.051
r^2	-0.026	0.016	-1.660	0.105
dum_{97}	0.003	0.011	0.229	0.821

Equation 2

F-statistic	1.141	*p*-Value	0.355
Obs*R^2	5.747	*p*-Value	0.331

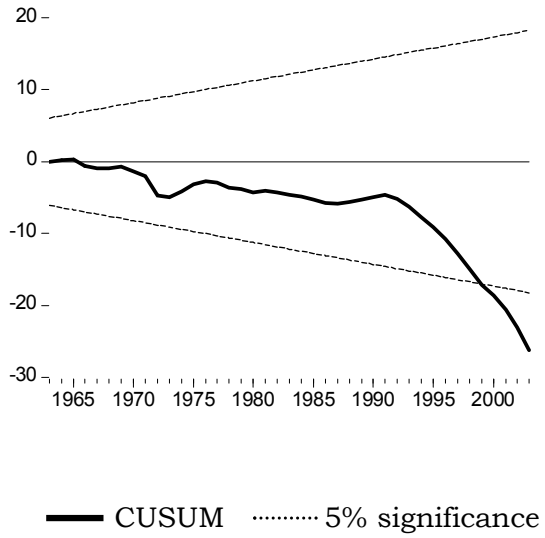
White Test Equation
Dependant Variable: residual^2

Variable	Coeff.	S.E.	t-Stat.	Prob.
Constant	0.438	0.275	1.595	0.119
tgr	-9.084	5.737	-1.583	0.122
tgr^2	43.749	27.861	1.570	0.125
r	0.060	0.032	1.875	0.069
r^2	-0.024	0.016	-1.470	0.150
dum_{97}	0.001	0.012	0.063	0.950

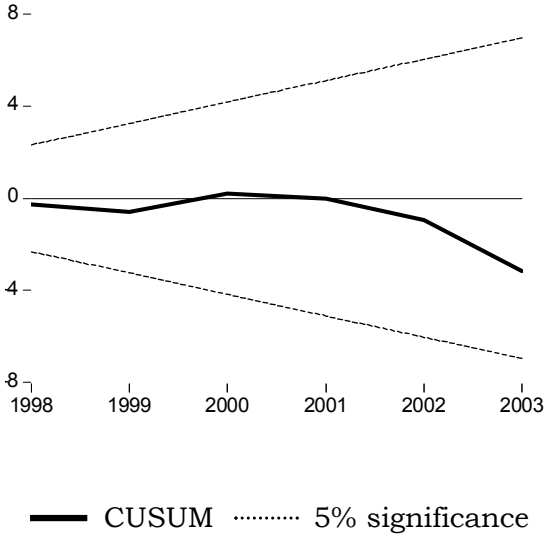
Observation: Insignificant *p*-value does not reject the hypothesis of 'no Heteroskedasticity' in both equations.

Testing the Stability of the Model: CUSUM Test (Brown et al, 1975)

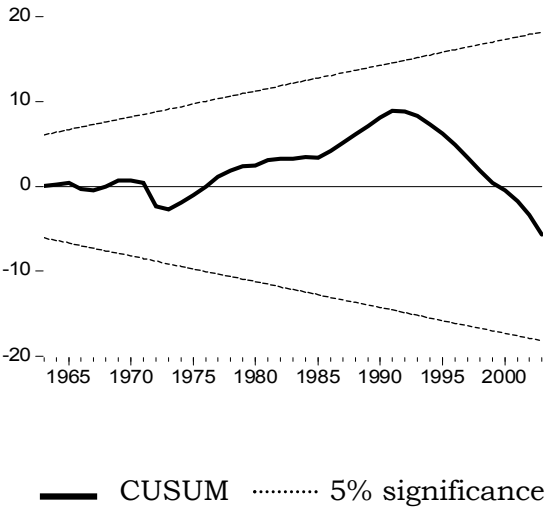
Equation 1 (without 1997 dummy)



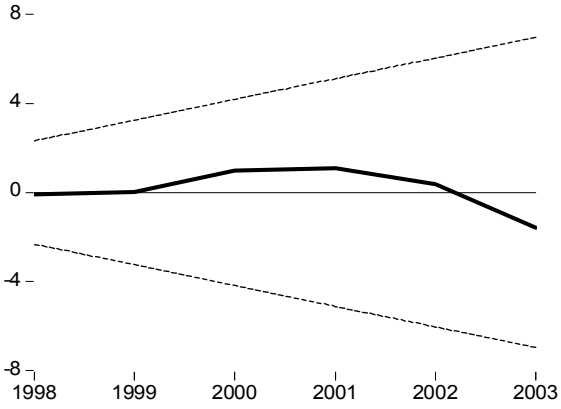
Equation 1 (with 1997 dummy)



Equation 2 (without 1997 dummy)



Equation 2 (with 1997 dummy)



Testing for Autocorrelation in the Model: Breusch-Godfrey Serial Correlation LM Test

Equation 1

F-statistic	0.420	*p*-Value	0.792
Obs*R^2	4.471	*p*-Value	0.345

BG Test Equation
Dependant Variable: *residual*

Variable	Coeff.	S.E.	*t*-Stat.	Prob.
Constant	0.041	0.168	0.244	0.809
tgr	-0.471	2.526	-0.186	0.853
r	0.007	0.080	0.091	0.928
dum97	-0.012	0.066	-0.182	0.857
MA(1)	0.598	1.471	0.407	0.687
resid(-1)	-0.478	1.473	-0.325	0.747
resid(-2)	0.457	0.640	0.714	0.480
resid(-3)	-0.308	0.329	-0.937	0.355
resid(-4)	-0.082	0.215	-0.380	0.706

Equation 2

F-statistic	1.268	*p*-Value	0.301
Obs*R^2	5.570	*p*-Value	0.234

BG Test Equation
Dependant Variable: *residual*

Variable	Coeff.	S.E.	*t*-Stat.	Prob.
Constant	-0.048	0.168	-0.289	0.774
tgr	0.881	2.520	0.349	0.729
r	-0.027	0.080	-0.334	0.740
dum97	-0.015	0.061	-0.239	0.813
MA(1)	0.426	1.384	0.307	0.760
resid(-1)	-0.304	1.388	-0.219	0.828
resid(-2)	0.463	0.656	0.706	0.485
resid(-3)	-0.320	0.360	-0.889	0.380
resid(-4)	-0.112	0.221	-0.506	0.616

Observation: Insignificant p-value does not reject the hypothesis of 'no autocorrelation' in both equations.

ENDNOTES

1. Authors are, respectively, head of research at the Institute of Business Administration, Karachi (qmasood@iba.edu.pk) and Economist, Social Policy and Development Center, Karachi (haiderhussain@spdc.org.pk) at the time of submission of this paper. The authors are grateful to the anonymous referee for his useful comments and suggestions. Usual disclaimers apply.

2. See Schneider and Frey (2001) for further discussion.

3. See, for instance, Fiege (1990) for an account of this taxonomy.

4. The results of Ahmed and Ahmed (1995), re-estimated with the stability test, can be made available on request.

5. λ for *tgr* takes the value 50 and 10 respectively in equation 1 and 2 while λ is 50 for *r* in both the equations. Empirically, Hodrick and Prescott (1997) suggest $\lambda \leq 100$; Maravall and del Rio (2001) propose $6 \leq \lambda \leq 14$ in the case of annual data.

6. Discussion of without-dummy models is trivial from a policy point of view. In a sample of *n* observations with the value of the dummy changing after *k* observations, the CUSUM test considers the dummy-included equation only for the sample of *n-k* observations (see also, for instance, Rao and Kumar, 2006). Since the dummy period in our model is relatively small (1997-2003), the argument of testing without-dummy models is presented only to discuss the model stability had the policy variable (d_{97}) not been incorporated. Interested readers, however, may contact the authors for the econometric results of without-dummy models.

REFERENCES

Ahmed M and Ahmed Q M (1995) 'Estimation of the Black Economy of Pakistan through the Monetary Approach', *Pakistan Development Review*, 34(4), 791-807.

Ahumada H and Garegnani M L (1999) 'Hodrick-Prescott Filter in Practice', *Economica*-(National-University-of-La-Plata) 45(4), 61-76.

Aslam S (1998) 'The Underground Economy and Tax Evasion in Pakistan: Annual Estimates (1960–1998) and the Impact of Dollarization of the Economy', *Pakistan Development Review*, 37(4), 621–631.

Bhattacharyya D K (1999) 'On the economic rationale of estimating the hidden economy', *The Economic Journal*, 109, F348-F359.

Brown R L, Durbin J and Evans J M (1975) 'Techniques for Testing the Constancy of Regression Relationships Over Time', *Journal of the Royal Statistical Society, Series B*, 37, 149–192.

Cagen P (1958) 'The Demand for Currency Relative to Total Money Supply', *Journal of Political Economy*, 66, 303–328.

Feige E L (1979) 'How Big is the Irregular Economy?' *Challenge*, 22, 5-13.

Feige E L (1990) 'Defining and Estimating Underground and Informal Economies: The New Institutional Economics Approach', *World Development*, 18(7), 989-1002.

Guttman P M (1977) 'The Subterranean Economy', *Financial Analyst Journal*, Nov.-Dec., 26-34.

Hodrick R J and Prescott E C (1997) 'Postwar U.S. Business Cycles: An Empirical Investigation', *Journal of Money, Credit, and Banking*, 29, 1–16.

Iqbal Z, Qureshi S K and Mahmood R (1998) 'The Underground Economy and Tax Evasion in Pakistan: A Fresh Assessment', PIDE Research Report No. 158.

Kemal A (2003) 'Underground Economy and Tax Evasion in Pakistan: A Critical Evaluation', PIDE Research Report No. 184.

Maravall A and del Rio A (2001) 'Time Aggregation and The Hodrick-Prescott Filter', Working Paper 0108, Research Department, Banco de España.

Pakistan, Government of (various issues), *Pakistan Economic Survey*, Ministry of Finance.

Pakistan, State Bank of (various issues), *SBP Annual Report*.

Qureshi M M (1989) *Fiscal Imperatives in Pakistan's Economic Development*, Lahore: Progressive Publishers.

Rao B B and Kumar S (2006) 'Cointegration, Structural Breaks and the Demand for Money in Bangladesh'. Working Paper, School of Economics, University of the South Pacific.

Ravn M and Uhlig H (1997) 'On adjusting the HP-Filter for the Frequency of Observations', Tilburg University Center for Economic Research Discussion Paper 50.

Schneider F and Frey B. S (2001) 'Informal and Underground Economy, Economics' in Ashenfelter O (ed) International Encyclopedia of Social and Behavioral Science, Vol. 12, Amsterdam: Elsevier Science Publishing.

Shabsigh G (1995) 'The Underground Economy: Estimation, and Economic and Policy Implications - The Case of Pakistan', IMF Working Paper: 95/101.

Tanzi V (1980) 'The Underground Economy in the United States: Estimates and Implications', *Banca Nazionale Del Lavaro Quarterly Review*, 33, 428-453.

Tanzi V (1982) 'Underground Economy and Tax Evasion in the United States: Estimates and Implications' In Tanzi V (ed) *The Underground Economy in the United States and Abroad*, Lexington, MA: Lexington Books.

Tanzi V (1983) 'The Underground Economy in the United States: Annual Estimates 1930-1980', *IMF Staff Papers*, 3(2), 283-305.

Thomas J J (1999) 'Quantifying the Black Economy: 'Measurement without Theory' Yet Again?', *The Economic Journal*, 109(456), 381–389.

White H (1980) 'A Heteroskedasticity-Consistent Covariance Matrix and a Direct Test for Heteroskedasticity', *Econometrica*, 48, 817–838.