Pakistan Journal of Applied Economics: Special Issue 2018, (411-430)

MONEY-INCOME-PRICE NEXUS IN PAKISTAN: Explaining the Role of Black Money

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Abstract

The main objective of this study is to examine the short-run and long-run causality between money, income, and prices in Pakistan by taking into account the black economy which is the hidden part of total economic activities. The Autoregressive Distributed Lag (ARDL) model is applied on annual data covering the period 1980 to 2012 to examine the level relationship (cointegration) between the underlying variables. The study finds that there is a significant level relationship between variables for both the price and income equations; whereas, no significant evidence of the existence of level relationship is found in the money-supply equation. The short-run causality analysis provide evidence of bi-directional causality between money supply and income. Results of the study suggest that although the view of both Monetarists and the Keynesian holds in short-run, and in the long-run, but only the Monetarists' view holds in Pakistan. This piece of evidence would be particular interest to policy-makers.

Key Words: Money Supply, Income, Price Levels, Level Relationship, Black Economy, Underground Economy, Causality, Cointegration, ARDL, Pakistan.
JEL Classification: E3; E4; N3.

I. Introduction

Money, income, and prices are considered the key macroeconomic variables which play a vital role in determining monetary activities in any economy. Theoretically, there has been a long debate in economic literature on the role of money in determination of income and prices. The conflict exists, mainly on whether money cause changes in income or income plays a leading role to change money stocks in the economy. In particular, there are two schools of thought who hold quite opposite views regarding the role of money in the economy. These schools of thought are the Monetarists and Keynesians. According to the Monetarists, money is the key factor that brings change in income and prices in an economy, without any feedback effect; whereas, income is a passive factor. However, according to the Keynesians, money does not have any key

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role in determining income and price level in the economy; rather, the converse is true. This implies that income affecting demand for money plays a major role in money stock changes. Therefore, one may predict that causality runs from income to money without any feedback effect. Taken together, it can be said that according to the Monetarists, the direction of causation is from money to income and prices; whereas, according to the Keynesians, the causation runs from income to money and prices.

The empirical evidence on this debate also remains in conclusive at best. Sims (1972) was the first economist to examine the relationship between money and income for the USA economy. As claimed by the Monetarists, he found a unidirectional causation running from money to income. Brillembourg and Khan (1979) scrutinized the relationship between money and income for USA, using a relatively longer dataset. Consistent with the findings of Sims (1972) they also found a unidirectional causality running from money to income and the prices. Wand, et al. (1980) examined the said relationship for Canada and also found a unidirectional causality running from money to income, confirming the Monetarists' claim.

However, several later studies do not support the results of Sims (1972). They either provide opposite or statistically insignificant evidences on the association between money and income. For example, as suggested by the Keynesians, findings of Williams, et al. (1976) revealed a one-way causality running from income to money in UK. Similarly, using the methodology similar to Sims (1972), Cuddington (1981) also found a unidirectional causality running from income to money for the UK, supporting the Keynesians' point of view. There are also some studies that have documented a two-way causality between money and income. For instance, investigating the relationship for UK, Barth and Bennett (1974) found bidirectional causality between money and income in the UK. Likewise, Lee and Li (1983) also found bidirectional causality between money and income in Singapore. Similarly, the results of Joshi and Joshi (1985) also documented a two-way causal relationship between money and income in India. However, there are also several studies that have failed to find any significant causation between money, income, and prices. For example, Turnovskey and Wohar (1984) found no evidence of a causal relationship between the underlying variables for USA. Similarly, Yadav (2009) also did not find any evidence of causality between money, income, and prices in India. The contrasting results may attribute to differences in methodology, sample coverage, and the empirical specification. Inconclusive empirical evidence on the money-income-prices causality inclined the researchers to investigate the causal relationship further, between the underlying variables to identify the particular direction of causality.

Reviewing the literature on Pakistan, it was found that the existing empirical evidence on associating money-income-prices is also inconclusive. For instance, an early study by Khan and Siddiqui (1990) found a unidirectional causality running from money to income. Later, Husain and Mahmood (1998), Husain and Abbas (2000), Zahid and Nighat (2010), Rasheed (2011), and Walliuallah, et al. (2011), also found

the evidence of a unidirectional causality running from money to income. On the other hand, several other studies, for example, Ahmed (2002), Husain and Rashid (2002-08), Abbas and Husain (2006), Husain and Rashid (2009), and Balquees, et al. (2012), found a unidirectional causation running from income to money in Pakistan, supporting the Keynesians' view regarding money-income relationship. Further, there are also several studies [e.g., Chaudhary and Ahmad (1995) and Bengali, et al. (1999), Jones and Khilji (1998), and Ahmad and Ahmed (2006)] that found a bidirectional causal relationship between money and income in Pakistan. Finally, there are even some studies that do not find any significant causal relationship between money, income, and prices in Pakistan [Abbas (1991) and Omer and Saqib (2008)].

Explaining the relationship between money, income, and prices, the previous studies have used the GDP/GNP as a measure of income of the economy. However, on looking at the literature of black economy (unreported economic activity), it is observed that the underground sector is a significant part of total economic activity in the economy, as documented by Tanzi (1980), Klovland (1984), Ahmed and Ahmed (1995), Shabsigh (1995), Iqbal, et al. (1998), Arby, et al. (2010), Yasmin and Rauf (2003), Kemal (2003), (2007), and Kemal and Qasim (2012)]; yet the previous studies do not consider the unreported economic activities as part of the national income of economy, and assumingly exclude it from the analysis while explaining causal relationship between money, income, and prices. Thus, the inconclusive results reported by previous studies may be attributed to exclusion of an important variable, namely the black economy, which is a significant part of total economic activity. Departing from the existing literature, this study, investigate the short-run as well as the long-run causality between money supply, income, and prices in Pakistan, by taking into consideration both the reported and unreported part of the total economic activity. Incorporation of black economy may yield more robust and unbiased results on money-income-prices causality that would help in understanding the dichotomy between the Keynesian and Monetarists. Further, the results of this paper would also be important for enhancing our understanding regarding the role of unreported economic activities in the dynamic structure of macroeconomic mechanisms.

The rest of paper is organized as follows. Section II discusses the theoretical framework, and Section III contains description of the data and methodology. Section IV presents the empirical results, whereas, Section V concludes the paper.

II. Theoretical Framework

The relationship between money supply, income, and prices have long been a subject of controversy between the Keynesian and Monetarist schools of thought. The Keynesians explain the link between money supply and income with the help of Hicks-Hansen, IS-LM model. In particular, according to the Keynesians, change in interest rate in the economy play a vital role in establishing relationship between money supply

and economic activities in the economy. They explain this relationship in a short-run model in which they assume that prices do not change frequently and even remain constant at least in the short-run. An increase in money supply will decrease interest rate in the economy, which (given that the demand for investment is elastic with respect to the rate of interest), will lead to increase investment spending in the economy. Higher level of investment will positively affect an aggregate demand, and in turn, income and job opportunities are increased in the economy. However, according to the Keynesians, the effects of investment spending on employment, output and national income, largely depend on the multiplier size. According to Keynes, the rate of interest and the level of income determine the demand for money, which in turn, determines the level of money in the economy. Given this milieu, the Keynesians claim that money supply does have some considerable role to play in changing the level of income and prices. Rather, changes in income levels play a significant role in changing money stocks in the economy by affecting the demand for money to hold. Thus, the causation runs from income to money but not the vice versa.

The Monetarists, on the other hand, use the equation of exchange as a theoretical framework to explain the effects of money on level of income in the economy.[1] Given that income velocity of money is constant, they argue that money supply has a direct and proportional effect on income. Specifically, the classical economists relate the amount of money in economy to nominal income based on the following two assumptions. First, the income velocity of money circulation is constant in the short-run. In this regard, they argue that institutions and technology which change slowly over time, affect the velocity. Second, they believe that flexible wages and prices assure output of an economy to be at its full-employment level.

Friedman (1963), Friedman and Schwartz (1963), and the subsequent work by Friedman and other Monetarists, strongly provide both the theoretical and empirical support for relationship between money and income as explained by the Monetarists. The Monetarists claim that money supply play an active role in income generation, and changes in income are significantly and largely caused by changes in money stock. Thus, it can be said that according to the Monetarists, the causality runs from money supply to income.

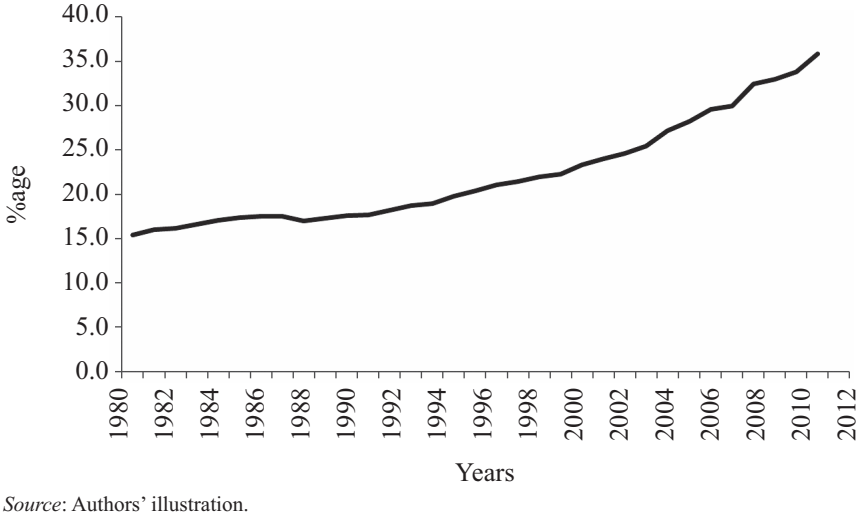
1. Black Money in Pakistan

It is a common belief that like in every other economy of the globe, the black economy also exist in Pakistan. Its existence is mainly because of socio-economic problems like corruption and money hoarding, which cause a fiscal deficit to the country. The black economy, therefore causes a direct loss to overall revenue of the government. It

[1] MV=PY, where M is the quantity of money, P is the price level, and Y is aggregate output (and aggregate income). V is velocity, which serves as the link between money and output.

is also a general belief that black economy in Pakistan, is growing with the passage of time. Many researchers have also documented the phenomenon of increasing the black economy in Pakistan. Examples of these studies include, Ahmed and Ahmed (1995), Iqbal, et al. (1998), Yasmin and Rauf (2003), Kemal (2003), (2007), and Kemal and Qasim (2012). The size of black economy changes, mainly with changes in socio-economic and the political environment of Pakistan. Due to unstable political conditions and the war against terror, the country is facing a high rate of inflation and severe energy shortage. This in turn, increases the cost of living which compels people to hoard money in order to maintain their real income (purchasing power). This study the volume of informal economy, estimating the model presented in Equation (4). Figure 1 presents the trend in estimated black economy as a percentage of GDP in Pakistan. Looking at the figure it is observed that there are rising, significant, and positive trends in the volume of block economy during the period under study. This suggests that we cannot ignore this part of the economy while analyzing any macroeconomic phenomena, such as the inter-actions between money supply, income, and prices.

Although, the estimates of black economy are based on a well-known statistical procedure, viz., 'the monetary approach' proposed by Tanzi (1980), (1983), several indications are observed around different segments of the economy to rationalize the estimated size of informal economy in Pakistan. Further, these indications unambiguously support the rising level of informal economy during the past three decades. Examples of these indications among several others, are increasing tax gap in the economy, a stagnant contribution of formal sector in terms of both the output and employment, a



Source: Authors' illustration.

FIGURE 1

Trend in Black Economy as a per cent of GDP

growing share of economic activities based on cash transactions, a rising segment of jobs in informal sector in total employment in the economy, a small number of firms listed on stock exchanges, and a declining number of companies on the tax register. Similarly, there are several factors causing the informal economy to expand at a rapid pace in Pakistan. For instance, weak governance, complicated institutional framework, unfriendly taxation policy, corruption, lengthy registration procedures, time consuming inspection practices, and knotty regulatory requirements are the key contributors of causing economic agents not only to arrange their economic activities on more informal ways but also to remain in the informal sector.

Given that the size of informal economy counts a significant proportion of total economic activities in the economy showing increasing trends, it is further gathering the pace; and it is hypothesized that informal economic activities have a significant role to play in establishing the association between money, income, and prices. This is predicted because most of the informal economic activities are based on cash transactions and the level of demand for money to hold according to both the Monetarists and the Keynesians, who plays a central role in formulating the money-income-prices nexus.

III. Data and Methodology

1. Variables and Data Sources

The variables included in this study are the total economic activities (TEA) which is the sum of reported economy (GDP) and unreported economy (black economy). Consumers' price index (CPI) is used as a proxy for overall price level in the economy and money supply is proxied by broad money (M2). All variables are taken in log-form in order to estimate their elasticities. Annual data covering the period 1980 to 2012 is used to carry out the empirical analysis. The data is taken from various issues of annual reports of the State Bank of Pakistan (SBP), Pakistan Economic Survey (various issues), and the Federal Bureau of Statistics Pakistan. It is estimated that the volume of black economy in Pakistan follows Tanzi (1980), (1983). The trends in the estimated black economy are presented in Figure 1.

2. Empirical Model and Estimation Method

The Autoregressive Distributive Lag Model (ARDL) is applied to examine the existence of the level relationship (cointegration) between money, total economic activity, and prices in Pakistan. The model takes the following form:

$$\Delta \ln TEA_t = \alpha_o + \sum_{i=1}^{n} \alpha_{1i} \Delta \ln TEA_{t-i} + \sum_{i=0}^{m} \alpha_{2i} \Delta \ln CPI_{t-i} + \sum_{i=0}^{k} \alpha_{3i} \Delta \ln MS_{t-i} + \gamma_1 \ln TEA_{t-1} + \gamma_2 \ln CPI_{t-1} + \gamma_3 \ln MS_{t-1} + \varepsilon_t \quad (1)$$

In Equation (1), TEA denotes the total economic activities which are the sum of reported income (GDP) and unreported income (black economy). CPI is consumer price index used as a proxy for prices. MS represents money supply and is taken as broad money (M2). In the first part of the equation, α_{1i}, α_{2i}, and α_{3i} shows the short-run, whereas γ_1, γ_2, and γ_3 show the long-run relationship among variables included in the model. To draw inference on the existence of level relationship, the null hypothesis of no long-run relationship is tested against the alternate of long-run relationship by imposing restriction on level parameters.

$H_o = \gamma_1 = \gamma_2 = \gamma_3 = 0$ [there is no long-run (level) relationship]
$H_1 = \gamma_1 \neq \gamma_2 \neq \gamma_3 \neq 0$ [there exists a long-run (level) relationship]

If we cointegration is found between the underlying variables, then the following equation is estimated to obtain the long-run estimates.

$$\ln(TEA)_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} \ln(TEA)_{t-i} + \sum_{i=0}^{m} \alpha_{2i} \ln(CPI)_{t-i} + \sum_{i=0}^{k} \alpha_{3i} \ln(MS)_{t-i} + \varepsilon_t \quad (2)$$

If there is a long-run relationship, then the error correction model (ECM) is estimated to examine the short-run dynamics. The coefficient of ECM shows the speed of adjustment towards equilibrium in the long-run. The ECM can be written as:

$$\ln(TEA)_t = \delta_0 + \delta_1 (ECM)_{t-1} + \sum_{i=1}^{n} \alpha_{1i} \Delta\ln(TEA)_{t-i} + \sum_{i=0}^{m} \alpha_{2i} \Delta\ln(CPI)_{t-i} + \sum_{i=0}^{k} \alpha_{3i} \Delta\ln(MS)_{t-i} + \varepsilon_t \quad (3)$$

This study is different from the previous studies because the impact of black economy/underground economy/unreported economy is considered a part of the reported income (GDP) in the model. It is expected that the presence of black economy significantly influences macroeconomic variables like prices, demand for money, money stocks, employment, wages, exchange rates, etc. To quantify the volume of black economy in Pakistan, this study follows the monetary approach pioneered by Tanzi (1980), (1983). According to this approach, the currency-demand model is written as:

$$\left(\frac{CC}{M2}\right)_t = \beta_o + \beta_1 \left(\frac{CC}{M2}\right)_{t-1} + \beta_2 \left(\frac{T}{Y}\right)_t + \beta_3 (R)_t + \beta_4 Yg_t + \beta_5 DM + \varepsilon_t \quad (4)$$

where, CC denotes the money in circulation in the economy at time *t*, Y denotes GDP, M2 i.e., broad money, (T/Y) is the Tax to GDP ratio, Y_g denotes the growth rate in per capita GDP, R is the interest rate, and DM is a dummy variable, which takes value one for the period before 1991 and zero otherwise. ε_t is the error term with zero mean and constant variance. After estimating the currency demand equation size of the underground economy is gauged via tax evasion. Specifically, the currency-demand model depicted in Equation (4) is first estimated with, and then without the variable taxes to find the extent of legal money in the economy. The remaining procedure for estimating the size of black economy is explained as:

Illegal money (IM) = $[(CC/M2)_{with} - (CC/M2)_{without}] \times M2$
Legal money (LM) = M2 - IM
Velocity of money (IV) = GDP/LM
Underground economy (UGE) = IM × IV
Tax evasion (TE) = UGE × (T/GDP)

The sign of the lag of tax to GDP ratio is expected to be positive in the above mentioned currency-demand function. This is because, with the rise in taxes level, people are indulged more to illegal activities and this act of masses is assisted by utilization of currency. If rate of interest is high, it might enlarge the magnitude of opportunity cost of money holding, and then the sign of real interest rate is expected to be negative. The expected sign of (Y_g) would also be negative. This is predicted because if there is an economic development in the economy, the transaction on currency will be replaced by other financial instruments like credit/debit cards, etc. According to Iqbal, et al. (1998) the structural modification policies in Pakistan have raised the inflation rate and poverty in absolute terms resulting in higher demand for currency hoarding. Therefore, it is expected that the sign of the dummy would be positive.

IV. Results and Discussion

1. Testing for Unit Root

To ensure that no variable in the model is integrated order greater than one, and the dependent variable is integrated order one, the two tests are applied for testing unit root, viz., the ADF and the KPSS. The estimated statistics of ADF and KPSS tests for level, as well as for first-differenced series are presented in Table 1. The ADF and KPSS test statistics are with and without a linear time trend; and since the ADF test results are very sensitive to lag length, the criterion suggested by Campbell and Perron (1991) is applied to select the appropriate lag. Specifically, it starts with maximum lag length of m, then it is based on standard *t-test*, and sequentially delete insignificant lags until the last lag appears statistically significant.

Results of the ADF test indicate that all variables are either *I(0)* or *I(1)* but none of them is integrated of order greater than one. The variable money supply appears stationary at its level when the ADF equation is estimated with a linear time trend. However, it does not mean that variables that appears stationary at levels (MS_t) does not have any effect on dependent variable (GDP_t). In fact, the bound test for cointegration can be applied for testing relationship at levels (cointegration), irrespective whether the variables are *I(0)* or *I(1)*. The KPSS unit root test is also applied to check robustness of the results of ADF test. The KPSS test, tests the null hypothesis of stationary against alternative of non-stationary. Similar to the ADF test, two statistics are estimated for KSPP test, namely $LM_{KPSS(c)}$ and $LM_{KPSS(c+1)}$, without and with a linear

TABLE 1

Unit Root Results

Variables	ADF		KPSS	
	$t_{ADF(c)}$	$t_{ADF(c+t)}$	$LM_{KPSS(c)}$	$LM_{KPSS(c+t)}$
Panel-A: Results for levels				
GDP_t	-1.776	-2.058	0.663	0.155
CPI_t	1.008	1.21	0.668	0.627
MS_t	1.683	-3.906** -11	0.671	0.071**
Panel-B: Results for first differences				
ΔCPI_t	-2.644**	-2.926**	0.013**	0.075**
ΔGDP_t	-3.376**	-3.744**	0.030**	0.098**
ΔMS_t	-5.754**	-6.307**	0.092**	0.079**

Note: All the variables are taken in log form. **represents the series is stationary at the 5% level of significance.
Source: Authors' calculation.

time trend at lag 3. The choice of three maximum lag lengths is justified as autocorrelation in an annual series which has considerably died at lag 3. The results of KPSS test, strongly support the results of the ADF test.

2. Testing for Level Relationship

The bounds test (i.e., Wald or F-and t-statistics) can be employed for testing the level relationship between variables in the ARDL framework regardless the underlying variables are *I(1)* or *I(0)*. However, these tests are very sensitive to the order of lag in the model. Therefore, it is essential that optimal lag order should be selected for an unrestricted conditional error correction model (UCECM) to get the robust results. In this study, using modified Akaike information criterion (MAIC), the maximum lag order as one, is selected for all the three models. Table 2 presents the estimated F-statistics in order to check the presence of long-run association between the variables subject to three different dependent variables. All equations have restricted trend and unrestricted intercept. Panel-A of table shows the result when TEA is taken as dependent variable. The panel also shows the upper and lower bound critical values (4.30 and 5.53) at the 5 per cent level of significance. The calculated F-statistic (5.55) is greater than the upper bound critical value, showing existence of the long-run relationship between TEA and the underlying explanatory variables. Panel-B of the table shows the result when MS is taken as dependent variable. The value of F-statistic (4.12) is greater than the lower bound value but less than the upper bound critical value (3.47 and 4.46) at even the 10 per cent level of significance, showing non-existence of the long-run association between the underlying variables in the money supply equation.

TABLE 2

Results of Bounds Test (F-test) for Level Relationship

Panel-A (TEA as a Dependent Variable)			
No. of Lags	F-statistic	Lower bound value	Upper bound value
1	5.55**	4.30	5.43
Panel-B (MS as a Dependent Variable)			
1	4.12	3.47	4.46
Panel-C (CPI as a Dependent Variable)			
1	4.55*	3.47	4.46

Note: * and ** show significance at the 10% and 5% level, respectively. Upper and lower bound critical values are taken from Pesaran, et al. (2001).
Source: Authors' calculation.

Regarding existence of the long-run relationship, findings between TEA and other variables included in the equation is consistent with findings of the previous studies, including Husain and Rashid (2002-08) which also provided evidence of the presence of cointegration between money supply and GDP. However, it should be noted that in this study, the sum of GDP and unreported income (black economy) is used as a proxy for income, rather than only the GDP. Since the money supply variable appears trend stationary at its level (Table 1), the absence of level relationship in money supply equation makes sense. However, a test for existence of level relationship was conducted because money supply appears nonstationary when a linear time trend is not considered while testing for unit root.

The estimate F-statistic is given in Panel-C of the table when CPI is taken as dependent variable. The value of F-statistic (4.55) is greater than the upper bound critical value (4.46) at the 10 per cent level of significance. This implies that there is a long-run relationship between CPI and the other underlying variables; namely, money supply and total economic activities.

After confirmation of that the underlying explanatory variables have significant levels effect on total economic activities (TEA) and the national price levels (CPI); the ARDL framework proposed by Pesaran and Shin (1999) is used to quantify the levels effects. In particular, the TEA equation is estimated considering maximum lag order equal to one as the TEA, MS, and CPI are cointegrated at this lag length. However, to get more robust estimates for levels (long-run) as well as for short-run effects, the Schwarz Bayesian criterion (SBC) is employed to seek more parsimonious model. The long-run coefficients estimated, based on the ARDL-UCECM model are given in Table 3. Specifically, Panel-A of the table provide the estimates of long-run relationship when TEA is taken as dependent variable. The estimated long-run coefficient of money supply (coefficient = 0.784; p-value = 0.025) suggests that money supply is positively and significantly related to total economic activity. The positive

effect of money supply implies that economic activities in economy increases with increase in money supply. This finding is in agreement with the Monetarists, who are of the view that money has a vital role in generating income in the economy.

The positive effect of money supply on income is also consistent with findings of Husain and Mahmood (1998), Abbas and Husain (2006), Husain and Rashid (2009), and Fazli (2011) which also provide evidence of the significant long-run relationship between money and income proxied by only GDP; yet, findings of the long-run association between money supply and income is contrary to Husain and Rashid (2002-08), who did not find any leading role of money in increasing national income (GDP), though they took the care of liberalization measures. Therefore, it can be stated that money supply has a significant effect on income in the long-run, particularly when one incorporates unreported income (black economy) as well, while measuring economic activities in the economy. The estimated coefficient of CPI (-0.887) is negative and appears statistically insignificant (p-value = 0.161). This implies that prices do not have any significant influence on income in the long-run.

Panel-B of Table 3 presents the long-run estimates of the effects of total economic activities (TEA) and the money supply (MS) on prices (CPI). The results show that MS is positively and significantly related to CPI, whereas, there is no significant relationship between TEA and CPI in the long-run. This suggests that other things being equal, the higher the MS, the higher would be the inflation in long-run. The evidence of long-run effect of money supply on prices is consistent with the earlier studies on Pakistan, such as Jones and Khilji (1988), Khan and Siddiqui (1990), Ahmed (2002), Abbas and Hussain (2006), and Husain and Rashid (2002-08).[2]

TABLE 3

Long-run Estimates of the ARDL Model

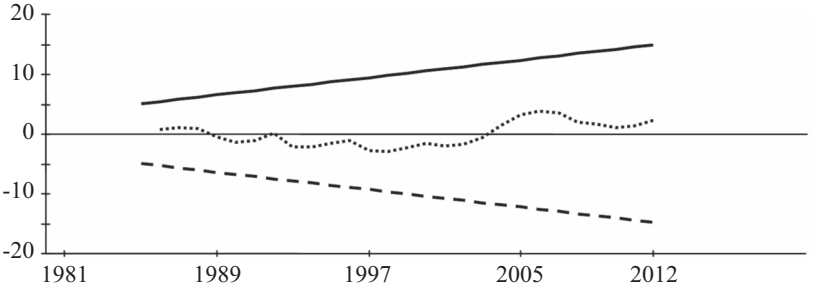
Variables	Coefficients	Standard Errors	P-values
Panel-A (TEA as a Dependent Variable)			
MS_t	0.784	0.331	0.025
CPIt	-0.887	0.616	0.161
Intercept	17.914	2.261	0
Panel-B (CPI as a Dependent Variable)			
TEA_t	0.552	0.442	0.224
MS_t	0.421	0.144	0.008
Intercept	-16.049	9.166	0.092

Source: Authors' calculation.

[2] Since we do not find any level (cointegration) relationship between money supply and other underlying regressors, the long-run estimates for money supply are not estimated.

3. Checking the Long-Run Stability

In order to check the stability of estimated ARDL models, the cumulative-sum (CUSUM) and cumulative-sum of squares (CUSUMSQ) tests was applied. The results of these tests are depicted in Figures 2 and 3. The plots of cumulative sum of recursive residuals, when TEA is taken as dependent variable are shown in Figures 2(a) and 2(b). The estimated line lies inside the upper and lower critical bounds, verifying the long-run stability of the estimated model. The CUSUM and CUSUMSQ tests for stability, when CPI is taken as dependent variable are shown in Figures 3(a) and 3(b), respectively. It can be seen that the estimated lines of cumulative sum and cumulative sum of squares lies in between the critical boundaries at the 5 per cent significance level. Therefore, the results of both the CUSUM and CUSUMSQ tests show the stability of estimated model in the long-run.

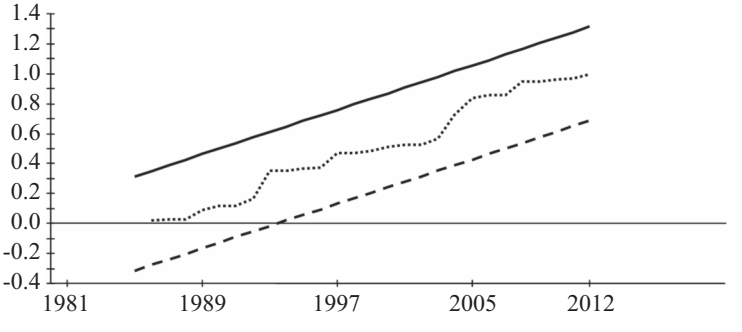


The straight lines represent critical bounds at 5% significance level

Source: Authors' illustration.

FIGURE 2(a)

Plot of Cumulative Sum of Recursive Residuals for TEA Regression

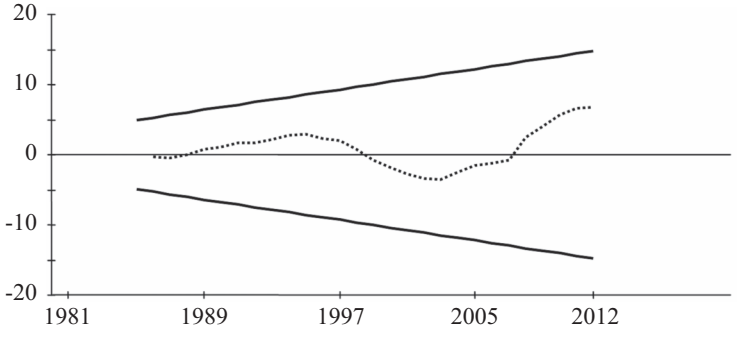


The straight lines represent critical bounds at 5% significance level

Source: Authors' illustration.

FIGURE 2(b)

Plot of Cumulative Sum of Squares of Recursive Residuals for TEA Regression

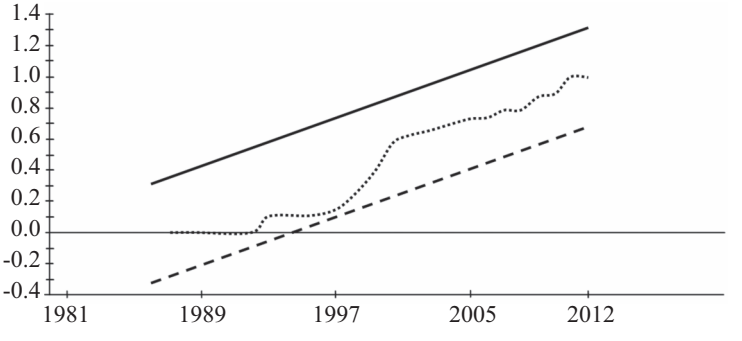


The straight lines represent critical bounds at 5% significance level

Source: Authors' illustration.

FIGURE 3(a)

Plot of Cumulative Sum of Recursive Residuals for CPI Regression



The straight lines represent critical bounds at 5% significance level

Source: Authors' illustration.

FIGURE 3(b)

Plot of Cumulative Sum of Recursive Residuals for CPI Regression

4. Exploring the Short-Run Dynamics

To examine the short-run association between the underlying variables, the error correction form of the selected ARDL-UCECM model have been estimated for income and price equations, while simple VAR model for the case of money supply, the authors of this study did not find any significant cointegartion. The results are given in Table 4. The estimated coefficient of error term ECM_{t-1} shows the speed of adjustment towards the long-run equilibrium. The negative sign and statistically significance of the coefficient of ECM_{t-1} are considered as an assurance of stability of the model and restoring to the long-run equilibrium. For both the income and price equations, coefficient

of error terms is negative and statistically significant, indicating significant convergence towards the long-run equilibrium. Yet, the speed of adjustment in price equation (about 21 per cent per year) is higher than that of income equation (only 9.2 per cent per year). This suggests that in case of disequilibrium of any shock in the short-run, prices restore equilibrium faster than the income.

Panel-A of the table shows the results when ΔTEA_t is taken as dependent variable. The results reveal that money supply is positively and significantly, whereas prices are significantly and negatively, related to income in the short-run. Further, the results suggest that one-period lagged of income is also positively and significantly related to income in the short-run. In Panel-B of Table 4, ΔMS_t is taken as a dependent variable. The results suggest that both the income and prices are positively and significantly, related to money supply in the short-run. This implies that changes in income and

TABLE 4

Results of Error Correction Model

Variables	Coefficients	Standard errors	P-values
Panel-A (ΔTEA as a Dependent Variable)			
ECM_{t-1}	-0.092	0.049	0.073
ΔTEA_{t-1}	0.907	0.049	0.000
ΔCPI_t	-0.082	0.031	0.015
ΔMS_t	0.072	0.023	0.005
Intercept	1.656	1.042	0.123
R^2	0.850	–	–
Panel-B (ΔMS as a Dependent Variable)			
ΔMS_{t-1}	0.677	0.094	0.000
ΔCPI_t	0.569	0.134	0.000
ΔTEA_t	1.574	0.628	0.019
ΔTEA_{t-1}	1.718	0.637	0.012
Intercept	2.645	4.066	0.521
R^2	0.950	–	–
Panel-C (ΔCPI as a Dependent Variable)			
ECM_{t-1}	-0.205	0.059	0.002
ΔCPI_{t-1}	0.584	0.126	0.000
ΔMS_t	0.086	0.045	0.070
ΔTEA_t	-0.471	0.300	0.129
Intercept	-3.291	1.694	0.063
R^2	0.640	–	–

Note: All the variables are taken in the log form.
Source: Authors' calculation.

prices play a significant role in enlargement of monetary base in economy. Short-term changes in money supply also, significantly depend on lagged value of money supply and income. Results are consistent with Bilquees, et al. (2012), who also documented a bidirectional relationship between money supply and prices in Pakistan. Further, these findings are in agreement with the Keynesians, who are of the view that income plays an important role to increase money stocks in the economy, at least in the short-run. Panel-C of the table presents the estimation results on the short-run dynamics when ΔCPI_t is considered as dependent variable. The table shows a significant positive impact of money supply on prices in the short-run; yet the results do not provide any significant evidence on the role of income in determining prices in the short-run. The results also suggest that higher the inflation in the previous period, higher the inflation would be in the current period.

In sum, the results given in Table 4 suggest that there is a positive and significant cause-effect relationship between income and money supply in the short-run. On the other hand, the results suggest that although higher prices have negative and significant impacts on economic activities (income) in the economy, increase in economic activities do not have any significant impact on price levels. Further, it is shown that there is also a significant positive cause-effect relationship between money supply and price in the short-run. Finally, the results also suggest that previous-year income, price, and money supply play a significant role in determination of their values in the current year.

5. Testing Granger Causality

To check the direction of short-run causality between income, money supply and prices, the Granger causality test is employed. The F-statistics are calculated by imposition of restrictions on the (lagged) coefficient(s) of the underlying variable given the other explanatory variables included in the specification. It is also check whether both the explanatory variables, jointly Granger cause the dependent variable by simultaneously restricting the coefficients of both variables. Table 5 presents the F-statistics calculated based on the specifications given in Table 4.

The results presented in Panel-A of the table indicates, that the null hypothesis is rejected at any acceptable level of significance. However, the calculated F-statistics do not provide any evidence of causality running from prices to total economic activities. Similarly, the study does find significant evidence of the combined causality running from money supply and prices to total economic activities. These results suggest that there is a short-run Granger causality running from money supply to total economic activities. However, prices are neither in isolation nor in combination with money supply cause (in Granger sense) to total economic activities in the economy.

Panel-B of the table presents the F-statistics to examine the direction of causality from total economic activities (income) and prices to money supply. The results suggest

that both the prices and income Granger cause money supply in the short-run. This finding holds even when joint restriction on coefficients is imposed. Panel-C shows the evidence of causality running from total economic activities and money supply towards price level. The results also show that there is no significant evidence of causality running from income to prices in short-run. However, both money supply and income together cause (in Granger sense) prices in the short-run.

In sum, Granger causality analysis suggests that there is a bi-directional short-run causality between money supply and the total economics activities (income). This finding confirms the cause-effect relationship between the money supply and income. The evidence of the existence of bi-directional causality between income and money supply suggests that Monetarists' as well as the Keynesians' views hold for Pakistan in the short-run. These findings also question the outcome of several previous studies that reported unidirectional causality running either only from money to income [Husain and Mahmood (1998), Husain and Abbas (2000), Zahid and Nighat (2010), Rasheed (2011), and Walliuallah, et al. (2011)] or only from income to money [Khan and Siddiqui (1990), Husain and Abbas (2000), Husain and Rashid (2009), and Balquees, et al. (2012)]. However, it should be noted that these studies have used (either the real or nominal) GDP as a proxy for income and totally ignore the underground part of economic activities. Since the volume of underground economy is substantial in Pakistan, not considering it as part of the total income of economy it may be one of the major reasons of why the prior studies have failed to establish the bi-directional Granger causality between income and money supply.

TABLE 5

Tests for Granger Causality between Money, Income, and Prices

Causation	F-statistic	P-value
Panel-A (ΔTEA as a Dependent Variable)		
$\Delta MS \rightarrow \Delta TEA$	8.846	0.001
$\Delta CPI \rightarrow \Delta TEA$	1.117	0.328
$\Delta MS/\Delta CPI \rightarrow \Delta TEA$	1.264	0.313
Panel-B (ΔMS as a Dependent Variable)		
$\Delta CPI \rightarrow \Delta MS$	2.518	0.013
$\Delta TEA \rightarrow \Delta MS$	1.194	0.031
$\Delta CPI/\Delta TEA \rightarrow MS$	4.800	0.006
Panel-C (ΔCPI as a Dependent Variable)		
$\Delta TEA \rightarrow \Delta CPI$	0.848	0.441
$\Delta MS \rightarrow \Delta CPI$	5.117	0.015
$\Delta TEA/\Delta MS \rightarrow \Delta CPI$	5.229	0.004

Source: Authors' calculation.

V. Conclusions

This study examines the short-run as well as the long-run causal relationship between money, total economic activities, and prices by taking into account the role of black economy in Pakistan. The study uses annual data covering the period 1980-2012. The volume of black economy is estimated by using the methodology proposed by Tanzi (1980), (1983). Existence of the level relationship between the underlying variables is examined in bounds testing procedure. To examine the short-run dynamics, the error correction form of ARDL model is estimated.

The study finds that there is a significant level relationship in case of both the income and price equations, whereas there is no significant evidence of the existence of such relationship for money-supply equation. The long-run estimates indicate that money supply is positively and significantly related to total economic activities (income) and price levels in the long-run, although income is not significantly related to money supply and prices, in the long-run. The Granger causality analysis suggests that there is bi-directional short-run causality between money supply and total economics activities (income). This finding confirms the cause-effect relationship between money supply and income. The presence of bi-directional causality between income and money supply suggests that both the Monetarists' and the Keynesians' views hold for Pakistan (at least) in the short-run. However, results on the level (long-run) relationship suggest that both the income and prices do not have any significant level relationship with money supply. Therefore, it is inferred that although the view of both the Monetarists and the Keynesians hold in the short-run and in the long-run, only, the Monetarists' view holds in Pakistan. This piece of evidence is of particular interest to policymakers.

Results of this study indicate the bi-directional causality between income and money supply and question the findings of previous studies carried out for Pakistan, which suggests only a uni-directional causality between money and income. Findings in this study, clearly suggest that the underground part of income activities plays a significant role in establishing causal relationship between income and money supply. Therefore, the policymakers should take into account the magnitude of black economy while designing any economic policy in general, and policies regarding money supply in particular. The findings also suggest that researchers may consider the role of black economy while examining the other well-known macroeconomic phenomena, such as the financial development-growth nexus, the energy consumption-growth relationship, the role of economic growth/income in poverty reduction, etc.

Bibliography

Abbas, K., 1991, Causality test between money and income: A case study of selected developing Asian countries, Pakistan Development Review, 30(4): 919-929.

Abbas, K., and F. Husain, 2006, Money, income, and prices in Pakistan: A bi-variant and tri-variant causality, South Asian Economic Journal, 7(1): 55-65.

Ahmad, N., and F. Ahmed, 2006, The long-run and short-run endogeneity of money supply in Pakistan: An empirical investigation, State Bank of Pakistan, Research Bulletin, 2(1): 267-278.

Ahmed, M., and M.Q. Ahmed, 1995, Estimation of the black economy of Pakistan through monetary approach, Pakistan Development Review, 34(4): 791-807.

Ahmed, M., 2002, Money-income and money-price causality in selected SAARC countries: Some econometric exercises, Indian Economic Journal, 50(1): 55-62.

Arby, M.F., M.J. Malik and M.N. Hanif, 2010, The size of informal economy in Pakistan, SBP working paper series 33.

Barth, J., and J. Bannett, 1974, The role of money in the Canadian economy: An empirical test, Canadian Journal of Economics, 7(2): 306–311.

Bengali, K., A.H. Khan and M. Sadaqat, 1999, Money, income, prices, and causality: The Pakistani experience, Journal of Developing Areas, 33(4): 503-514.

Bilquees, F., T. Mukhtar and S. Sohail, 2012, Dynamic causal interactions of money, prices, interest rate, and output in Pakistan, Journal of Economic Cooperation and Development, 33(3): 37-64.

Brillembourg, A., and M. Khan, 1979, The relationship between money, income, and prices: Has money mattered historically? Journal of Money, Credit, and Banking, 1(1): 358–365.

Campbell, J.Y., and P. Perron, 1991, Pitfalls and opportunities: What macroeconomists should know about unit roots, in: O. Blanchard and S. Fischer (eds)., NBER Macroeconomics Annual, 1991. Cambridge, Mass.: MIT Press.

Chaudhary, A.M., and N. Ahmad, 1995, Money supply, deficit, and inflation in Pakistan, Pakistan Development Review, 34(4-3): 945-956.

Cuddington, J.T., 1981, Money, income, and causality in the United Kingdom: An empirical re-examination, Journal of Money, Credit and Banking, 13(3): 342-351.

Dereyes, F., D. Starleaf and G. Wang, 1980, Test of direction of causation between money and income in six countries, Southern Economic Journal, 47(2): 477-487.

Friedman, M., 1963, Inflation: Causes and consequences, London: Asia Publishing House.

Friedman, M., and A. Schwartz, 1963, A monetary history of the United States 1867-1960, Princeton University Press.

Granger, C.W.J., 1980, Long memory relationships and the aggregation of dynamic models, Journal of Econometrics, 4(2): 227-38.

Husain, F., and K. Abbas, 2000, Income, money, and prices in Pakistan: trends and interrelationship, Pakistan Development Review, 39(4): 843-855.

Husain, F., and A. Rashid, 2002-08, Economic liberalization and the causal relations among money, income and prices: The case of Pakistan, Pakistan Journal of Applied Economics, 18(1&2): 103-121.

Husain, F., and A. Rashid, 2009, Price hikes, economic reforms, and causality in money, income and prices: Evidence from Pakistan, Pakistan Development Review, 48(2): 155-168.

Husain, F., and T. Mahmood, 1998, Causality between money and prices: Evidence from Pakistan, Pakistan Development Review, 37(4): 1155-1161.

Hussain, M., 1991, Money, income and causality: Some evidence from Pakistan, Pakistan Development Review, 30(4): 907-918.

Iqbal, Z., S.K. Qureshi, and R. Mahmood, 1998, The underground economy and tax evasion in Pakistan, Pakistan Institute of Development Economics, Research report 158.

Jones, J., and N. Khilji, 1990, Money growth, inflation, and causality: Empirical evidence for Pakistan 1973-85, Pakistan Development Review, 28(1): 45-58.

Joshi, K., and S. Joshi, 1985, Money, income, and causality: A case study of India, Arthavikas, 21(1): 1-2.

Kemal, M.A., 2003, Underground economy and tax evasion in Pakistan: A critical evaluation, PIDE Research report 184.

Kemal, M.A., and A.Q. Qasim, 2012, Precise estimates of the unrecorded economy, Pakistan Development Review, 51(4): 505-516.

Kemal, M.A., 2007, A fresh assessment of the underground economy and tax evasion in Pakistan: Causes, consequences, and linkages with the formal economy, PIDE Working paper 13.

Khan, A.H., and N.A. Siddiqui, 1990, Money, prices and economic activities in Pakistan: A test of causal relation, Pakistan Economic and Social Review, 28(2): 121-136.

Klovland, J.T., 1984, Tax evasion and the demand for currency in Norway and Sweden: Is there a hidden relationship? Journal of Economics, 86(4): 423-439.

Lee, S., and W. Li, 1983, Money, income and prices and their lead-lag relationship in Singapore, Singapore Economic Review, 28(1): 73-87.

Omer, M., and O.F. Saqib, 2009, Monetary targeting in Pakistan: A skeptical note, SBP Research Bulletin, 5(1): 53-76.

Pesaran, M.H., and Y. Shin, 2002, Long-run structural modeling, Econometric Reviews, 21(1): 49-87.

Pesaran, M.H., and Y. Shin, 1999, An autoregressive distributed-lag modelling approach to cointegration analysis, in: S. Strom, (ed)., Econometrics and economic theory in the 20th century: The Ragnar Frisch Centennial Symposium, Chapter 11, Cambridge: Cambridge University Press.

Pesaran, M.H., Y. Shin and R.J. Smith, 2001, Bounds testing approaches to the analysis of level relationships, Journal of Applied Econometrics, 16(3): 289-326.

Rasheed, A.M., 2011, The relationship between money and real variables: Pakistan's experience, Pakistan Business Review, 12(4): 715-754.

Shabsigh., 1995, The underground economy: Estimation, and economic and policy implications, The case of Pakistan, IMF working papers, WP/95/101.

Sims, C.A., 1972, Money, income and causality, American Economic Review, 62(4): 540-552.

Tanzi, V., 1980, The underground economy in the United States: Estimates and implications, Banca Nazionale del Lavoro Quarterly Review, 472-475.

Tanzi, V., 1983, The underground economy in United States: Annual estimates, 1930-80, IMF staff papers, 30 (2): 283-305.

Turnovsky, S., and N. Wohar, 1984, Monetarism and the aggregate economy: Some long- run evidence, Review of Economics and Statistics, 66(4): 619-29.

Waliullah and Fazli Rabbi, 2011, Effectiveness of monetary policy in Pakistan: Empirical evidences based on bound test approach, International Journal of Business and Social Science, 2(1): 190-199.

Williams, D., C.A.E. Goodhart and D.H. Gowland, 1976, Money, income, and causality: The UK experience, American Economic Review, 66(3): 417-423.

Yadav, I.S., 2009, Co-integration, causality, money and income in India (mimeo), Department of Economics, University of Hyderabad, India.

Yasmin, B., and H. Rauf, 2002, Measuring the underground economy and its impact on the economy of Pakistan, Lahore Journal of Economics, 9(2): 93-103.

Zahid, A., and J. J. Nighat, 2010, Causal order between money, income, and price through graph theoretic approach for Pakistan, Economics Bulletin, 30(3): 2515-2523.