

# Nexus of Price and Income with Money in Bangladesh

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This thesis paper is submitted to the Department of Economics and Social Science in partial fulfillment of the requirements for the degree of M.Sc. in Applied Economics.

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# Declaration

It is hereby declared that

1. This thesis submitted is my own original work for completing degree at BRAC University.
2. This thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. This thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at any other university or institution.
4. I have acknowledged all main sources of help in writing this thesis.

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# Approval

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of Spring, 2019 has been accepted as satisfactory in partial fulfillment of the requirement for  
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# Abstract

The key objective of this thesis is to investigate the linkages of money with income and price level using annual time series data for the period of 1978 to 2018 of Bangladesh. The stationarity of the data has been tested through unit root test by using both Augmented Dickey Fuller (ADF) test and Phillips Perron (PP) test. It is also applied OLS regression and bi-variate Granger causality tests to define the direction of causality of money to price or income or both. This paper discovers that money supply in Bangladesh is not income generating rather it is inflationary. This result is also reinforced by the Granger causality test. Therefore, monetary policy as a means to employment generation or poverty reduction or to curb inflation in Bangladesh should be designed and implemented with more care particularly credit flow needs to be headed for thirsty, productive and efficient sectors of the economy. The data and econometric techniques used in the paper is also a progress over the early studies.

# Acknowledgement

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## 1. Introduction

The paper likes to examine the impact of money on price and income of Bangladesh which remains a prolonged contentious and empirical issue in the empirical literature. In the backdrop of the price stabilization and growth incurring strategy by the central bank of many countries, the empirical relationship of income and price with money have received great attention over the decades. This emanates from the theoretical fact that controlling money supply becomes the major tool to stabilize price level and poverty reduction through generating higher incomes. Despite a large and growing theoretical and empirical literature there is no consensus regarding the overall evidence of causality by money on income and price.

Monetary policy in Bangladesh, as outlined in Bangladesh Bank order 1972, is formulated around inflation and output growth rates as the basic policy targets. In the preamble of the presidential order it is mentioned clearly, "it is necessary to establish a central bank in Bangladesh to manage the monetary and credit system of Bangladesh with a view to stabilising domestic monetary value and maintaining a competitive external par value of the Bangladesh Taka towards fostering growth and development of country's productive resources in the best national interest". To achieve these targets (channeling credits to thirsty sectors and maintaining a healthy par value of Bangladeshi Taka) a rule based monetary aggregates such as reserve money, broad money and domestic credit (both private sector and government) are also projected, monitored and controlled to achieve desired targets by the central bank of Bangladesh. Following table 1 postulates the projections and actual implementations of such credit targets for last few years:

Table 1: Projected and actual money supply of Bangladesh

Year	Broad Money Growth		Credit Growth		Core Inflation Rates		Real GDP Growth Rate	
	Projected	Actual	Projected	Actual	Projected	Actual	Projected	Actual
1999		12.8		17.1		3.05		5.31
2000		18.6		16.7		4.61		5.37
2001		16.6		16.2		5.71		6.01
2002		13.1		15.8		4.45		5.44
2003		15.6		14.2		4.33		5.61
2004	11.9	13.8	11.4	15.9	6.32	5.21	6.21	5.26
2005	14.2	16.7	15.0	17.5	5.56	5.32	6.64	5.96
2006	14.3	17.0	16.7	17.0	5.87	5.73	6.75	6.63
2007	14.8	17.2	17.2	16.1	6.12	8.34	6.87	6.51
2008	15.2	17.1	18.8	17.1	5.23	3.54	6.91	6.43
2009	15.4	17.5	20.4	17.5	5.56	6.49	6.50	5.05
2010	15.5	22.4	15.6	17.9	5.02	3.74	6.74	5.57
2011	16.7	21.4	18.0	17.5	5.87	5.46	6.49	6.55
2012	17.0	17.4	20.0	19.2	5.89	6.11	6.55	6.38
2013	16.5	16.7	17.2	10.9	5.26	5.52	6.62	6.16
2014	16.0	16.1	18.6	11.6	5.02	5.71	6.21	6.06
2015	16.5	17.0	17.4	14.0	5.61	5.92	6.43	6.55
2016	18.5	15.6	16.8	16.5	5.87	6.22	6.95	7.22
2017	15.5	15.5	16.4	16.4	4.83	5.81	7.02	7.31
2018	13.5	14.8	16.4	15.8	4.62	5.43	7.58	7.38
2019	12.0	-	15.9	-	4.92	-	8.21	-

Source: MPS Published by Bangladesh Bank (various issues)

The blank cells indicate that data is either absent or yet to generate. Further, it also seen very clearly that in most cases central bank has failed to achieve the desired target of the monetary

aggregates. The above table 1 also shows the yearly economic growth and inflation rates of Bangladesh for the corresponding money supply growth.

For measuring price stability in conducting monetary policy the CPI inflation, expressed as the rate of change of Consumer Price Index, is used in Bangladesh. Based on the country's long run inflation performance and the high seasonal price volatility of the goods in the consumption basket the central bank decides whether to adopt a loose or a tight monetary policy. Since its independence in 1972 Bangladesh has experienced a moderate rate of inflation except a brief spell of high instability of prices in the mid-seventies. Though the economic volatilities across the first world since 1970s gradually Bangladesh is showing its' very good performance in terms of different macroeconomic indicators which has attracted global attention very much. Even recently Bangladesh has graduated to developing country status from less developing status. However, at the same time Bangladesh has also experienced inflation rates from upper single digits to lower double digit besides of impressive economic performance over the same period. Though experts are saying that this is the consequence of prudent manipulation of fiscal and monetary policies but this has raised a question to the stakeholders whether central bank is pursuing prudential monetary policy. So, it is a relevant query whether adopted monetary and fiscal policy in Bangladesh is inflationary or growth incurring. However, this study will only concentrate to judge the impact of monetary policy on inflation and income of Bangladesh. The impact of fiscal policy on price and income is totally ignored.

The monetary policy in Bangladesh is guided mainly by the International Monetary Fund (IMF) and other the supranational organizations. To curb the inflationary pressure Bangladesh Bank has tried predominantly to adopt tight monetary policy when it is required by the contemporary economic backdrops. Similarly, when it wants to stimulate the economy it adopts expansionary monetary policy to finance the economically revealed potential sectors. Nevertheless, its' achievements are mixed of both success and failure because it has also record of failure to stabilize the price level though the output growth is around more than 6% or more for long period. Therefore, it is necessary to examine the relationship of money growth with income growth and inflation rates in case of Bangladesh, i.e. whether inflation is monetary phenomena or money purely generates income in Bangladesh or both. In addition Bangladesh has accelerated financial sector reforms since 1990s with outward orientation of the economy; therefore, it is also important to see the structural shift of the money-price or money-income relationships over the study period.

The paper is outlined as per following sections. After introducing the issues in the first section, the second section deals with the theoretical issues and section three and four are giving empirical evidence of the money-price and money-income relationship for both Bangladesh and rest of the world. The fifth section highlights data and section six describes estimation techniques and methodology. The empirical results are explained in the section seven. Finally, the section eight draws conclusions and policy recommendations of the study.

## **2. Theoretical discourse and Debates**

### **(a) Money and Price:**

The relationship between money and price has a long history, which dates back to 1752 following the publication of David Hume's 'Of Money'. Hume establishes a proportional relationship between money supply and the absolute price level. The classical school discussed that changes in prices, the most important target variable in achieving stabilization,

is basically due to changes in money supply. That is, money supply is neutral to put effect on the real variables of output growth or employment generations. The ultimate implication is that there is a unidirectional causality runs from money to price.

The quantity theory of money postulates a direct and proportional relationship between money supply and price level. The traditional quantity theory of money as presented by Fisher's equation is as follows

$$MV = PY \dots \dots \dots (1)$$

Where, the symbols have their usual connotations in economics. Under the classical assumption of full employment and the short run stability of the velocity (V), equation (1) postulates the proportional relationship between money (M) and price (P). Equation (1) can also be written as

$$P = M(V/Y) \dots \dots \dots (2)$$

Equation (2) implies the proportionality between money and price.

By taking natural log and subsequent differentiations in both side of equation (2), it can be rewritten as

$$G_P = G_M + G_V - G_Y \dots \dots \dots (3)$$

Where G indicates the growth rate of the relevant variables. Due to the full employment Output (Y) and by assumption velocity (V) in short run is fixed, so we can say that

$$G_P = f(G_M) \dots \dots \dots (4)$$

This is how classical school establishes proportional relation between money supply and price level of an economy.

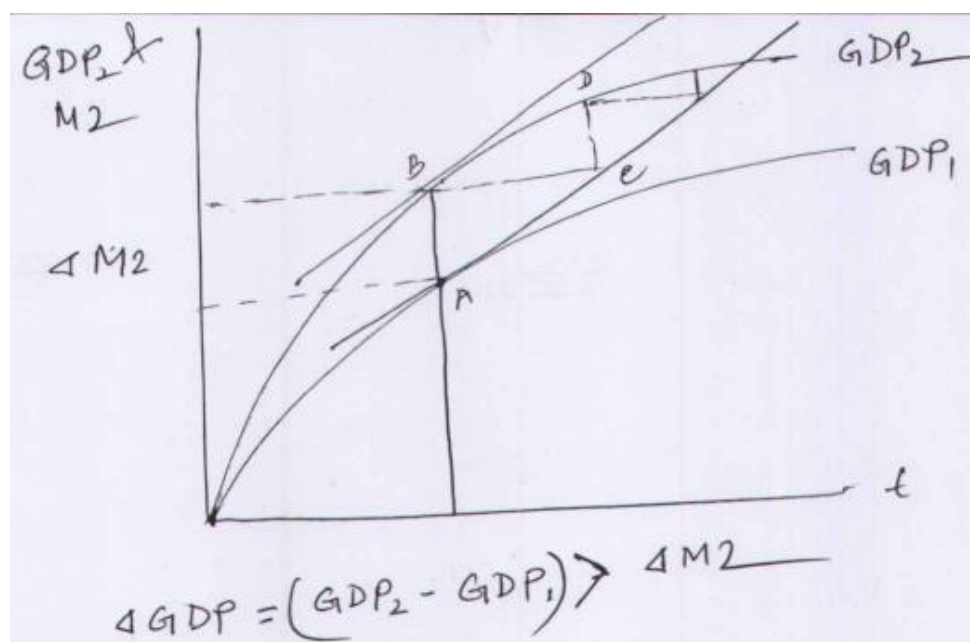
**(b) Keynesian view on money and economic growth**

However, Keynesians criticized and rejected the proportionality between money and price. They argued that money has effects both on price and output level. According to them increasing money supply causes inflation but also induce growth of income. However, Keynes or his followers did not assume full employment. They acknowledged that this phenomenon is valid only in the situation when unemployment is prevailed in the economy. Therefore, there is a direct but not necessarily proportional relationship between money and price. Because, money stimulates the real sector of the economy. Thus, according to the Keynesian school the changes in wages subsequently the price level and the rate of inflation can be non-monetary phenomena and is caused by different structural factors of the economy.

The Keynesian phenomenon is postulated in the figure 1 bellow. In this figure, initial GDP growth path is GDP<sub>1</sub> projection line. In this condition, say, central bank has increased money supply by ΔM<sub>2</sub> = AB. In this case, ΔM<sub>2</sub> amount of GDP will increase instantly. In the second period, the increase of GDP due to the first period money supply increase will be slightly lower than ΔM<sub>2</sub> which is actually CD(<AB). In this way, the increase of GDP by increasing this money supply ΔM<sub>2</sub> in the subsequent period will be gradually lower and once this increment effect will be vanished out and stopped. Thus, total increase of GDP should be = AB+ CD+ .....+ Keynesian Cross= Y\*. So, income multiplier MM = Y\*÷ΔM<sub>2</sub>.

According to Keynesians if money supply is increased by one unit income will be increased by MM units.

**Figure 1: Expansionary Monetary Policy Brings Higher Income in the Economy**



**(c) Endogenous growth model: source of growth is technological innovation:**

In the backdrop of the presence of high inflation in different countries after World War II (particularly 1970s in first world countries and 1980s in Latin American countries) due to the adoption of easy monetary policy the Keynesian ideas also came under severe criticism by Monetarists. They held the view that money plays active role in changing both income and price; and the causality is unidirectional from money not only to income and but also to prices. The proponent of the Monetarist is the New Classical/Rational Expectations School (RES), while the opponent is the Real Business Cycle School/ New 'Classical Macro Economics, The RES has ignored the existence of Phillips curve (inverse relationship between unemployment rate and price level) even in the short run. So, they believe that any change in money supply has a direct impact of prices - it is true. But the RES also assumes that real variables of the economy including output are determined of monetary factors. Therefore, both income and prices have a direct and proportional relationship with money. It is true that their opinion is much similar to Keynesians view. However, they also believe that the technological shock is the dominant cause of changing income and price level in the economy- in which point Keynesians have no opinion.

**(d) Opinion of other economists**

The unidirectional causality from money to price has been questioned many times by many economists over the last several decades. Fisher (1985) claims the possibility of reverse causation concludes that there is mutual interaction between money and other macro variables. Friedman and Schwartz (1963) also support this argument by stating that though the influence of money to economic activity is predominant there is also the possibility of influences running the other way (at least in the short run). The Banking school supports the reverse causation between money and income thereby arguing for endogeneity of money supply in price changing. According to them money is not exogenous as assumed by the

macroeconomists over the periods. They argued that central bank is an important player in the economy. When economy exhibits indication of slow down then central banks come forward and adopts easy monetary policy and increase money supply of the economy to generate higher demand and do the opposite in reverse position. So, clearly money is endogenous in inflation as well as growth models.

Thus despite the theoretical debate conclusion is that the impact of money in an economy is country specific and the impact is matter of exploration not unique. It is not similar and fixed in all economies across the globe. It can be either income generating or inflation incurring or even both. This notion is reinforced by the empirical findings by the researchers for both developed and developing countries. Researchers failed to reach in any consensus by the empirical works in this regard. This debate is also relevant by different empirical studies in context of Bangladesh. So, this study focuses what is the real scenery in case of Bangladesh regarding this live theoretical discourse with updated data and new estimation technique.

### **3. History, Theory and Empirical Studies in This Topic**

#### **3.1 Money and Price Relationship:**

The empirical relationship between money, price and income becomes an agile and active area of research in economics particularly after the provoking paper by Sims (1972). Based on Granger causality, Sims developed a test of causality and applied it to the US data. Using Sims procedure Brillembourg and Khan (1979) examined the money price relationship for the US data over the period 1870 to 1975 and found unidirectional causality from money to prices. Similar directions of causation are also found by Lee and Li (1983) and Ramachandran and Kamaiah (1992) who investigated the causal relationship in Singapore and India respectively. Again, Aghevli and Khan (1978), using the data on Brazil, Columbia and Dominican Republic found bidirectional causality between money and prices. Jones (1989) used the Granger causality test between money and prices for the US over the period 1950:1 to 1986:2 and found the bidirectional causality between money (M1, M2) and prices (CPI, WPI). Ali (1986) found the validity of the Quantity 'Theory of Money' in predicting price levels for Pakistan. This result was also supported by Jones and Khilji (1988). Using Sims' procedure and quarterly data for the period 1972-1981 for Pakistan, Khan and Siddiqui (1990), found unidirectional causality from M1 to CPI but bidirectional between M2 and CPI. Further, Khan and Sadaqat (1997) found bidirectional causality between money (both M1 and M2) and CPI for the same country using the quarterly data for the period of 1972-1990. Using bi-variate methodology developed by Lemmens et al. (2008) to decompose Granger causality between money supply, prices and output in frequency-domain Sharma et al. (2010) has got that in case of Indian economy there is evidence for money-output trade-off over the short-run, but in the long-run, money supply determines prices, not output. The empirical results of them also indicate that output and prices does not Granger causes money supply reflecting exogeneity of money supply. Ghazzali et al. (2008) examined the relationship between money and prices in case of Malaysia. Considering monthly data of M1, M2, M3 and Consumer Price Index (CPI) from January 1974 to September 2006 and using the Johansen co-integration method the research suggests that there is a long-run equilibrium relationship between money supply with prices. By Toda-Yamamoto causality tests they find that there is uni-directional causality running from money supply to CPI. Therefore, the empirical evidence from Malaysia supports the quantity theorist's view. Husain et. al (2000) re-investigated the causal relationship between money and prices for Pakistan using data from July 1981 to June 1998 and employing co-integration and error correction models. Two measures of prices (CPI and WPI) and three measures of money stocks (M0, M1, and M2) were taken for the mentioned period. The analysis indicates a long run relationship between prices and M2 definition of money. The other definitions of money did not seem to be related

with prices. The analysis further suggests a unidirectional causality running from money to prices and thus supporting the monetarist's claim regarding the role of money. Madurapperuma (2007) has worked with a large volume of data of Sri Lanka for the period 1950 to 2007. The discussion is a preliminary attempt to revisit the relationships between money, inflation and growth. Evidence reconfirms the monetary growth through the growth of high powered money in case of Sri Lanka. The evidence also confirms a strong positive relationship between money and prices i.e. Money has caused inflation. The study also looked at the conceptual relationships between the different variables. However, a weak relationship could be established between growth of money and the real economic growth. That is, in economic literature, historically overall causality result of money and price is mixed in nature.

### **3.2 Money and Income Relationship:**

The relationship between money and economic growth is of great interest in macroeconomics and monetary policy since very long time. Therefore, it is a much cherished and extensively studied topic to the researchers too. However, the results of those research works are not uniform. Such studies can be segregated into two groups: a single country and a group of countries based. They have also considerable variations in terms of methodology and data they have used. The empirical findings and recommendations too have not reached in any consensus and, in fact, they are highly conflicting and tremendously inconclusive. Some studies have revealed that money promotes economic growth (Rapach 2003), some have got no relationship between money and growth (Wai 1959, Bhatia 1960, Johansen 1967), and interestingly others have reached conclusion that money retards economic growth or activities (Friedman 1956, Barro 1995, Fisher 1993), and finally, some of them concluded that money and growth have positive relationship up to certain threshold and beyond that they have opposite nexus (Phillips 1998). According to Walsh (1998) during expansionary monetary policy, banks reserves increase, interest rate falls, which stimulates both consumption and investment decisions by households and firms, consequently national income increases.

The possible positive relationship between money and income is based on the argument that higher money supply can lead higher investments in the economy which ultimately generates economic growth. On the other hand, probable negative relationships between this couple of variables is originated from the notion that higher money supply produces higher inflation in the economy. Inflation brings inefficiency, uncertainty and international incompetency in the export oriented economies and these create disturbances both in the internal and external demand for the goods and services of the country. Similarly, theoretical foundation of the threshold relationship is that low growth of money supply generates low inflation and stability in the economy. This situation creates positive externality in both financial and goods markets which brings efficiency in the economy but when money supply increases in the economy with an accelerated pace same is happened in inflation rate. This high inflation hinders export, investment climate and aggregate demand in the goods and services markets of the economy. All of these negative aspects are detrimental to the economic activity and, thus, growth is hampered. Which of the above notions will be activated in a particular country depends on multiple factors of socioeconomic condition.

## **4 Literature Reviews**

### **4.1 Literature Reviews based on non-Bangladeshi papers**

Kesavarajah and Amirthalingam, (2012) has investigated the relationship between money supply growth and price growth in Sri Lanka for the period of 1978-2010. They have used Johanson and Juseliues multivariate co-integration test and Granger causality test methods to examine the long-run relationship between the variables. The estimated result indicates that the presence of long-run relationship between money and price and the employed Granger causality test also shows that for the concerned period there was a significant causality directed from money supply to inflation in Sri Lanka.

Abbas and Husain, (2006) examined the causal link between money supply and output growth and between money supply growth and inflation rate in Pakistan. Their Johansen co-integration analysis confirms that the existence of long-run link among money, output and CPI inflations. The causal effect between money supply stock and rate of inflation indicates a bi-directional causality that money supply expansion increases the aggregate price level of the economy and inflation in turn increases the money supply stock in Pakistan.

Using bivariate methodology developed by Lemmens et al. (2008) to decompose Granger causality between money supply, prices and output in frequency-domain, Sharma et al. (2010) has got that in case of Indian economy there is evidence for money-output trade-off over the short-run, but in the long-run, money supply determines prices, not output. The empirical results of them also indicate that output and prices does not Granger causes money supply reflecting exogeneity of money supply.

For Nigeria Chimobi and Uche, (2010) studied the linkage between Income, Money and Inflation by utilizing co-integration and Granger causality test techniques. According to their findings there is no existence of a co-integration in the series considered. However, money stock is found Granger causes both income and prices. The result also implies that curbing monetary expansion growth can stabilize price increase in the Nigerian economy.

However, Using yearly data Umaru and Rahan, (2012) examined the effect of inflation rate on output growth in Nigeria for the period of 1970 to 2010 through Granger causality method of causality between income and price. The result of causality demonstrates that income causes price and not price causes income. The result also reveals that inflation has a positive effect on output growth through encouraging productivity and boosting up total factor productivity.

In Tanzania Ailkaeli, (2007) has studied Money and Inflation volatility dynamics in Tanzania. He has used GARCH model on seasonally adjusted monthly data for the period of 1994-2006 and the results of the investigation shows that a current change in money supply may have impact on inflation rate significantly. Moreover, the impact of money supply on inflation rate is not just a one-time strike on inflation rate but a persistent shock of seven months.

Teshome, (2011) has examined the source of inflation and GDP growth in Ethiopia using various analytical techniques of statistical methods. According to his findings, between the year 2004 and 2008, the higher desires of household expenditure and higher import price with low growth of aggregate supply of inland economy contributed to higher inflation rate in the country. He has got that, inflation in Ethiopia is not a monetary phenomenon, and according to his findings controlling money supply to control inflation may hinder income growth of the economy. Additionally, curbing the injection of money to the economy cannot stop inflation due to high velocity of money caused by growth of financial institution and, financial and economic transaction in the economy. The author also mentioned that it is very difficult to

specify the exact relationship between inflation rate and output growth and one must study the structure of government spending and the nature of economic growth of the country.

Ghazali et al. (2008) examined the relationship between money and prices in case of Malaysia. Considering monthly data of M1, M2, M3 and Consumer Price Index (CPI) from January 1974 to September 2006 and using the Johansen co-integration method the research suggests that there is a long-run equilibrium relationship between money supply with prices. Toda-Yamamoto Granger causality test finds that there is a uni-directional causality running from money supply to CPI. Therefore, the empirical evidence from Malaysia supports the quantity theorist's view.

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#### **4.2 Empirical Literature by Multiple Countries (Panel data)**

Mallik and Chowdhury,(2001) has detected the short and long-run dynamics relationships between inflation rate and income growth for the leading four South Asian countries namely India, Pakistan, Sri Lanka and Bangladesh by applying Johansen co-integration technique and error correction models (ECM) by using yearly data for each. Their results postulate that there are positive and significant link between inflation rate and output growth for each country and the sensitivity of growth to changes in inflation rates is lower than that of converse.

Chuan-Yeh, (2012) have examined the causal link between inflation rate and GDP growth using a very large Panel data of 140 countries over the period of 1970 of 2005. The results have suggested that the inflation rates hinder the growth rates while the impact of income growth rate benefit to the inflation rate. Furthermore, his research has postulated some important and interesting additional results. He has divided his cross-country data into three subgroups namely low income, middle income or developing, and high income countries. The outcome of the result shows that in low income nations the negative impact of inflation rate on growth rate is bigger than in middle and high income nations. In contrast, he also investigated the difference in impact of the growth rate on inflation rate for the countries having difference in income level. According to his findings higher income growth does not translate into improvement of inflationary control in high and low income countries. But



unfortunately, high GDP growth incurs higher inflationary effect in the low income group nations.

Moroney (2002) has developed a long-run version of the quantity theory. Using this model of money, real GDP, and price level growth, he gets that the cross-section inflation rates can be completely explained by the supply of broad money growth rates. He has explained his finding that the countries experiencing high money growth and inflation beget the coefficient of broad money supply (M2) growth is very close to one which strongly obeys the rules of the quantity theory money. However, in nations with relatively low rate of money growth and inflation, the estimated money growth coefficient is 0.69, 31% lower than the high money growth countries. By this way he reached in a decision that the quantity theory of money performs very inefficiently to explain the rate of inflation for these countries. Further, his findings postulate that money and income growth are nearly neutral when the long-run monetary growth comes in the question. The conclusion of this study is very clear and precise that the quantity theory of money is an utter reliable model of inflation for most of the countries, but only for those who have high long-run growth of money.

Grauwe and Polan (2005) have also involved to formulate a big number of sample by gathering data of about 160 countries for 30 years to investigate the nexus among growth rates of GDP, money and price. They have got a strong and positive relationship of the long-run inflation and broad money growth rates on output growth in the concerned sample. They have argued that the strong relation between inflation and money growth is almost completely applicable to the high inflation countries in the sample.

Georgios (1993) uses yearly post-WWII data for his selected 32 countries and gets that income and inflation are positively linked to the aggregate supply and negatively linked to the aggregate demand of the economies. They have opined that this finding actually means that a negative correlation between inflation and growth rates means that the high inflation has a countercyclical affect to aggregate supply which is basically by dominated aggregate demand. He has also explained his findings that money supply growth rate has positive and permanent impact on inflation rate. However, his result also has further added that monetary expansion may affect output only in the short-run but in the long-run money is neutral for his selected sample.

### **4.3 Literature Reviews for Bangladesh:**

The empirical literature on the relationship between money and price is plenty and is still developing. But for Bangladesh it is in nascent stage. Probably the first study conducted by Jones and Sattar (1988) examined the causal link between money-income and money-inflation for the period of June 1974 to December 1985. The study found that money causes prices in Bangladesh in the short run, with a lag in general of twelve month, which disappears in the long run. They also found the evidence of unidirectional impact of money on output, with lag of twenty four to thirty six months. The implication of their result is that monetary expansion might have a significant impact on output growth, although as a consequence the economy may experience moderate to high inflation in the short run.

Chowdhury *et. al* (1995) investigated the relationship between money, prices, output and the exchange rate in Bangladesh using quarterly data for the period 1974 to 1992 by applying multivariate vector autoregressive (VAR) model. Their result is in line with Taslim (1982) that the inflationary process of Bangladesh cannot be explained solely by the 'monetarist' or the 'structuralist' type explanation. That is, there is no straightforward causal relationship between money and price for Bangladesh.

Using quarterly data for Bangladesh for the period 1974-1999 Ahmed (1999) concludes that monetary policy has crucial importance in determining output in Bangladesh. This study also found that interest rate and money are big cause for output and price but converse is not true i.e. output and price do not cause interest and money.

Yunus (2007) concluded that money has no relation for output growth in Bangladesh but has severe inflationary impact on Bangladesh economy. Using quarterly data and unrestricted error correction techniques she wrapped up that in Bangladesh expansionary money supply ultimately raised price level but not boosted up output for the concerned period.

Hossain (2008) study for period of 1975-2008 found a unidirectional relationship between (broad) money to price. Using Granger causality and Error Correction procedures he concluded that in case of Bangladesh money is a big cause for inflation for both in short and long run.

The above studies confirm that there is a unidirectional causal relationship between money and income in Bangladesh. However, the result on the relationship between money and price is mixed. But, presently the reliability of the above results may be undermined in terms of data used and techniques applied. This study is an improvement over the existing studies as it examined the stationarity and Granger causality approach to understand the implication of money on income and price. The subject matter of this study is to provide a guideline for the central bank of Bangladesh about its' impact on two important macroeconomic variables like inflation and growth rate- the main focus of monetary policy of the country.

Given the divergent results of the previous works on Bangladesh and around the globe, the main impact of money on income or price still remains inconclusive, demands further examination of the issue with updated data and techniques. The above studies confirm that the results on the relationship among money, income and price are mixed. But, presently the reliability of the above results may be eroded in terms of data used and models or econometric techniques applied. This study is an improvement over the existing studies as it examined the stationarity of data and fitted econometric models supported by the data.

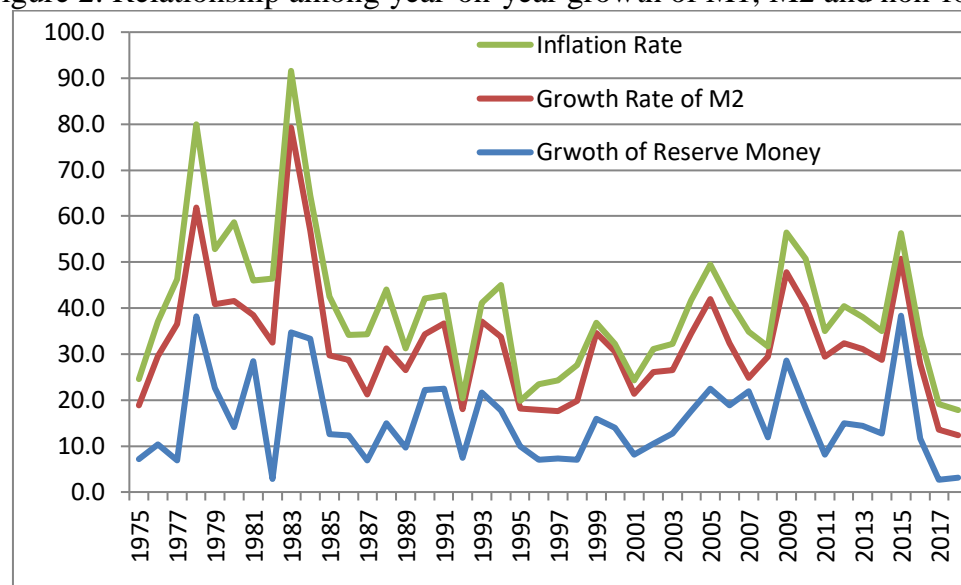
This thesis conveys the result in favor of price not of income. The direction of causality is inclined to price means that the central bank can decrease inflation rate by lessening money supply without decreasing economic growth or national income. Finally the Granger causation technique has reinforced the results of the prior models. The additional contribution of this study is that it provides a clear and concrete indication of the money-price-output relationship in Bangladesh i.e. how money stock changes can affect price and output.

## **5.1 Data**

This study is based on the annual data for the period 1976 to 2018. Choosing this period is reasoned that the country started to run in full swing in the present capitalistic mood and restoration of socioeconomic normalcy in 1976. After independence in December, 1971 country was following the socialist principle and from 1972 to 1975 was a period of massive socio-economic turmoil due to the devastated of infrastructure in 1972 caused by 1971 war, severe drought and famine in 1974 and gross political murders and brutal army rule in 1975. Data of this period excluded from the study because of these turbulence of this post war country. The data for this study comes from the various published issues of Economic Trends of the Bangladesh Bank. The broad money (M2) is considered as monetary stock. In the case of CPI inflation generation 60% is given in food price of the country. But food inflation is highly infected by the seasonal volatility as it is driven by supply of food items of the

country. Food supply condition heavily dependent on agricultural production level which is a subject of congenial atmosphere of nature or weather. Due to such uncertainty of natural condition food price is not a monetary phenomenon at all. So, like many other studies (Ibrahim, 1999, Jones and Sattar 1988, Chowdhury *et. al* (1995); Hossain, (2009)) I have used only non-food price and the broad money stock of the country as two policy variables. For the third variable we have relied on yearly GDP of Bangladesh. Plots of the year on year (Y-O-Y) growth of all three time series are shown in Figure 2.

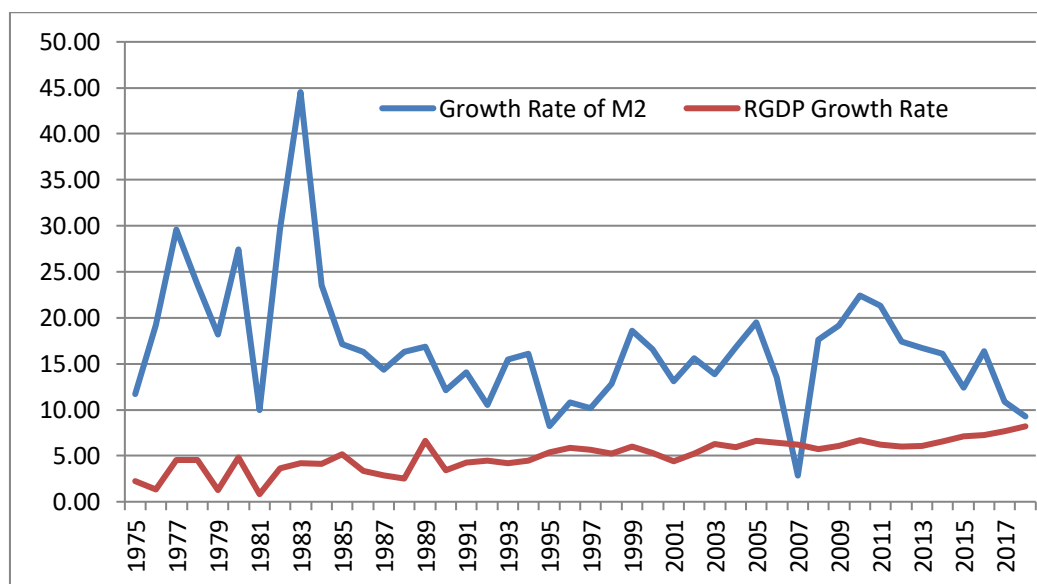
Figure 2: Relationship among year-on-year growth of M1, M2 and non-food



Source: Economic Trend published by Bangladesh Bank (various issues)

The Figure 2 shows that the GML, GM2 and GRGDP exhibit a synchronized gesture i.e. have a tendency to move together, implying that they are likely to be causally linked to each other. This link, obviously, has further been tested by different econometric techniques.

Figure 3: Relationship among year-on-year growth of RGDP and M2



Source: Economic Trend published by Bangladesh Bank (various issues)

However, there is a systemic relationship between money and price and but not in case of money and income which can be seen by the above picture and following correlation matrix:

Table 2: Correlation Matrix of important variables related to Monetary Policy.

1976-1980					2000-2009				
	Gr. Non-Food CPI	Gr. RGDP	Gr. RM	Gr. M2		Gr. Non-Food CPI	Gr. RGDP	Gr. RM	Gr. M2
Gr. Non-Food CPI	-	-	-	-	Gr. Non-Food CPI	-	-	-	-
Gr. RGDP	-0.66	-	-	-	Gr. RGDP	0.47	-	-	-
Gr. RM	-0.73	0.42	-	-	Gr. RM	0.33	0.61	-	-
Gr. M2	-0.92	0.69	<b>0.41</b>	-	Gr.M2	0.45	0.51	<b>0.81</b>	-
1981-1900					2010-2018				
Gr. Non-Food CPI	-	-	-	-	Gr. Non-Food CPI	-	-	-	-
Gr. RGDP	-0.16	-	-	-	Gr. RGDP	-0.57	-	-	-
Gr. RM	0.29	0.51	-	-	Gr. RM	-0.04	0.11	-	-
Gr.M2	0.11	0.31	<b>0.89</b>	-	Gr.M2	0.38	-0.65	<b>0.38</b>	-
1990-1999					1976-2018 (Whole Sample Period)				
Gr. Non-Food CPI	-	-	-	-	Gr. Non-Food CPI	-	-	-	-
Gr. RGDP	0.36	-	-	-	Gr. RGDP	-0.31	-	-	-
Gr. RM	0.16	0.61	-	-	Gr. RM	0.13	0.22	-	-
Gr.M2	0.39	0.51	<b>0.82</b>	-	Gr. M2	0.26	-0.05	<b>0.71</b>	-

Source: MPS and Economic Trend Bangladesh Bank (various issues)

We have presented above a brief table about monetary policy related variables for 1976 to 2018. However, there can have structural change in this over long period of four decades. Therefore, we have calculated five correlation matrix where each for one decade and one correlation matrix for the whole period. Now, there are huge ups and downs in the correlation between Non-food inflation rate and Broad Money growth rate from -0.92 to 0.45. On the other hand, growth rate of RGDP and Broad Money has positive but very poor correlation coefficients from 0.69 to 0.26. It means that in Bangladesh neither price nor income is monetary phenomenon. It confirms that by changing money supply central bank has little power to manipulate the either inflation or GDP. However, there is a strong correlation between Broad Money and Reserve Money which means that the central bank is successful to control money supply in its' desired track by changing the high powered money or reserve money of the economy. But this ratio is gradually decreasing (0.89 in 1980s and 0.38 in 2010s) meaning that central is losing the power of money supply control as well. Link between Broad Money and RGDP growth is gradually lessening. Further, link between Broad Money and Price is very poor.

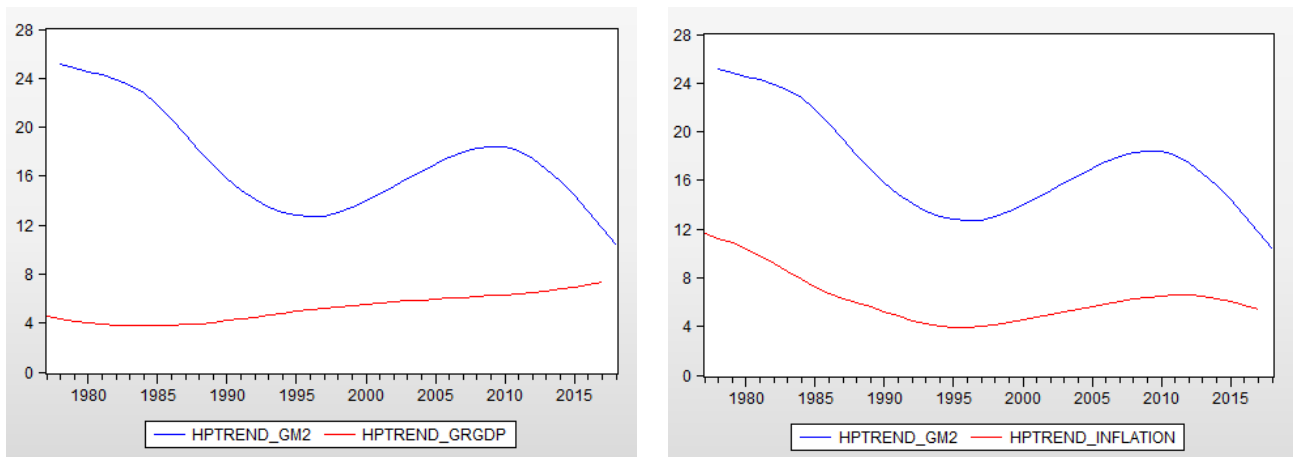
Data is covering the period of FY1976 to FY2018. We were bound to begin our data series from 1976 to avoid a few dangerous outliers of inflation those were recorded for until 1975. The reason that data of pre-1976 is not considered as quality of that period data is not good. According to the recorded data Bangladesh's inflation 1974 was 80% which can be considered a heinous outlier that would destroy the overall regression results. As always outliers distort the estimation process and presents spurious result. Misleading co-efficients will give us wrong conclusion and policy suggestion will also be incorrect. Almost more than a half of decade in post independence period of the war ravaged Bangladesh has registered an abnormal fluctuation and mazed outliers in majority of Macroeconomic variables including

price and income of Bangladesh. So, I believe data of the period 1971 to 1975 should be excluded from this study.

The data for this study comes from the various published issues of Economic Trends of Bangladesh Bank - the central bank of Bangladesh. We have considered non-food inflation as the representative of price and level of Broad money as money supply. The reason for considering only non-food inflation is very obvious. Food inflation in Bangladesh is driven basically by supply side only. If the production takes place without any disruption such that flood, drought, over rainfall or other sorts of natural calamity the food price volatility increases. So, food inflation is not a necessarily monetary phenomenon i.e., monetary policy is not liable for food inflation Bangladesh. Since, weight of food price in CPI inflation is 60% and since food inflation is not caused by central bank monetary policy, we cannot incorporate the CPI inflation in our model. Further, we did not incorporate fuel inflation in this paper too as this essential item is highly subsidized in Bangladesh and does not follow the international ups and downs. As our considered inflation is non-food and non-fuel we can term our inflation is core inflation of Bangladesh. Now, both theoretically and empirically broad money is considered by actual the money supply of the economy. We considered the real GDP as income of the economy. So, dependent variable is derived by the ratio of non-food inflation and growth rate of real GDP. Since inflation and growth rate neither has any unit the dependent variable does not has any unit too. Similarly, real supply of broad money is derived by the ratio of nominal stock of broad money and 12-month average CPI inflation. After that we derived the growth rate of real broad money supply.

Though the data of money supply is available and monetary policy is mostly a short-run policy, lack of high frequency data for income we were bound to consider yearly data instead of quarterly or monthly. Further, although the country has a big agricultural sector and as a rapidly growing economy high consumption fossil fuel is one of the important production input of the country, volatility of agriculture output price is not considered in this study as supply level has ascendancy on price not money stock of the economy and, moreover, fuel price has not variation as the input is highly government subsidized and less frequency of variation as the price government administered. Supply shock and government subsidy are considered the main driver of agriculture and fuel prices respectively in Bangladesh. So, we did not consider incorporating them in our study. "The CPI inflation in Bangladesh has significantly been influenced by seasonal and short-run volatility rather than underlying monetary events. In such a situation, focus on CPI inflation as the operation guide to monetary policy has limitations as changes in CPI inflation might be highly influenced by volatile and non-trend components. This factors cause changes in prices that are transitory and reversible in nature such as those emanating from supply side shocks (natural disasters) and similar unexpected phenomena. In view of the above, core inflation (non-food and non-fuel) which separates persistent components of inflation is often treated as a better guide to monetary policy" (Mujeri et. al. 2008) . So, crafting a prudent monetary policy a (non-CPI) core inflation can be a proper guideline for the central bank. This is another reason why we have omitted the CPI inflation for this study. So, to fight against inflation targeting core inflation would be the most effective tool for the central bank of Bangladesh.

Figure 4: Trend of Non-food (core) Inflation and RGDP Growth with Real M2 Growth Rate of Bangladesh.



Source: Economic Trend Bangladesh Bank (various issues)

The above two panels of Figure No. 4 are the Hordic Prescott filterized trend of core inflation and real GDP growth with real money growth rate of Bangladesh. The visual inspection of the figures say that broad money growth rate seemingly drives the inflation rate but not real GDP growth rate of Bangladesh. As the broad money growth and inflation rates are synchronized in gesture there may have positive relationship between them. But such relationship is not prevailed between money and income.

## 6 Econometric Techniques

### 6.1 Unit Root or Stationarity Tests

As the data is time series before we run a regression we need to perform the stationary properties of the time series is to be checked by unit root test. That is it has to be tested whether the considered variables are  $I(1)$ . If the-variables are found to be  $I(1)$  they are stationary. This can be done in various ways: Dickey Fuller test, Augmented Dickey Fuller test, Phillips-Perron test etc. with trend and without trend. This study applies augmented Dickey-Fuller (ADF) test, which is based on the regression equation with a constant and a trend in the form as follows:

$$\Delta Y_t = a_1 + a_2t + bY_{t-1} + \sum_{i=1}^k \rho_i \Delta Y_{t-1} + \varepsilon_t \text{ -----(5)}$$

where,  $\Delta Y_t = Y_t - Y_{t-1}$  and  $Y$  is the variable under consideration,  $k$  is the number of lags in the dependent variable, chosen by Schwarz criterion and  $\varepsilon_t$  is the stochastic error term. The null hypothesis of a unit root implies that the coefficient of  $Y_{t-1}$  is zero. If the null hypothesis is rejected then the series is stationary and no differencing in the series is necessary to establish stationarity. The result is also further justified by Phillips and Perron (1988) test. The results of these tests are presented in Table 3.

**Table 3: Test for Stationarity**

Variables	ADF	Phillip-Perron
	Level	Level
GM2	-4.212***	-3.976***
GNFCPI	-3.779***	-3.803***
GRGDP	-8.129***	-8.113***

Note: \*\*\* denotes the rejection of the null hypothesis at the 1% level.

Table 3 reveals that the time series GM2, GNFCPI and GGDP are stationary both at their levels and at first difference. When time series data is stationary at their level form they usually become stationary also in the first difference but obviously we do not need to perform that test as we have got all variables are  $I(0)$ . That is each of the series are integrated at level form or they are simply  $I(0)$ . Both the ADF and the PP test provide the same result as shown in the table 2. Now as the data is  $I(0)$  we can run OLS regression technique for our study.

**6.2 Methodologies**

Macro-econometric models are in general performs a couple of basic tasks which are (1) provides a macroeconomic forecasts and (2) an inference to guide an appropriate policy prescription. In this regard, our function is very simple where ratio of RGDP growth rate and inflation rate is our dependent variable and independent variable is yearly growth rate of Real Stock of Broad Money (i.e. real balance). The hypothesis is if growth rate of RGDP is higher than growth rate of price level and the coefficient of broad money growth rate should be positive then money is income generating, but if growth rate of price level is higher than growth rate of RGDP and the coefficient of broad money growth rate should be negative and money is inflation generating. In implicit equation form:

$$\frac{\text{Gr. RGDP}}{\text{Gr. Price (or Inflation Rate)}} = f(\text{Gr. M2}) \dots\dots\dots (6)$$

**6.3 Granger Causality**

Accordingly we shall perform a bi-variate Granger Causality test between the pair of variables considered under an augmented Vector Auto-regression (VAR) framework will be estimated with appropriate lag selected by usual criteria.

The functional form of this bi-variate regression functions are as follows:

$$Y_t = \alpha_0 + \alpha_1 y_{t-1} + \dots + \alpha_n Y_{t-n} + \beta_1 X_{t-1} + \dots + \beta_n X_{t-n} + \epsilon_t \dots\dots\dots (7)$$

$$X_t = \gamma_0 + \gamma_1 x_{t-1} + \dots + \gamma_n X_{t-n} + \delta_1 Y_{t-1} + \dots + \delta_n Y_{t-n} + \eta_t \dots\dots\dots (8)$$

Here the reported F-statistics are the Wald-statistic for the joint hypothesis of

$$\beta_1 = \beta_2 = \dots = \beta_n = 0 \dots\dots\dots (9)$$

$$\delta_1 = \delta_2 = \dots = \delta_n = 0 \dots\dots\dots (10)$$

for equation (7) and (8) respectively.

The equation (9) is the null hypothesis that "X does not granger cause Y" and equation (10) is the null hypothesis that "Y does not granger cause X" respectively.

## 7 Econometric Results

### 7.1 Regression Results

Now to draw inference we need to conduct an econometric operation. Based on the function form shown in the above equation we in an econometric form as follows:

$$IPR_t = C + b*GM2_t + U_t \dots\dots\dots(11)$$

Where C and U are the constant and error terms respectively.

We have estimated this function by using data described above and the estimated equation is as follows:

$$IPR = 1.835879 - 0.039901 (GM2) \dots\dots\dots(12)$$

(0.337376)	(0.018400)	(SE)
0.000000	0.036300	(p-value)

The details of the regression results are given in the appendix. The coefficient of broad money growth is negative. It means that when money supply increases price level in Bangladesh increases in a higher level than the increase of income. It justifies the claim that money is inflationary in Bangladesh. The terms in the brackets are standard errors of the respective estimates and numbers below of them are their p-values. All of these statistics indicate that both constant and coefficient of GM2 are statistically highly significant. The R-squared and Adj. R-squared are pretty high. The goodness of fit statistic R-square says that 77 percent of the variability of the dependent variable is explained by only the GM2 variable. Besides of high significance of t-statistic, the high significance of F-statistic (= 4.702626 and p-value = 0.006278) also confirms that the fitted regression model is not completely nonsense. The nearness to 2 of D-W statistic means that the error term is not suffering from serial correlation. So, perhaps estimates of the fitted regression model are BLUE and the estimated model is not spurious at all.

### 7.2 Granger Causality Test

By the above regression analysis we have reached in decision that money in Bangladesh is inflation generating not income generating. This can be further tested by employing pair-wise Granger causality tests. If we can reach in same conclusion by Granger causality test our result will be reinforcing in favor of our earlier results. According to Granger (1969), measuring the Correlation between two variables is not enough to construct a complete understanding about the relationship between couple of time series. Because correlation does not necessarily implies and ensures Causation always. This is because some correlations may be spurious and not meaningful at all, as there might be the selected of pair variables cannot have any relationship at all but mathematically they have high correlation co-efficient. When there is a theoretical justification of having Correlation between two variables and if this relationship is evidenced by other econometric tests, then having Ganger Causality (1969) can reinforce this established relationship. This is the core idea of performing the Ganger Causality test.

Therefore, to check the hypothesis of the existence of a feedback/bi-direction or unidirectional relationship between GM2 and IPR in Bangladesh we have conducted Granger



Causality test as well. In this case we can expect the results consistent with two main diverging theoretical paradigms: the “supply leading hypothesis” and the “demand following hypothesis”. While the ‘supply-leading’ hypothesis posits a unidirectional causation that runs from 'GM2' to 'IPR' and the ‘demand-following’ hypothesis posits an opposite direction of causality, a unidirectional causation from 'IPR' to 'GM2'. If the “supply leading hypothesis” is found then we can say that money growth ‘GM2’ leads the income price ratio ‘IPR’. However, if demand following hypothesis is established then we can say the opposite notion is correct. In the first case central bank increases money supply at first then its’ impact goes on income price ratio and in later case the converse will be true. The bi-directional causality will mean that a link between 'IPR' and 'GM2' in the form of both way causality and are in favor of the view of a joint evolution of the IPR and GM2.

After examining the nexus between the variables IPR and GM2, we use the Granger Causality test to determine the causality between the variables. As we have found significant link between the variables, we may expect uni or bidirectional causality impact between the series. We examine the causal relationships between considering two variables in Bangladesh within an augmented VAR framework presented in equation No. (8) and (9). The Table 4 below is showing the causal channels results of the Granger Causality between the variables.

**Table 4** Bi-variate Granger Causality Tests

<b>Observation 40</b>	<b>Dependent Variable</b>	
	<b>GM2</b>	<b>IPR</b>
<b>IPR</b>	4.35607**	-
<b>GM2</b>	-	7.14903***

(\* , \*\* and \*\*\* denote statistical significance at the 10%, 5% and 1% levels respectively)

As seen, in the context of Bangladesh, IPR and GM2 have bi-directional causality. Therefore, in case of Bangladesh, IPR and GM2 are showing a very strong evidence of the 'Joint evolution' hypothesis, i.e., we are not getting evidence any of ‘supply leading’ or ‘demand-following’ hypothesis. If GM2 causes IPR then we can infer that money may cause income or price but in this case we cannot reach in a clear conclusion because the direction of causality is bi-directional. Thus, the result is inconclusive. So, we have conducted pair-wise Granger causality between GM2 and GNFCPI, GM2 and GRGDP. The result is as follows:

**Table 5** Bi-variate Granger Causality Tests

<b>Observation 40</b>	<b>Dependent Variable</b>		
	<b>GRGDP</b>	<b>G(NonFoodCPI)</b>	<b>GM2</b>
<b>GRGDP</b>	-	NC	2.18421
<b>G(NonFood CPI)</b>	NC	--	1.99568
<b>GM2</b>	0.5343	5.14146**	--

(\* , \*\* , \*\*\* and NC denote statistical significance at the 10%, 5%, 1% levels and Not Considered respectively)

In the above table presenting bi-variate Granger causality of GM2 with GNFCPI and GRGDP we see that there is a uni-directional causality running from GM2 to GNFCPI but there is no such causality is seen from GM2 to GRGDP. It means that supply of higher money incurs growth of price in Bangladesh but the same has no impact on GRGDP. This result supports and strengthens the earlier OLS regression findings that monetary policy in Bangladesh historically was inflationary. That also means that the pursued monetary policy in Bangladesh was not income generating or employment generating or poverty alleviating. As a developing country whose monetary policy should be pro-poor has not been historically evidenced by the data. This result also supports the Monetarists view. In other way, it is strongly an opposite result of Keynesians view. The result also has very similar outcomes of Yunus (2007) and Hussain (2008) results.

## 8 Conclusions and Policy Implications:

The objective this study is to investigate for find out whether increasing money supply in Bangladesh is inflationary or income generating. We have collected data from various issues of Economic Trend, published by Bangladesh Bank from 1976 to 2018. To this end, the paper has examined the empirical causal relationships of money to price and income. After taking care time series behaviors of data we have fitted econometric models and techniques. The paper is an improvement over the earlier studies in terms of data used and techniques applied.

The result of this paper suggests that increased money supply has very robust impact on inflation instead of income. According to this result conversely it can also be claimed that inflation in Bangladesh is predominantly a monetary phenomenon i.e., monetary aggregates have independent stimulus effect to price level in Bangladesh. The Granger causality test also shows that money is not neutral in price which is consistent with monetarist notions. Therefore, monetary policy as a tool to curve inflation in Bangladesh should be designed and implemented with high care to achieve the desired objective. Similarly, if the intension of the central bank is to achieve high growth by crafting monetary policy, it should revise and redesign monetary policy to switch it to income generating pattern.

To find out a solution of this frustrating result we need to look at the monetary aggregates of the broad money which causes inflation of Bangladesh. Broad money can be define through the asset and liabilities of the banking system. To figure out the reason of inflationary impact of money supply in Bangladesh we need to contemplate on asset side definition of broad money which is as follows:

$$\begin{aligned} M2 &= \text{Net Foreign Assets (NFA)} + \text{Net Domestic Assets (NDA)}. \\ &= \text{stock of foreign currency in the vault of banking system} + \text{National Credit}. \\ &= \text{stock of foreign currency} + (\text{Private Sector Credit} + \text{Public Sector Credit}). \end{aligned}$$

According to the above definition of broad money it is decomposed into three major parts namely: (a) stock of foreign currency, (b) private sector credit, and (c) public sector credit. That is, broad money is created by largely credit creation process for public and private sectors. Data and graphical illustration of them in earlier sections of this paper have shown that the central bank in Bangladesh is successful to control the level of broad money supply. But it is not successful to generate higher income by controlling money supply process. It means that perhaps credit is not channeling to the productive sectors of the economy. Public

sector credit is largely used for financing budget deficits which is utilized for the payment of salary of government employees and financing annual development programs planned in annual fiscal budget. This is highly questionable use of public money as it is considered as the inefficient way expenditure. Because the economic theories have a general presumption that there is a causal relationship between budget deficit and inflation. "if a significant part of fiscal deficits are continued to be financed by borrowing from banks then, new money creation will add pressure on domestic price levels and the central bank will no longer be able to maintain price stability" Afrin (2013). Similarly, the other part of broad money is the private sector credit which also perhaps not is going to the efficient and thirsty income generating sectors of the economy in enough level. So, it is now imperative that central bank as well fiscal side should take steps to channel the national credit flow to the income generating, thirsty and productive sectors of the economy.

Friedman (1963) also claims that inflation is always and everywhere a monetary phenomenon. Finding of this research is very much consistent with Friedman claims and has very important policy implication. Monetary policy should be conducted with high care as increase of money supply can cause inflation instead of economic growth in Bangladesh. However, if central bank intends to achieve high growth by increasing money supply, with a hope that as a third world country Bangladesh has still lot of unemployed resources, it should consider about the low earning people of the country. As the country still have large volume of population are poverty stricken and in that case, as poor people are highly affected by inflation because of their subsistence level of earning, the government should also consider to subsidize them. The central bank of Bangladesh believes that monetary policy can create better employment opportunities and ensure adequate resources mobilization to the productive sectors of the economy and this will help to poverty reduction through inclusive growth of the country. The finding of this research has given a completely opposite result of this claim. Therefore, the central bank should make monetary policy with great care so that it can prevent excessive and unnecessary price hike in the economy. The bank should be cautionary in using monetary policy to stabilize the economy by counter cyclical measure. The result also intuitively shows that the monetary policy alone is not enough for poverty reduction at desired rate. Such inflation prone monetary policy may have adverse impact on people of the country living under poverty line and employment generation of monetary policy may not incur favorable and good result. To ensure the efficacy of monetary policy for creation of employment opportunities the financial sector can be reformed to translate it as a well-functioning financial sector so that it have enough capability to ensure adequate resource flows in economically productive usage. It may also require labour market reforms to mobilize and develop the human resources of the country for income generation activities. Bangladesh Bank's monetary policy stance also should be aimed at providing support to growth augmenting policies and keeping the demand side pressures under control in line with emerging developments and requirements of the economy so as to keep inflation under control. Measures also should be taken to achieve greater fiscal and monetary coordination such that both sides create congenial economic atmosphere for ensuring macroeconomic stability and rapid growth.

Obviously, keeping inflation in tolerable level involves a long term struggle with prudent policies and their implementation. For this, it is important to ensure both the demand and supply side management policies for the highest sustainable growth. Monetary policy is a demand management and short run policy where the fiscal policy is considered as a long run and supply side policy. Each of them needs to be consistent and supportive to each other. To ensure such strong coordination it requires that continuous pursuit of supportive macroeconomic policies, robust business confidence and desired growth in private and public

sector credit for productive investment, removing infrastructural constraints, implementation of structural, institutional and financial sector reforms.

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## 10. Appendix

Dependent Variable: IPR  
 Method: Least Squares  
 Date: 10/19/18 Time: 23:34  
 Sample: 1978 2018  
 Included observations: 41

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.835879	0.337376	5.441642	0.0000
GM	-0.039901	0.018400	-2.168554	0.0363
R-squared	0.771605	Mean dependent var		1.151812
Adjusted R-squared	0.750723	S.D. dependent var		0.800773
S.E. of regression	0.766100	Akaike info criterion		2.352543
Sum squared resid	22.88948	Schwarz criterion		2.436132
Log likelihood	-46.22714	Hannan-Quinn criter.		2.382982
F-statistic	4.702626	Durbin-Watson stat		2.115588
Prob(F-statistic)	0.006278			

### Granger Causality Test

Pairwise Granger Causality Tests  
 Date: 03/25/19 Time: 21:27  
 Sample: 1978 2018  
 Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
IPR does not Granger Cause GM	40	4.35607	0.0438
GM does not Granger Cause IPR		7.14903	0.0111

Pairwise Granger Causality Tests  
 Date: 03/25/19 Time: 21:48  
 Sample: 1978 2018  
 Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
GRGDP does not Granger Cause GM2	40	2.18421	0.1286
GM2 does not Granger Cause GRGDP		0.53543	0.5904

Pairwise Granger Causality Tests  
 Date: 03/25/19 Time: 21:47  
 Sample: 1978 2018  
 Lags: 1

Null Hypothesis:	Obs	F-Statistic	Prob.
GCPI does not Granger Cause GM2	40	7.99568	0.0076
GM2 does not Granger Cause GCPI		5.14146	0.0295