

Inflation and Cost Push in Iran's Economy

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Abstract

There have been two broad theories of inflation, namely the demand pull theory of inflation (that is nowadays mainly the monetary theory of inflation) and the cost push theory of inflation. The mainstream macroeconomics views inflation as a monetary phenomenon in the long run. Iran has experienced double digit rates of inflation for about four decades. Our main aim is an explanation for the long run movements in the rate of inflation. We have used the raw data and the filtered data on the rate of inflation and the growth rate of money supply to show that there is a long run relationship. Also, we have used co-integration VAR method to show that there is a long run relationship between the price level and the money supply but not between the price level and the cost push factors. The empirical findings are not inconsistent with the monetary theory of inflation in Iran.

Keywords: Inflation, Cost Push, Iran, Monetary Policy.

1- Introduction

Iran's economy has had double digit inflation rates for (almost) four decades. At the same time, the rate of inflation has not been even and has experienced periods of rapid increases and sharp decreases. Although there has been a more or less consensus among well-distinguished economists in the country that inflation is mainly a monetary phenomenon and the result of constant increase in the money supply, there are yet some that believe

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inflation in Iran is not just the outcome of monetary policy and could be attributed to other factors, especially to cost push elements.

Since Iran has experienced many cost push shocks, there could be an examination on the effects of cost push shocks on inflation alongside the effect of monetary policy. A fact about high and persistent inflation in Iran is that there have not been high inflation rates without high rates of growth of money supply. However, there are short periods in which inflation rate has begun to decrease while the growth rate of money supply has been quite high. Based on such observations, some have contended that inflation could not be explained by the growth rate of money supply. Although there are such short-period occasions of break in the relationship between the growth rate of money supply and the rate of inflation, there could be an explanation that views inflation as a monetary phenomenon, at the same time that it is possible to justify the occasions of break in the relationship between the growth rate of money supply and the rate of inflation without resort to the cost push inflation explanation.

The main purpose of current study is to insist on the conventional explanation of inflation as a result of the increase in the money supply in the long run at the same time that the effects of cost push shocks are incorporated to account for some short run explanations of inflation. To analyze the high and continuing inflation in Iran, the methodology is time-series method by using aggregate data on inflation and other related variables for about five decades.

The paper is organized as follows: Next section is a summary on Iran's economy and its inflation during the last five decades. Section 3 provides a short review on the theoretical background. Section 4 is a review on cost push inflation. Section 5 is on data and estimation. Section 6 concludes the paper.

2- Inflation in Iran's Economy: History

Although there is data on Consumer Price Index in Iran since 1933, the data on most economic aggregates are available since 1959 when the central bank of Iran was established and began to gather, to process and to publish the data on national accounts and many other important aggregate variables. Therefore, our review of the developments in economy and especially inflation will be confined to the time period 1959-2011.

Iran suffered from some economic problems before establishing the central bank such as high inflation, balance of payments deficit and budget deficit. In fact, those problems led to increased motivation to establish the central bank. After being established, the central bank began its policy making with a package of prescriptions from IMF to alleviate the mentioned economic problems. Iran experienced a decade of high economic growth with very low inflation during 1960s (golden economic decade). Although all economic success could not be attributed to the conduct of monetary policy but the monetary policy of the central bank was one of the main contributors to that success.

Iran encountered a situation of lower economic growth in sectors other than oil sector and much higher inflation in 1970s just before the Islamic Revolution, that were brought about by the injection of oil incomes into the economy. Although GDP grew rapidly as a result of high oil prices and increased production of oil, long run economic growth experienced a turning point with a lower economic growth thereafter (see Figure 1). Also, the rate of inflation that was nearly zero in 1960s saw a turning point to higher and double-digit inflation rates. In contrast to the stagflation experience of oil importing countries with low economic growth (and even negative economic growth) and high inflation rates that is well-known in macroeconomic theory, Iran's economy had high inflation rates and oil-driven economic growth that could be viewed as the outcome of demand pull inflation. Temporarily, the economy benefited from the injection of oil incomes with a boom in construction, trade and service sectors at the same time that imports helped the inflationary pressures to be absorbed to some extent. With the passage of time, the positive effects of oil incomes on the real sector of the economy weakened (that could be attributed to Dutch Disease, resource curse and increased rent-seeking and corruption) while the effect on inflation strengthened with the highest inflation rate till that time just a year before revolution.

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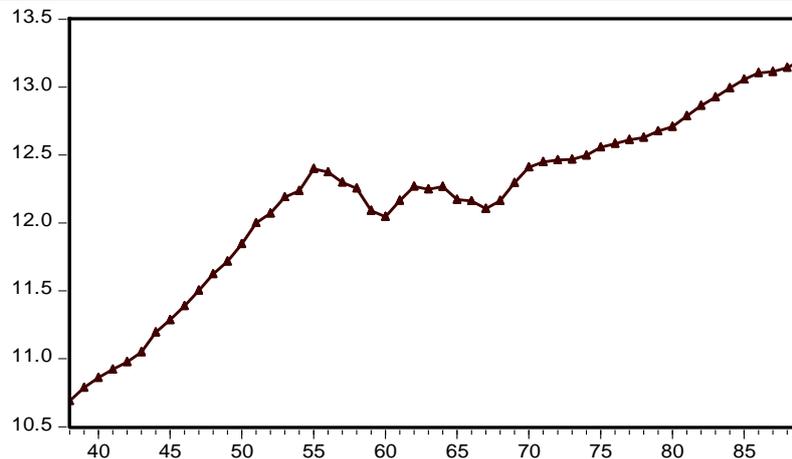


Figure 1: The Trend of Log GDP (1959-2011)

After revolution, Iran suffered from several adverse supply shocks (revolutionary environment that brought about uncertainty for economic activity of private sector, nationalization of almost all big businesses, eight years of war with Iraq, and sanctions) with a sharp decrease in GDP and continued (but higher) inflation rates in 1980s. Much bigger public sector with its natural inefficiency and destructive outcomes of war (for example, the destruction of Abadan refinery as the biggest refinery in Iran) resulted in adverse effects on the real sector and increased inflationary pressures. At the same time, huge budget deficits (brought about by decreased oil incomes as the main source of government revenues and increased government expenditures as a result of war and related problems) that was financed mainly by printing money, added to inflationary pressures in the economy. Very low oil prices in the last years of war deteriorated the above mentioned situation and resulted in very high inflation rates.

When the war with Iraq ended in late 1980s, an era of new economic policies was declared which aimed at promoting efficiency and higher economic growth. A package of deregulation, privatization, and liberalization policies was invoked. At the same time, a development and reconstruction program was begun with the effect of injecting large amount of funds into the economy. Later, a part of the reforms (mainly the creation of a floating exchange rate regime) came to a halt as the balance of payments problem deteriorated and inflationary pressures increased. In this period,

government oil incomes increased as a result of both increased production and exports of oil and, on average, higher oil prices. At the same time, government could earn more money for domestic expenditures because it sold oil dollars in a higher price to the central bank. But, unsuccessful privatization and a wrong combination of depreciation and expansionary monetary and fiscal policies resulted in very high and record inflation rates in mid-1990s that brought about political pressures to stop economic reforms.

Between 1997 and 2005 the economy experienced a period of moderate and stable economic growth accompanying by lower, on average, inflation rates that could be attributed to stable economic policies and lack of exogenous shocks. At the same time, Iran's oil income increased gradually which was crucial for economic success. But, unlike previous increases in oil incomes, all those incomes were not injected in the economy that could be to some extent behind economic success. Although the rate of inflation was yet double-digit in mid 2000s, it was quite lower compared with mid-1990s.

Since 2005 there has been a big shift in the economic policies. The main changes consisted of very expansionary fiscal and monetary policies, a sharp increase in imports, and recently a shift from indirect subsidies to direct ones. Sharp increase in oil incomes as a result of very high oil prices which was almost fully injected in the economy or used for imports, brought about opposite pressures on inflation rate and asset prices. Inflation was tamed by unprecedented level of imports, of course temporarily. Asset prices, especially house prices, increased sharply and even experienced bubble. On average, economic growth was lower compared to the previous decade that could be attributed to Dutch disease and resource curse of the increased oil incomes. At the same time, the rate of inflation increased gradually when imports slowed. Recently, a combination of economic sanctions and removal of indirect subsidies have resulted in increased inflationary pressures.

Therefore, the rate of inflation was very low in 1960s, much higher (compared to 1960s) in 1970s, 1980s, and early 1990s. It experienced the highest record in mid-1990s and then began to decrease gradually. After 2005, inflation has been tamed by huge imports but has begun to increase gradually. Although there have been some adverse and cost shocks that are behind temporary inflationary pressures, the history of Iran's economy shows that increased aggregate demand brought about by increased government

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expenditures accompanying by increased money supply has been the main determinant of inflation in Iran.

3- Theoretical Background

A small open economy with a managed floating exchange rate is assumed. So, aggregate demand is defined as

$$Y=C+I+G+X-M \quad (1)$$

Based on infinite horizon models of consumer inter temporal utility maximization, it is assumed that, in the absence of shocks to preferences, technology and government expenditures, all the components of aggregate demand including consumption, investment and government expenditures grow at a constant rate equal to the exogenous rate of growth of labor force and the rate of growth of technology in equilibrium (in the long run). Also, it is assumed that the real demand for money that is derived from utility maximization has a unit elasticity to real output. It is assumed that X is exogenous (that could be justified because oil price is exogenous) and grows at a rate equal to the sum of the rate of growth of labor force and the rate of growth of technology in the absence of shocks. Also, it is assumed that the volume of imports or the exchange rate will adjust to hold balance of payments equilibrium (which means current account balance because capital movement does not too matter in Iran) in the long run.

If there is no shock from technology, preferences, government expenditures, and exports, and the money supply grows at a rate equal to the sum of the rate of growth of labor force and the rate of growth of technology (or in a rate equal to the rate of growth of real output), there will be no pressure on the price level and the rate of inflation. On the other hand, if the rate of growth of money supply is more than the rate of growth of real output, there will be a positive rate of inflation. The higher the difference between the rate of the growth of money supply and the rate of growth of real output, the rate of inflation will be higher.

Positive technology shocks without a long run and significant wealth effects result in lower inflation temporarily because they do not bring about much increase in consumption and aggregate demand. On the other hand, positive technology shocks with a persistent effects on real output, does not influence the rate of inflation significantly, because they increase aggregate

demand in the same rate as the real output. So, shocks to technology are not much important in determining the rate of inflation if it is assumed that they are random and normally distributed.

Shocks to preferences cannot explain inflation, too. If it is assumed that the shocks to preferences are random and normally distributed, they cause the rate of inflation to fluctuate. So, there is no basis to assume that these shocks accelerate the rate of inflation just at the times that other determinants of inflation have such an effect.

Both the shocks to government expenditures and exports can be candidates to explain the persistent inflation and the ups and downs in the rate of inflation. A shock to government expenditures could bring about pressures on the rate of implicit rate of interest with a crowding out effect. But, it will necessitate a higher growth rate of money both to finance the government expenditures and to tame crowding out effects. So, government expenditures growth and its shocks could be a main driver of the rate of inflation and its volatility.

Also, shocks to exports can be a determinant of the inflation variability and development, especially in the short run. When there is a positive shock to the exports, the consequent increase in the monetary base and liquidity results in inflationary pressures but the surge in imports offsets those pressures. Therefore, it is expected that the increase in exports does not initially lead to high inflation. With the passage of time, the constraints on imports become more binding with the effect of lower imports or higher exchange rate, while the lagged effects of the increase in liquidity on aggregate demand begin to appear. So, a positive shock to exports will bring about a higher rate of inflation, eventually. On the other hand, a negative shock to exports does not lead to a decrease in money supply and liquidity because the dependency of government budget on oil revenues cause the budget deficit to increase with the consequent increase in monetary base that offsets the negative effect of foreign reserves of the central bank. At the same time, a decrease in exports could result in lower imports or depreciation that brings about short run inflationary pressures.

In fact, the only cost push shock that is important in Iran's economy is the depreciation which is the result of negative exports shocks (since there is no important labor force union, the wage push inflation is negligible).

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Depreciation causes the cost of imported raw materials and intermediate goods to rise with the consequent increase in the price level and inflation.

Therefore, there seems that the long run trend of inflation is explained by the growth rate of money supply that is mainly the result of the developments in the government expenditures and budget deficit. Also, the shocks to exports and then the exchange rate could be an explanation for the changes in the rate of inflation, especially in the short run.

It must be emphasized that the relationship between the growth rate of money supply and the rate of inflation could be weak when a two-dimension plot of the two variables or a simple regression of the rate of inflation on the rate of growth of money is used for raw data. Lucas (1980) points out that the relationship between the rate of inflation and the rate of growth of money supply is a theoretic relationship and there is no actual data on these variables that coincide with their theoretical concept and at the same time we cannot conduct natural experiments to obtain the data which is appropriate for testing the quantity theory. Then, he uses filtered data on the rate of growth of money supply and the rate of inflation in accordance to theoretical backgrounds. While the actual data does not show a strong relationship between the rate of inflation and the rate of growth of money supply, the filtered data implies a strong relationship that is consistent with the quantity theory as a long run relationship.

4- Review of Literature

Since the emergence of economics as a discipline and especially the emergence of macroeconomics, there have been two main broad theories behind the explanation of inflation; that is, demand pull inflation and cost push inflation. A standard textbook model to explain and distinguish demand pull and cost push inflations is AD-AS model (see, for example, Gordon (1976)). In this model, an increase in money supply, an increase in government expenditures (or a decrease in taxes) or an exogenous increase in private sector spending shifts aggregate demand curve to the right and bring about an increase in both the price level and real output depending on the slope of aggregate supply curve. In the extreme case of a vertical aggregate supply curve, a rightward shift in AD curve just results in an increase in the price level without any effect on real output.

Old quantity theory asserted that the only cause of the increase in the price level and inflation was the increase in money stock and the increase in the price level was proportional to the increase in money supply. Revival of the quantity theory was begun by the works of Friedman in 1950s and 1960s. In their study on the history of monetary policy of the US, Friedman and Schwartz (1963) tried to show that the changes in money supply led the changes in nominal income and had a causal relation to the changes in nominal income, a contention that was pursued in other studies of the Monetarists. This means that aggregate demand curve shifts mainly as a result of the change in money supply and other determinants of aggregate demand are not much important. In 1968, Friedman in his revision of Philips curve argued that unemployment and other real variables such as real output are determined in a Walrasian general equilibrium in the long run and aggregate demand developments cannot affect real variables. Therefore, changes in aggregate demand that are brought about almost exclusively by the changes in money supply affect real variables such as real output in the short run because expectations formation is adaptive, but the effect on real variables disappear in the long run and the exclusive effect of the changes of money supply will be on the price level. In a simple textbook version of the new quantity theory of money in which velocity is constant and real output grows in a constant rate not related to the changes in money supply, the rate of inflation is equal to the difference between the growth rate of money supply and the growth rate of real output. So, a constant rate of money supply growth is required to stabilize the price level and reach a zero rate of inflation.

Cost push theory of inflation initially was an explanation of the effect of the increase in wages on prices in the post-Keynesian conflict inflation theory (Palley, 2012). A well theoretical explanation of the wage push inflation was provided by Davidson and Weintraub (1973). In this theory, a conflict exists between wage earners and profit earners and the wage rate is bargained exogenous to the semi- Walrasian general equilibrium and its determination is quite different from other prices. Workers in a collective and harmonized bargaining, ask for wages that ensures a higher level of purchasing power for them. Then, other prices will be determined as a mark-up over wage and other costs to ensure a profit margin for firms. This will result in lower level of employment and aggregate real output if the central

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bank does not accommodate higher level of money supply that is needed to cover higher level of working capital the firms encounter. Therefore, an increase in wages and then costs is the cause of the increase in the price level and inflation. Cost push inflation was extended to include the effect of the increase in the prices of raw materials and commodities (especially after the oil price shocks of the 1970s) and also the effect of the increase in profit margins of firms that obtain much market power (see, for example, Branson and Myhrman (1976), Dhakal et al (1994), Thoresen (1982), and Zaleski (1992)).

What is clear from a short review of literature on the determinants of inflation, no matter from which point of view it is analyzed, is that it is not possible for inflation and especially high inflation to continue without expansion in the money supply. In fact, there could be no explanation on inflation without the increase in money supply. But competing views on inflation have different explanations for the expansion of money supply that accompanying inflation. Monetarists view the changes in money supply as exogenous and cause of inflation, while post-Keynesians view the changes in money supply endogenous and the effect of inflation (Moore, 1979). Neo-Keynesians consider the changes in money supply as ineffective in changing aggregate demand in extreme cases and accommodating the requirements of fiscal policy. New-Keynesians like Monetarists and New-classics believe that aggregate demand is mainly determined by the monetary policy and inflation is mainly a monetary phenomenon. In fact, post-Keynesians saw the increase in money supply to accommodate the increase in wages and other costs and neo-Keynesians viewed the increase in money supply to accommodate the expansionary fiscal policy because borrowing from private sector has a limit.

The most important cost push inflation that has been examined especially for oil importing countries in the literature since 1970s is oil prices. The first oil price shock of the seventies caused the rate of inflation to become double digit in most industrialized countries. Then, a change in the conduct of monetary policy and more commitment of the central banks to keep inflation under control caused the inflation rate to lower substantially. So, sharp and continuous increase in the oil price in 2000s did not result in inflation in oil importing economies. It could be explained by standard model of aggregate demand and aggregate supply. The increase in oil price in seventies was the

outcome of a decrease in the supply of oil which should lead to an adverse supply shock and stagflation. That was what happened in the seventies. In contrast, the increase in oil price since 2000 was the result of the expansion in the real economic activities of developed and emerging economies which should lead to increase in the demand for oil. So, in the latter case there was no adverse supply shock and no stagflation. Many empirical studies have shown that the significance of oil price in creating inflation has lowered in comparison to seventies and eighties.

Zaleski (1992) examined the effect of market power in the mark-up of the first oil price shocks on the price level. Although it is naturally concluded that the industries with more market power must contribute to the inflationary pressures of the increase in oil prices, the findings showed that it was not the case and that meant that cost push inflation was not too important even in the first oil price shock of seventies. Hooker (2002) found that there was no significant effect from the increase in oil prices on the measures of the US inflation when energy products are excluded.

Leblanc and Chinn (2004) examined the effect of oil prices on the headline CPI inflation for major global economies and found a modest role for oil price shocks. De Gregorio et al (2007) examined the pass through of oil price changes to consumer prices for 34 industrialized and emerging economies. They found a considerable reduction in the pass through and therefore lowered significance of oil prices in inflation.

Nelson (2008) examined the diverging trend of inflation in Switzerland and Ireland after the first oil price shock of seventies. He focused on these two countries because their inflation rates were not much correlated over the Great Inflation period. In Switzerland, more consensus on the monetary view of inflation helped policymakers to tame inflation very well but the dominance of nonmonetary views of inflation in Ireland caused the policymakers to conduct the monetary policy poorly which could be blamed for high and persistent inflation. This finding means that it is not the oil shock that cause persistent inflation but the way monetary policy reacts to the shock is determinant.

Blanchard and Gali (2007) examine the trend of the strength of oil price shocks as a determinant of inflation for G7 countries excluding Canada. They find that the inflationary impact of oil price shocks has weakened since mid-1980s. Killian (2008) finds similar results for G7 countries. The

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findings show quite small contribution on average of an exogenous oil price shock on inflation and a negligible contribution for 2002-2003 oil price shock. Also, responses of the GDP deflator are more muted and less significant than the corresponding responses of CPI inflation implying less significant indirect impact of oil price shocks.

Alvarez et al (2011) examine the direct and indirect impacts of oil price changes on Spanish and euro area consumer price inflation. They find that the inflationary effect of oil price changes in both economies is limited but oil price fluctuations are the main determinants of inflation variability. Especially, they find that the indirect and secondary round effects of oil price changes on inflation seem to have been less important.

There are some other studies emphasizing the role of aggregate demand development and especially monetary policy on inflation (For example, Branson and Myhrman (1976), Dhakal et al (1994), Budina et al (2006), Castelnuovo (2010), Zhang (2012)).

Kia (2006) developed a monetary model of inflation rate, taking into account both monetary and fiscal policies as well as other internal and external factors for Iran's economy. His main findings are that in the long run a higher exchange rate results in higher price level and fiscal policy is very effective to tame inflation. Also, he finds that in the long run the main determinants of inflation are internal factors; although in the short run both internal and external factors could be the sources of inflation.

Since the focus of this study is on the validity of monetary theory in the long run and insignificance of cost push inflation in Iran, we will shortly review the related literature to provide a basis for our empirical results.

The primary evidence provided by Monetarists on the importance of money on inflation, were mainly short run correlation between the growth rate of money and the rate of inflation. Among them is the historical work of Friedman and Schwartz (1963). After seventies, the robustness of such evidence has been questioned (See for example, Estrella and Mishkin (1997) and Hafer and Wheelock (2001)). Therefore, Monetarists' studies focused on the long run relationship that should somehow be obtained. The studies that

have tried to show the long run relationship between the growth rate of money and the rate of inflation have been done via three approaches¹.

The first approach tries to use a cross-section of the average rates of the growth of money and the rate of inflation for a time period and a sample of countries. McCandless and Weber (1995) examine the long run relationship between the growth rate of money and the rate of inflation for a sample of 110 countries over 30 years. They find that the long run coefficient of correlation between the rate of inflation and the rate of growth of money varies between 0.92 and 0.95 depending on the definition of money that is used. Therefore, the quantity theory of money and monetary theory of inflation is confirmed. Abel and Bernanke (1995) find a similar result for high inflation countries. Hall and Taylor (1997) find a strong relationship between the rate of inflation and the rate of growth of money for G-7². King (2002) and Hang and Dewald (2004) find similar results.

The second approach uses time-series data on the growth rate of money and the rate of inflation for a country with low frequencies. This approach is based on this belief that the long run relationship between variables cannot be examined by using the raw data. The time-series data contain short run variations and the shorter the time period for which data is gathered the variations will be more. So, before using time series data to find the long run relationship between variables in statistics and econometrics, the short run variations should somehow be omitted. This means that we should use the filtered data to find the long run relationships.

Lucas (1980) finds a weak relationship between the rate of inflation and the rate of growth of money over 1955-75 for the US when raw data is used. But, a strong relationship consistent with the quantity theory of money is found by using the filtered data. He uses Hodrick-Prescott filter to remove the short run variations from the raw data. Berentsen et al (2008) examine the long run relationship between the rate of inflation and the growth rate of money over 1955-2005 for the US based on the work of Lucas and find the same results

Benati (2005) examines the relationship between the rate of inflation and the growth rate of money for low frequencies of these variables in the US

1- Woodford, 2008.

2- Walsh, 2010.

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and the UK since 1970 and finds a strong relationship for low frequencies of these variables. Also, Jeager (2003) and Assenmacher-Wesche and Gerlach (2007) find a strong long run relationship between the rate of inflation and the growth rate of money for EU members.

The third approach uses co-integration to discover the long run relationship between the rate of inflation and the growth rate of money. In this approach, first it should be confirmed that the variables are non-stationary, and then the existence of co-integration between the variables means a long run relationship. Monfort and Pena (2008) find a strong long run relationship between the rate of inflation and the growth rate of money supply by using this approach for Paraguay. Kugler and Kaufman (2008) find co-integration and a strong long run relationship between the rate of inflation and the growth rate of money supply for the EU.

Since the first approach mentioned above is not applicable for a country, we have used the second and the third approaches to examine the long run relationship between the rate of inflation and the growth rate of money for Iran's economy in the next section.

5- Data and Empirical Results

To examine the determinants of inflation empirically we have used the data for the time period 1959-2011 (1338-1389 in Iranian calendar). All the data is from the Central Bank of the Islamic Republic of Iran. As we mentioned, our focus is on the determinants of inflation in the long run.

First, we examine the relationship between the rate of inflation and the growth rate of money for the actual data that shows the short run relationship and the same relationship for the low frequency or filtered data. In Figure 2, a scatter of the rate of inflation and the growth rate of money supply (both M1 and M2) is plotted by using the raw data for the time period 1338-1389 (1959-2011). As it is seen, there is a positive but weak relationship. It is why some researchers contend there is no long run relationship and insignificance of the effect of the money supply on inflation by seeing such a weak relationship for a long period of time.

As was mentioned, the relationship found in the raw data is a short run relationship and contains the short run variations. In order to find the long run relationship between the rate of inflation and the growth rate of money supply, we must remove the short run variations from the above variables.

Based on the initial work of Lucas (1980) and also the work of Berentsen et al (2008), we have used Hodrick-Prescott filter. To use Hodrick-Prescott filter, we need to assign a value to the smoothing parameter. The higher the value of this parameter, the short run variations of the variables will be more removed. In Figure 3, we have shown the scatter of the low frequency or filtered rates of inflation and the growth rate of money supply or the long run relationship between them for the values of smoothing parameter 100 and 1600. As it is seen, there is a strong relationship between filtered date of the rate of inflation and the growth rate of money supply that implies a strong long run relationship between them. This finding is quite similar to the findings of Lucas and Berentsen et al.

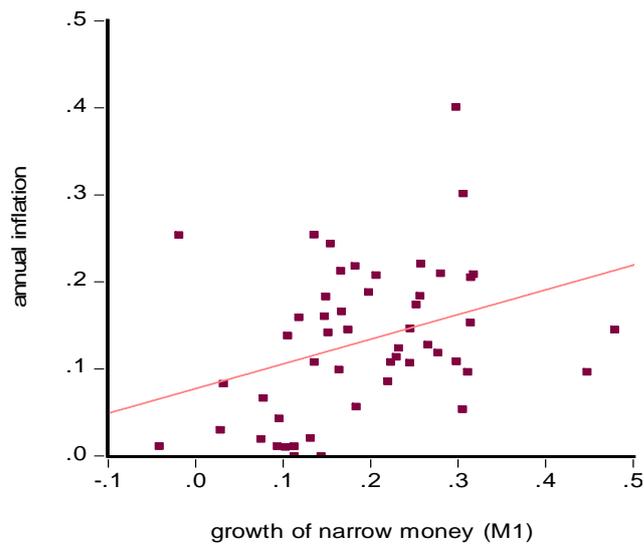


Figure 2: The Short Run Relationship between Money and Inflation

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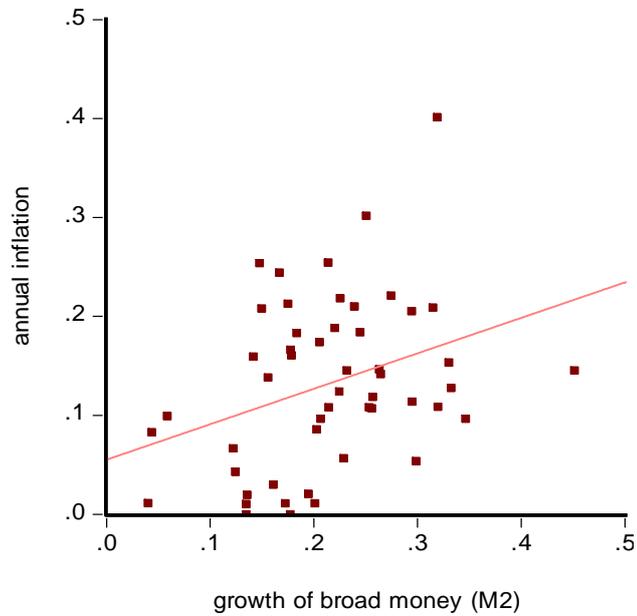
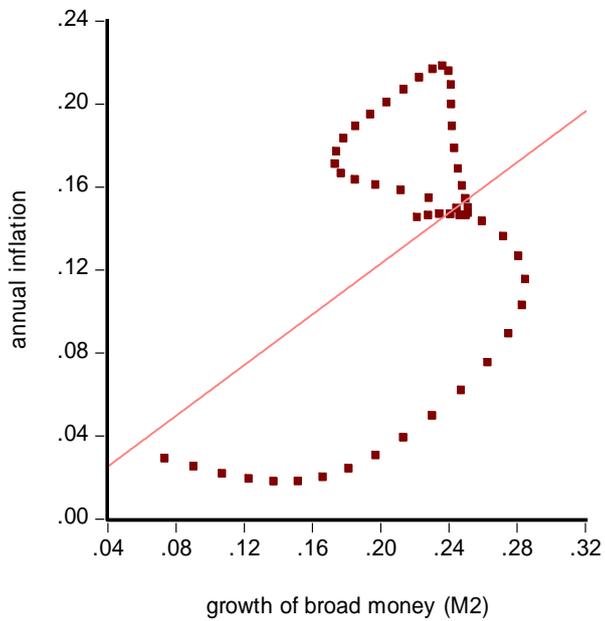
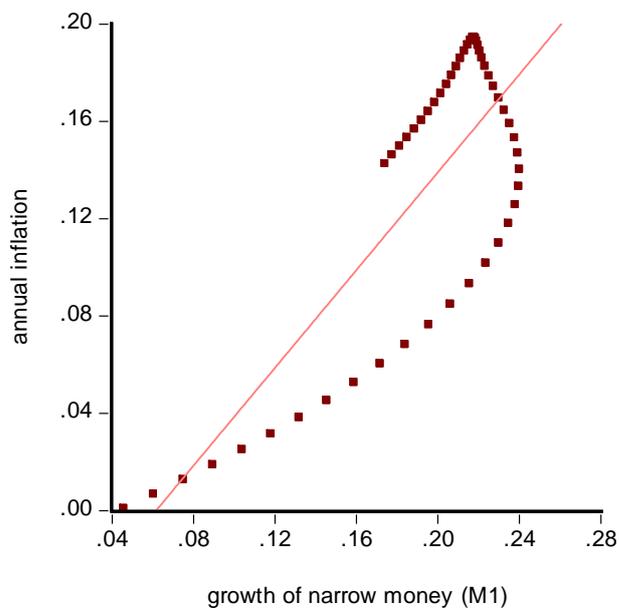
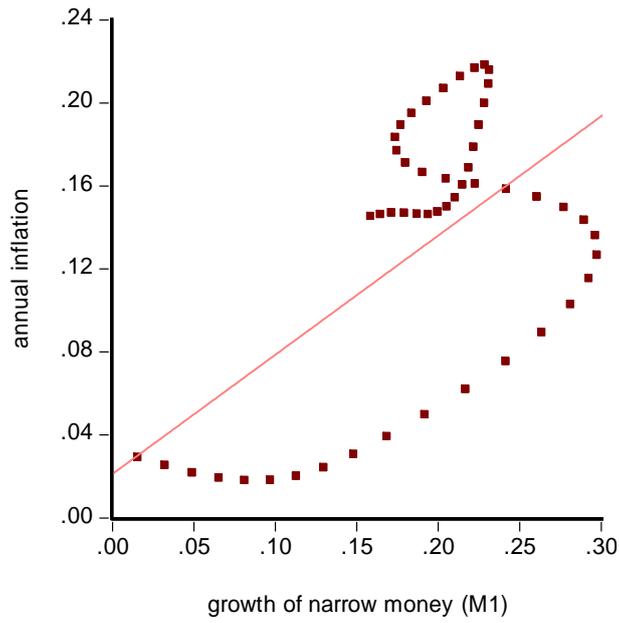
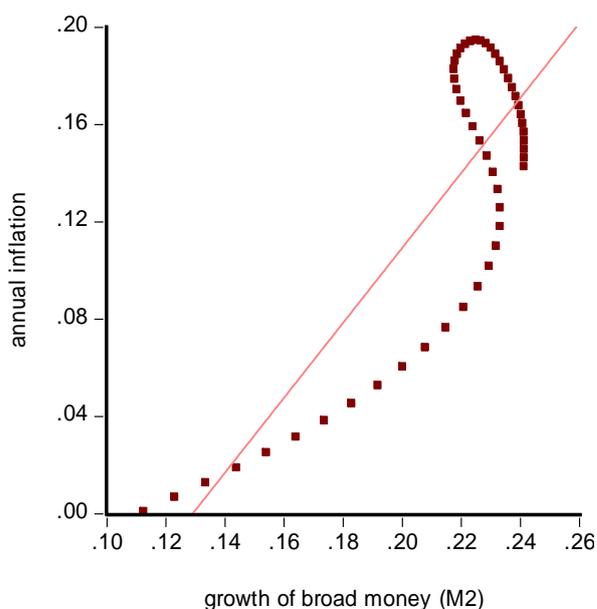


Figure 3: The Long Run Relationship between Money and Inflation





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Now, we examine the long run determinants of inflation in Iran in line with the third approach mentioned above. We focus on the explanatory power of two opposite theory of inflation, namely the monetary theory and the mark-up theory of inflation. The monetary theory could be explained by the equilibrium in the money market that is as follows:

$$m^s - p = m^d(y, r)$$

In which m^s is the log of money supply, p is the log of the price level, m^d is the log of money demand, y is the log of national income and r is the interest rate. It is assumed that the demand for money is an increasing function of the level of national income and a decreasing function of the interest rate. Based on a linear money demand function, the following relation is obtained that could be estimated:

$$p_t = \beta_1 m_t + \beta_2 y_t + \beta_3 r_t$$

The existence of a co-integration vector with the restriction $\beta_1 = 1$ implies that the monetary theory of inflation is confirmed.

In contrast, the mark-up theory of inflation contends that the price level is proportional to the costs of production. Total cost of production is a combination of labor costs (W), the costs of inputs that are produced within the economy (D), and the costs of imported inputs (F). The mark-up theory can be formulated as follows:

$$P = e^{\mu} W^{\alpha} D^{\beta} F^{\gamma}$$

That could be shown in log format as follows:

$$p_t = \mu + \alpha w_t + \beta d_t + \gamma f_t$$

The existence of a co-integration vector with the restriction $\alpha + \beta + \gamma = 1$ implies the validity of the mark-up theory and the significance of supply side determinants of inflation. Since the variables we want to examine their relationships are not stationary (the results are not shown to save the space), using co-integration method is appropriate. We use co-integrated VAR method introduced by Johansen (1991) to determine the number of co-integration vectors and the long run relationships. The results of co-integration tests are shown for the monetary theory of inflation in Table 1. The variables consist of CPI (for the price level), broad money or M2 (for the money supply), GDP in 1376 (1998) prices (for the level of income) and the interest rate on banks loans (for the interest rate). In the Johansen method, there are two test statistics. The first block reports the so-called *trace* statistic and the second block reports the *maximum eigenvalue* statistic. For each block, the first column is the number of co-integrating relations under the null hypothesis, the second column is the ordered eigenvalue, the third column is the test statistic, and the last two columns are the 5% and 1% critical values. The trace and maximum eigenvalue statistics imply that the null hypothesis of no co-integration relations could be rejected at 5% significance level. The results imply at most two co-integration vectors and a long run relationship between the price level and the supply of money.

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Table 1: Co-Integration Tests for the Monetary Theory of Inflation

Unrestricted Co-integration Rank Test (Trace)				
	Eigenvalue	Trace Statistic	Critical Value	Prob
None *	0.746774	77.59521	47.85613	0
At most 1 *	0.576114	35.01758	29.79707	0.0114
At most 2	0.231899	8.410533	15.49471	0.4226
At most 3	0.007445	0.231658	3.841466	0.6303
Unrestricted Co-integration Rank Test (Maximum Eigenvalue)				
	Eigenvalue	Max-Eigen Statistic	Critical Value	Prob
None *	0.746774	42.57763	27.58434	0.0003
At most 1 *	0.576114	26.60704	21.13162	0.0077
At most 2	0.231899	8.178875	14.2646	0.3608
At most 3	0.007445	0.231658	3.841466	0.6303

The results of co-integration tests for the mark-up theory of inflation are reported in Table 2. The variables consist of CPI (for the price level), the index of the labor force compensations in the construction sector (for the labor costs), an index of fuel and energy (for the costs of domestic inputs) and unofficial exchange rate (for the costs of imported inputs). The results imply that the null hypothesis of no co-integration relationship between the price level and the supply side factors cannot be rejected at 5% level of significance. This means that the mark-up theory or cost push theory of inflation cannot explain the long run developments in the rate of inflation.

As mentioned above, the results of co-integration tests imply a long run relationship between the price level and the money supply. Therefore, we just estimate the long run coefficients for equation (3). The results are shown in Table 3. All estimated coefficients are statistically significant at %1 level. As it is expected, the coefficient of money supply is 1.02 in line with the monetary theory of inflation. The coefficient of GDP that is the elasticity of money demand with respect to the level of income is 2.54 and is more consistent with Monetarists' empirical findings than Baumol and Tobin's theory of money demand. Some other studies have obtained similar results (see for example, studies on Albania's economy (Rother, 2000), Armenia (Grigorian et al, 2004), and Russia (Oomes and Ohnsorge, 2005)).

Table 2: Co-Integration Tests for the Mark-up Theory of Inflation

Unrestricted Co-integration Rank Test (Trace)				
	Eigenvalue	Trace Statistic	Critical Value	prob
None	0.611821	53.23051	55.24578	0.0744
At most 1	0.399642	25.78816	35.0109	0.3388
At most 2	0.307934	10.99151	18.39771	0.3898
At most 3	0.010884	0.317363	3.841466	0.5732
Unrestricted Co-integration Rank Test (Maximum Eigenvalue)				
	Eigenvalue	Max-Eigen Statistic	Critical Value	prob
None	0.611821	27.44235	30.81507	0.1224
At most 1	0.399642	14.79665	24.25202	0.5156
At most 2	0.307934	10.67415	17.14769	0.338
At most 3	0.010884	0.317363	3.841466	0.5732

Table 3: The Long run Coefficient for the Monetary theory of Inflation

	Coefficient	Standard Error	t-statistic
Broad money	1.0160	0.0417	24.36
GDP	2.5421-	0.3634	6.99-
Interest rate	0.01444	0.0295	4.89

Based on the above findings, we conclude that inflation could be a monetary phenomenon and there is a strong long run relationship between the rate of inflation and the growth rate of money supply in Iran. This does not mean that other factors and especially cost push factors are not important in the short run developments of inflation. Also, it is necessary to conduct more empirical work to see if the price level is exogenous to the money supply that is not the focus of current study.

Conclusion

Iran has experienced double-digit inflation rates almost for about four decades. Although there have been some supply side shocks to the economy like the war with Iraq, the inflation has been high beyond those events. In fact, the record rate of inflation was experienced about seven years after the end of the war. Although the most distinguished economists in the country believe that Iran's inflation is mainly a monetary phenomenon and the result of the growth of money supply that itself is mainly the result of budget deficit and in some periods the result of the increase of the foreign reserves of the central bank, some believe that cost push factors could be important in the explanation of inflation in Iran.

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After a description of Iran's economy and the episodes of high and low inflation in Iran's history and a short review of literature, we have focused on the long run determinants of inflation empirically. First, we have used the raw data on the rate of inflation and the growth rate of money supply and then the filtered data on the same variables to show that the relationship between the rate of inflation and the growth rate of money supply is not much strong in the raw data but very strong in the filtered or low frequency data that is more in accordance with the theoretical background of the monetary theory. Then, we have used the co-integration VAR method to test for the existence of the long run relationship between the movements of the price level and both monetary factors and cost push factors. Our empirical findings imply a strong long run relationship between the rate of inflation and the growth rate of money supply and not long run relationship between the rate of inflation and the cost push factors. Therefore, monetary theory of inflation is not inconsistent with the long run movements of inflation in Iran.

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