

A TWO-WAY RELATION BETWEEN INFLATION AND PUBLIC SECTOR ECONOMICS: THEORY WITH AN APPLICATION TO THE CASE OF ISLAMIC REPUBLIC OF IRAN

A. Jafari-Samimi
University of Mazandaran

Abstract

The purpose of this study is to provide a two-way relation between inflation and public sector economics. It is shown that since in general considerable ambiguity surrounds the relation between inflation and budget deficit across countries, the case of each country must be studied individually. In a simultaneous equation model in which both inflation and government budget deficit are considered as endogenous variables, we have shown in economics where money creation is the only means of financing government budget deficit, how inflation and budget deficit interact with each other. The application of this model to the case of the Islamic Republic of Iran as an example of a developing country which has not experienced hyperinflation, supports the hypothesis that higher budget deficit raises the inflation rate which, in turn, results in a higher budget deficit.

The purpose of this paper is to show that there is a two-way relationship between inflation and public sector economics¹ and the relationship is not simple as it may seem to be. In other words, while government budget deficit may cause higher inflation, government expenditure and revenue and therefore government budget deficit is itself affected by the inflationary process. Therefore, inflation and budget deficit are both considered as endogenous variables.

It is shown that although in general there may be some ambiguity with respect to the effect of budget deficit on inflation and vice versa, as far as the features of public sector economics in most developing countries are concerned, we have presented that higher budget deficit causes monetary base to increase and this, by increasing money supply, raises the rate of inflation. Similarly, as a result of higher inflation, budget deficit increases; therefore the process of self-generating inflation continues as long as budget deficit is not being eliminated. The empirical part of this paper, concentrating on the case of the Islamic Republic of Iran as a typical example of developing countries, supports the above hypothesis.

The rest of this paper proceeds as follows: in the next section the theoretical impact of budget deficit on inflation is discussed. The theoretical analysis of inflation on budget deficit is discussed after that. In the next section, by concentrating on the features of public sector economics in most developing countries, we derive the basic two-way simultaneous equations model in which budget deficit and inflation are both considered as endogenous variables. The estimation results using

the data for Islamic Republic of Iran as a typical developing country are shown after that. The concluding section brings out the major implications of the study.

Impacts of budget deficit on inflation: theoretical analysis

An important and arguable question is whether higher government budget deficits are always correlated with higher inflation. Sargent and Wallace (1985) maintain that financing government budget deficits by money creation causes higher inflation; therefore, they answered the above question positively. But it should be mentioned that there is ambiguity with respect to the relation between budget deficit and inflation because deficit can be financed by borrowing as well as through money creation.

In general, as far as the financing of government budget deficits is concerned, the following identity can be written.

Government deficit financing = money creation + internal debt financing + external debt financing.

Therefore, the impact of deficit on inflation depends on how they are financed. According to Easterly and Schmidt-Hebbel (1993) money creation causes inflation. Domestic borrowing means that the government increases its demand for available credit, therefore the price of credit – that is, interest rate – must go up which causes a fall in private investment. In other words, government budget deficits displace or “crowd out” productive private investment.² External borrowing leads to a current deficit and sometimes may cause an external debt crisis.

Following Dornbusch, Sturzenegger and Wolf (1990), it can be argued that in economies like most of the developing countries, where money creation is the only way to finance government budget deficit, the budget deficit becomes a principal determinant of money growth and inflation.³

McCallum (1984) considers the possible theoretical validity of the following "monetarist hypothesis": that a constant, positive government budget deficit can be maintained permanently and without inflation if it is financed by the issue of bonds rather than money. He has shown that the monetarist hypothesis is defined exclusive of interest payments, but that it is valid under the usual definition.⁴

In general, despite the ambiguities with respect to the impact of the government budget deficit on inflation, the budget deficit in different countries may cause the following:⁵

1. Can stimulate the economy when it is performing below full employment, or when there is adequate productive capacity. Under this circumstance there would be no pressures on inflation to rise.
2. Can lead directly to an increased inflationary process. This is true when as a result of increasing demand caused by higher government budget deficits, aggregate supply does not increase to adjust itself to the increasing demand.
3. If government budget deficit is financed by public borrowing and if private investment is highly sensitive to the rate of interest, then government budget deficit would crowd out private investment and therefore reduce short-run growth which in the long-run would have an adverse effect on inflation.
4. If government budget deficit is financed mostly by money creation, this would result in an injection of new money into the economy and because too much money chases too few goods, it leads to increased inflation.

Impacts of inflation on budget deficits: theoretical analysis

It should be mentioned that inflation also affects government expenditures and tax revenue and therefore government budget deficits. During the hyperinflation periods of this century, it was generally acknowledged that inflation reduced the revenue of governments and that, by implication, deficits would be smaller if inflation could be reduced.⁶

In terms of tax revenue, two important factors play an essential role. These are the elasticity of tax with respect to nominal income and the length of time

between tax assessment and tax payment, or the "collection lag".⁷ Inflation will erode the real value of all taxes with an elasticity below one.⁸ The adverse response of taxes and therefore deficit to inflation is now known as the Olivera-Tanzi effect.⁹

If taxes are not indexed, the real value of government tax income will be reduced due to the existence of the collection lag. At any given rate of inflation, the longer the lag, the greater the reduction in the real value of tax revenues. Similarly, at any given collection lag, the faster the inflation is, the greater the reduction will be.

Following Tanzi (1978), we may make a distinction between six cases of different elasticities and collection lags:

	Long lag	Short lag
Elasticity less than 1	A	B
Elasticity equal to 1	C	D
Elasticity greater than 1	E	F

Case A is the most unfavourable for the real value of tax income, while case F is the most favourable. In case D inflation may have little effect on real tax income. Cases A and C are most typical for the most developing countries. Therefore, in these countries real value of government tax revenue as a result of inflation falls drastically.¹⁰

In addition, it has been experienced in reality that inflation deteriorates tax compliance, and so this public demoralization effect causes the tax income to decrease faster.

As far as the impacts of inflation on government expenditures are concerned, the following channels are being identified.

1. Salaries and wages, a major component of government expenditures, usually lag prices in the early stages of inflation and later they are subject to irregular adjustments. With increased inflation and unchanged indexation intervals for wages and salaries, then the average real public sector wage between adjustment dates declines.
2. Nominal interest payments on domestic borrowing now includes an inflation premium. This will cause government debt service to rise.
3. The real value of government payments on long run borrowing which are fixed in nominal terms declines.
4. Subsidies to state-owned enterprises often have to be increased during inflationary periods, because their selling prices lag behind their costs.

Aghevli and Khan (1978) have shown that government expenditures are adjusted more quickly to

inflation than taxes are, with the result that the budget deficit is enlarged.¹¹

Testing the Aghevli-Khan hypothesis for a sample of 24 developing countries, Heller (1980) concluded that the net impact of inflation on the budget deficit is not generally predictable. Heller found that expenditures did adjust more rapidly than taxes in more than half of the countries in the sample, but the opposite was the case in a large minority of countries. His findings indicate that as the inflation rate accelerates, expenditures adjust more rapidly than taxes, but when the inflation rate stabilizes at a new high level the difference in speed of adjustment tends to vanish, with both expenditures and revenues settling at lower real level than in the low-inflation period.

Combining the two-way relation impacts between inflation and budget deficits, it is impossible to come up with a certain and unique conclusion across countries. Table (1) shows in reality any kind of relation between inflation and government budget deficit may be observed across countries. In other words, although some countries with high inflation experienced relatively high budget deficit (Argentina, Brazil and Mexico),¹² there are countries with low inflation rate which experienced relatively high budget deficit (Morocco, Zimbabwe and India). Furthermore, it is seen from Table (1) that some countries with relatively high

inflation experienced relatively low budget deficit (Ghana, Colombia and Chile).

To sum up, it is reasonable to say that considerable ambiguity exists on the relation between inflation and government budget deficit across countries.¹³ Therefore, one must look at individual cases.

A two-way simultaneous equations model

Most developing countries share the following features in their public sector economics.¹⁴

1. A low tax-GDP ratio.
2. A relatively high government expenditures-GDP ratio.
3. Their central governments run a large deficit each year.¹⁵
4. Their government budget deficits are largely financed through borrowing from Central Banks.¹⁶
This method of deficit financing is responsible for a sharp increase in their money supply.
5. The deficit is sometimes due partly to government reluctance to impose sufficient taxes or tax reforms to cover planned expenditures and partly as mentioned earlier to the fact that the nominal value of taxes, do not increase with inflation, whereas nominal government expenditures do.
6. Tax collection is sometimes faced with a

Table 1. Inflation and government budget deficits in some developing countries (1980-1989)

Country	Inflation rate: average annual rate of GNP deflator (percent)	Central government budget deficit as a Percentage of GNP (average annual rate)
Argentina	334.5	6.9
Zimbabwe	10.9	9.2
Morocco	7.4	8.6
Iran, I.R.	14.0	9.1*
Mexico	72.8	7.4
Pakistan	6.7	6.7
Chile	20.5	0
Colombia	24.3	1.0
Ghana	43.9	2.1
Brazil	227.9	6.6
South Korea	5.1	1.0
India	7.7	7.3
Thailand	3.2	3.3

Notes: Source: World Bank, World Development Report, various issues (1984-1993)

*Calculated from Statistical Yearbook of Iran's Center of Statistics, various issues (1975-1990)

considerable lag after assessment, therefore by the time that taxes are actually paid, their real values have depreciated

The result of the above characteristics – especially the fact that money creation is the only means of deficit finance – is that the budget deficit becomes a main determinant of monetary base growth which, in turn, determines the growth of money supply. In addition, faster money supply growth in these countries leads to a higher inflation which, in turn, causes the nominal deficit to be larger than otherwise would have been the case. Therefore, inflation also determines the deficit. If the additional deficit is financed by more money creation, the above process will be repeated again.¹⁷

Having discussed the above two-way relation between inflation and government budget deficit in developing countries, the following four simultaneous equations models explain the process by which inflation and budget deficit are related to each other.¹⁸

- (1) $\frac{dMB}{MB} = f(BD)$
- (2) $\frac{dM}{M} = g\left(\frac{dMB}{MB}\right)$
- (3) $\frac{dP}{P} = h\left(\frac{dMB}{MB}\right)$
- (4) $BD = Q\left(\frac{dP}{P}\right)$

Where, $\frac{dP}{P}$ denotes the rate of inflation, $\frac{dM}{M}$ is the rate of money supply growth,¹⁹ $\frac{dMB}{MB}$ is the rate of growth of monetary base²⁰, and BD is government budget deficit.²¹

Equation (1) shows that an increase in government budget deficit raises the monetary base.²² Equation (2) relates the rate of money supply growth to the rate of increase in monetary base. In other words, this equation shows that an increase in the rate of growth of monetary base implies an increase in the rate of volume of money supply. Equation (3) indicates that an increase in the rate of money supply results in an increase in the rate of inflation.²³ Finally, equation (4) examines the impact of inflation on the nominal budget deficit. It is assumed that an increase in inflation rate results in an increase in government budget deficit.

As it is seen in our four simultaneous equations model, all variables are considered to be endogenous. The following specific form has been used to estimate

the two-way relation between budget deficit and inflation:²⁴

- (1)' $\text{Log}MB_t = \alpha_0 + \alpha_1 BD_t + \alpha_2 \text{Log}MB_{t-1} + U_{1t}$
- (2)' $\text{Log}M_t = \beta_0 + \beta_1 BD_t + \beta_2 \text{Log}M_{t-1} + U_{2t}$
- (3)' $\Delta \text{Log}P_t = \gamma_0 + \gamma_1 M_t + \gamma_2 \text{Log}Y_t + U_{3t}$
- (4)' $BD_t = \lambda_0 + \lambda_1 \Delta \text{Log}P_t + \lambda_2 \text{Log}BD_{t-1} + U_{4t}$

Where the expression $\Delta \text{Log}P_t = \text{Log}P_t - \text{Log}P_{t-1}$ denotes percentage change in P (Price index) from the end of period t-1 to end of period t (i.e., the rate of inflation); Y_t is the real GDP.

MB_t , M_t , $\Delta \text{Log}P_t$, and BD_t are endogenous variables. MB_{t-1} , M_{t-1} , BD_{t-1} and Y_t are non-endogenous variables, and U_{it} (i=1,2,3,4) are the error terms.

Empirical results: application to the case of Iran

Previous empirical studies on the relationship between government budget deficit and inflation have either used a single-equation model (i.e., one-way relation between budget deficit and inflation) or have applied their models to countries experiencing hyperinflation.²⁵

Our empirical work is based on the data for Islamic Republic of Iran for the period 1973-1990 as a typical developing country which has not yet experienced hyperinflation and, as mentioned earlier, it is an example of economies where money creation has been the only means of deficit finance. Table 2 presents the relevant data required to estimate our four simultaneous equations (1)' - (4)'.²⁶

Now we shall examine the results of the estimation.²⁷

- (1)' $\text{Log}MB_t = 1.075^{**} + 0.00015^{*} BD_t + 0.874^{*} MB_{t-1}$
(7.889) (2.178) (36.9) $R^2 = 0.998$
- (2)' $\text{Log}M_t = 0.548^{*} + 0.503^{*} \text{Log}MB_t + 0.441^{*} \text{Log}M_{t-1}$
(4.002) (2.704) (2.467) $R^2 = 0.998$
- (3)' $\Delta \text{Log}P_t = 295.12^{**} + 1.228 \text{Log}M_t - 31.3^{**} \text{Log}Y_t$
(2.009) (0.945) (-1.956) $R^2 = 0.237$
- (4)' $BD_t = -527.47 + 60.5^{**} \Delta \text{Log}P_t + 0.486^{**} BD_{t-1}$
(-1.82) (2.007) (2.632) $R^2 = 0.562$

In equation (1)' both estimates of α_1 and α_2 are significant at the 5 percent level. From this equation we see that although the effect of budget deficit on the growth of monetary base is small, it still shows there is a positive relation between the two variables. In other

words, an increase in budget deficit by 1 billion rials raises the rate of monetary base growth by 0.015 percentage points. In equation (2), both estimates B_1 and B_2 are significant at the 5 percent level. From this equation it is seen that partial elasticity of money supply with respect to monetary base is 0.5 which indicates as a result of a one percentage change in monetary base money supply rises by half a percentage point. In equation (3), although we observe a positive relation between money supply growth and changes in the rate of inflation, the coefficient is not significant. In this equation, the negative relationship between the real growth of GDP and inflation rate is also verified. Finally, equation (4) implies inflation in the Islamic Republic of Iran has had a positive effect on the government budget deficit during the period 1973-1990. In other words, as a result of an increase in the inflation rate by one percent, the government budget deficit increased by almost 60 billion rials.

Our empirical results with respect to the case of the Islamic Republic of Iran support the hypothesis that there is a two-way relationship between government

budget deficit and inflation. A higher budget deficit, through monetary base and money supply channel raises the rate of inflation which, in turn, causes the nominal deficit to be larger than would otherwise have been the case. If additional deficit is financed by more money creation, the above process would be repeated again.

If government uses measures to eliminate its deficit then equation (4), would be eliminated from the system of simultaneous equations and thereafter neither a two-way relation between inflation and budget deficit nor the process of perpetuating inflation could be observed.

Conclusion

The purpose of this paper has been to examine a two-way relation between inflation and public sector economics. For this purpose, we concentrated on a theoretical analysis to determine how inflation and budget deficit interact with each other. We found out in general there were considerable ambiguities on the relation between inflation and government budget deficit across developing countries due to different methods of financing deficits as well as macroeconomic performance of each country. Therefore, it has been

Table 2. Macroeconomic and public sector performance in Iran (Billion of Rials 1973-1990)

Year	M	BD	P (CPI)	MB	Y (In 1982 prices)
1973	202.7	67.4	24.4	188.3	7977.5
1974	327.2	116.9	28.2	310.9	9342.7
1975	446.5	193.8	30.9	419.6	9227.8
1976	611.2	169.8	36.1	566.9	11254.3
1977	790.5	458.0	45.1	738.6	11183.8
1978	1236.5	608.9	49.6	1209.8	10070.8
1979	1665.8	528.3	55.2	1543.0	10543.1
1980	2203.3	972.5	68.2	1988.9	9323.1
1981	2707.5	937.0	83.9	2654.9	9175.2
1982	3483.9	775.7	100.0	3405.9	10335.4
1983	3869.6	1072.2	114.8	3753.7	11536.7
1984	4557.6	718.0	126.7	4239.5	11587.1
1985	4923.6	621.9	135.4	4909.2	11607.4
1986	5811.0	1375.0	167.5	6062.1	9861.7
1987	6776.8	1429.8	213.9	7542.0	10019.8
1988	7758.1	2125.2	275.7	9519.5	9234.3
1989	8987.2	1142.1	323.8	10310.6	9514.6
1990	11195.3	418.6	352.8	10711.7	10930.2

Note: Source: Iran's Center of Statistics (1975-1990)

emphasized that the case of each country must be examined individually. We have shown that in economies where money creation is the only means of deficit finance there would be a two-way relation between inflation and government budget deficit.²⁸

In a simultaneous equations model where both inflation and government budget deficit were considered as endogenous variables, it has been shown how budget deficit through the channel of monetary base and money supply became a main determinant of inflation and conversely how inflation through the channel of taxes and expenditures affected the budget deficit.

Our empirical study which examined the case of the Islamic Republic of Iran as a typical developing country which has not yet experienced hyperinflation, supported the hypothesis of a two-way relation between inflation and budget deficit. We have shown if government applies measures to eliminate its deficit or uses other means of deficit finance, then neither the two-way relation between inflation and budget deficit nor the process of perpetuating inflation could exist anymore.

Notes:

1. In this paper we concentrate on budget deficit (i.e., the difference between government expenditures and revenues) which measures the net impact of public sector variables and therefore the government performance in the economy.
2. It should be mentioned that the crowding-out argument is not always correct. If the increased government domestic borrowing results from a tax cut, then the net income after tax (i.e., disposable income) would rise by the same amount. Some of the increase in income (depending on the marginal propensity to save) will be saved. As a result, the borrowing demands of the private sector fall and there is no pressure on interest rates to rise. Penner (1988) argues that in reality the correlation between budget deficits and interest rates would most likely be negative.
3. In their model by assuming the budget deficit as a share of real GDP and by the assumption that velocity is a linear function of inflation (i.e., $v = a + b\pi$) using the equation of exchange, they obtained an expression for steady-state inflation.
The above equation (which is equation (5) in their paper), indicates that inflation is an increasingly non-linear function of the government budget deficit. It should be mentioned that we could have written the above equation as follows:
This equation indicates that budget deficit itself can be a nonlinear function of inflation. Therefore, there will be a two-way relation between inflation and government budget deficit.

4. It should be added that there are many problems related to the measurement of budget deficit. These problems occur because it is difficult to measure both government incomes and expenditures. For more information see Boskin (1982).
5. As it has been discussed, we should mention other factors such as the performance of the financial system, monetary rules used by the country and the exchange rate system also play an important role in this regard. For example, in a system of fixed exchange rates, financing by money creation is less inflationary than financing by borrowing from the public because it keeps interest rates down. The opposite is true under the flexible rate system where, financing deficit through public borrowing may be less inflationary than money printing. (In a flexible exchange rate system, the exchange rate changes are negatively related to the inflation rate and positively related to the rate of interest.)
6. See Brescianti-Turronic (1937), Graham (1930), and League of Nations (1946).
7. In addition to tax revenues, it should be added that the lack of full indexation of public sector prices, such as for energy, transport, and telephones also caused public enterprise revenue to fall and government budget deficit to rise as a result. For example, during the inflationary period of 1985-88 in Peru, tax collection as a percentage of GDP fell from 13 in 1985 to 11 in 1986, to 9 in 1987 and to 7 percent in 1988 while public enterprise revenue as a percentage of GDP for the same period fell from 26 to 18, to 14, and to 12 percent respectively and as a result the government budget deficit as a percentage of GDP rose from 6, to 10, to 12 and to 12 percent respectively. See Dornbusch, Sturzenegger, and Wolf (1990, p.13).
8. Inflation will have no impact on the real value of taxes with elasticities equal to one (i.e. proportional taxes). It will increase the real value of taxes with elasticities greater than one (i.e. progressive taxes).
9. See Olivera (1967) and Tanzi (1977, 1978).
10. The effect of inflation on tax revenues, given the elasticities and collection lags, will be greater the higher the tax ratio will be. In other words, a country which has a good tax system may suffer a greater loss of real tax income than a country with a poor tax system.
11. If, as is the case in most developing countries, the additional deficit is financed by more money creation, inflation will be further increased and the process will become self-generating. This statement verifies the need of a two-way analysis between inflation and government budget deficit.
12. Even in this group we observe that a country with high inflation does not necessarily have a higher budget deficit ratio.

13. The lack of a significant relationship across countries between inflation and government budget deficit as mentioned earlier, is mainly due to the different methods of financing deficit as well as other factors such as macroeconomic performance of each individual country.
14. Some of these features have been discussed by Dutton (1971) too.
15. Sometimes the amount of government budget deficit has been even greater than the revenue. For example, the case of the Islamic Republic of Iran in 1988.
16. For example, in the Islamic Republic of Iran, the annual percentage of government deficit financed through money creation for the period 1986-1990 was 93.4, 96.1, 96.3, 99.6 and 133.1 respectively.
17. If the government uses measures to eliminate its budget deficit, or attempts to use other methods of financing this process would be stopped and any inflation experienced thereafter would not be self-perpetuating.
18. It should be mentioned that similar conclusions, but for a two-way relationship between money and prices, were reached by Aghevli and Khan (1978), Frenkel (1977) and Jacobs (1977).
19. Money supply is defined as currency outside banks plus demand deposits held by the public.
20. Monetary base consists of currency held by the public plus reserves (i.e., currency held by bank plus commercial bank deposits held by central bank).
21. In another version, we used the budget deficit as a percentage of GDP in equations (1) and (4). This version of the model and the estimated results are shown in the appendix.
22. Since changes in monetary base are mainly due to the increase of foreign reserves as well as government bonds held by central bank.
23. It is assumed that real output cannot adjust itself to higher aggregate demand caused by increase in money supply which is usually true for most developing countries. This equation can be interpreted as an application of the quantity theory of money.
24. In this paper is taken to be the base of all logarithms.
25. See as an example Dutton (1971) and Saunders (1985).
26. We have used two-stage least squares (2SLS) method to estimate equations (1) - (4). Since each equation in the model contained more than one endogenous variable, therefore the ordinary least squares (OLS) method could not be used. For more information see Maddala (1988).
27. Figures in paranthesis denote the t-statistics. * denotes significance at the 5 percent level and ** denotes significance at the 10 percent level.
28. For example, through introducing tax reforms to raise its revenue on the one hand and through privatization and cutting unproductive government expenditures on the other hand.

References

- Aghevli, Bijan, B., and Khan, Mohsin S. (1978). Government deficits and the inflationary process in developing countries, *International Monetary Fund Staff Papers*, 25, 383-416.
- Boskin, M. (1982). Federal government deficits: Some myths and realities. *American Economic Review*, Papers and Proceedings, 72, 296-303.
- Brescianti-Turronic, C. (1937). *The economics of inflation: A study of currency depreciation in post-war Germany* (Millicent. E. Sayers, Trans). London: G. Allen and Unwin Ltd.
- Dornbusch, R., F. Sturzenegger, F. & Wolf, H. (1990). Extreme Inflation: Dynamics and Stabilization. *Brookings Paper on Economic Activity*, 2, 1-84.
- Dutton, D. S. (1971). A model of self-generating inflation, the Argentine case. *Journal of Money, Credit and Banking*, 3, 245-262.
- Easterly, W. & Schmidt-Hebbel, K. (1993). Fiscal deficits and macroeconomic performance in developing countries. *The World Bank Research Observer*, 8 (2), 211 - 37.
- Frenkel, J. A. (1977). The forward exchange rate, expectations, and the demand for money: The German hyperinflation. *American Economic Review*, 67, 653 - 70.
- Graham, D. (1930). *Exchange, prices and production in hyperinflation Germany 1920 - 1923*. N. J., Princeton: Princeton University Press.
- Heller, P. S. (1980). Impact of inflation on fiscal policy in developing countries. *International Monetary Fund Staff Papers*, 27, 712- 48.
- Iran's Center of Statistics. (1975-1990). *Statistical Yearbook*. Tehran, Islamic Republic of Iran.
- Jacobs, R. L. (1977). Hyperinflation and the supply of money. *Journal of Money, Credit and Banking*, 9, pp. 287 - 303.
- League of Nations. (1946). *The Course and Control of Inflation: Review of Monetary Experience in Europe after World War I*, Geneva.
- Maddala, G. S. (1988). *Introduction to econometrics*. N.Y.: Macmillan.
- McCallum, B. T. (1984). Are bond financed deficits inflationary? A Ricardian Analysis. *Journal of Political Economy*, 92, 123- 35.
- Olivera, J. H. G. (1967). Money, prices and fiscal lags: A note on the dynamics of inflation. *Banco Nacional del Lavoro Quarterly Review*, 20, 258- 67.

- Penner, R. G. (1988). The consequences of persistent large budget deficits. In H. Cavanna (Ed.), *Public sector deficits in OECD countries*. London: Macmillan Press.
- Sargent, T. J. and Neil, W. (1985). Some unpleasant monetarist arithmetic. *Federal Reserve Bank of Minneapolis Quarterly Review*, 9, 15-31.
- Saunders, P. (1985). Public expenditure and economic performance in OECD countries. *Journal of Public Policy*, 5, 1-21.
- Strauss- Kahn, D. (1988). Public sector deficits and the Growth of National Debt. In H. Cavanna (Ed.), *Public sector deficits in OECD countries*. London: Macmillan Press.
- Tanzi, V. (1977). Inflation, lags in collection, and the real value of tax revenue. *International Monetary Fund Staff Papers*, 24, 154-67.
- (1987). Inflation, real tax revenue, and the case for inflationary finance: Theory with an application to Argentina. *International Monetary Fund Staff Papers*, 25, 417-51.
- World Bank, (1975-1993). *World Development Report*. Oxford: Oxford University Press.

Appendix

The following model is an alternative to our four simultaneous equations model (1)-(4) where government budget deficit as a percentage of nominal GDP (i.e. BD/Y) has been substituted for government budget deficit (i.e. BD):

- $$(1)'' \text{LogMB}_t = \alpha_0 + \alpha_1(BD/Y)_t + \alpha_2 \text{LogMB}_{t-1} + U_{1t}$$
- $$(2)'' \text{LogM}_t = \beta_0 + \beta_1 \text{LogMB}_t + \beta_2 \text{LogM}_{t-1} + U_{2t}$$
- $$(3)'' \Delta \text{LogP}_t = v_0 + v_1 M_t + v_2 \text{LogY}_t + U_{3t}$$
- $$(4)'' (BD/Y)_t = \lambda_0 + \lambda_1 \Delta \text{LogP}_t + \lambda_2 (BD/Y)_{t-1} + U_{4t}$$

Equations (1)''-(4)'' have been estimated by two-stage least squares method. The following are the empirical results using the data for the Islamic Republic of Iran for the period 1973-1990.

- $$(1)' \text{LogMB}_t = 0.764^* + 0.0101(BD/Y)_t + 0.921^* \text{LogMB}_{t-1}$$
- (6.478) (1.472) (70.74) $R^2 = 0.997$
- $$(2)' \text{LogM}_t = 0.552^* + 0.495^* \text{LogMB}_t + 0.448^* \text{LogM}_{t-1}$$
- (3.997) (2.639) (2.484) $R^2 = 0.998$
- $$(3)' \Delta \text{LogP}_t = 295.14^{***} + 1.232 \text{LogM}_t - 31.31^{**} \text{LogY}_t$$
- (2.01) (0.949) (-1.957) $R^2 = 0.237$
- $$(4)' (BD/Y)_t = -1.534 + 0.397 \Delta \text{LogP}_t + 0.3595(BD/Y)_{t-1}$$
- (-0.402) (1.589) (1.458) $R^2 = 0.333$

Figures in parantheses denote the t-statistics,* denotes significant at the 5 percent level and ** denotes significant at the 10 percent level.

As we see this version of the model also supports the two-way relation between government budget deficit and inflation in the Islamic Republic of Iran. However, the statistical results of this version are somewhat weaker than the original version.