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REASSESSING THE EFFECT OF FISCAL AND MONETARY POLICIES IN IRAN: THE ST. LOUIS EQUATION REVISITED

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The purpose of this study is to observe the effect of fiscal and monetary policy actions on the Iranian economy. The famous St. Louis equation, an econometric model with lagged independent variables, is the key model for this study. Interestingly, the findings are converse to what scholars found when examining Western countries, especially the United States. With regard to Iran's case, monetary policy is much less effective than fiscal policy in stimulating permanent economic growth. It is suggested that government interference is the reason. Furthermore, these findings support the equation's general validity and its application, due to its parsimonious construction.

Keywords: Fiscal Policy, Iran, Monetary Policy, St. Louis Equation, TRAMO/SEATS
JEL classification: E52, E62, E63

1. INTRODUCTION

For over thirty years, the Iranian economy has been under great pressure, with sanctions and embargos applied by many western countries (Ilias, 2009; gives an interesting summary). As a result of such pressure, a progressively more intense belief, on the part of most Iranian politicians and various sectors of the public, is that because the government is responsible for stabilizing and stimulating economic growth, it is also therefore obliged to explore all financial and political possibilities without exception or restriction. This attitude could potentially also foster an excessive and inefficient use of fiscal assets by the Iranian government. Notably, some politicians could use such policies more to pursue their own political objectives, rather than for the public and national benefit. Mazarei (1996) argues that populist economic policies have mainly influenced Iran's economic conditions since the post-revolution period after 1979. This issue is amplified by the fact that the Central Bank's monetary policy is controlled by

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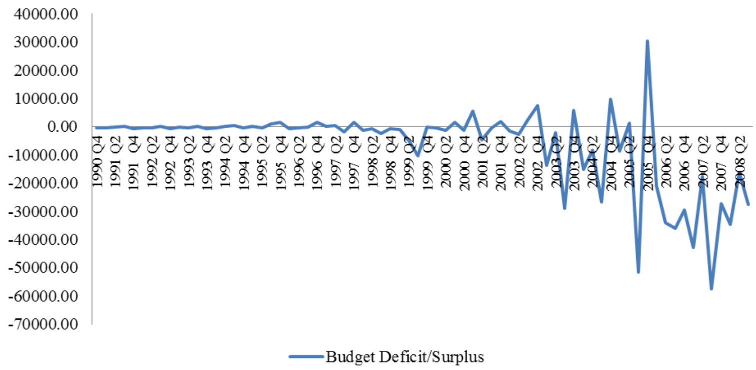
the government. Naghshineh-Pour (2009) criticizes the dependant central bank policy with regard to Iran's banking problems. He (on page 2) comments further: "A government-dependent central bank often tenders short-sighted politicians to try to wrangle a temporary economic roar to promote themselves". These concerns imply an insignificant economic effect induced by monetary actions. Although such concerns are frequently voiced, they are rarely investigated. Nevertheless, this study aims to show that these concerns are justified as empirical results demonstrate.

The St. Louis equation may no longer be revolutionary and provocative, but so far, its critics have still failed to present any clear evidence to refute it. One notable advantage of the model is indeed its simplicity, especially when reliable data is scarce. For instance, due to information barriers and restrictions in many non-western countries, such a model can be an excellent tool, especially for a qualitative assessment of the impact of fiscal and monetary actions on economic growth. Certainly, some scholars may criticize that the model's simplicity is what makes it inadequate in analyzing policy effects on complex economics, especially for the case of developing countries. Indeed, it's debatable whether complexity can solve this issue. Hence, Summers (1991) points out that "the empirical facts of which we are most confident and which provide the most secure basis for theory are those that require the least sophisticated statistical analysis to perceive". The St. Louis equation is certainly an unsophisticated approach and hence a good analysis tool for those scholars who agree with Lawrence Summer's point of view. The results of the study are presented in the third section of this paper, which is followed by a discussion. In the last section, we derive some conclusions.

The paper is organized as follows. Section 2 introduces the issue of Iran's subsidized economy. Section 3 presents a short literature review regarding the St. Louis equation. The following Section 4 introduces the model and data while Section 5 presents the results and robustness checks. Section 6 presents policy implication and Section 7 finally concludes.

2. THE IRANIAN ECONOMY AND ITS FISCAL DEPENDENCE

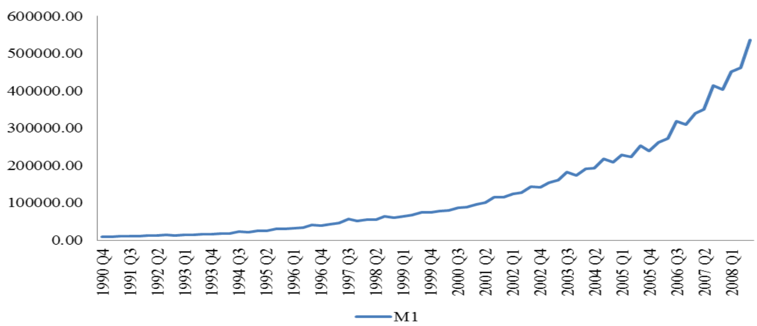
Since the Islamic revolution in the late seventies, massive and ongoing subsidy payments and investments in both the public and private sector have burdened the state's budget. According to Paulo and Zakhavova (2009), implicit energy subsidies in Iran were more than double the size of capital outlays in 2006. Villafuerte and Lopez-Murphy (2010) note a massive deterioration in Iran's fiscal balances in 2008. Figure 1 reflects how volatile Iran's budget has become since the 1990s. Notably, from 1990 to 2007, the mean share of oil revenue to total fiscal revenue accounted for about 57 percent, as Husain *et al*. (2008) point out. Thus, as for all oil exporting countries in the Middle East, oil prices play a significant role in Iran's fiscal policy spending activities. These activities can be justified through the objective of achieving economic growth and stability, in despite of sanctions and international political issues.



Source: Data received from Iran's Central Bank online data base.

Figure 1. Iran's Financial Budget Development from 1990-2008, in Billions of Iranian Rials

In observing the situation more closely, it is evident that the key difference between Iran and most developed countries is that its government has unlimited power in the use of monetary and fiscal politics in the interests of fostering economic growth. The Iranian president has the power to dismiss the Central Bank's president (which occurred in 2008), whenever monetary policy which is favored by the government is not provided. By contrast, in many developed countries, the Central Bank is able to choose its policies freely, without pressure or interference by the government. Naghshineh-Pour (2009) argues that an independent central bank ensures higher performance and economic stability. Therefore, in most countries, the only path for a government to address its economic ambitions is through fiscal policy. However, Iran's government has freedom of choice between both instruments. The continuous increase in the supply of narrow money, as shown in Figure 2, implies a very inflexible and solely growth-oriented monetary policy.



Source: Data received from Iran's Central Bank online data base.

Figure 2. Growth of Narrow Money (M1) in Iran from 1990-2008, in Billions of Iranian Rials

Hence, fiscal and monetary policies have been, and still are, used simultaneously by the Iranian government to address and support economic targets. This study aims to explore the impact of fiscal and monetary policy on the Iranian economy. In order to achieve this objective, the well known St. Louis equation is used as a parsimonious model for observing the effect of fiscal and monetary actions on the Iranian economy.

3. LITERATURE REVIEW

The St. Louis model has faced considerable criticism since its introduction by Andersen and Jordan in 1968. As Batten and Thornton (1983a) point out, many critics are motivated largely by the fact that the model contradicts many prevailing convictions, through denying any lasting impact of fiscal policy on economic growth. This is furthermore highlighted by the significant long-run effect of monetary policy on economic growth. The St. Louis model may indeed seem suspect to many scholars as its empirical results often support the view of Monetarists. Indeed, the creators of the model considered themselves as such. Yet, Keynesian and Monetarists in the past have made all possible efforts either to invalidate or support the St. Louis equation. When studying the vast literature, taking into account a pro or contra position towards the model and its findings (e.g., Batten and Thornton, 1983a; De Leeuw and Kalchbrenner, 1969; Davis, 1969; Corrigan, 1970; Goldfeld and Blinder, 1972; Blinder and Solow, 1974; Modigliani and Ando, 1976; Koot, 1977; Schmidt and Waud, 1973; Barth and Bennett, 1974; Hafer, 1982), it is clear from the start, that the debate focused mainly on either validating or invalidating the results and the model itself by criticizing the composition of the model and/or the econometric techniques used.

Ahmed and Johannes (1984) as well as Batten and Thornton (1986) point to three major criticisms. First, a misspecification of the original model was claimed by Blinder and Solow (1974) as well as Modigliani and Ando (1976) since exogenous variables were not included. Second, De Leeuw and Kalchbrenner (1969) argued that an endogenity issue exists which may lead to spurious findings. Finally, it was argued that Andersen and Jordan (1968) did not choose relevant exogenous indicators of monetary and fiscal policy actions. Although De Leeuw and Kalchbrenner (1969) and Schmidt and Waud (1973) did not succeed in replicating the findings presented by Andersen and Jordan (1968), Batten and Thornton (1986) argue that differences resulted from differences in estimation software and the imposition of polynomial results. Indeed, some scholars, when conducting such recalculations, have used the wrong econometric techniques to analyze the model. For example, the joint testing of coefficient significances via the *t* test, rather than with the appropriate *F* test, meant that the model was methodologically unsound, as noted by Ahmed and Johannes (1984). Nevertheless, the debate itself led to various modifications and improvements of the model and its estimation procedure. Ahmed and Johannes (1984) revisit the critique, whilst Batten and Thornton (1986) present a very detailed summary of criticisms, in addition to their own analytical results in favor of the model. Interestingly, an application of the model for the case of oil producing countries was not part of this debate.

Nowadays the St. Louis Equation is rather regarded as an antique model which has been replaced by more modern theories and more sophisticated econometric models (e.g., Vector Autoregression). However, as Jordan (1986) correctly points out, the single-equation and simple approach used by Andersen and Jordan (1968) is an enduring and valuable contribution which should not be devalued. The St. Louis equation represents a very parsimonious approach which may bear more analytical value than many scholars assume. This paper not only presents a further development of the St. Louis equation but also its application for the case of a well-known, oil producing country without an independent Central Bank.

4. MODEL AND DATA

The original St. Louis equation consists of narrow money (M) and full employment government expenditure (G) as the exogenous variables of the model. Nominal GNP (Y) represents the endogenous variable and also the indicator of economic growth.

The model is estimated in the following form:

$$\Delta Y_t = \alpha + \sum \beta_i \Delta M_{t-i} + \sum \gamma_i \Delta G_{t-i} + u_t \,, \tag{1}$$

where the endogenous variable Y denotes nominal GNP. The money stock and high-employment government expenditure (fiscal policy indicator), being the exogenous variables, are denoted by M and G respectively. The usual random error is represented by u_t. As with all such models, the data in its level form is non-stationary, with the first-difference form denoted by the delta sign being computed. An alternative form of the model recommended by Carlson (1978), transforms variables into a growth rate form, instead of the first-difference form. Carlson's suggestion is based on his observation that the original equation in the first-difference form, suffered from non-constant error variances, whilst in the growth rate form, this issue is not present. Alternatively, data can be transformed into natural logarithmic form, before taking the first difference, as applied by Matthews and Ormerod (1978).

In response to another major criticism, namely that the original equation excluded important exogenous variables, the model was widely used in the following extended version. Batten and Hafer (1983) were among the first to apply it:

$$\Delta Y_t = \alpha + \sum \beta_i \Delta M_{t-i} + \sum \gamma_i \Delta G_{t-i} + \sum \delta_i \Delta E_{t-i} + u_t \,, \tag{2}$$

which includes merchandise exports E as an additional exogenous variable.

Since Equation (2) shows signs of misspecification, it is transformed by adding other monetary policy variables. Indeed, we assume that the Central Bank's monetary policy activities are not fully reflected by the narrow money variable. In this context, two new variables are introduced. Since the main Central Bank's goal is to control for inflation, controlling deposit rates and the currency exchange rate, namely the rate of Iranian Rials (IRR) to one US Dollar, are major policy actions. Hence, the initial equation is expanded by the following transformation:

$$\Delta Y_t = \alpha + \sum \beta_i \Delta M_{t-i} + \sum \gamma_i \Delta G_{t-i} + \sum \delta_i \Delta E_{t-i} + \sum \lambda_i \Delta D_{t-i} + \sum \rho_i \Delta X_{t-i} + u_t \tag{3}$$

with D representing the three month deposit rate (in natural log form) and X standing for the natural log of the IRR/USD exchange rate. Both new variables are integrated by order one.

The appropriate lag length of the model has varied since its inception by Andersen and Jordan (1968). In Andersen and Jordan's study, they chose a lag length of three for all exogenous variables, and in order to estimate the equation, they assumed each distributed lag coefficient to lie on a fourth-degree polynomial. Another major criticism of the model is the constraint of the polynomial endpoint to a value of zero. Since its inception, various modifications have been introduced by scholars, which have resulted in different lag lengths and/or a replacement of the polynomial estimation technique by ordinary least squares (OLS). Batten and Hafer (1983) prefer the OLS estimation technique, since they doubt an endpoint restriction to be valid for all countries. With regard to the appropriate lag length, they chose different lengths for each exogenous variable, letting M enter with five, G with nine, and E with eleven unconstrained lags. Batten and Thornton (1983a), however, allowed each variable to enter with nine unconstrained lags. Scholars tend to choose the appropriate lag length by referring to different decision criteria, such Andersen (1969) and Schmidt and Waud (1973) having the minimum standard error as the criterion. Batten and Hafer (1983) use an orthogonal regression technique, whereas Batten and Thornton (1983b) study pointed to the most likely insignificant effect of lag length choice on the qualitative results, which was confirmed previously by Elliot (1975). According to Elliot's study, neither lag structure nor the restrictions underlying the polynomial estimation technique affect the qualitative conclusions.

In this present study, Equation (2) represents the model applied, with all variables entered in natural logarithmic form. The appropriate lag length of one is chosen, by considering Akaike and Schwarz's values as decision criterions, since such measures account for the goodness of fit of the model, as well as for its parsimony. With regard to the rather limited number of observations, considering more lags will decrease the standard error value, but on the other hand, also consume more and more degrees of freedom, which would negatively affect the parsimony of the model. The model is estimated by using the OLS estimation procedure, as McDowell (2004) shows in his study that the polynomial estimation technique does not provide better numerical properties compared to OLS. Tests for heteroskedasticity and autocorrelation are also performed in order to confirm the model's stability, with the results presented in the following section. In order to evaluate the reliability of our parsimonious model, a vector-error correction model (VECM) is set up to evaluate our OLS results. For this, all variables in Equation (3) are transformed into a VECM and appropriate calculation procedures as described in Section 5 are conducted. Via the resultant model we are able to analyse the impact of our OLS model variables on *Y*, both in the short run and the long run.[1]

For calculation purposes, quarterly data was gathered for the third quarter of 1990, until the first quarter of 2008, from Iran's Central Bank time series database, which can be accessed through the bank's official website (http://www.cbi.ir). It should be noted that there is currently a lack of available data from this database, which is why it is not possible to examine a more extensive time frame in this study. It should also be noted that original data from Iran's Central Bank is provided in accordance with the Iranian calendar, which is a Solar Hejri calendar. Accordingly, the first quarter of the year starts at the end of the Gregorian calendar month of March, on approximately 22nd March.

5. ANALYSIS OF RESULTS

Unlike *E*, data for *Y*, *M* and *G*, suffer more or less from seasonality. The HEGY test -according to Hyllberg *et al*. (1993)- is conducted in order to detect the presence of unit-roots at seasonal frequencies. Deseasonalized data is obtained by applying the TRAMO/SEATS seasonal adjustment program (provided free of charge by the Spanish central bank, http://www.bde.es). Once the data is seasonally adjusted, the HEGY test clearly indicates variables integrated by order one, as seen from Table 1. It is evident that, with respect to the annual frequency, the joint annual *t*-statistics value is relevant.

Given the non-stationarity of all variables, the regression was estimated with variables in the first difference form. The estimated coefficient values and the analysis of variance are listed in Table 2.

Table 1. HEGY Quarterly Seasonal Unit Root Test for Seasonally Adjusted Variables

	Y	*M*	*G*	*E*	5% critical values	10% critical values
Frequency Zero	-1.3090	-0.5280	-1.7570	-0.6700	-3.0300	-2.6850
Bi-Annual	-5.1940	-4.7340	-4.9800	-3.7650	-3.0020	-2.6670
Lagged Annual	-6.0720	-5.6770	-6.1300	-5.0840	-3.5450	-3.2020
Annual	-3.0900	-4.8700	-0.9430	-4.2940	-1.9720	-1.5300
Joint Annual	32.1020	51.6370	20.0210	34.3010	6.5880	5.5230

[1] For a detailed explanation of a VECM please refer for instance to Kirchgässner and Wolters (2008).

Table 2. Estimation Results for Equation (2)

	Coef.	Std. Err.	t-statistics	P-value	[95% Conf	Interval]
ΔM	-0.0074	0.1531	-0.05	0.961	-0.3135	0.2986
ΔM_{t-1}	0.3856	0.1535	2.51	0.015	0.0786	0.6926
ΔG	0.1013	0.0255	3.97	0.000	0.0503	0.1523
ΔG_{t-1}	-0.0264	0.0264	-1.00	0.321	-0.0794	0.0264
ΔE	0.1435	0.0194	7.40	0.000	0.1047	0.1823
ΔE_{t-1}	-0.0297	0.0197	-1.51	0.137	-0.0692	0.0097
Constant	0.0302	0.0109	2.76	0.008	0.0083	0.0520

Source	SS	df	MS	Number of Observations	69
				$F(6, 63)$	21.29
Model	0.0779	6	0.0129	Prob > F	0.0000
Residual	0.0378	62	0.0006	R-squared	0.6732
				Adj R-squared	0.6416
Total	0.1158	68	0.0017	Root MSE	0.0247

All independent variables are jointly significant. Interestingly, money supply growth is individually statistically insignificant, whilst the one-quarter previous demand yields statistical significance at the five percent level. The summed impact of money growth is insignificant at a one percent level, indicating no (short-run) effect on economic growth. Contrarily, government expenditure and net exports are individually highly significant at a one percent level, but not in their lagged form. Nevertheless, the summed impact of government expenditure is both positive and significant. The same qualitative result is found for net exports. Therefore, government expenditure and net exports imply a positive impact on the growth of Iran's economy. The Wald test results are presented in Table 3. In this regard, a one percent increase in government expenditure causes an increase of about 0.07 percent in GNP over a half year period. On the other hand, an increase in net exports of one percent results in a positive effect of more than 0.11 percent in GNP growth over the same period. However, the qualitative result is that only growth in expenditure and exports will significantly increase GNP. The St. Louis equation has been estimated at a symmetric lag length of up to six quarters, and the qualitative results remained the same in the process.

Table 3. Summed Impact of Variables for Equation (2)

	Summed Value	F-statistics	P-value
$\sum \Delta M$	0.3782	3.32	0.0426
$\sum \Delta G$	0.0749	11.70	0.0000
$\sum \Delta E$	0.1138	33.03	0.0000

The estimation yields neither a significant sign of heteroskedasticity, nor any of autocorrelation, as shown in Table 4. In order to exclude the assumption of possible near-correlation among the variables, variance inflation factors are calculated (see Table 5). With the highest factor of lagged government expenditure of one and a half, the conditioning of the model shows no sign of near-collinearity.

Table 4. Specification Tests for Equation (2)

	H_0	χ^2 value	P-value
Breusch-Pagan/Cook-Weisberg test for heteroskedasticity	Constant variance	1.200	0.2737
Breusch-Godfrey LM test for autocorrelation	No serial correlation	1.354	0.2446

Table 5. Variance Inflation Factors for Equation (2)

Variable	VIF
ΔG_{t-1}	1.50
ΔG	1.43
ΔE_{t-1}	1.26
ΔE	1.21
ΔM_{t-1}	1.17
ΔM	1.17
Mean	1.29

Nevertheless, the stability of the model must be tested for any signs of structural breaks. In this regard, as Bonato (2008) points out, in observing the relationship between inflation and monetary policy via an econometric Vector Autoregressive Model, the Iranian economy has faced many significant events since the Iranian Revolution of 1979. Therefore, the stability of Equation (2) must be tested for potential structural breaks, but the difficulty is in deciding which events may cause such breaks. In order to ease the decision, a close look at major political events in Iran after 1990 needs to take place. When doing so, the time span evaluated can be divided in two major components, namely the period before the election of Mahmoud Ahmadinejad, and the period of his Presidency which will end constitutionally in 2013. Hence, we must test two periods, 1990/Q3-2005/Q2 and 2005/Q3-2008/Q1 for any signs of factor instability. By referring to the calculated F (7, 55)-value of 0.0352 (p-value of almost 1), we do not reject the null-hypothesis of structural stability. Nevertheless, since one could suspect the existence of other unknown structural breaks during this time span, we have also conducted an Elliot-Műller-stability test which simultaneously tests for parameter constancy and unknown structural breaks. The results are presented in Table 6.

Table 6. Elliott-Müller q_{LL} Test Statistic

H_0: All regression coefficients are fixed over the sample period (N=69)			
Test statistic	1% critical values	5% critical values	10% critical values
-15.051	-23.42	-19.84	-18.07

Note: This is the test for time varying coefficients in the model of ΔY, 1991Q3-2008Q1, allowing for time variation in 3 regressors, computed with 1 lag.

As we cannot reject the null-hypothesis at any significance level, the stability of Equation (2) can be assumed.

Since the original St. Louis equation was designed and first applied in a country in which the Central Bank's independence is granted, using narrow money as a monetary policy indicator seems appropriate. However, in Iran's case, we have to consider that an increase in money supply can be caused mainly by government sales of petro-dollars to the Central Bank, as highlighted by Naghshineh-Pour (2009). Therefore, expanding the equation by adding other monetary policy indicators is necessary in order to be able to rule out any monetary policy efficiency. In this regard, the question arises as to whether the equation used so far may have generated biased results, due to omitted variables. Yet, as argued previously, by including E into the equation, various scholars have confirmed its validity. Nevertheless, so far, the equation has not been tested for a country with the issue of dependent monetary policy actions, as is the case for Iran. Hence, an observation of this possible error appears to be necessary. When applying the Ramsey RESET test for possible omitted variables, the null hypotheses can be rejected at the five percent level as shown in Table 7.

Table 7. RESET Test for Omitted Variables for Equation (2)

	H_0	F-value	P-value
Ramsey RESET Test Using Powers of the Fitted Values of Y	No Omitted Variables	3.18	0.0303

As noted before, the Central Bank cannot make any policy decisions independently and thus D and X are influenced by the government as well. Nevertheless, this does not automatically mean that the influence of these variables is insignificant too and thus further investigation is legitimate. As for Equation (2) the appropriate lag length of one is chosen by considering Akaike and Schwarz's values as decision criterions. Notably, this equation shows no sign of omitted variables, since the null hypothesis cannot be rejected, see Table 8.

Table 8. RESET Test for Omitted Variables for Equation (3)

	H_0	F-value	P-value
Ramsey RESET Test Using Powers of the Fitted Values of *Y*	No Omitted Variables	1.45	0.2396

When observing the new estimation results (see Table 9), the impact of *G* and *E*, respectively, is still significant. Table 10 reflects the summed impact of all variables, still showing a slightly significant impact of money supply on economic growth. Since a one percent depreciation of the Iranian Rial against the US Dollar decreases economic output by 0.1 percent, it is no surprise that the Central Bank has done its best for many years to keep the exchange rate at an artificially low level. Since Iran has a heavily import-dependent economy and a constantly negative trade balance, currency depreciation will have a negative effect on output growth. Notably, the summed impact of *X* is almost insignificant at the five percent level, which leads to the assumption of a short-term positive influence of exchange rate manipulations.

Surprisingly, the results reveal a positive and statistically highly significant relationship between deposit rates and output growth. In many countries high deposit rates usually reflect high borrowing costs, which are assumed to be growth adverse for the economy. However, in Iran's case, an increase in deposit rates by one percent increases economic output by 0.07 percent. We can assume that deposit rates are kept at a high level, in order to combat exchange rate depreciation and inflation, respectively. With regard to the constantly increasing deposit rates, this result also suggests how inflexible this monetary policy action has been so far, most likely due to government interference.

Table 9. Estimation Results for Equation (3)

	Coef.	Std. Err.	*t*-statistics	P-value	[95% Conf	Interval]
ΔM	-0.0296	0.1499	-0.20	0.844	-0.3298	0.2705
ΔM_{t-1}	0.4144	0.1545	2.68	0.010	0.1051	0.7238
ΔG	0.0842	0.0248	3.39	0.001	0.0344	0.1340
ΔG_{t-1}	-0.0645	0.0275	-2.35	0.022	-0.1196	-0.0094
ΔE	0.1459	0.0183	7.95	0.000	0.1092	0.1827
ΔE_{t-1}	-0.0165	0.0192	-0.86	0.394	-0.0550	0.0219
ΔX	-0.1040	0.0470	-2.21	0.031	-0.1981	-0.0100
ΔX_{t-1}	0.0625	0.0431	1.45	0.153	-0.0238	0.1489
ΔD	0.0710	0.0247	2.87	0.006	0.0215	0.1205
ΔD_{t-1}	-0.0043	0.0248	-0.18	0.860	-0.0540	0.0452
Constant	0.0316	0.0105	3.01	0.004	0.0106	0.05271

Source	SS	df	MS	Number of observations	69
				F(10, 59)	15.64
Model	0.0844	10	0.0084	Prob > F	0.0000
Residual	0.0313	58	0.0005	R-squared	0.7295
				Adj R-squared	0.6828
Total	0.1157	69	0.0017	Root MSE	0.0232

Table 10. Summed Impact of Variables for Equation (3)

	Summed Value	F-statistics	P-value
$\sum \Delta M$	0.3848	3.68	0.0314
$\sum \Delta G$	0.0197	14.61	0.0000
$\sum \Delta E$	0.1294	35.42	0.0000
$\sum \Delta X$	-0.0415	3.16	0.0498
$\sum \Delta D$	0.0667	4.13	0.0210

In order to monitor for possible high internal correlation between variables which may devaluate the validity of the observed results, we estimate the variance inflation factors, listed in table 11, and find no signs of near-correlation.

Table 11. Variance Inflation Factors for Equation (3)

Variable	VIF
ΔG_{t-1}	1.84
ΔG	1.53
ΔE_{t-1}	1.35
ΔE	1.22
ΔM_{t-1}	1.34
ΔM	1.27
ΔX_{t-1}	1.31
ΔX	1.56
ΔD_{t-1}	1.34
ΔD	1.33
Mean	*1.41*

Last but not least, no signs of specification errors or a structural break are found, as shown in Tables 12 and 13, respectively. The Chow test for structural break at the previously assumed break point yields a F(11.47)-value of about 0, which reflects a p-value of 1, leading to no rejection of the null-hypothesis. The Elliott-Müller q_{LL} test statistic computed also motivates us to assume a stable equation and valid results.

Table 12. Specification Tests for Equation (3)

	H_0	χ^2 value	P-value
Breusch-Pagan /Cook-Weisberg Test for Heteroskedasticity	Constant Variance	0.660	0.4183
Breusch-Godfrey LM Test for Autocorrelation	No Serial Correlation	0.697	0.4036

Table 13. Elliott-Müller q_{LL} Test Statistic

H_0: All regression coefficients are fixed over the sample period (N=69)			
Test Statistic	1% critical values	5% critical values	10% critical values
-25.926	-35.09	-30.6	-28.55

Note: This is the test for time varying coefficients in the model of ΔY, 1991Q3-2008Q1, allowing for time variation in 5 regressors, computed with 1 lag.

The Vector Error Correction Model

In order to recheck whether our unsophisticated approach to investigate the sophisticated nature of Iran's economy portends a problem of producing biased results, the introduced OLS Equation (3) is modified into a Vector Error Correction Model (VECM). Prior to estimating a VECM, a check for cointegration (according to Johanson, 1991) is necessary as our variables are integrated by order one. Table 14 presents the cointegration test results which indicate that our variables are cointegrated by rank one.[2] Hence, the linear combination of the individually integrated variables appears to be stationary and thus a long-run relationship between the underlying variables in Equation (3) can be assumed. The estimated VECM lagged error correction (LEC) terms are presented in Table 15. The LEC terms for *M*, *G* and *E* are significantly different from zero. Since for *M* and *G*, negative parameters are witnessed, they bring back *Y* to equilibrium by imposing negative feedbacks. Especially *G* appears to have the strongest adjustment effect. Hence, these parameters significantly affect equilibrium adjustments in the short run. The parameter estimates for *D* and *X* show up no significant short run effects. With regard to Table 16, the long run effect of all parameters except for *X* is confirmed. Therefore, the VECM results correspond almost completely to the St. Louis model's results with regard to *G* and *M*.[3] Interestingly, *X* reveals a more or less insignificant effect on economic growth in both models while *D* shows up an insignificant impact when referring to the VECM estimation results. Nonetheless, our VECM results confirm our previous core results and thus strengthen the St. Louis model's reliability.

Table 14. Johansen Tests for Cointegration (Trend: constant, Lags: 1)

Max. rank	Eigenvalue	Trace statistic	5% critical value
0		109.4490	94.15
1	0.50254	60.5720*	68.52
2	0.34724	30.7142	47.21
3	0.20475	14.6772	29.68
4	0.12020	5.7132	15.41
5	0.07462	0.2846	3.76
6	0.00406		

Note: * H_1 of one cointegration equation is accepted at 5% significance level.

[2] The appropriate lag length of one for the cointegration test was determined by consulting the final prediction error (FPE), Akaike's information criterion (AIC), Schwarz's Bayesian information criterion (SBIC), and the Hannan and Quinn information criterion (HQIC) lag-order selection statistics.

[3] Our model satisfies all stability conditions but I may be noted that the parameters may not be efficient estimators since the error terms appear not to be normally distributed. Nevertheless, the parameter estimates are still consistent.

Table 15. VECM - LEC Results

	Coef.	Std. Err.	P-value	[95% Conf. Interval]	
ΔY	-0.05695	0.0412023	0.167	-0.1377055	0.0238045
ΔM	-0.06287	0.0199225	0.002	-0.1019255	-0.0238306
ΔG	-0.28894	0.1372239	0.035	-0.5578952	-0.0199875
ΔE	0.34074	0.1666137	0.041	0.0141887	0.6673023
ΔX	-0.10202	0.0744583	0.171	-0.2479614	0.0439099
ΔD	0.04186	0.0408527	0.305	-0.0382032	0.1219364

Table 16. Predictions from the Cointegration Equation

	Coef.	Std. Err.	P-value	[95% Conf. Interval]	
ΔY	1				
ΔM	-0.9357395	0.1247985	0.000	-1.18034	-0.6911389
ΔG	0.6976645	0.141171	0.000	0.4209744	0.9743546
ΔE	-0.6580729	0.0724166	0.000	-0.8000068	-0.5161389
ΔX	-0.0411024	0.0734517	0.576	-0.1850651	0.1028604
ΔD	-1.000272	0.2000482	0.000	-1.392359	-0.6081847
constant	0.1494081				

6. POLICY IMPLICATION

Overall, after expanding the St. Louis equation, the positive effect of fiscal policy remains a fact. Nevertheless, choosing the supply of narrow money as the only indicator for monetary policy, leads to a biased finding, namely a very weak significance of monetary policy. In order to avoid this error, two additional monetary policy action indicators are included in the initial equation. The results suggest that, although monetary policy is not conducted freely, but rather under governmental supervision and control, monetary policy has a weak significant effect on output growth although deposit rate regulation is the only main effective policy action. For many years, Iran's Central Bank has increased the money supply without any significant output effect. At the same time, in order to combat inflation, deposit rates have been increased constantly, while exchange rates have been controlled to counter a depreciation of the Iranian Rial. However, only deposit rate control has been significantly effective. Therefore, the question arises as to whether these policies have been used to cure the result of the expansive fiscal policy, rather than to support economic growth independently of government interests. The findings detected would thus reflect this trade-off by detecting a monetary policy which in reality has lost its power, not as the result of a deliberate decision, but in favor of excessive fiscal actions.

Since nominal GNP has been used for the analysis, the question may arise whether government expenditure affects inflation rather than real incomes. In order to investigate this question, we have re-conducted the analysis (including diagnostic tests) by using real output data. Referring to the observed results, government expenditure significantly increases real output while monetary policy, in contrast to the nominal case, proofs to be significant only in regard to imposed exchange rate regulations. This observation may rather indicate that inflation has eliminated deposit rate effects. In this regard, an inverse relation between inflation and the stimulating effect of deposit rates is evident which can be related to the Fisher Effect. Nevertheless, the overall findings confirm as well that monetary policy is rather weakly affecting economic growth. Thus, using real output for the previously performed calculations doesn't alter the observed main findings.

7. CONCLUDING REMARKS

The presented findings suggest that fiscal policy and exports exert a lasting significant effect on the Iranian economy, by contributing to economic growth. This conclusion is very surprising, as many countries tested so far have reported the opposite. Batten and Hafer (1983) report completely contrary results for the United States, which supports the qualitative findings of Andersen and Jordan (1968). Consequently, there appears to be support for fiscal policy in terms of achieving economic growth in some countries. However, the Central Bank's monetary policy has had a significant effect on economic growth, but this study fails to shed a positive light on monetary policy as a reliable stimulator of economic growth in Iran. Furthermore, the only significant monetary policy effect on nominal output has been achieved through deposit rate control. On the other hand, exchange rate control fails to demonstrate ongoing success in promoting nominal output growth. For the case of real output we observe the opposite outcome. These very contradictory results may indicate a minimal level of overall success of monetary policy, due to lack of Central Bank independency.

The results of this empirical study clearly refute the standard St. Louis findings that only monetary policy supports economic growth, and not fiscal policy. Interestingly, although critics of the St. Louis equation argue that the equation tends to support monetary policy, due to its composition, this study yields a result which instead supports fiscal policy. Nevertheless, the study aims not to support an expansive and continuous fiscal policy in Iran, as the negative effect of such a policy is currently reflected in the government's large budget deficit. Furthermore, it supports the standpoint that Central Bank independence is crucial, in order to avoid economically ineffective monetary policy actions and to sustain economic stability.

Nevertheless, this study supports the St. Louis equation's validity and suggests its expansion by adding two further indicators for tracing monetary policy effects. Since in many developing countries reliable time series data is hardly available, such a parsimonious model represents a good alternative in order to observe monetary and fiscal output effects properly.

With regard to future research, it would seem useful to find further empirical support of the negative impact of government interference on monetary policy's output effectiveness in countries that are dependent on oil exports.

REFERENCES

Ahmed, E., and J. Johannes (1984), "St. Louis Equation Restrictions and Criticisms Revisited: Note," *Journal of Money, Credit and Banking*, 16, 514-520.

Andersen, L. (1969), "Money Market Conditions as a Guide for Monetary Management," in Brunner, K., eds., *Targets and Indicators of Monetary Policy*, San Francisco.

Andersen, L., and J. Jordan (1968), "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization," *Federal Reserve Bank of St. Louis Review*, 50, 11-24.

Barth, J., and J. Bennett (1974), "A Note on the Relationship between FEBS and GNP," *Economic Inquiry*, 12, 403-405.

Batten, D., and R. Hafer (1983), "The Relative Impact of Monetary and Fiscal Actions on Economic Activity: A Cross-Country Comparison," Federal Reserve Bank of St. Louis, January Issue, 5-12.

Batten, D., and D. Thornton (1983a), "Polynomial Distributed Lags and the Estimation of the St. Louis Equation," *Federal Reserve Bank of St. Louis Review*, 65, 13-25.

_____ (1983b), "Lag-Length Selection Criteria: Empirical Results from the St. Louis Equation," Federal Reserve Bank of St. Louis Working Paper, 83(8).

_____ (1986), "The Monetary-Fiscal Policy Debate and the Andersen-Jordan Equation," *Federal Reserve Bank of St. Louis Review*, 68, 9-17.

Blinder, A., and R. Solow (1974), "Analytical Foundations of Fiscal Policy," in Blinder, A. *et al*., eds., *The Economics of Public Finance*, The Brookings Institution, Washington D.C..

Bonato, L. (2008), "Money and Inflation in the Islamic Republic of Iran," *Review of Middle East Economics and Finance*, 4, 1-18.

Carlson, K.M. (1978), "Does the St. Louis Equation Now Believe in Fiscal Policy?" *Federal Reserve Bank of St. Louis Review*, 60, 13-19.

Corrigan, G. (1970), "The Measurement and Importance of Fiscal Policy Changes," *Federal Reserve Bank of New York Monthly Review*, June, 133-145.

Davis, R. (1969), "How Much Does Money Matter? A Look at Some Recent Evidence," *Federal Reserve Bank of New York Monthly Review*, June, 119-131.

De Leeuw, F., and J. Kalchbrenner (1969), "Monetary and Fiscal Actions: A Test of Their Relative Importance in Economic Stabilization-Comment," *Federal Reserve Bank of St. Louis Monthly Review*, April, 6-11.

Elliot, J.W. (1975), “The Influence of Monetary and Fiscal Actions on Total Spending,” *Journal of Money, Credit, and Banking*, 7, 181-192.

Goldfeld, S., and A. Blinder (1972), “Some Implications of Endogenous Stabilization Policy,” Working Paper, Brookings Papers, 3, 525-640.

Hafer, R. (1982), “The Role of Fiscal Policy in the St. Louis Equation,” *Federal Reserve Bank of St. Louis Monthly Review*, January, 17-22.

Husain, A.M., K. Tazhibayeva, and A. Ter-Martirosyan (2008), “Fiscal Policy and Economic Cycles in Oil-Exporting Countries,” IMF Working Paper, WP/08/253.

Hyllberg, S., R. Engle, C. Granger, and B. Yoo (1993), “Seasonal Integration and Cointegration,” *Journal of Econometrics*, 44, 215-238.

Ilias, S. (2009), “Iran’s Economic Conditions: U.S. Policy Issues,” (available at http://www.crs.gov).

Johanson, S. (1991), “Estimation and Hypothesis Testing of Cointegration Vectors in Gaussian Vector Autoregressive Models,” *Econometrica*, 59, 1551-1580.

Jordan, J. (1986), “The Andersen-Jordan Approach after Nearly 20 Years,” *Federal Reserve Bank of St. Louis Review*, 68, 5-8.

Kirchgässner, G., and J. Wolters (2008), *Introduction to Modern Time Series Analysis*, Berlin Heidelberg: Springer.

Koot, R. (1977), “On the St. Louis Equation and an Alternative Definition of the Money Supply,” *The Journal of Finance*, 32, 917-920.

Matthews, K.G.P., and P.A. Ormerod (1978), “St. Louis Models of the UK Economy,” *National Institute Economic Review*, 84, 65-69.

Mazarei, A. (1996), “The Iranian Economy under the Islamic Republic: Institutional Change and Macroeconomic Performance (1979-1990),” *Cambridge Journal of Economics*, 20, 289-314.

McDowell, A. (2004), “From the Help Desk: Polynomial Distributed Lag Models,” *The Stata Journal*, 4, 180-189.

Modigliani, F., and A. Ando (1976), “Impacts of Fiscal Actions on Aggregate Income and the Monetarist Controversy: Theory and Evidence,” in Stein J., eds., *Proceedings of Brown University Conference on Monetarism*, Amsterdam.

Naghshineh-Pour, A. (2009), “Iran’s Banking and Monetary Problems,” MPRA Working Paper, 15790.

Paulo, M., and D. Zakharova (2009), “A Primer of Fiscal Analysis in Oil-Producing Countries,” IMF Working Paper, WP/09/56.

Schmidt, P., and R. Waud (1973), “The Almon Lag Technique and the Monetary vs. Fiscal Policy Debate,” *Journal of the American Statistical Association*, 68, 11-19.

Summers, L.H. (1991), “The Scientific Illusion in Empirical Macroeconomics,” *Scandinavian Journal of Economics*, 93, 129-148.

Villafuerte, M., and P. Lopez-Murphy (2010), “Fiscal Policy in Oil Producing Countries During the Recent Oil Price Cycle,” IMF Working Paper, WP/10/28.

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