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Is IS-LM Still a Good Model for Analyzing Fluctuations in Iran National Income? Introducing and Comparing IS-MP-AS with IS-LM-AS

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ABSTRACT

Regarding the high importance of gross domestic product (GDP) and identifying the fluctuations and variables affecting it, this research studies factors influencing Iran GDP according to one of the newest economic models, IS-MP-AS (Romer, 2000). Beside the estimation of this model, the effect of IS-LM-AS on Iran's economy is also examined and results are compared with Romer's model. Research results show that Iran GDP, in the framework of IS-MP-AS, has a negativecorrelation with budget deficit, predicted inflation, coin prices (to show the effect of wealth) and a positive correlation with real effective exchange rate and oil revenues. It can be well defined by these five variables. According to IS-LM-AS, there is also a positive significant correlation between money supply and GDP. Other estimations reveal no significant difference between two models.

KEYWORD

Gross Domestic Product (GDP), IS-LM-AS, IS-MP-AS,

INTRODUCTION

GDP is a primary variable that is studied in macroeconomics and helps in analyzing the most important subjects of macroeconomics, including full employment, economic stability, and economic growth. Identifying factors affecting it, thus, have been invariably important in economists' and politicians' view. If we can virtually find the leading factors influencing GDP, we could act more precisely in policy-making and bring higher levels of economic growth for our country. This is a matter of the utmost importance in a way that macroeconomic modeling and estimating the national income balance are roughly the equivalent of macroeconomics. In 1940s, inspired by Keynes's theories economists such as Hicks presented a regular and theoretical framework for national production and modeled it. As this model analyzes the balance of the commodity and service markets (saving analysis-investment) and, at the same time, cash markets, it was called IS-LM.As to the fact that economists had concentrated, at that time, on the demand side of economy, this model was just adopted to analyze demands. In next decades, the supply side was also added to it. Being highly efficient and easy to use, it is now the most functional model for economists and politicians to analyze fluctuations in national income.Despite of positive qualities, right from the onset, the model was largely criticized by economists. Some of these criticisms, such as lack of microeconomic bases which has structural aspects, have been posed from the start (New Keynesian economists have started correcting them since last two decades) and we are not supposed to study them. Whereas, some criticisms refer to the procedures of economic enterprises and countries' current microeconomic situations which have to be necessarily modified in this model and we aim to introduce one of these models. One of the newest modifying models is IS-MP-AS which was developed by Romer in 2000. Solving some problems of IS-LM, it benefits from more positive features. By introducing this model and estimating it for Iran's economy, this research aims to identify factors affecting Iran GDP according to this model. It then specifies by comparing results obtained by this model with IS-LM-AS results that which adapts better to Iran's current economic conditions.

Theoretical principles are then followed by a look at criticisms leveled at IS-LM. Afterwards, IS-MP-AS would be briefly introduced. Reviewing the research literature, later on, we would have a glance at the effect of different variables on Iran GDP. Finally, IS-LM-AS and IS-MP-AS are then introduced and estimated and results are compared.

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THEORETICAL PRINCIPLES

To identify the causal relations between existing variables in macroeconomic and subsequently the variables affecting the national income, we need to have a clear perception of macroeconomic conditions and composing markets. Macroeconomic is divided into three leading markets: commodity and service market, money market and labor market. In the open economy, the external world is also added. Commodity and service market, which is analyzed by the aggregatesupply and demand of commodities and services, includes total consumption, total investment, government budget, and foreign or international trade. Consumption and taxes are a function of national income and investment is considered as a function of interest rate. Money market is one of the important markets, which is composed of money supply and demand. In this market, demand for money is a function of the interest rate and the national income. Note, also, that money supply is determined by the Central Bank. Commodity and service market together shape the demand side of the economy. To study the general economic balance, we have to analyze the supply side. The supply side takes its shape by labor market and the production function. Labor market includes the supply and demand of labor force, which is determined as a function of wage rate. It is more affected in short-term by employment with the aid of production function and builds the supply side. In the frame of this setting and given the clarity of supply and demand, we can study a general balance for the economy. In commodity and service market, government spending and taxes are two financial tools. In the money market, money supply is the most frequently employed tool of monetary policies. When government spending rises, there is, in fact, an increased demand for commodities and services. In case of stable money supply, as demand for money is a positive function of income, to keep it in the same level as supply, the interest rate should decrease. When the interest rate goes up and given the negative correlation between the interest rate and investment, investment goes down. This would result in reduced national income. Here, investment and government spending replace the private investment. It is called, in economic literature, as “crowding out”. On the other hand, if the escalated commodity and service supply do not fit well to the grown demand, price rates would go up as a result of demand surplus. Any growth in money supply can bring about elevated income and declined interest rate. As to the effect the interest rates have on investment, this would intensify investments and the aggregate demands. As mentioned above, if commodity and service supply is not adjusted to the aggregate demand, price rates would grow.

Any growth in the level of interest rate and prices, any reduction in investment, and crowding out all depend on macroeconomy. And there are different economic speculations and theories on the effects and the levels of these changes. Keynesians, for example, believe that fluctuations in money market have a partial impact on the interest rate and growing government spending does not raise the interest rate as high as income. The effect of crowding down is, therefore, extremely high and there is a trivial growth in income. The effects and the theories of different schools of thought, which fit separately to particular conditions, can be explained in full details. However, we overlook them to avoid redundancy in our discussion.We used economic models to analyze the theoretical principles in economic literature. As mentioned, the most frequently employed model for analyzing macroeconomic conditions has been IS-LM-AS in past decades. As most economists know it, we do not explain it here. However, there have been criticisms aiming at this model from the onset and we will refer to some of them in the following section [19].

CRITICISMS LEVELED AT IS-LM-AS

Many criticisms are aimed at different sides of IS-LM-AS. The most common one is on its non-dynamism that Robinson (1974) has well referred to [16]. The model does not refer to the dynamism and time and does not tell anything about the adjustment route of balance in the economy and how a balance can be transferred to another balance. Robert Lukas (1976) reviewed the short-term view on the analysis of this model and stated that the long-term economic conditions should also be analyzed. This is while IS-LM just considers a short-term perspective [14].Another criticism leveled at this model results from a neoclassic approach, which Chick (1996-1998) well explains it. He stated that the balance of this model occurred in an economy with transparent and certain markets. However, we live in a world of uncertainties and unbalances. So IS-LM cannot be highly efficient [2,3].With the increasing emergence of new advancements in the economy, some other criticisms have been also raised. Considering these oppositions, Romer (2000) presented several solutions and introduced IS-MP-AS to put an end to these objections [15] .The new model modifies and takes three sides of IS-LM, which are difficult, non-adaptive, and unreal, into account.Firstly, despite of interest rate in IS-LM, there are different rates which complicate the model. The real interest rate is very important in commodity market and is used in IS diagram. On the other side, it is the nominal interest rate that plays a vital role in money market. So it is employed in LM curve. Secondly, the diagrams of aggregate supply and aggregate demand are considered in the level of prices-revenues. However, the economic tendency is toward analyzing the association between income and inflation. For example, negative demand shock may result in reduced inflation but does not make any reduction in prices. And thirdly, the Central Bank steadily supplies money and accordingly implements its policies. But there are many banks that do not take this into their policy-makings and usually meet their goals through interest rates. In the remainder of our paper, we briefly introduce IS-MP-AS.

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INTRODUCTION OF IS-MP-AS

This is the same as IS-LM-AS that have been revised and modified to soothe the complications of this model and adjust it to the current macroeconomic conditions of countries around the world. Inspired by Taylor's theories (1993-1998), this model was developed by Romer in 2000. The most important difference of this model is the substitution of the equilibrium condition in the money market (LM) for monetary policy function (MP).The key hypothesis in the new approach is that the Central Bank follows the principle of interest rate. The principle is that the real interest rate is a function of macroeconomic variables, including inflation and income. This supposition considerably better explains the reaction of Central Banks to the principle of money supply. There is a fine difference between interest rate and money supply principles. For instance, if the Central Bank adjusts the interbank offered lending rate to keep money supply as long as possible over an exogenous target route, it should follow a targeting principle by supplying money; but most banks do not involve in such a process. They actually select the interest rates to achieve their purposes in terms of inflation and income and money generally plays a trivial role in such selections [4][15].Another important matter is that the Central Bank adopts the principle of real interest rate. There are two main reasons. Firstly, it is more real. When the Bank determines the nominal rates, any growth in predicted inflation reduces the real rates. So another nominal rate is considered. In a period beyond the short-term, the principle of real interest rate is more real than the nominal rate principle. The second reason to assume that the Central Bank follows the real interest rate principle can be attributed to the simplicity and continuity of this model. In IS-LM, as the real rates are important in commodity market, it is a good idea to use these rates in IS and commodity and service market. Accordingly, we use real rate principle in monetary policy function to preserve the continuity of model.

The simplest principle for real interest rate is that it turns to a function of inflation:

$r = r(\pi)$

The assumption is that the function is additive. There is a transparent logic behind this rule. The Central Bank mostly intends to keep inflation low and income high. When there is a heightened inflation, the main challenge is to overcome it. It then selects a high real interest rate to contract incomes and decrease inflation.1In the condition of low inflation rate, there is no concern about inflation and a low interest rate should be adopted to increase incomes. In Keynesian model, the real interest rate substitutes for LM curve. As we assumed that the selection of real interest rate by the Central Bank depends on the rate of inflation, for a given inflation rate, the interest rate principle is a horizontal line in the setting of income-real interest rate. This line is recognized as MP (due to monetary policy). Figure 1 shows this curve together with IS curve with a descending slope. The intersection represent income and the real interest rate in a given inflation rate. Put it differently, the Central Bank select a particular interest rate and then specifies the IS for income. Under an assumption that elevated inflation lead the Central Bank to raise the real rates, MP curve would have an ascending transfer. Diagram 1(A) displays this transfer. In IS, economy longitudinally moves up and income moves down. Therefore, there is an inverse correlation between income and inflation, which have been depicted at the bottom of the figure. As this relation is on the side of demand, we call it the "aggregate demand curve". The next step is to estimate the aggregate supply. We follow the method applied by Taylor to show it (Taylor, 1998). This approach is based on this assumption that the inflation has been estimated at any moment. In the absence of inflation shocks, if income is higher than its normal rates (full employment), inflation rate goes up and in case of lower than normal rates (full employment), it goes down[17][18]. The model assumes that in case of equal rates of income and full employment and there is no inflation shock, the rate of inflation is stable. The assumption that the inflation has been considered in a point of time indicates that the curve for aggregate supply in short-term in inflation-income setting is horizontal. As the aggregate supply measures that how inflation changes with income, this line is called "inflation adjustment line". Figure 8 shows IA and AD diagrams. The intersection represents inflation and income. Inflation is derived from the economic history. The Central Bank finds the real interest rates regarding inflation and the real interest rates determine the level of income (see dig. 1B). Imagine the intersection of IA and AD shows a point where the level of income is under the normal rates (or the state of full employment). According to the assumption of adjusting inflation, in states under full employment, there is reduced inflation. Thus, IA line moves down. Put it simpler, it is better to have a continuous descending transfer rather than disconnected stages. In AD, economy longitudinally moves down, income increases and inflation moves down. This continues so that the rate of income reaches full employment (ELR). At this point, the inflation is stable and no other change occurs, unless an economical shock occurs. Deflation of income from full employment results in a change in inflation and consequently forces the Central Bank to change the real rate of exchange. This turns the income into its full employment state. Such simple dynamisms allow us to study the directions of leading macroeconomic variables for returning to a long-term economic equilibrium. These dynamisms are real. For example, in many experiences when the income rate is in the level of full employment, an anti-inflation state or an inflation reduction occurs following a transfer in monetary policy in high interest rates [15]. Through an example, we put an end to the explanation of IS-MP-AS. Economy starts from a long-term equilibrium. The income rate is at the level of full employment and there is a stable inflation rate.

[1] According to $R - \pi = r$, to escalate the real interest rate, the Central Bank should raise the nominal rate more than inflation to increase the real rates.

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Consumers' trusts then decrease and the consumption function has a downturn. Accordingly, consumption is less than before in a given income level. We can use IS-MP to find short-term effects on income. Consumers' declined trusts transfer IS to the left side. As the inflation rate does not immediately respond, MP curve does not move. IS-MP, thus, shows that the income decreases in short-term, but no change is made in the interest rate.

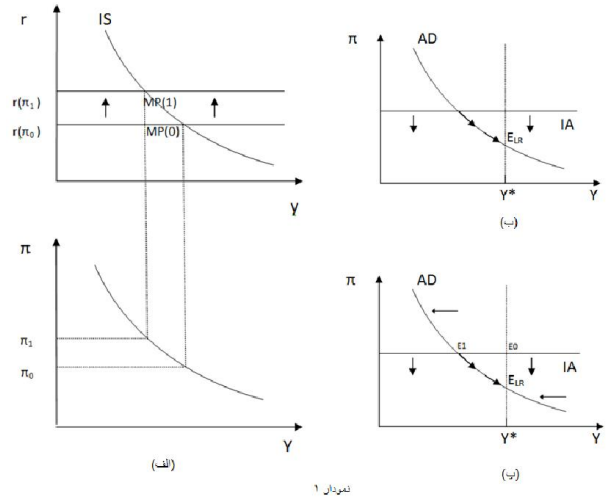

Fig.1

A similar analysis reveals that for any given level of inflation, the income rate is lower than before. This means that consumers' declined trusts transfer aggregate demand curve to the left side. Economy then immediately moves from E0 to E1. No change is made in the inflation rate (as the analysis of IS-MP shows) and income decreases. When the income level is under the level of full employment, the inflation rate starts to fall down. In such situation, the Central Bank reduces the real interest rate to increase income. Accordingly, the economy moves down in the aggregate demand curve. As it was shown in the figure, this process continues so than the income comes back to its level of full employment (ELR point in C, dig 1).

LITERATURE REVIEW

As to the freshness of the subject, it was less empirically studied and we will refer to the most important ones. The most extensive work has been done by Ph. Yu Hsing, from Southeastern Louisiana University. Note, also, that this is a new matter in Iran and to the best of our knowledge, no study have been carried out in this regard. Yu Hsing applied IS-MP-AS to analyze short-term fluctuations in income in Poland (2005), Germany (2005), Singapore (2005), Estonia (2006), and Taiwan (2006). In these countries, GDP is a function of the main variables of predicted inflation, the debt-to-GDP ratio and the real exchange rate. Regarding the macroeconomic conditions in these countries, other variables, which had a determining role in GDP fluctuations, were also added to the model. For example, in Singapore, as a small country, regarding the importance of export for national GDP, global income was considered as an independent variable [7,8,9,10,11]. Results showed that the predicted inflation always had a negative impact on GDP. As the debt-to-GDP ratio is usually an indicator of government financial disorders, it displays a negative impact on GDP. There was an uncertain relation between exchange rate and GDP. The net effect depended on this fact that whether the positive impact of money value on consumption and investment due to lower exchange rate had increased or it had decreased as a result of the negative impact of reduced net export. Results agreed with what BahmaniOskuee and Mitza (2003) found about the effect of weakened national currency or lowered money value depending on theoretic models, regression techniques, studied countries and the time duration of the process. Practicing this model for US economy, Yu Hsing (2007) studied the national income fluctuations by this model; at the same time he used IS-LM-AS to examine fluctuations. He then compared the results and concluded that there were significant differences in some cases. [12] Wen-jen Hsieh (2007) used this model for Egypt's economy and studied income fluctuations. His results did not differ significantly with Hsing's findings and confirmed them. [13] As it was mentioned before, according to the researcher, in Iran, no research study has been carried out for analyzing Iran's income fluctuations by these two models. However, we will refer to several studies on the effects of different factors on GDP as follows. Sameti (1992), KhodaRahmi (1993) and Hatami and Mirshamsi (2004) studied the effect of government spending on GDP growth. They observed that government spending had a significant effect on GDP. In a study over the effect of government spending by Baro curve, Hassanpour (2006) concluded that growing ratio of government spending to GDP by 22% had a positive impact and beyond that negatively affected GDP [22,25]. Given the impact of budget deficit, Hashemisahmi (1997) and Azizi (2006) found out that budget deficit is of the key factors of inflation in Iran because of the strategies used to eliminate it, borrowing from the central bank in particular. Studying the relationship between liquidity and inflation, Hadian and Parsa (2008) suggested that liquidity changes significantly affected inflation at least for the next three periods. [29,26,28] Dadgar et al. (2006) looked at the relationship between inflation and the economic growth. They proposed that there was a causal relation between inflation and the economic growth. It was concluded that to a particular rate of inflation, there was a positive relation, beyond that the relation turned negative [23]. Regarding the strong impact of oil revenues on Iran's economy, its effect on GDP has been widely studied. Suri (2005) examined the role of oil revenues in government spending and the economic growth. He found out that when there was an ascending economic growth, oil revenues had a larger share in the growth. In a research study on the effect of elevated oil price on GDP, Motevaseli and fuladi (2006) adopted a general equilibrium model to show that higher oil prices are followed by increased GDP. Ascending price brings with itself more job opportunities in oil and gas, construction and service sectors. Due to the high

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importance of oil revenues, we added this variable as an explanatory variable to the model [24,27]. Exchange rate is of effective variables affecting GDP in different way. The effect of this variable has been widely studied. Milani et al. (1996) and Khataei and GharbaliMoghadam (2004) have rejected a significant correlation between exchange rate and GDP [21].

EXPLAINING IS-MP-AS FOR IRAN'S ECONOMY

According to the model proposed by Romer's (2000 and 2006) and the one offered by Yu Hsing, it is assumed that household consumption expenditures are a function of income, taxes, the real exchange rate, and price of coins (to study the effect of wealth) and investment is affected by income, taxes, the real exchange rate, and the price of coins. The net export is also a function of real exchange rate. Moreover, the real interest rate, which is determined by the Central Bank, is a function of inflation, income and the real exchange rate. In the aggregate supply function, the inflation rate is measured by the predicted inflation and the difference of income and potential income [4][15]. The equilibrium in commodity market (IS), the extended Taylor rule, monetary policy function and aggregate supply are shown as bellow:

(1)Y = C(Y – T, R, S) + I(Y, R, S) + G + NX [e (P* / P)]
(2) R = R (π, Y, e)
(3) $\pi = \pi e + \theta(Y - Y^*)$
Where,
Y = real GDP
C = household consumption expenditure
T = tax
R = real interest rate
S = price of coins
I = investment spending
G = government spending
NX = net export
e = nominal exchange rate (USD to IRR rate; increased exchange rate decreases the national currency)
Y* = potential income
P = price rates
P* = price rates in selected countries
π = inflation rate
πe = predicted inflation rate
In equation 1, the coin price is added to the consumption function so that the effect of wealth is checked (other countries use Exchange Price Index to show the effect of wealth, but it is not applicable to Iran because of insufficient statistical data). Iranians usually keep their properties in forms of real estate or coin. Accordingly, coin prices can be a criterion of people's wealth. (Another index is the real estate price index which cannot be used due to lack of data). Although coins increase people's assets, they exclude the capital market of a part of financial resources, because it is kind of saving does not turn to investment. So it is not added to the investment function. Equation 2 represents the extended Taylor rule. The dependent variable is the short-time real interest rate which is controlled by the Central Bank.

While LM in IS-LM-AS is based on equilibrium between money supply and demand, it is measured by nominal interest rate, real income and other dependent variables.
It is assumed that equations 1, 2 and 3 include partial derivatives and there is a negative correlation between household consumption expenditures and the real interest rate. Thus, we have
0 < CY < 1, CT < 0, CR < 0, CS > 0, IY > 0,
(1 – CY – IY) > 0, IR <0, IS < 0, NXe>0,
R□□□□□0, RY □□0□□□□Y □□0,□□□□□0.
The slope of equations 1 and 2 are shown by equations 4 and 5:
$\frac{dR}{dY}\Big|IS = -\frac{1-C_Y-I_Y}{-(C_R+I_R)} < 0$ (4)
$\frac{dR}{dY}\Big|MP = -\frac{-R_Y}{1} > 0.$
The Jacobin determinant of exogenous variables by equation 6:
$|J| = (1 - CY - IY) - \theta R\pi\ (CR + IR - RY(CR + IR) > 0.$ (6)
Using the implicit function theorem and solving it for equilibrium values of the real income, interest rate and inflation rate, we can write out the balance of income as follows:
Y = Y [πe, G, T, e, (P*/P), S, Y*] (7)
A positive correlation is expected between balance income and government spending. Balance income has a negative correlation with predicted inflation rate and taxes. This is not clear for income and the exchange rate [7].
When coin price increases, higher household expenditure is projected. While the investment spending of enterprises go down, the final effect of coin price on the national income is unclear. The static analyses of the impact of ascending money value on balanced income are presented as bellow:
(8) $\frac{\partial y}{\partial e} = [NX_e(P^*/P) + R_e(C_R + I_R)]/|J|$
> 0 if $|NX_e(P^*/P)| < |R_e(C_R + I_R)|$
< 0 if $|NX_e(P^*/P)| > |R_e(C_R + I_R)|$
Thus, the net effect depends on whether the positive impact of elevated money value on consumption expenditure and investment due to lower exchange rate has increased or it has decreased as a result of the negative impact of reduced net export.

EXPLAINING IS-LM-AS FOR IRAN'S ECONOMY

IS-LM-AS can be explained by following relations according to the model proposed by Romer's (2000 and 2006) and the one offered by Yu Hsing.

(9)Y = H(Y, R, G, T, e (P*/P), S), (10) M / P = L(Y, R, S),(11) P = PC +α (Y − Y *).

DATA ANALYSIS AND PROCESSING

Where,
M = real money PC = the core price
By solving national income, interest rate and prices, we can reach the balanced national income, which has been shown in equation 12:

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$$Y = Y [M, \pi e, G, T, e, (P^*/P), S, Y^*] \quad (12)$$

The Jacobin determinant of endogenous variables is as follows:

$$|J| = - LR (1 – HR) – \alpha HRMP-2 – HRLR > 0.$$

(13)We can also show how national income reacts to any change in the real money supply, the real budget deficit and the real interest rate:

$$\partial Y / \partial M = -HR P-1 / |J| > 0,$$

$$\partial Y / \partial G - \partial Y / \partial T = (-HG LR – HT LR) / |J| > 0,$$

$$\partial Y / \partial e = (-He LR – \beta HR MP-2 + HR Le) / J > \text{or} < 0.$$

Note that it is not clear here how national income reacts to the real exchange rates and depends on the net effect. That is to say, it depends on the positive effect of increased money value on consumption expenditure and more investments [12].Time series of Iran's economy has been provided by the Central Bank's database. The price indices of the selected countries were obtained by WDI. The pertinent time series is 1971 to 2006 with annual data. We used augmented Dicky Fuller test to all variables. Results show that GDP is not stationary. But if we remove the effect of the trends, it would be 88% Stationary. We, thus, added trend to the estimations. The first-order differential of this series is Stationary and the series is cumulative from 1 degree or I(1). Predicted inflation is among variables which are not directly observable and should be estimated. To estimate this variable, there are different methods such as comparative predictions approach or rational prediction approach. As to the simplicity of comparative expectations approach, we applied this method. In this case, we consider expectations in a comparative process and consume that people in any period balance their inflation predictions regarding their previous errors. Accordingly, inflation rates are modeled to calculate the estimated values as the predicted inflation rate. After studying different models by econometrics of time series and observing ACF and PACF, the following AR (1) model was selected as the best model for estimating the inflation rate:

Dependent variable: inflation rate (P)

Table 1: theestimation of the predicted inflation rate by AR (1)

Dependent variable	Coefficient	t (probability)
Constant coefficient	12.42	4.57 (0.00)
Inflation rate in last year p(1)	0.28	2.07 (0.04)
Dummy variable	27.02	3.77 (0.00)
		R2 = 0.46
		F = 13.28
		Durbin Watson = 1.74
		Source: research findings

In above model, the dummy variable eliminated the effect of 1995 in which Iran experienced an unprecedented inflation of 49% to present a better estimation. We considered the estimated values (obtained by the difference of inflation rate and model remnants) as the predicted inflation rate and used them in estimations. We used the debt-to-GDP ratio to show the effect of government financial policies. The variable is achieved by dividing the real budget deficit by GDP in the same year. We studied USD to IRR rate. This means that increased exchange rate is accompanied by lower IRR rate and national money value. To estimate the real exchange rate, we multiply the informal exchange rate by price indices of the selected countries (Europe as the most important trading partner). Coin prices show the price of BaharAzadi Coin, which have been balanced by the price index. As mentioned before, to display the effect of wealth, it was added to the estimations. The real money supply was balanced by price indices. The following table presents the Stationary test results for all variables used in these models.

Table 2: augmented dickey-fuller unit root test Results to study the Stationary of variables

Variable	t	Critical level (5%)	Results
De-trended real GDP	-1.12	-3.50	88% Stationary
GDP first order differential	-1.52	-1.94	Stationary
Real money supply	-2.96	-2.92	Non Stationary
Real money supply First order differential	2.33	-1.95	Stationary
Debt to GDP ratio	-4.14	-1.95	Non Stationary
Debt to GDP ratio First order differential	-1.97	-2.95	Stationary
Predicted inflation	-4.62	-2.95	Stationary
Effective real exchange rate	-4.11	-2.95	Non Stationary
Balanced effective real exchange rate	-1.75	-1.95	Stationary
Oil income	-2.42	-1.95	Non Stationary
Oil income first order differential	-0.75	-1.95	Stationary
Coin price	-5.07	-1.95	Non Stationary
Coin price first order differential	-5.38	-1.95	Stationary

RESULTS AND DISCUSSION

To study Iran's monetary and financial policies based on IS-MP-AS, the country's economic conditions were widely estimated. We will refer to the best one and study the analysis and policy results. Examining the estimated values achieved by IS-MP-AS, we compared them with IS-LM-AS results. Finally, we studied the differences of two models and policy results.

IS-MP-AS ESTIMATION

We should be assured of a long-term relation between variables to avoid any forged regression. The following table presents the Johansen cointegration test, which was carried out for GDP, debt to GDP ratio, coin price and oil revenues.

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Table 3: Johansen cointegration test results over GDP log and debt to GDP ratio log, coin price log and oil revenues log

Null Hypothesis	TRACE	Critical Level (5%) (probability)
There is no cointegration between variables	65.18	63.87 (0.03)
Source: research findings		

Table results reveal that the null hypothesis (there is no co-integration between variables) is rejected. Thus, there is at least a long-term correlation between variables and they are co-integrated. And if we use them in regression, there would be no forged regression.

IS-MP-AS was widely estimated. Finally the estimation in table 4 is considered as the best acceptable one regarding the econometric methods. In all estimations, variables applied in logarithmic scale, except in case a variable had negative values. As it is observed, Iran GDP was well articulated by five factors- debt to GDP ratio, predicted inflation, real exchange rate, coin price, and oil revenue. In fact, R2 is around 95%. This shows that the above factors can well explain the national income fluctuations.

Table 4: estimation results for IS-MP-AS in Iran (Dependent Variable: log GDP)

Independent variable	Coefficient	t (probability)
Constant coefficient	11.59	26.6 (0.00)
Debt to GDP ratio	-98.17	-2.43 (0.02)
Log inflation	-0.12	-2.42 (0.02)
Log balanced real exchange rate	-5 e 2.75	1.75 (0.09)
Log coin price	-0.05	-1.64 (0.10)
Trend	0.02	18.78 (0.00)
Log oil revenues	0.14	5.72 (0.00)
		$R^2 = 0.95$
		F = 107.36
		Durbin Watson = 1.40
		Source: research findings

In addition to above R2, F or the significance level of regression shows that the fitted model has a high level of significance. Given the high and low limit of 95% Durbin-Watson statistic, we have DL = 1.08 and DU = 1.89. As to 1.40 Durbin-Watson statistics, we see that there is no self-correlation in the model. We used White heterogeneous variance test to study the heterogeneity of the model. The null hypothesis confirms the homogenous variance. F is 1.97 and the probability of 0.20 shows that the null hypothesis is not rejected. So no heterogeneous variance is observed and the results are valid. As results display, all variables are significant at 95% level, except coin price and the real exchange rate. Coin price and the real exchange are significant at 90% and 89% respectively.

IS-LM-AS ESTIMATION

We should be assured of a long-term relation between variables to avoid any forged regression. The following table presents the Johansen cointegration test, which was carried out for GDP, debt to GDP ratio, coin price and oil revenues. Results show that these variables have a long-term correlation and would not have any forged regression.

Table 5: Johansen cointegration test results over log GDP and log debt to GDP ratio, log coin price and log oil revenues

Null Hypothesis	TRACE	Critical Level (5%) (probability)
There is no co-integration between variables	80.57	69.81 (0.00)
Source: research findings		

The following table summarizes the estimation of IS-LM-AS. Here, if all variable values are not negative, we can use their logs.

Table 6: estimation results for IS-LM-AS in Iran (Dependent Variable: log GDP)

Independent variable	Coefficient	t (probability)
Constant coefficient	11.25	23.51 (0.00)
Log money supply	0.06	1.74 (0.09)
Debt to GDP ratio	-89.95	-2.21 (0.00)
Log inflation	-0.12	-2.48 (0.02)
Log balanced real exchange rate	3.72 e5	2.28 (0.03)
Log coin price	-0.04	-1.27 (0.21)
Trend	0.02	12.45 (0.00)
Log oil revenues	0.13	5.1 (0.00)
		$R^2 = 0.96$
		F = 91.49
		Durbin Watson = 1.29
		Source: research findings

According to results, GDP can be predicted by independent variables, including money supply, debt to GDP ratio, predicted inflation, exchange rate, and coin price and oil revenues. R2 at around 96% and F or the significance level of regression shows that the fitted model has a high level of significance. Given the high and low limit of 95% Durbin-Watson statistic, we have DL = 1.99 and DU = 1.99. As to 1.29 Durbin-Watson statistics, we see that there is no self-correlation in the model. F estimated at 1.97 by homogeneous variance test

and the probability of 0.29 shows that the null hypothesis is not rejected.2 So no heterogeneous variance is observed and the results are valid. According to the models' results, we can derive several points. In both models debt to GDP ratio has a negative impact on GDP. In fact, the ratio increases with the government budget deficit and GDP falls down. Additionally, the native relation between debt to GDP ratio and GDP states that the budget deficit has not been used as a good financial policy, because it highly affects government investment spending. Thus, the national income decreases with investment spending. As theories and research studies on Iran's economy and the economy of other countries show, there is a negative correlation between the predicted inflation and GDP [1][23][7][8]. Since we considered the inflation rates of past years, policies resulting in high inflation would have a high preventive effect on reducing GDP. The estimation of both models reveals that there is a positive correlation between exchange rate and GDP. The correlation of IS-MP is significant at 95%. As we considered USD to IRR rate, increased exchange rate was accompanied by lower IRR rate and national money value. However, this common principle of the economy that the lower money value increases the net export and national income is not true about Iran. The efficiency of this method to increase GDP is low by IS-MP-AS. But if our analysis is based on IS-LM, the significance of the coefficient goes up. As it is seen, coin price negatively associate with GDP. The significant levels of this variable in IS-MP-AS at 89% and in IS-LM-AS at 79% are low. By observing the negative coefficient of coin price, it can be concluded that although higher prices raise people's wealth and convince them to have more consumption, people are seduced to buy coin and the investment market liquidity goes down. This would have a negative effect on investment and GDP. Research results revealed that the negative effect on investment is higher than the positive effect on consumption. On the other hand, despite of the negative effect coin prices have on GDP, the significance levels of coefficients were insignificant (especially in IS-LM-AS). The high, positive and significant coefficients of oil revenues are indicators of the high effect of oil revenues on GDP. This confirms the fact that GDP growth highly depends on oil revenues. As results by IS-LM-ASshows, money supply has a positive and significant effect (90%) on GDP. Put it differently, monetary policies affect the real variables of Iran's economy. Thus, we can employ such policies to change the real variables including GDP. The conclusion was also confirmed by other empirical research studies carried out in Iran [25].

CONCLUSIONS

As mentioned before, fluctuations in Iran GDP are highly predicted by five variables of debt to GDP ratio, predicted inflation, real exchange rate, coin prices and oil revenues in IS-MP-AS. Debt to GDP ratio, predicted inflation and coin prices have negative effects and the real exchange rate and oil revenues positively affect GDP. According to IS-LM-AS, we can also study the effect of money supply as an effect variable for national income together with other variables. Estimations indicate that real money supply has a positive significant impact on GDP. This confirms the efficiency of monetary policies in Iran.

Our paper studied the IS-MP-AS and IS-LM-AS for Iran's economy. Results were then compared and no significant difference was observed between them.

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