An Analysis of the Inflationary Effect of "Subsidies Targeting" Scheme of IRAN: Flow- of- Funds Approach

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Abstract

In the beginning of 2011, Islamic Republic of Iran underwent a Scheme called "Subsidies Targeting". This scheme meant to replace subsidies on goods and services especially energy, which had kept prices low for decades, with a monthly refund to every resident as compensation plan. Considering the magnitude of price change up to ten times and the importance role of Energy carriers in production and households' consumption, it would be necessary to analyze the inflationary effect of that Scheme. Therefore we developed a RMSM-X model including six sectors and added some behavioral links among economic variables to forecast Inflation and Growth rates for a four-year period. Unlike other studies done about this subject in Iran, RMSM-X ensures economic consistency among all sectors of an economy. The RMSM-X projection results suggest that the Scheme increases inflation rate by 24% and reduces the growth rate by 5%. Even though inflation rate levels of the year after running the Scheme but it will not fall back to base scenario by 2015.

Keywords: Cointegration Techniques, Price Transmission, Error Correction Model, Iranian Tea Market, Concentration Ratio and Herfindahl- Hirschman Indicator.

1- Introduction

It has been decades that Iran's Government was intervening in the prices of strategic goods and services by subsidizing them and keeping their prices low. Such interventions, especially in price of energy carriers, have been made the producers to invest chiefly in energy-intensive production technologies. In February 2011, Government started to cut subsidies and increase the price of energy carriers remarkably. As the compensation

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scheme, government promised to distribute evenly the 50% of its earnings from running the whole scheme between households and 30% to producers. The Government would invest the remainder in infrastructures and new technologies. They claim that their Scheme imposes the economy a price shock and no subsequent inflation follows in the upcoming years. Before the scheme actually was launched and while it was being developed, many studies tried to forecast the effect of this plan on major economic variables but many of them modeled the economy under a framework that would not necessarily ensure economic consistency between sectors like Jaluli, M. [2009] and Ghorbannejad, M. [2011]. This study uses RMSM-X in order to build a consistent model.

2- Model
2-1- Basics of RMSM-X

RMSM-X model is based upon the concept of a consistent flow-of-funds. The basic RMSM-X model contains four economic agents or sectors: public, private, financial and foreign. The public sector is defined as the Central Government and the Financial Sector is defined as the Monetary System, consisting of the central bank and deposit money banks. That leaves non-central government agencies, parastatal enterprises, non-monetary financial institutions as Private Sector. Foreign Sector is simply the balance of payments viewed from outside of the country, which means that credits and debits are reserved. The RMSM-X relies on fundamental accounting identity of standard national income accounts.

$$Y = C + I + X - M$$

Gross domestic product (at market prices) must be equal to expenditures on consumption, investment and net exports. The basic model requires both consumption and investment to be divided into public (central government) and private components. If one knows the value of Y, I, X, and M, the value of C can be deduced simply. And if one knows the value of C and one of its components the other component can be deduced.

In addition to the GDP identity, RMSM-X incorporates budget constraints for each of the four sectors which require not only that the total sources (revenues) for each sector equals its total uses (expenditures), but

also that a use in one sector must be a source in another sector. These budget constraints are declared as current and capital accounts for each sector. These relationships ensure consistency with the flow-of-funds accounting methodology.

Current Income – Current Expenditures = Net Savings
Net Savings = Net Accumulation of Wealth

Behavioral functions project how external variables evolve over the time. Behavioral constraints on the model are embodied in four financial asset market-clearing relationships for money demand, foreign asset, government borrowing from the private sector, and domestic monetary credit. These relationships yield a system of nine equations, of which eight are independent and one is determined by Walras law. Therefore the model can be solved for eight unknown values – the endogenous or residually estimated variables of the model.

There are many solutions or closures exists for the model, defining which variables are given in the model and which ones are left to be solved endogenously. In this study, Policy Closure is used which defines a path of government policies and the behavior of some private sector variables and the model generates the paths of nominal and real GDP and the remaining private sector variables.

Combination of policy variables path with behavioral functions and endogenous variables which are solved with the consistent framework of flow-of-funds lets the model to be simulated recursively over time.

2-2- RMSM-X Structure

RMSM-X model disaggregates economy into sectors and defines current and capital budgetary identities for each of them. Since the data provided by the Central Bank of Iran divides the economy into six main sectors, the RMSM-X was adjusted accordingly so as to include, Households, Central Government, Oil, Non-financial Enterprises, Financial Enterprises and Foreign sectors. The budgetary identities of those six sectors are as follows:

Households Sector
Current account:

$$VA_p + WR_{total} + PL_{mp} + PL_{ep} + (CT_{gp} + SR_p) + i_{SD} + SD_p + i_B.B_p = TD_p + CT_{pm} + i_{BC}.BC_p +$$

$$e.i_{FD}.FD_p + C_p + S_p$$

Capital account:

$$S_p + e.\Delta FD_p + \Delta BC_p = KT_{pe} + KT_{pm} + \Delta B_p + \Delta CU_p + \Delta SD_p + I_p$$

Central Government Sector
Current account:

$$VA_g + TI - (SUB - STR) + TD_{total} + PL_{mg} + PL_{ep} + PL_{og} = WR_g + (CT_{gp} + SR_p) + SR_e + i_B.B_{total} + i_{BC}.BC_g +$$

$$e.i_{FD}.FD_g + C_g + S_g$$

Capital account:

$$S_g + \Delta FB_{total} + \Delta BC_g + \Delta FD_g = KT_{go} + KT_{ge} + KT_{gm} + \Delta CU_g + I_g$$

Oil Sector
Current account:

$$VA_O = WR_o + TD_o + PL_{og} + i_{BC}.BC_g + e.i_{FD}.FD_o + S_o$$

Capital account:

$$S_O + KT_{go} + \Delta BC_O + e.\Delta FD_O = KT_{oe} + \Delta CU_O + I_O$$

Non-financial Enterprises Sector
Current account:

$$VA_e + i_{SD} + i_B.B_e + SR_e = WR_e PL_e + PL_{ep} + CT_{eg} + TD_{ep} + i_{BC}.BC_e + e.i_{FD} FD_e + S_e$$

Capital account:

$$S_e + KT_{me} + KT_{oe} + KT_{ge} + KT_{pe} + e.\Delta FD_e + \Delta BC_e = \Delta B_e + \Delta CU_e + \Delta SD_e + I_{ee}$$

Financial Enterprises Sector
Current account:

$$VA_m + CT_{pm} + i.._{BC}.BC_{total} + i_B.B_m = WR_m PL_m + PL_{mp} + TD_{mg} + i_m.SD_{total} + e.i_{FD}.FD_m + S_m$$

Capital account:

$$S_m + KT_{gm} + KT_{pm} + e.\Delta FD_m + \Delta CU_{total} + SD_{total} + e.FD_m = KT_{me} + \Delta BC_{total} + \Delta B_m + I_m$$

Foreign Sector

Current account:

$$IM + ei_{FD}.FD_{total} = WR_f + EX + S_f$$

Capital account:

$$S_f = e.\Delta FD_{total}$$

Term	Description	Term	Description
B	Government Bonds	i_{SD}	Interest Rate Saving Deposits
BC	Debt to Financial Sector	IM	Imports
C	Consume	KT	Capital transfers
CT	Current Transfers	PL	Profit and Loss
CU	M2	S	Saving
E	Non-official exchange rate	SD	Saving Deposits
EX	Export	TD	Direct Tax
FD	Foreign Debt	TI	Indirect Tax
GDP	Gross Domestic Product	VA	Value Added
i_B	Bonds Interest Rate	WR	Work Remittance
i_{BC}	Interest Rate on Domestic debt	STR	Subsidies Targeting Income
i_{FD}	Interest Rate on Foreign debt	SR	Subsidies Refund

Subscript	Description
P	Households
G	Central Government
O	Oil
E	Non-financial enterprises
M	Financial enterprises
F	Foreign sector

Like the works of Luis Serven [1990] for Chile and Luc Everaert [1992] for Turkey, there are two general approaches to solve a typical RMSM-X model, the positive and normative. In this study we are implementing the positive approach therefore given policy variables such as government expenditures and monetary policies we can solve the model to project inflation and growth rates.

In order to integrate "Subsidies Targeting" scheme into the model, Three new variables were introduced to budgetary identities i.e. STR which

represents the funds that Government saves1 by running the scheme so it is subtracted from total Subsidies and then SR_e and SR_p which indicate respectively the money that government returns to non-financial enterprises and households under compensation plan. The above mentioned variables can be determined endogenously as follows:

$$STR = C_{p-fuel} \times (P_{fuel2} - P_{fuel1}) + En \times (P_{eng2} - P_{eng1})$$
$$SR_p = \%50 \times STR$$
$$SR_e = \%30 \times STR$$

By equation13 STR is simply the changes in fuel and energy prices multiplied by Households and non-financial enterprises consumption of energy carriers. Variables $C_{p\text{-}fuel}$ and EN denote respectively the households and non-financial enterprises consumption of energy carriers in million gallons crude oil scale. Half of government's income from the Scheme is supposed to be passed to households and %30 to enterprises under compensation plan.

In RMSM-X model, some variables of researcher's choice can be determined using the simple budgetary identities as residual variables. Other ones should be projected using behavioral functions. The behavioral functions are categorized into five markets .i.e. goods & services, money, domestic debt, bonds and foreign debt markets. By the word Market, we mean that the model requires the equity of Supply and Demand.

2-3- Goods & Services Market

This market includes the variables that build national identity. Note that this market mostly covers the variables that are described in constant prices. When nominal variables are required, we use uppercase characters.

$$y = c + i + g + ex - im$$

The supply side of the national identity is the gross domestic product and it is assumed to have the following simple Cobb-Douglas form:

1- Government is the only sector that sets the price of Energy Carriers and supplies them to other sectors.

$$y = A \cdot L^{\beta_1} \cdot K^{\beta_2} \cdot En^{\beta_3} \qquad \beta_1 + \beta_2 + \beta_3 = 1$$

where β_1, β_2 and β_2 are the production elasticity of labor, capital and energy respectively. Unlike the other form of production functions, we included consumption of energy carriers into production function in order to analyze its effect on production.

Energy carriers in million gallons scale, are projected it by estimating the following demand function

$$En = f\left(y, \frac{peng}{pd}, En_{(-1)}\right)$$

where P_d is the GDP deflator that here is used to convert the nominal energy prices to constant ones.

Capital stock (K) can be estimated endogenously in the model using the following equation:

$$K_t = (1 - \delta) \times K_{t-1} + I_{t-1}$$

where δ is the rate by which capital wears out. Finally as for Labor, it was projected by assuming that the production function remains on its optimum curve at least in short-run. Therefore:

$$L = \frac{\beta_1 \times Pd \times y}{PL}$$

where P_L is the price of labor and it is increased every year by inflation rate of previous year. This has been the method that Government has used for years to compensate the reduction in labor's purchasing power.

As for demand side of national identity we have the following functions:

$$C = C_{pnf} + \frac{p_{fuel}}{Pd} \times C_{p-fuel} + C_g$$

$$i = i_p + i_g + i_o + i_e + i_m$$

$$nex + ex_{no} + ex_{oil} - im$$

Referring to equation 21, consumption (C) is composed of households' consumption of non-fuel goods and services (C_{pnf}) plus consumption of fuels ($C_{p\text{-}fuel}$) and the Central Government expenditures (C_g). Households' consumptions can be projected by following functions:

$$c_{p-nf} = f(c_{p-nf(-1)}, y_d)$$

$$c_{p-fuel} = g(y_d, \frac{P_{fuel}}{CPI})$$

$$y_d = \frac{VA_p + WR_{total} + PL_{mp} + PL_{ep} + i_{SD}.SD_p + i_B.B_P - i_{BC}.BC_p - i_{FD}.FD_p + CT_{ep} + CT_{gp} - CT_{pm} - TD_p}{CPI}$$

Where y_d is the disposable income.

Central Government expenditure is function of its income (in_g), derived from budgetary functions, and lagged expenditures.

$$c_g = f(in_g, c_{g(-1)})$$

Investment, the most unpredictable part of national accounts, is composed of five parts according the data provided by Iran's Central Bank. The investment by Oil and Enterprises sectors are simply a function of what they have saved in every period. The investment size by monetary sector is insignificant compared to other sectors but it can be considered as a function of the total saving deposits that it holds. Central Government and Households'' investments are both calculated as residual respectively from Government's budgetary identity and national account. The respective investment equations are:

$$I_o = f_2(S_o)$$

$$I_e = f_3(S_e)$$
$$I_m = f_4(SD_{total})$$
$$I_g = S_g + e.\Delta FD_g + \Delta BC_g + \Delta B - KT_{go} - KT_{ge} - KT_{gp} - \Delta CU_g$$
$$I_p = GDP - C - EX + IM - (I_g + I_o + I_e + I_m)$$

The price index used to convert Investment from constant prices to nominal ones and vice verse is the Producers Price Index which will be discussed in Money Market section.

Real imports are function of real GDP and real exchange rate but exports are divided into two parts, i.e. export of non-oil products and export of oil. Export of non-oil products can be described as a function of foreign country's income and real exchange rate. Iran's export of oil is relatively stable because it is determined as a part of OPEC's total export, and hence it can be described as a function of its lagged value and the average price of crude oil in previous year. The related equations are as follows.

$$im = f(gdp, e_{real})$$
$$ex_{no} = g(gdpw, e_{real})$$
$$ex_{oil} = h(ex_{oil(-1)}, P_{oil(-1)})$$
$$e_{real} = e.\frac{pm}{pd}$$

2-4- Money Market

Money supply (M_2) is determined by money basis (H). Apart from the constant growth rate that has been considered for Money Basis, it is also dependent on the volume of Government borrowings from Central Bank. According to Central Bank's reports; borrowing from financial sector, including Central Bank, has been a common method that Government has used to clear its deficits. Thus government's deficits need to be included in Money Basis function.

$$H = f(H_{(-1)}, Deficit$$
$$M_2 = k.H$$

By multiplying the money basis by K, which is money multiplier coefficient, money supply (M2) can be calculated.

On demand side, we have the real economy output or simply y which was projected in Good & Services market and GDP deflator (P_d). Given M2 and y we can find P_d.

$$P_d = f(GDP_{real}, M_2, Pd_{(-1)})$$

P_d at previous period is added to make the deflator dynamic.

Price indexes are assumed to be a geometric average of P_d and price index of imported goods.

$$CPI = P_\alpha^{\alpha 1} \times (e.P_m)^{\alpha 2} \qquad\qquad \alpha_1 + \alpha_2 = 1$$

$$PPI = P_\alpha^{\beta 1} \times (e.P_m)^{\beta 2} \qquad\qquad \beta_1 + \beta_2 = 1$$

$$WPI = P_\alpha^{y 1} \times (e.P_m)^{y 2} \qquad\qquad y_1 + y_2 = 1$$

2-5- Bank Credit Market

Bank credits are provided by financial sector. The total credits that can be given to other sectors is assumed to be a fixed ratio of the total money in circulation. Given the total bank credits, the change in this variable is simply the difference between the two subsequent periods.

$$BC_{total} = f(M2)$$

$$dBC_{total} = BC_{total} - BC_{total(-1)}$$

Central Government and Oil sectors clear a part of their deficit by borrowing from financial sector. Non-financial enterprises borrow from financial sector to finance their Investments. Given the total credits, the bank credits to households will be specified as a residual variable. Therefore the bank credit variables are as follows:

$$dBC_g = \alpha_1 . Deficit_g$$

$$dBC_o = \alpha_2 . Deficit_o$$

$$dBC_e = \alpha_3 . I_e$$

$$dBC_p = dBC_{total} - dBC_g - dBC_o - dBC_e$$

2-6- Foreign Debt Market

Iran has been running surpluses for years, thanks to its oil exports. So the foreign debt variables mostly appear with negative sign. On the other hand Exchange rate is being controlled by Central Bank and is allowed to fluctuate only in a tight range. So the variable e, which denotes nominal exchange rate, assumed to be fixed in short-run projections.

The total foreign debt is being projected as a function of imports, exports, work remittance, foreign debt in previous period and finally the average of interest on foreign debt.

$$e.dFD_{total} = f(IM, EX, WR_f, e.FD_{total(-1)}, i_{FD}) \tag{49}$$

Since the borrowing for Government is time consuming, the net value of Government's borrowing is assumed to be a function of its deficit and its debt in previous year. As for oil and enterprises sectors, a part of their deficit is financed by domestic borrowing and logically the remainder should be financed by foreign debt. The financial sector's debt can be driven using its budgetary identity. Given the total foreign debt and the debt of every sector, the last sector's debt, i.e. households, can be derived. Foreign debt equations and behavioral functions are as follows:

$$e.dFD_g = g(e.FD_{g(-1)}, Deficit_{g(-1)}) \tag{50}$$

$$e.dFD_o = Deficit_o - dBC_o \tag{51}$$

$$e.dFD_e = Deficit_e - dBC_e \tag{52}$$

$$e.dFD_m = I_m + dBC_{total} + dB_m + KT_{me} - dM_2 - S_m \tag{53}$$

$$e.dFD_p = e.(dFD_{total} - dFD_g - dFD_o - dFD_e - dFD_m) \tag{54}$$

2-7- Bonds Market

It is assumed that the only sector that issues bonds is the Central Government, although this assumption contradicts the actual data. But since on one hand, other sectors do not issue bonds regularly and on the other hand the model is build using the consistent accounting framework of flow-of-funds, it imposes no limitation on further analyses. Thus if a sector except Central Government issue Bonds, in this simplified model the Government

pays bond holders interest and then gets the interest back from the sector that actually has issued the bonds.

The total net bonds that Government needs to issue are its actual deficit that could have been financed neither by bank credit nor foreign borrowing. The value of changes in Non-financial sector bonds is a function of its deficit and the net capital transfers that it receives from financial and oil sectors. The ratio of total bonds held by financial sector to the money in circulation is a function of the ratio of total saving deposits to money in circulation. By forecasting the total bonds which financial sector holds, calculation of the net changes in its value is straightforward. Like the other variables related to households, the change in the value of bonds that they hold is calculated as a residual variable by having the change in total bonds and the given change in the bonds of other sectors.

$$dB_{total} = Deficit_g - dBC_g - dFD_g$$
$$dB_e = f(Deficit_e, KT_{me}, KT_{oe})$$
$$\frac{Bm}{CU} = g(\frac{SD_{total}}{CU})$$
$$dB_m = B_m - B_{m(-1)}$$
$$dB_p = dB_{total} - dB_m - dB_e$$

The interest rate according which government pays interest to bond holders, unlike non-Islamic Governments, is not fixed. Government is supposed to calculate the benefits of the construction projects that they had completed using those funds gained by bonds and then repay the difference to the holders by the end of the year. Dividing the total money paid by Government as interest by the total volume of bonds, one can determine that generally the final interest rate does not exceed more than one percent from the rate they announced firstly as a provision interest rate while the provision rate has been ranging from 15 to 17 percent depending on the bonds. Moreover the calculations steps needed to derive the real interest rate by which should the holders be paid is far more complicated than the whole RMSM-X model. Therefore the real Government interest rate that was taken into account calculated as the firstly announced rate plus average of

differences between final and firstly announced rates over the past years in order to avoid further complications into the model.

3- Results

As mentioned earlier, the combination of budgetary constraints with the behavioral functions described earlier in five markets; let the model to be solved for the endogenous variables including GDP and GDP deflator in goods and services market. Afterwards using the recursive nature of the model, it can be solved for upcoming years. In order to measure the effect of subsidies targeting scheme on the model, the variables SR_p and SR_e and STR are set as exogenous variables defining the path of Government policies. As the Baseline scenario the model will be solved supposing that the Government did not run the scheme whereas Subsidies1 and Subsidies2 scenarios solve the model as the Government ran the scheme. Unlike Subsidies1 which imposes a constant exchange rate to the model, Subsidies2 scenario suppose exchange rate to be increased by 4% yearly.

The model used to project the values of inflation and growth rates for a 4-year period from 2011 to 2015. The scenarios are as following:

1- Baseline: The price of energy carriers continue to rise every year by 10% as the common policy taken by Iran's previous Government up to year 2005.

2- Subsidies 1: A sudden increase in price of energy carriers but holding the prices constant for the upcoming years

3- Subsidies 2: A sudden increase in price of energy carriers and keep increasing it by 4% for the upcoming years.

Note that the government increased the price of energy carriers for productive sectors up to 5.5 times and for households up to 8 times.

By running the baseline scenario the growth rate hovers around %5 and inflation rate around %15 for the years after 2011 up to 2015.
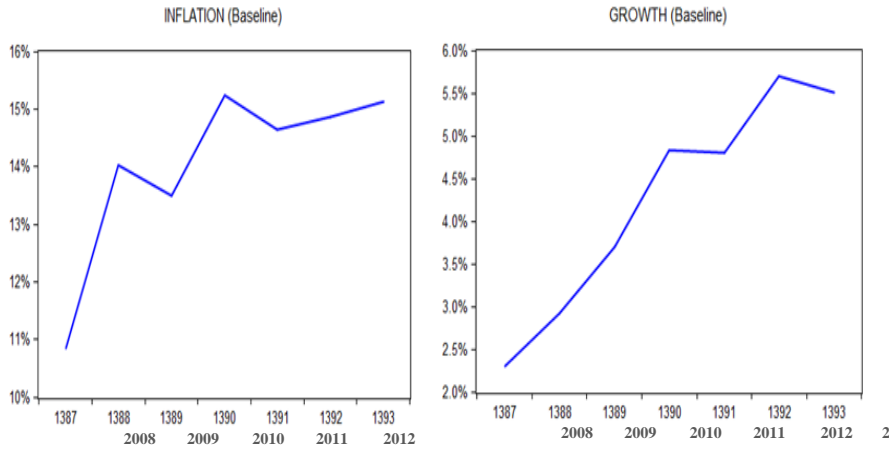
Figure 1: Inflation and Growth rates under Baseline Scenario

Under the next two scenarios, the results suggest that after the first year of implementing the "Subsidies targeting Scheme" the inflation rate increases by %25 and the growth rate falls by %2.5 and goes negative. But for the years after, the growth rate keeps going up and inflation rate starts falling back. In Subsides 2 scenario, since the price of energy carriers keeps increasing; the growth and inflation rates do not recover as fast as they do under Subsides 1 scenario.
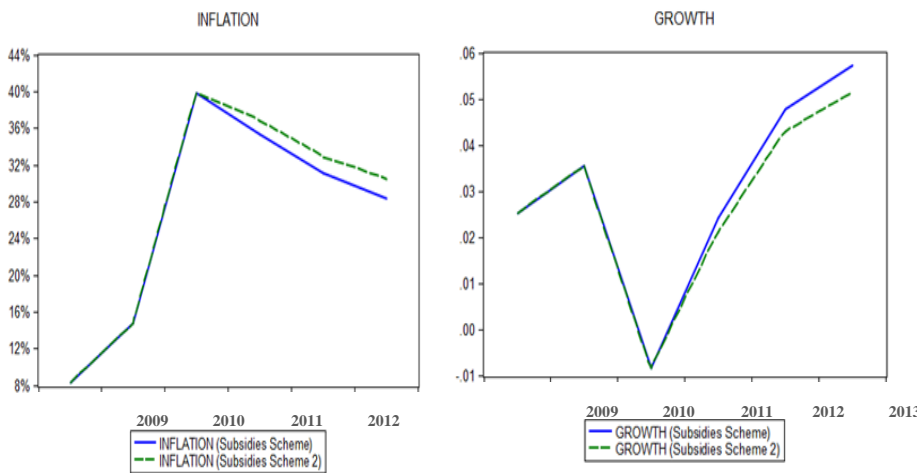
Figure 2: Inflation and Growth rates under Subsides 1 & 2 Scenarios

The table below shows the result of RMSM-X simulation under the three different scenarios.

Table 1: The Projection Results for Growth Rate

Year	Baseline	Subsides 1	Subsides 2
2011	% 4.83	%-0.08	%-0.08
2012	% 4.81	% 2.42	% 2.12
2013	% 5.69	% 4.78	% 4.28
2014	% 5.51	% 5.73	% 5.13

Table 2: The Project Results for Inflation Rate

Year	Baseline	Subsides 1	Subsides 2
2011	% 15.24	% 39.87	% 39.87
2012	% 14.65	% 35.32	% 36.80
2013	% 14.86	% 31.15	% 33.89
2014	% 15.13	% 28.35	% 30.44

Conclusions

As a program to reform the economy structure, Iranian Government introduced a scheme called "Subsidies Targeting". Under that scheme subsides was cut and the prices of oil carriers increased up to ten times. Many approaches were implemented to forecast the economy's major parameters but most of them could not ensure economic consistency between sectors therefore we modeled the economy using RMSM-X which is based on flow-of-funds accounting. By integrating the compensation plan of Government and the prices of fuel elements into households' budgetary identities and by adding the energy factor into the economy's production function we could project the inflation and growth rates for years 2011 to 2015.The projection results clearly suggest that, unlike the Government's claims, Iran will undergo a recession and experiences high inflations for the years following the scheme implementation.

Unfortunately, by the year 2012 Iran experienced another significant change in its economic imposed by a sharp rise in exchange rate. Right after the USA put embargo on Iran's central bank, the exchange rate doubled and

then tripled and even went for a for times rise but then fell back. Moreover the exchange rate, which has been stable and fixed to some extent for years, became volatile. It entered significant uncertainty into the economic and had dramatic effect on the inflation since many machinery and raw materials used in productive sectors was imported (accounted for about 80% of total imports). The Iran's political situation at that time in addition to sharp increase of exchange rate and the effect of running subsidies targeting scheme, which caused fuel careers prices to rise on average about 10 times, all together made the government to avoid central bank declaring the annual data of GDP growth. But the inflation rate which reflects the average of price changes announced by central bank is 21.5% for 2011 and 30.5% for 2012. Note that since the detailed table of prices reflects a wide range of changes from 8.4% to 89.9% depending on the sectors. And since the inflation rate is calculated as a weighted average of that wide range of changes, it may not clearly reflect the real economic situation of Iran.

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