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Increasing the Efficiency of Transfer Payments in Iran Using System Dynamics

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Abstract

Iran's economy is remarkably influenced by its oil industry and hence, the level of social welfare strongly depends on its oil market. Because of the prevailing and global increase of oil price, it seems conceivable to improve the social welfare through some efficient policies. In this research first the current situation of Iran's national economy and social welfare is analyzed in order to discover the current policies' malfunctions and their origin. The dominant scheme here is to use holistic insight in applying sustainable development approach as well as trying to stabilize the fluctuations in welfare and economic levels of the society. In this study three policies are used in order to cope up with imposed fluctuations of oil price. These policies include reducing oil subsidies, investing on health, education and manufacturing-construction areas, and a gradual increase in taxes. Finally, an effort is made to develop Iran's economy by increasing the role of non-oil industries.

Keywords: Oil economy, Sustainable development, Novel investment, Transfer payments, Subsidy elimination.

1. Introduction

Considering the importance of oil market in countries' economy, many investigations have been carried out on oil and its price changes, such as the works done by Ghiasi (2003) and Mobasherpour (2006) in Iran. These investigations imply the importance of global oil price fluctuation all around the world. Numerous studies are devoted to investigate macroeconomics and oil economics separately. But mutual effects of oil price and macroeconomics have been also surveyed by researchers such as Ahmadian (1999), Tamizi (2001) and Onsori (1972). Sensitivity analysis is a popular method to measure the influence of oil price on economic variables. Studying asymmetric effects of oil price shocks on Iran economic development by (Tamizi, 2001) and oil price fluctuations and its effects on some important variables of Iran macro-economy by (Mobasherpour, 2006) are two proper examples.

During the last few decades, beside the studies accomplished about oil-based economies, systematic thinking has been considered vastly to bridge the existing gap in various domains, such as cultural, social, political and economic ones. Systematic thinking as an important basis for learning organizations has attracted remarkable attentions to itself in a way that on one hand it is considered as a proper method for developing and improving the decision making process in organizations and on the other hand it is known as a vital element for departing toward the learning organizations. Mashaiekhi and Araghi (2004) emphasize on the necessity of applying systematic thinking and dynamic insight in its own implementation procedure in order to take advantage of its benefits in a permanent and efficient manner. Otherwise after establishing and applying System Dynamic (SD) approach, this insight will be able to grow for a short period of time. But, after a while prevailing effect of growing loops will be diminished and balancing loops will prevent systematic thinking to proceed. They finally present some solutions to solve this contingent problem.

Energy economy has been occasionally investigated with system dynamics approach in order to discover how oil-dependent economies are threatened by changes in oil market, and how to present novel and intelligent policies to cope with these malfunctions using a systematic and dynamic approach. Energy is an effective factor in economic activities since it is an inseparable part of industrial productions. It is noteworthy that even though the world population has been tripled from 1890 to 1990, the average of Gross National Product (As an index of public welfare) has increased more than five times. Considering the increase of 1200 percent in global energy consumption from 1900 to 1990 (Battjes, 1999), the importance of energy carriers especially fossil fuels in world’s present industry and welfare can be illustrated.

Farzanegan and Markwardt (2003) state that Iran’s economy is significantly affected by oil fluctuations. They analyzed the dynamic relationship between oil price shocks and main economic factors in Iran. The result demonstrates that both positive (increasing) and negative (decreasing) shocks lead to inflation. They mentioned Iran’s oil revenue as both golden opportunity and threat to implicate the necessity of applying compatible and intelligent policies (specifically in positive shocks periods).

Kazemi et al. referred to the fact that subsidy payments cause wasteful consumption to increase (Kazemi et al., 2005). They also presented a model to analyze available policies using system dynamics insights and to find how these policies will deal with short-term and long-term problems. Nwafor et.al (2006) surveyed the impact of various social services including: welfare systems, banking, medical-pharmaceutical systems and insurance services on the quality of life for lower deciles of society. At last they concluded eliminating regular subsidy payments without using the subsidy budget for public's sake in a more intelligent way leads poverty to spread across the country. Coadi & Newhouse (2005) have presented an effective welfare system in which the revenue acquired by eliminating subsidies will be devoted to medical and educational services. As discussed before, Gupta and his colleagues (Gupta et.al, 2000 ;Gupta et.al, 2003) claim that public subsidy payment system will lead to intensification of negative effects of global oil price fluctuations.

Due to the above cited articles, picking intelligent policies to spend the income earned by eliminating oil subsidy is a highly important and sensitive task. Therefore, using systematic insight and system dynamic techniques to develop efficient policies is advised. Considering recent changes in Iran's transfer payment policies and the vital role of national oil revenue in Iran's economy, it is necessary to investigate different applicable policies in order to find a permanent solution for the present energy and subsidy problems.

In order to have a stable society with a high public satisfaction level, economic and social welfare fluctuations should be properly damped. So in the current study, authors decided to choose the criterion of public satisfaction (as a generalized form of social welfare) instead of the social welfare criteria. In this regard, short to long term indicators are presented in order to evaluate public satisfaction. Studying civilizations, from ancient times to now a days and behavior of their inhabitants teaches us that a successful civilization should provide its people by a sustainable and continuous form of welfare not a luxurious but temporary and fluctuating form of life. In other words, only a reliable kind of welfare can create satisfaction in a society. Hence, we are going to introduce two different types of welfare with different impressions. So during the future analysis, these two distinguished concepts should be investigated separately. From this point forward, these two types of welfare are referred to as "Sustainable welfare" and "Temporary welfare". Thus a kind of welfare which can be transferred to the future and plays a sustainable role in development of public satisfaction will be mentioned as Sustainable welfare. On the other hand, a social welfare which is provided temporarily with short-term effects and cannot be transferred to the future will be called temporary welfare. Temporary welfare will increase public's expectation of future welfare. Consequently it has a negative impact or anti welfare role that reduces future public satisfaction indirectly.

For example, a global temporary increase in oil price will raise the income of oil-producing countries such as Iran. Consequently a higher level of social welfare is expected for these countries. But when this positive shock is passed, since global oil price is reduced to its former value these expectations cannot be fulfilled. So government's disability to fulfill these expectations will lead to public dissatisfaction in the coming years.

Due to these arguments, national income and social welfare's fluctuations should be treated as an undesired phenomenon which impacts public satisfaction harshly. This conclusion is also approved by recent studies measuring the sensitivity of macroeconomic variables to the oil shocks and fluctuations in different countries (Nagy and Al-Awadi 2001; Zaytsev 2010; Akpan 2001; Kpodara and Djiofack 2009; Hakan Berument et al. 2005; Chang and Fong Wong 2003; Balke et al. 2010; Siami and Fahimifar 2003). So a lot of studies concluded that national income and social welfare fluctuations caused by oil price fluctuations should be damped in order to sustain the national economic situation (Gupta et al. 2003;Gupta et al. 2000; Farzanegan and Markwardt, 2003). Negative effects of oil shocks and fluctuations on Iran's economy are also established by (Mirzaei, 2000). Mirzayi investigates asymmetric effects caused by both negative and positive shocks and concludes that positive shocks are potentially more destructive than effective.

Operative factors such as oil resources restriction, dependence of modern technologies on various oil products, population changes, global attempt to optimize oil utilization, replacing major oil consuming technologies with efficient ones etc, should be considered in order to predict a country's peak oil production. With this regard, Kiani et al. (2009) employed stock and flow diagrams to predict Iran's peak oil production by taking advantage of system dynamics approach. They expressed the important role of Iran's oil export in global oil market as the 4th world major oil exporter country in the year of 2008. From their point of view the amount of oil production in Iran explicitly influences domestic and global energy policies. Based on their simulation, an annual increment of 2 to 3 percent before the year of 2043 is predicted. Then production rate is anticipated to drop sharply with a 3 to 4 percent downturn within each year. Obviously, peak oil production is predicted to occur in the year of 2043 and after that reduction in oil production will occur in a way that Iran's oil production in 2084 is predicted to be equal to its previous level observed in 1988. At last they recommend energy specialists to make intelligent decisions in order to cope with this anticipated reduction and avoid disasters from happening.

It was mentioned earlier that the economy of oil exporting countries is highly influenced by global oil price and its fluctuations. The influence of global oil price fluctuations on sustainable and temporary welfares in Iran, as one of the major oil exporter countries, can be easily observed. Based on recent studies, appropriate policies are required to deal with future changes in global oil price and domestic oil production. Consequently, a stock and flow diagram is presented in the following sections to evaluate different policies. After employing the model and analyzing present policies, new ones are presented to eliminate the shortfall of the old ones as much as possible. Then an efficient combination of these new policies is recommended to optimize their performance. Finally, optimized values are assigned to the parameters of the recommended policy. Sensitivity analysis is applied in order to find optimal values for the mentioned parameters. As a final check, the recommended policy with optimal parameters is analyzed and evaluated. Next section of this paper discusses the effects of global oil price fluctuations. Required concepts and applied approach are introduced in section 3. Causal diagram is presented in section 4 and next section is devoted to the presentation of stock and flow model. Then results are analyzed in section 6. Finally, conclusion and recommended future work directions are mentioned in section 7.

1.1. Local linear neuro-fuzzy models

Several linear regression models are combined together in order to form a locally linear neuro-fuzzy model. In a way that every regression model has the most reliability for a specified range of input variables which can be modified by using a normally Gaussian membership function. A Locally Linear Model is abbreviated to LLM. The range in which a LLM is considered reliable should be defined due to the central value and variation of its corresponding Gaussian function. Final aggregated output of the initial model is actually a combination of its constitutive LLMs. Considering a specific input, the LLM which allows that input to have the most membership value in its reliability range has the most impact on the final output.

$\hat{y}_i$ represents LLM_i's output. Therefore following equation is concluded:

$$\hat{y}_i = w_{i0} + w_{i1}x_1 + ... + w_{ip}x_p$$

W_{ij} is used to show the parameters which belong to neuron *i*.

$\varphi_i(x)$ is employed to demonstrate reliability of LLM_i and is calculated by the means of this equation: $\varphi_i(x) = \exp(-0.5(x-c_i)^T \sum_i (x-c_i))$

Consequently following equation is applied to calculate final output of the initial model:

$$\hat{y} = \sum_{i=1}^{M} \hat{y}_i \times \varphi_i(x)$$

The procedure of adjusting parameters of a locally linear neuro-fuzzy model in order to accommodate them with the desired system/function is called LLNF. Locally Linear Model Tree abbreviated to LoLiMoT is known as one of the most popular training algorithms for locally linear neuro-fuzzy models (Nelles & Isermann, 1996). LoLiMoT divides the space made by input variables into super rectangular which have sides in parallel with the main axis. In any iteration, one of the super rectangular is divided and consequently a new LLM will be created (Nelles et al., 1996). LoLiMoT consists of an outer and an inner loop. Structure of input space partitioning is modified in the outer loop, while the method of weighted least squares is applied to estimate each LLM's parameters locally in the inner loop.

LoLiMoT algorithm can be summarized as below (Nelles, 2001) :

1. Starts with an initial model: determining where different rules are applicable and estimating every LLM's parameters in the initial model.
2. Finds worst LLM: computing a local cost function for every LLM and finding worst LLM with biggest local cost function.
3. All possible partitions are checked in this stage: worst LLM is broken into pieces. This breaking procedure will be tried for every axis of the input space. After determining reliability ranges and LLM's parameters, their corresponding local functions will be found.
4. Finding best partitions: best partition should be selected among all partitions made in the previous step. Consequently a new LLM will be added to the initial model.
5. Convergence check: stop the algorithm if converged, else go to step 2.

1.2. System Dynamics (SD)

Applying system dynamics approach makes it possible to bring in causal relations and feedbacks along with the common unilateral relations. Due to this prominence of SD, systems can be simulated more genuinely. Using a linear (non-systematic) insight causes the effective external factors to be in a constant proportion with the system's internal variables. Due to this linearity assumption, the behavior of system's variables cannot change over time. In contrary, in a non-linear system (where a systematic insight is applied), the proportion between external factors and internal variables is not constant and the system response to changes is related to the present situation of the system. System's situation depends on the previous decisions and these recurrences indicate dynamism and continuity of the system.

1.3. Systematic insight on welfare

Policies should be judged based on their consequences. Comparing these consequences is not possible unless by means of appropriate criteria. Welfare per capita is one of the most typical measures that have been used in many studies to assess performance of governments and their working systems from the community's perspective. Different researchers have employed different methods to measure the value of this criterion based on their understanding of welfare concept.

Unfortunately, researchers are not used to take advantage of systematic approaches when they are trying to find criteria to measure a socio-economic phenomenon. In this research, public satisfaction indicator will be investigated instead of common welfare indices. In this study, two types of welfare with completely different impact on public satisfaction are introduced. "Sustainable welfare" is the first one which is distinguished form "Temporary welfare" due to its reliability. In fact, as the result of using common welfare indices, Sustainable and Temporary welfares usually will be treated in a same way. On the other hand, Sustainable welfare has a positive impact on public satisfaction while Temporary welfare is supposed to have a negative impact on public satisfaction criterion. Changes in oil domestic consumption and sustainable development level are two major consequences of reducing direct subsidy payments and increasing oil domestic price. Hence, two indicators are presented to assess the changes in public satisfaction that are caused by each of these consequences.

1.4. Sustainable Development

Modest increment in oil price leads to an enormous surplus revenue for the government. The extra money earned by eliminating oil subsidies should be paid back to public through transfer payments. In the current study, two common procedures named as direct and indirect subsidy transferring methods and also their combinations are compared. They are evaluated based on their consequences. This surplus revenue can be paid to public in cash or it can be invested to improve the society in economic, political, scientific, cultural, hygienic, educational and industrial manner. From this point forward, the term of indirect subsidy transferring policy refers to these intelligent investments. As the result of applying indirect subsidy transferring policy, national non-oil production and income is expected to grow intensively. Both temporary and sustainable welfares can be produced when national income is improving. In other words, although increase of national income always is mentioned as a remarkable development, a temporary growth in national income will create temporary kind of welfare and will reduce public satisfaction in long terms. But sustainable welfare can be created by income growing sustainably. To trace and separate different type of welfares made by transferring subsidies, concept of sustainable development is employed.

Sustainable development means walking a person, an organization, a country or the whole world through the development path, steadily and sustainably without any breaks or regressions. Due to the above definition, developments are accounted as sustainable if they can be repeated frequently and also cause further development opportunities to arise. Thus, all countries especially developing ones need to employ a sustainable approach to create a better future. For the time being, Iran needs sustainable development as well as sufficient economic, cultural, national and human resources to provide necessary requirements needed to establish the concept of sustainable development in presence of an insightful management.

1.5. Human Development Index (HDI)

The origins of HDI, the index that has become one of the most influential and widely used indices to measure human development across the world, are found in the annual Human Development reports of the United Nations Development Program. A Pakistani economist, Mahbubul Haq introduced HDI in 1990 to shift the focus of policies from economic development to human development (United Nations Development Programme 1999, Fukuda-Parr & Sakiko 2003).

“People are the real wealth of a nation,” Haq wrote in the opening lines of his first report. “The main objective of development is to create an environment that lets people enjoy long, healthy and creative lives. This may appear to be a simple truth but it is usually forgotten in the immediate concern with the accumulation of commodities and financial wealth.” Haq was sure that a simple composite measure of human development was needed in order to convince the public, academics, and policy-makers, to evaluate development not only by economic advances but also improvements in human well-being.

HDI is a composite statistic used to rank countries by their level of "human development" into four classes of "very high", "high", "medium", and "low" developed countries. It is also a comparative measure of life expectancy, literacy, education and standards of living for countries worldwide. Furthermore, it is a standard mean of measuring the well-being, especially child welfare in each country. HDI can be used to distinguish whether the country is a developed, a developing or an under-developed country, and also to measure the impact of economic policies on the quality of life. In the current study, HDI is calculated to investigate sustainable development and its fluctuations.

1.5.1. Calculating HDI

In the work at hand, a new method that was presented in human development report of United Nations Development Program is chosen to compute Iran's HDI.

Table 1: Auxiliary variables required for HDI calculation

Variables	Abbreviations
Human Development Index	*HDI*
Life Expectancy Index	*LEI*
Life Expectancy	*LE*
Education Index	*EI*
Mean Years of Schooling	*MYS*
Mean Years of Schooling Index	*MYSI*
Expected Years of Schooling	*SYS*
Expected Years of Schooling Index	*EYSI*
Income Index	*II*
Gross National Income per capita in equal purchasing power	GNI_{pc}^{ppp}

$$LEI = \frac{LE - 20}{83.2 - 20} \quad (1) \qquad MYSI = \frac{MYS - 0}{13.2 - 0} \quad (2) \qquad EYSI = \frac{EYS - 0}{20.6 - 0} \quad (3)$$

$$EI = \frac{\sqrt{MYSI * EYSI}}{0.951} \quad (4) \qquad II = \frac{\ln(GNI_{pc}^{ppp}) - \ln(163)}{\ln(108211) - \ln(163)} \quad (5) \qquad HDI = \sqrt[3]{LEI \times EI \times II} \quad (6)$$

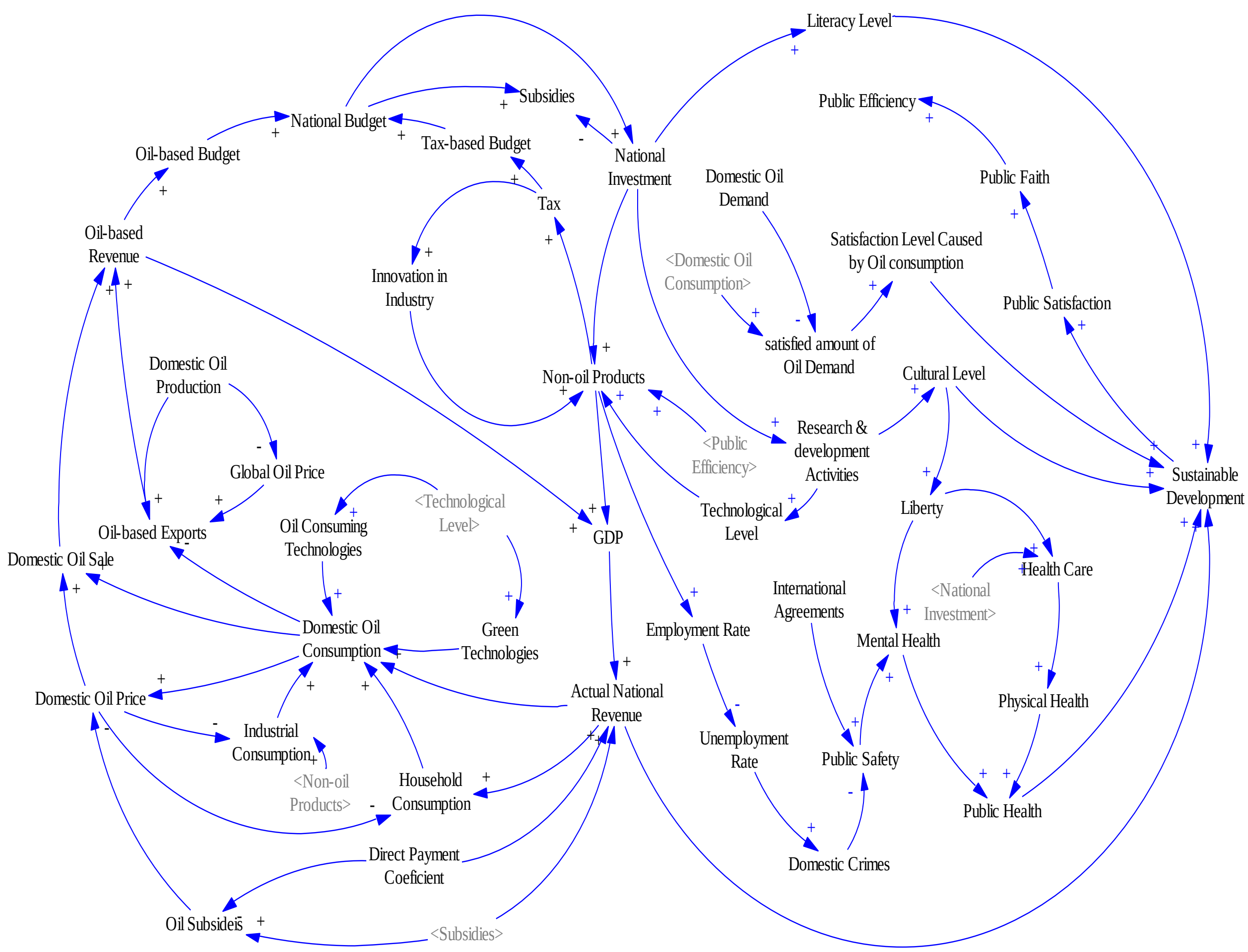
Since *HDI* is known as one of the most appropriate measures to evaluate Sustainable Development, a fluctuating *HDI* even a high level one is not desirable at all. So in a sustainable development point of view, *HDI* value for a most desirable society should have a non-descending trend.

2. Modeling

2.1. Causal Diagram

Figure 1. Causal Diagram

2.1.1. Main Loops



In current sub-section, three main loops of the presented causal diagram will be described.

Figure 2. Sustainable Development's reinforcing behavior due to the positive interaction between public utilization and national income

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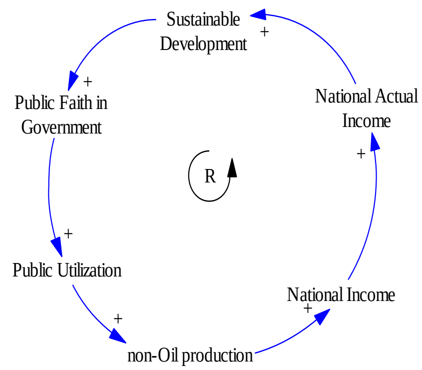
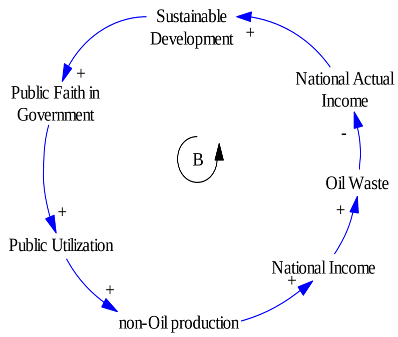


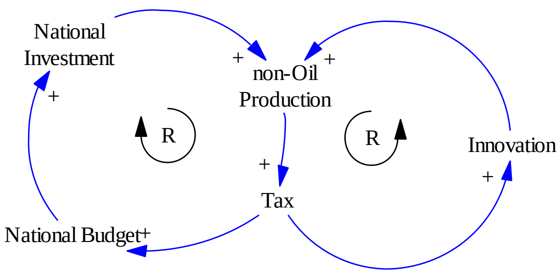
For example, an increase in non-oil productions enhances the amount of national revenue. Then the country is expected to move toward sustainable development. In other words based on the Equation 6, an increase in Income Index (II) directly leads to an increment in HDI. On the other hand, an improvement in the efficiency of national production as a result of increasing public welfare and satisfaction is simply predictable. Considering above variables and positive and reinforcing relations among them, they are expected to change (grow/decay) in an exponential manner.

Figure 3. Sustainable Development's balancing behavior due to the negative interaction between the amount of oil waste and national actual income



Despite Figure 2, amount of non-oil products can affect sustainable development negatively through the balancing loop shown in Figure 4. This Figure reveals the positive effect of national income on wasting and its negative impact on sustainable development.

Figure 4. Non-oil production's reinforcing behavior as a result of tax payments



Taxes on production activities are supposed to be calculated by multiplying the amount of national products by the tax absorption ratio. This equation demonstrates the positive effect of national production on taxes. On the other hand, taxes increase the amount of national production by increasing innovation in industries and investments.

2.2. Stock and Flow Model

The authors intend to simulate the interactions of a set of socio-economic macro variables, where some external and internal factors such as global oil price, oil subsidies and taxes on production activities are changing. The model is designed to demonstrate internal feedbacks and also internal variables' responses to the externals. Simulation methods and software are required in order to predict the trend of every internal variables along with the time horizon and in the presence of various policies and scenarios. Golden opportunity and threat, (Farzanegan & Markwardt, 2003) used both of these terms to mention Iran's oil revenue. Consequently, applying suitable and intelligent policies seems to be the only way to take advantage of oil revenues properly. (Nwafor et al. 2006) expressed that eliminating subsidies without spending them intelligently, will cause increment in public poverty. Gupta and his colleagues (Gupta et al., 2000; Gupta et al., 2003) announced intensification of negative impacts made by global oil price fluctuations as the result of applying a public subsidy payment system to pay public directly in cash. In other words, using a public subsidy payment system causes national income to go up and down as global oil price fluctuates. Consequently an intelligent system is designed in order to transmute these threats into golden opportunities for creating a better future and developing sustainably. World will run out of oil sometime in the future. As Kiani and his colleagues (Kiani et al., 2009) anticipated a reduction in Iran's national oil production occurs after 2043. Thus, compatible policies are required to prevent Iran's national economy form breaking due to such oil related events.

Iran's GDP (Gross Domestic Product) is strongly influenced by its oil industry. Hence, Iran's national economy depends highly on its oil revenue and risk of recessions due to some external factors such as changes in global oil price or demand is undeniable. Considering the predicted reduction in future oil production, some precautions should be taken to avoid future economic disasters.

The stock and flow diagram is applied in order to simulate three following novel policies and their consequences. First is the gradual and sustainable reduction of direct subsidies paid to reduce oil domestic price. Second is the indirect distribution of oil revenues in short-term to long-term investments in the fields of health, education, manufacturing and construction. Third is the gradual and sustainable increase in production taxes. In fact, these investments are suggested to invigorate infrastructures of public health, education, manufacturing and construction. Considering *HDI* criteria, enlivening their infrastructures will reduce public satisfaction's dependence on some external factors such as global oil economy.

2.2.1. Model key variables

- Domestic oil price
- Domestic oil consumption per capita
- Oil waste
- Taxes on non-oil products
- Share of non-oil products in *GDP*
- Satisfaction level caused by oil consumption

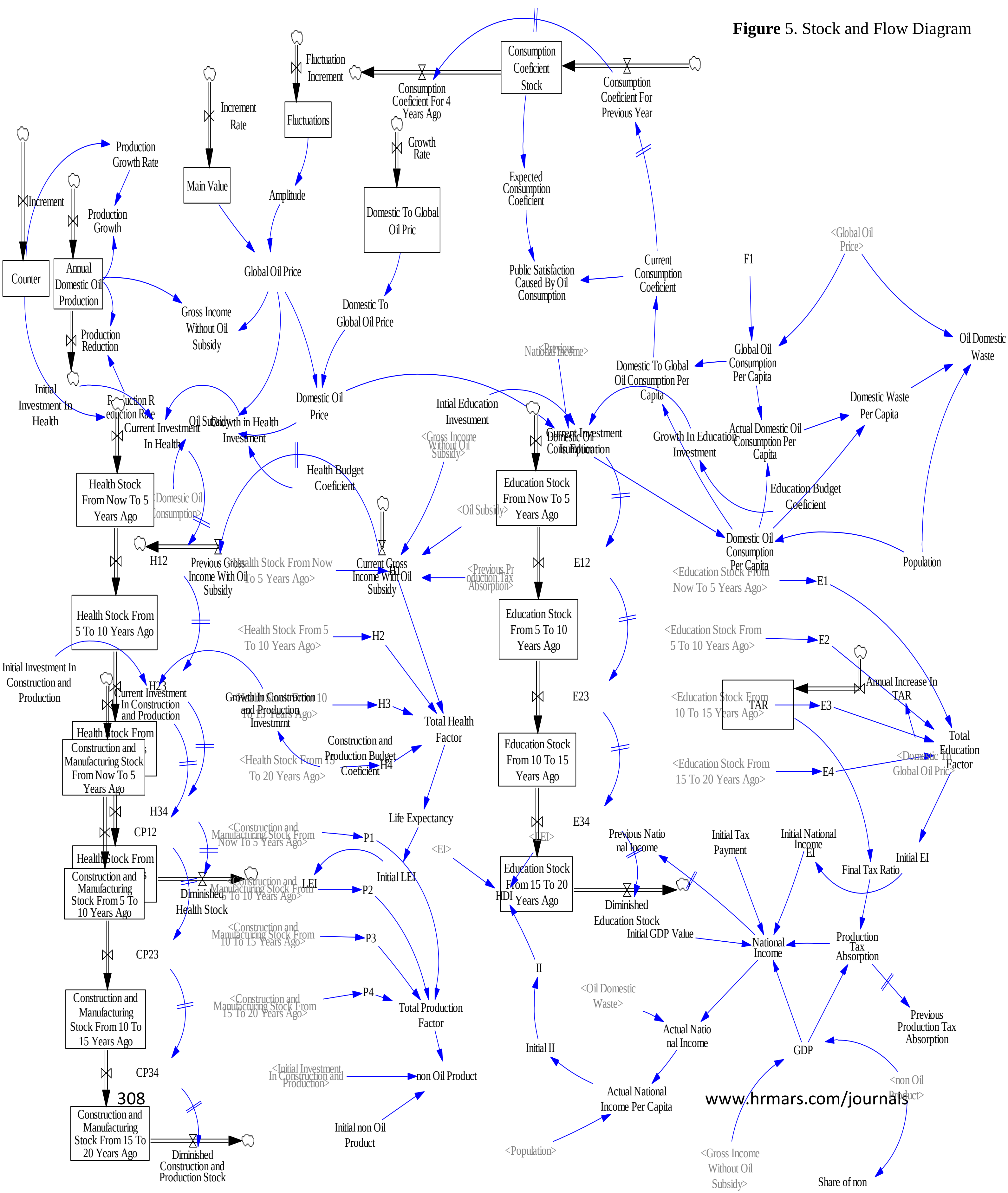
Global oil price is considered to be the only external and uncontrollable variable in the designed model. Therefore different scenarios are applied to give us an idea about what happens when global oil price is acting like those scenarios.

As mentioned above, one of the necessary factors to calculate Human Development Index is Income Index (II). Hence in the proposed model, gross oil income and national non-oil product are two major factors employed to calculate this index. Share of oil revenues represents ratio of gross oil product to gross national product. Tax absorbed by the government equals to final tax ratio (tax absorption rate) multiplied by gross national product. National income is calculated by deducting tax from gross national product.

The differential of national income with wasteful consumption of oil is defined as real national income. Finally, after converting the real national income to income index, *HDI* can be calculated using equation 6.

From this point forward, ratio of domestic to global oil price is called Public Payment Coefficient

Figure 5. Stock and Flow Diagram



that is abbreviated to PPC. Also percent of national non-oil production income which is claimed by government as tax payments is called Tax Absorption Ratio and abbreviated to TAR. As mentioned earlier, new policies are required in order to reduce the share of oil products in Iranian's GDP significantly. So a simultaneous and gradual increase in PPC and TAR is proposed in this study.

Table 2: Parameters used in the model

Parameters	Optimal Values
Annual increase in PPC	0.026
Annual increase in TAR	0.01
Education investment absorption ratio	0.20
Health investment absorption ratio	0.25
Manufacturing-construction investment absorption ratio	0.55

Alternatives can be simulated by assigning different values to the above parameters. For example, the intensity of subsidy elimination policy depends on the amount of annual increase in PPC. By assigning zero value to the annual increase in PPC, oil subsidies will not be eliminated at all. Also the policy of transferring oil subsidies directly to people can be simulated by setting all investment absorption ratios to zero.

2.2.2. Calculating optimum value for the "annual increase in PPC"

According to Kiani *et al.* (2009), following results have to be considered in order to calculate optimum value for the "annual increase in PPC":

- Peak of oil production in Iran will occur in 2043.
- A 2-3 percent annual increase in domestic oil production till 2043 is predicted.
- After 2043 an annual decrease of 3-4 percent in domestic oil production will happen.

The anticipated trend for Iran's domestic oil production dictates the complete elimination of oil subsidies prior to 2044. By considering PPC's value in 2010 as 0.1, optimum value for annual increase in PPC is calculated as below:

Optimum value for annual increase in PPC = $\frac{PPC(2043) - PPC(2010)}{2043 - 2010}$ = 0.026

Optimum values for other parameters are defined experimentally by running some sensitivity analysis. These optimal values are justified by investigating present socio-economic situation of Iran. For example, according to the statistics published in 2010, Life Expectancy and Literacy Rate in Iran is more acceptable than its economic situation. Consequently optimal value assigned to manufacturing-construction investment absorption ratio is decided to be much greater than the two other ones.

2.2.3. Look up Function estimation

Four following look up functions are needed:

- Health Investment Function
- Education Investment Function
- Manufacturing-Construction Investment Function
- Domestic Consumption Function

Above Investment Functions are designed to use amount of investments on health, education and manufacturing-construction areas and calculate *HDI* components including Life Expectancy, Education and Income Indices. Due to the complexity and nonlinearity of these functions LoLiMoT approach is employed to estimate them with least possible errors. Two following errors are computed to evaluate the performance of each neuron.

Table 3: Error functions

Root Mean Square Error (RMSE)	$RMSE = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(A_i - F_i)^2}$
Mean Absolute Percentage Error (MAPE)	$MAPE = \frac{100}{n}\sum_{i=1}^{n}\left\lvert\frac{A_i - F_i}{A_i}\right\rvert$

A_i and F_i are representatives for actual and Forecasted values.

Finally Investment Functions are estimated by the means of LoLiMoT method coded in MATLAB software. Their RMSE values versus different neurons are plotted in Figures 6-8.

Figure 6: Health Investment Function

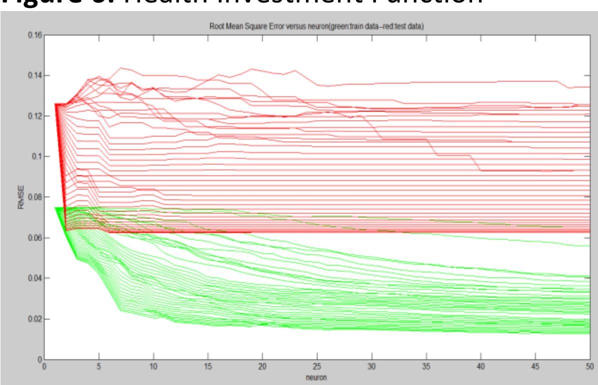


Figure 7: Education Investment Function

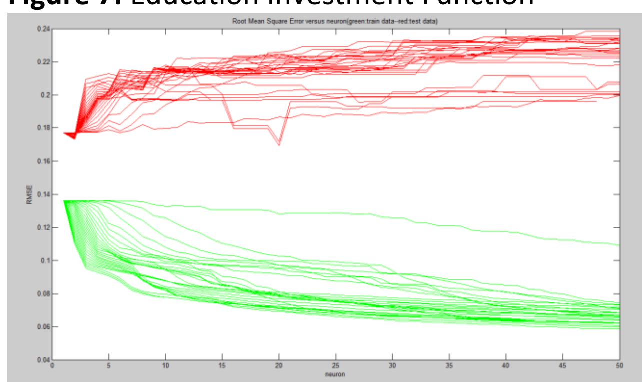
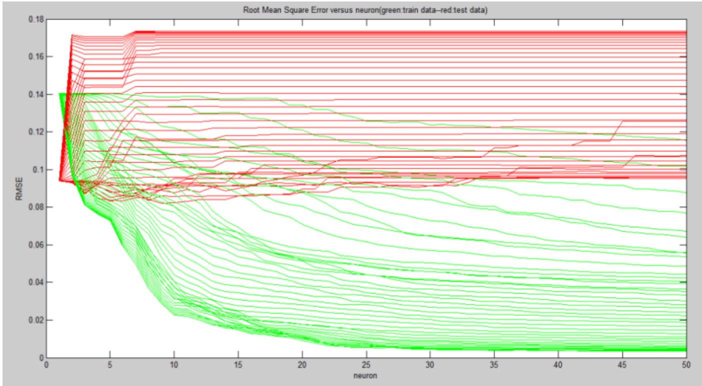


Figure 8: Construction-Production Investment Function



Minimum RMSE and MAPE values and their corresponding neurons for all Investment Functions are presented in the following Table.

Table 4: Minimum computed RMSE and MAPE

	RMSE	Corresponding neuron	MAPE	Corresponding neuron
Health Investment Function	0.0623	1822	0.0549	1822
Education Investment Function	0.0685	2104	0.0467	2104
Manufacturing-Construction Investment Function	0.0027	1588	0.0041	1961

These trivial errors calculated for estimated Investment Functions imply their high accuracy. Consumption demand functions have been formulated repeatedly by regression methods in the literature of Econometrics. Therefore in this study, Domestic Consumption Function is estimated by regression analysis. Econometric techniques are applied to estimate the amount of Domestic Oil Consumption as a function of non-Oil annual production, Net National Revenue and domestic Oil Price. Accuracy of the concluded function is verified by the following results:

R value	R^2	***adjusted*** R^2
0.972	0.946	0.942

3. Results Analysis

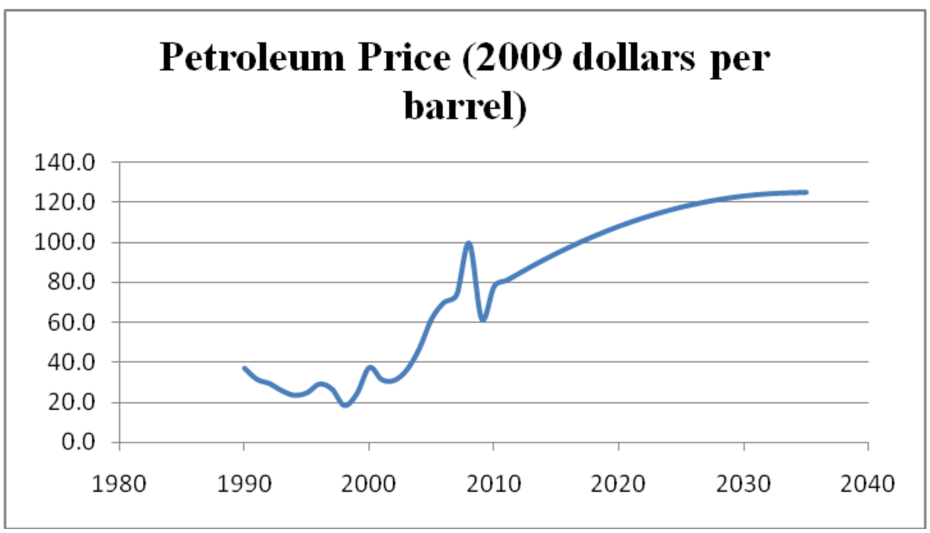
The proposed Stock and Flow model is used to simulate trend of its key variables under different circumstances and where different policies are affecting parameters of the model. As discussed earlier, main aim of this study is to compare different policies under different circumstances in order to plan for a better and more sustainable future. So the following Table is presented to show all possible combinations of policies and scenarios.

Table 5: Policies and scenarios

Combination	Policy	Scenario (Global Oil Price)
P1S1	Current policies	Increasing and high fluctuating
P1S2	Current policies	Increasing and low fluctuating
P2S1	Proposed policies	Increasing and high fluctuating
P2S2	Proposed policies	Increasing and low fluctuating

Based on U.S. energy Information Administration, International Energy Outlook published in September 2011, World Petroleum Price is forecasted to increase continuously in the next 25 years. Anticipated trend for World Petroleum Price is shown in Figure 9. Consequently Global Oil Price in both likely scenarios has an increasing trend. But considering above explanations about temporary and actual kind of welfares and their completely different impacts on public satisfaction, future Oil Price fluctuations are as important as its major trend. Therefore two scenarios are designed to simulate both low and high fluctuating future Global Oil Price and analyze the impacts of these fluctuations on public satisfaction.

Figure 9: Petroleum Price published by U.S. energy Information Administration, International Energy Outlook published in September 2011



None of the three novel policies proposed earlier, is considered in current policy. On the other hand, the proposed policy is an intelligent combination of domestic oil price increment, national investments and tax absorption increment strategies.

Figure 10: Simulated HDI trend

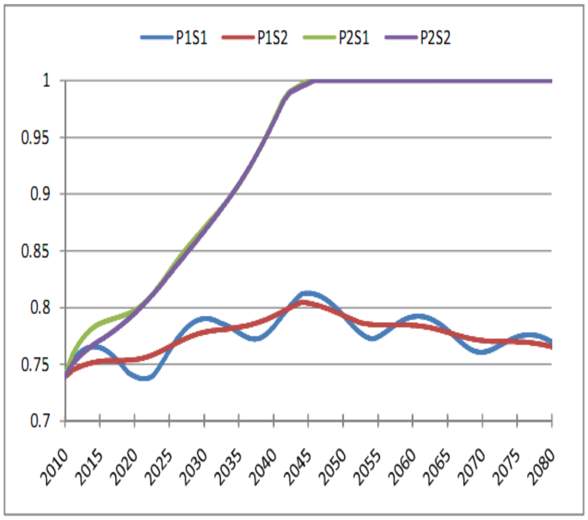
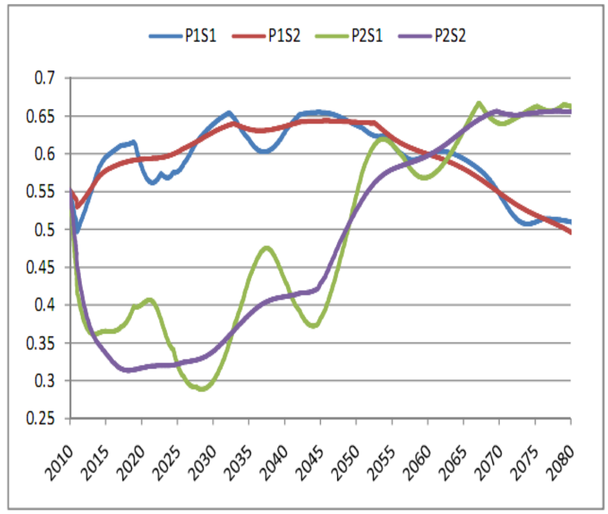


Figure 11. Simulated Oil Domestic Consumption Trend



As Figure 10 implies, taking advantage of systematic insight and sustainable development concepts, leads *HDI* to a non-descending and very low fluctuating trend. So based on the simulation results, *HDI* will get and stick to its maximum possible value in 2045. On the other hand, two types of fluctuations are observed in *HDI* value where government is allowed to go on without renovating its current policies. Happening first scenario causes first type of fluctuation easily observable. It concludes the fact that a fluctuating Global Oil Price is the main reason of *HDI* short-term fluctuations. In the other words, applying current policy transfers Global Oil Price fluctuations directly to *HDI*, while applying the proposed policy damps these fluctuations and prevents them to be transferred through the model. Contrary, Second type of fluctuations or long-term fluctuations are easily observable whether first or second scenario is happening. Due to *HDI*'s non-descending trend caused by applying the proposed policy, this policy is found completely capable of eliminating long-term fluctuations. For all combinations of policies and scenarios, *HDI*'s maximum value is acquired in 2045. But applying proposed policy enables the country to get and stick to *HDI*'s highest possible value while lack of some sort of intelligent policies will cause *HDI* to fluctuate under 0.8. Finally due to Figure 10, outstanding role of the three proposed policies in approaching toward sustainable development is undeniable. Considering combination of proposed policy and high fluctuating scenario, the slight fluctuation occurred at the beginning of time horizon is due to the approximations made in estimation of some variable's primal values. As we can see after a while, this fluctuation fades as the impact of these primal values is also fading.

Unfortunately both policies are incapable of controlling oil product's domestic consumption. In a way that due to Figure 11, short to long term fluctuations is observed for both policies. Future studies are recommended in order to smooth these fluctuations as much as possible. Due to the increment observed in consumption index as the result of implementing the proposed policy, an overall growth in consumption index is concluded for this policy. And also it is noteworthy that because of its ascending trend since 2020, further increment in consumption index is expected. But as the result of applying current policy, in addition to the overall decay observed for consumption index, it is expected to continue descending even after 2080.

4 Conclusion

Three policies including gradual reduction in oil subsidies; investing oil subsidy elimination revenues on health, education and manufacturing – construction; and gradual increase in taxes are proposed to move toward sustainable development. Coping with imposed oil price fluctuations and reducing dependence of Iran's economy on its oil revenue are referred to as some of these novel policies' long-term consequences. Two different types of welfare with entirely different consequences have been explained. Impacts of Iran's oil industry on its economy and its public satisfaction has been investigated in this study. These investigations on Iran's economy made us aware of the fact that, welfare caused by Iran's oil revenue appears most often in a temporary type. Then destructive effects of temporary welfare on public satisfaction were studied. In fact, the proposed investment system is designed intelligently to absorb annual surplus revenues into capital stocks. Since only surplus revenues are planned to be absorbed so this mechanism can hardly affect public satisfaction in a negative manner. But these capital stocks are designed to reduce the intolerable pressures of crisis situations. In other words, this intelligently designed system absorbs the temporary welfare generated in a growing economy and turns them into actual welfare. This actual welfare is kept to be released in a time of crisis. An appropriate tax system provides reliable infrastructures for the proposed investment system. In a desirable economy, domestic production should be influenced by its national income positively as well as the positive effect of its domestic production on its national income. Tax absorption and reducing subsidies will provide required investments in order to increase the impact of national income on the next year domestic production. As the result of applying these policies a strongly reinforcing loop will be activated which leads to an exponential growth in some key macroeconomic variables such as Gross Domestic Product and National Income.

Considering above analysis and results of the stock and flow diagram, the proposed policy is concluded to be more efficient than the current one in every aspect, including both human development and consumption satisfaction.

This study has a high potential to be extended. For example following suggestion are made in order to increase the accuracy of the proposed model and extend its applicability:

- A variety of forecasting techniques and fitting methods such as Time Series and Neural Networks are recommended to increase the accuracy of look up functions of the presented model.
- Extending the boundaries of the model by considering different production functions, new technologies, alternative energies etc.
- Improving the presented policy, for example: by implementing the proposed policy,

model estimates an exponential growth in domestic production and national income. What is the most appropriate way to take advantage of this surplus income? New policies such as foreign investments should be hired in order to use this surplus income.
- Designing similar models and policies based on similar approaches to lead different countries toward sustainable development.

References

Ahmadian, M. (1999). Oil Theoretical and Functional Economy, Economics Institute of Tarbiat Modarres University, Yaran Press.
Akpan ,E. (2001). Oil price shocks and Nigeria's macro economy
Balke N, Brown S., and Yücel. M. (2010). Oil Price Shocks and U.S. Economic Activity: An International Perspective, Resources for the future, July 2010, RFF DP 10-37
Battjes. J. (1999). Dynamic Modeling of Energy Stocks and Flows in the Economy Articles, Phd Thesis, Rijksuniversiteit Groningen.
Chang. Y and Fong Wong. J. (2003). Oil price fluctuations and Singapore economy, Energy Policy 31, 1151–1165.
Coady David and Newhouse David. (2005). "Ghana: Evaluation of the Distributional Impacts of Petroleum Price Reforms," Technical Assistance Report (unpublished; Washington: International Monetary Fund).
Farzanegan. M and Markwardt. G. (2003). The effects of oil price shocks on the Iranian economy.
Fukuda-Parr, Sakiko. (2003). "The Human Development Paradigm: operationalizing Sen's ideas on capabilities". Feminist Economics 9 (2–3): 301–317. doi:10.1080/1354570022000077980.
Ghiasi. H. (2003). Oil Price Instability, MSc. Thesis, Faculty of Economics, University of Tehran
Gupta, S., M. Verhoeven, R. Gillingham, C. Schiller, A. Mansoor and J. Cordoba, (2000),"Equity and Efficiency in the Reform of Price Subsidies", (Washington: International Monetary Fund).
Gupta, S. B. Clements, K. Fletcher, and G. Inchauste. (2003). "Issues in Domestic Petroleum Pricing in Oil-Producing Countries," in Fiscal Policy Formulation and Implementation in Oil Producing Countries, ed.by J.Davis, R.Ossowski, and Fedelino (Washington: International Monetary Fund).
Hakan. B, Basak. C and Dogan. N. (2005). The Impact of Oil Price Shocks on the Economic Growth of Selected MENA Countries
Kazemi. R, Tavazoei. M, Nasr. N and, Mashayekhi. N. (2005). An Investigation on The Process of Modification of Subsidy Policy
Kiani. B, Hosseini. S and Amiri. R .(2009). Examining the Hubbert Peak of Iran's Crude Oil: A System Dynamics Approach, European Journal of Scientific Research, ISSN 1450-216X. 25 (3), 437-447.
Kpodara. K and Djiofack. C. (2009). The Distributional Effects of Oil Price Changes on Household Income: Evidence from Mali, Journal of African Economies, 19 (2), 205–236 doi:10.1093/jae/ejp023 online date 16 December 2009.
Mashayekhi. A, Araghi. M, Motaabed. Sh. (2004). Studying Growth Dynamism and development of systematic thinking in Organizations
Mobasherpour. A (2006). Oil Price Fluctuation and Its effects on some of the Macro Variables of

Iran's Economy, MSc. Thesis, Faculty of Economics, University of Tehran
Mirzaei. H (2000). Modelling Iran's Business Cycles Based on Oil Price Shocks
Nagy. E and Al-Awadi. M (2001). Oil price fluctuations and their impact on the macroeconomic variables of Kuwait: a case study using a VAR model. Int. J. Energy Res. 2001; 25:939}959 (DOI:10.1002/er.731)
Nelles, Isermann. R. (1996). Basis Function Network for interpolation of local linear model, Proceeding of IEEE Conference on Decision and Control, Kobe, Japan. 470-475
Nelles, Sineel. S, Isermann. R. (1996). Local Basis Function Networks, UKACC International Conference on Control, 2-5 September, 1996
Nelles .(2001). Nonlinear System Identification, Springer, Berlin, Germany
Nwafor. M, Ogujiuba. K and Asogwa. R. (2006). "Does Subsidy Removal Hurt the Poor" SISERA Working Paper
Onsori. M (1972). Role of Oil Industry in Economic Development of Iran, MSc. Thesis, Faculty of Economics, University of Tehran
Siami. E and Fahimifar. F. (2003). The Effects of Oil Price Shocks on Monetary policy in Iran
Tamizi. R. (2001). Studying the Asymmetric Effects of Oil Shocks on Economic Development in Iran, MSc. Thesis, University of Tehran
United Nations Development Programme (1999), Human Development Report 1999. New York: Oxford University Press.
Zaytsev. O. (2010). The impact of oil price changes on the macroeconomic performance of Ukraine. A thesis submitted in partial fulfillment of the requirements for the degree of MA in Economics, Kyiv School of Economics.