An Investigation on The Process of Modification of Subsidy Policy

Reza Kazemi , Masood Tavazoei , Nikrooz Nasr and Ali Naghi Mashayekhi

Abstract— **In recent years, increase in energy price in international markets has turned paying energy subsidy into a serious challenge, because those countries paying subsidies are in constant pressure (Gupta 2003). Rise in energy price and demand has encountered those countries with earnest problems in energy pricing (Davis 2001). Besides, subsidy elimination and imparting the resulted money to the society, without planning for solving its short-term and long-term consequent problems, will lead to public dissatisfaction as well as industrial performance downturn and also it will cause inflation. In this paper while offering a comprehensive model for this problem and dynamic analysis of the policies implemented so far and also investigation of those policies in short-term and long-term frames, another policy is suggested for solving this problem which not only guarantees industrial development and increase in public welfare level, in the form of powerful social service systems, convenient transportation system or free high quality education, but also will gradually remove energy subsidy from government budget and thus will help the government to get rid of this intolerable burden.**

Keywords. Subsidy, Energy Consumption, Free Riding,Income, Inflation.

I. Introduction

Having a retrospect on researches about Energy subsidies manifests a great focus on the effects of eliminating the subsidies on low-income division. Manson et al. elaborated the interaction between the low-income division and different operating parts of the society such as welfare system, banking and medical sectors as well as insurance systems. Analysing the effects of eliminating subsidy on the performance of firms, Transportation system and government Manson concluded that elimination of subsidy without spending the resulted deposit will lead to increase in poverty in society. David Coady et al centered on the effects of elimination of fuel subsidy on real income and the cost of households and they also estimated the short-term and long-term effect of price growth and the distribution of these effects among different income divisions using a relatively simple math model. They hold the view that degrading in income of low-income householder is more noticeable than the decrease in hogh-income householders. At the end he suggest an effective welfare system and spending the deposit caused by elimination of subsidies in education and medication system as two effective policy to alleviate the effect of price growth on low-income division. Kagni Kpodar also discusses the distribution of the effect of price growth on different social division and he believes that the diagram of effect of price growth in terms of cost per person has a U shape. This effect relates to escalation in householders cost in short term while in long-term or mid-term demand regulate in a way that minimize the effect, Kagni thinks that price growth put the pressure on low-income division that can be lessened using a powerful welfare system. He also believes that spending cost on education and medical section will make the best advantage for the poor. Jonathan Halpern and Douglas F. Barnes studied the role of subsidy and its effect .they pointed out that because the subsidies are on the consumption cost rather than on primary cost of energy utilization they are not appropriate for the poor, since they cannot afford the primary cost and as a result they can take advantage of subsidies on consumption. Gupa et al. hold that most of the oil exporter countries, offer the oil product in a lower price comparing with the world price and this type of subsidy is inefficient and unfair, because the opportunity cost of offering oil products in such a low price is very high,besides these subsidies do not target the poor division. They also mention the financial effects of subsidies that put a huge burden on the government , leading an increase in doverment's debt. Gupta believes that this mechanism deteriorate the effect of fluctuation in oil price on the economical conditions. He admitted that subsidy elimination is pretty complex and controversial issue which lies in the resistance of subsidy users. In his point of view the most pressure will be on the low-income division, since then, he believes that the government support is required to protect them. According ti what was mentioned earlier the main focus on the previous researches was on low-income division whose resistance is considered the main barrier in the way of subsidy elimination and as a result, previous researchers sought for a policy to degrade the pressure on this division. While there are other critics who believe that the high-income division, rather than low-income division, who takes the most advantage of the subsidies are the main obstacles in implementing the elimination of subsidies. For example David Pearce and Donate Fink suppose that solely eliminating the subsidy will not success because the rent-seeking nature of subsidies that oppose the subsidy or rent eradication. They deduce a political and economical is necessary before subsidy elimination. The more unfair the subsidy is distributed, the greater will be the resistance, because the capability of withstanding among the high-income is much more than the low-income. In this article we intend to investigate the causes of failure in subsidy elimination in countries using a system dynamic approach. We are also trying to find out the most crucial barriers mentioned earlier to suggest an effective and practical policy at the end.

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II. Statement of the problem

In OECD studying, any action taken in order to set the price lower than market price for the consumer and higher for producers is considered as subsidy. In other words subsidy lessen the cost for the consumers and producers. IEA also suppose Energy subsidy as an action taken by the government That aims Energy section and reduces production cost of energy or raises the price paid to producers or declines the price paid by consumers. Steven Lippman suppose economical rent as the difference between current income resulted of one of the production factor and the income resulted of utilizing that production factor in the next best choice. Pasour believes that any action taken in order to getting welfare and retaining it without returning any welfare to the society is rent-seeking. common cause holds the view that considering the definition of rent and subsidy, it is logical to take subsidy as a type of rent, because usually the product or service price is equal to their import price, whereas the energy price is much less, by this, one who uses energy, utilize the welfare subsidy without providing any welfare for the society. David Pearce holds that the difficulty of subsidy elimination lies in the fact that there are some people who takes advantage of the subsidies and therefore if the subsidy was eliminated, there would be certainly crucial losers who has a noticeable capability to stop the reforms. As a result he believes that considering the subsidy elimination as a win-win process is totally misleading. In the definition given earlier, only the monetary aspect of the rent was focused, while it is also possible to redefine rent in terms of utilization, consequently all of the people in the society are using energy rent. Because the utilization by gas heating or electrical light is more than the utilization in their next best usage, all of the people in the society much or less are using energy rent and as a result there will be resistance against subsidy elimination. In other words the consequences of subsidy elimination will be public goods such as justice, development, etc while according to Mansur Olson theory the probability of a group consensus to use the public good is low that is called as the Free-Rider Problem. To state the matter differently in this condition everyone will say:"why should I pay the price of this public good. Others can pay and I can use it. Olson believes the more decision maker, the less probable is to come to a consensus. He also emphasizes that if people are forced to pay for the cost of the reform and they are from the low-income division the Free-Rider Problem is more likely to happen ,hence the probability of failure in group consensus increases.

A. The Concern

According to economical and population growth energy demand of the country has risen up. Accordingly the Energy consumption in the country has increased.Because the energy price is too low in the country the government will pay a huge subsidy for energy.This will intensify the financial burden on the government. But the government while tolerating the unfavorable immense economical pressure cannot eliminate the subsidies and is settled to a gradual non regular increase (see Figure. 1).

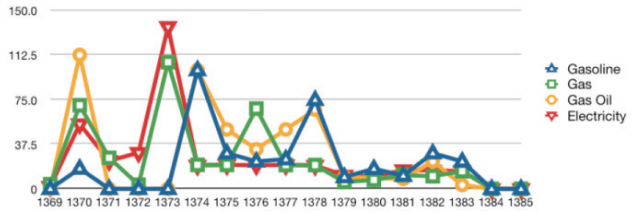

Fig. 1: Energy Price

Fig. 2: Public Budget Shortage

III. Dynamic hypothesis

It is possible to divide the people into 2 parts. those who use subsidy altogether will be called rent seekers(the minority) and those who use energy subsidy(no more than household usage) will be called the majority. As it was mentioned earlier the since the majority are using energy rent they are also reluctant to subsidy elimination and the politician will act in accordance with the majority desires. But assuming the energy consumption growth, the amount of subsidy paid by the government will also rise and a financial burden is imposed on the government (see Figure. 2).

So, the politicians are forced to raise the price although the society is not content with the reform. However, the majority will not seriously oppose the reform because there is cost in protesting and according to Olson theory since the population is large, the income is low and their benefit is insignificant and symmetrical the probability of free rider problem among them will increase, consequently they will not succeed to express opposition in groups.(see Figure. 3)

While the rent seeker find their rent gone, withstand against the policy. Pearce believes this opposition will be in the form of lobbying with politician, though, in Iran this reluctance might be observed in different form. In Iran because of the governmental economy most of governmental firms comprise the rent seekers. In other words the main part of the rent seekers is in the government and on that account, has a great influence on decision makers. The group in question tends to regain or increase their rent by putting pressure to increase

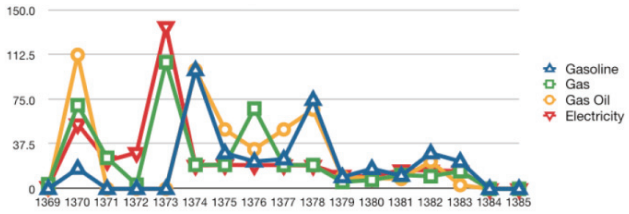

Fig. 3: The Change In Energy Price

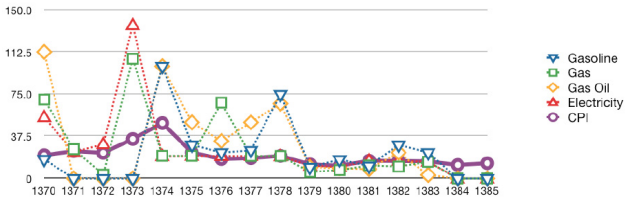

Fig. 4: Increase in energy price and the price of consumptive products

the price of its service and products whether justifiable or unjustifiable(see Figure. 4).

In this case, another view lies in the fact that budget shortage leads to inflation and price growth is not compatible with the trends illustrated in Figure. 5, however it has strong theoretical basis.

Politicians under the pressure of rent seekers and in order to satisfy the majority, settle to an inconspicuous energy price increase. It is worthy to add that according to Olson's theory the less the decision maker and the more asymmetrical their decision benefits, the more probable it is to come to a group unanimous consensus. As a result making a group decision among the rent seekers is more likely comparing to the majority group. Thus, the prices will be fixed for a while or rise slightly until the energy consumption grows more and the financial burden on the government become greater and so on. As Pearce believes, as the time interval in which the government pays subsidy increases, the rent seeking for the subsidy grows faster and the investment on this type of activities escalates that leads to fostering the rent seekers. In other words if the government pays the subsidy for a longer

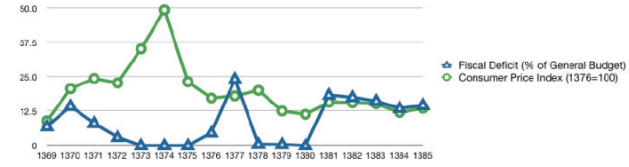

Fig. 5: Budget shortage and inflation

time, it would be more difficult to step back.

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IV. Policies Implemented So Far

- **Raising the energy price**: As it was elaborated earlier, increasing the price without considering the benefit of dominant group and politician, resulted in failure to fully implement the policy.
- **Offering incentives to low-income division**: In this policy, because of overlooking the dominant group (the industry) the government in its best case could eliminate the subsidy paid to people that may decline the demand and consequently put a great pressure on the industry sector that will compel the government to reduce the household energy price.
- **Rationing**: This policy usually is taken in household sector, because rationing the industrial energy leads to decreasing the production that is not plausible neither for the government nor for the industry.
- **Investment on hygiene, education and transportation**: Since this policy will have long-term improvement and people will observe the effects after a long time, politicians do not take it seriously and therefore it is not executed properly.

V. Model Structure

A. General Model

As it is depicted in the Figure. 6, main model comprises 3 sectors, including: Government, Consumption, Production that are interdependent via some variables shown in the figure. In the following we will discuss the structure of each sector in detail:

B. Sector1 : Production

In this structure (see Figure. 7) a parameter named "interest" is defined regarding price and piece cost that indicates the investors desire in investment and is computed by $(Price \setminus PriceCost)$ ratio. The geater the ratio, the more interest investors have for investment. Following that, using interest, Normal Production and a look up fuction called "f int" the variable "Desire Production" is defined that determines

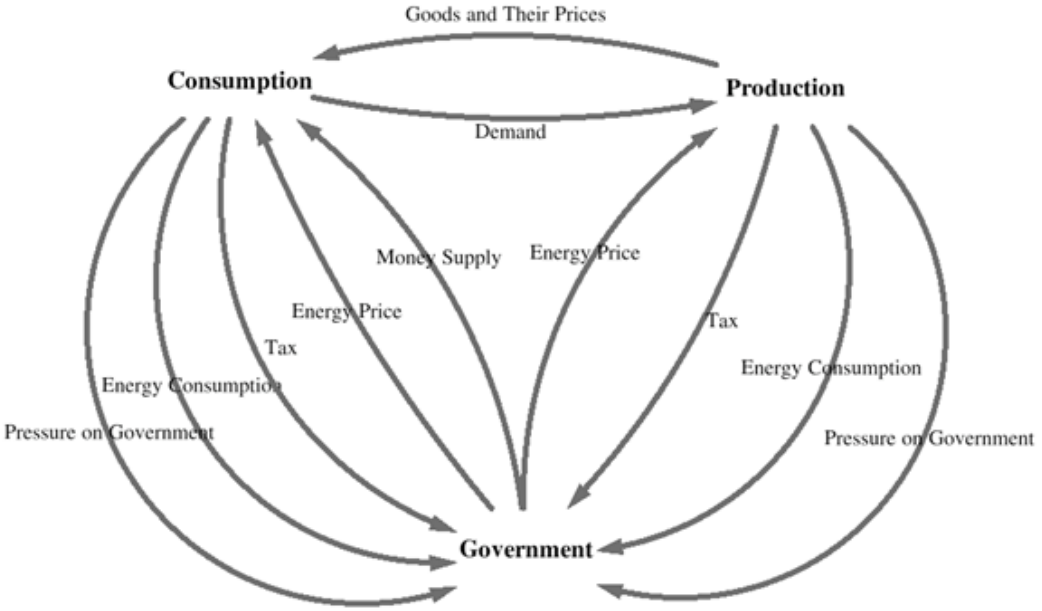

Fig. 6: Sector Map

the desired capital. Afterwards, regarding the discrepancy between Desired capital and Capital (Real Value)and also time needed for capital absorption, monthly investment is determined. In addition, energy productivity is calculated in terms of product price, level of production, energy price and energy consumption. Providing a high energy productivity manufacturers tend to use more energy in their production, or in other words, the energy intensity of new investments will rise, since it is economical and relatively cheap to use more energy in production line. Subsequently, Energy intensity will raise product prime cost as well as factories' energy consumption (Ene Increase) The product price is determined by Supply-demand mechanism through the variable "Ratio" defined as demand/supply. Giving the ratio as above 1 the price will rise and if it is below, the price will dwindle. The cost of Goods sold (Price Cost), mentioned earlier, will be determined by other cost(including prime cost) and also the cost of energy consumed which is illustrated in the stock-flow model.

1) Validation: As it is shown in the Figure. 8 production follows the changes in demand and since production is greater than demand, so there will be price plunge until an equilibrium is reached and as it mentioned earlier because of efficiency decline caused by price drop, the industry tends to produce new products utilizing lower energy intensity. This scenario is reflected in the model via the variable "Energy intensity of new investment"

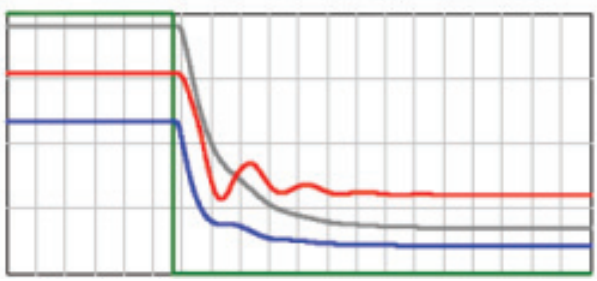

Fig. 8: Validation ;Price(blue),Production(red),Demand(green),Energy Intensity of new Investment

C. Sector2 : Government

This sector (see Figure. 9)has the function of price regulating. People and governmental organization will pressure the government corresponding to special parameters. Meanwhile the government budget and the amount of subsidy paid by government are two other sources of pressure. The resultant pressure will decide the energy price for people and industry. There are two crucial parameters involved in people pressure on the government which are Good utilization (which indicates in what extent people utilize products comparing to normal condition) and the level of public welfare that is determined by the government's residual budget. On the other hand, the pressure exerted by industry to government is settled by two pivotal parameters which are the Capacity utilization of the factories (utilization of capacity) and total profit earned in

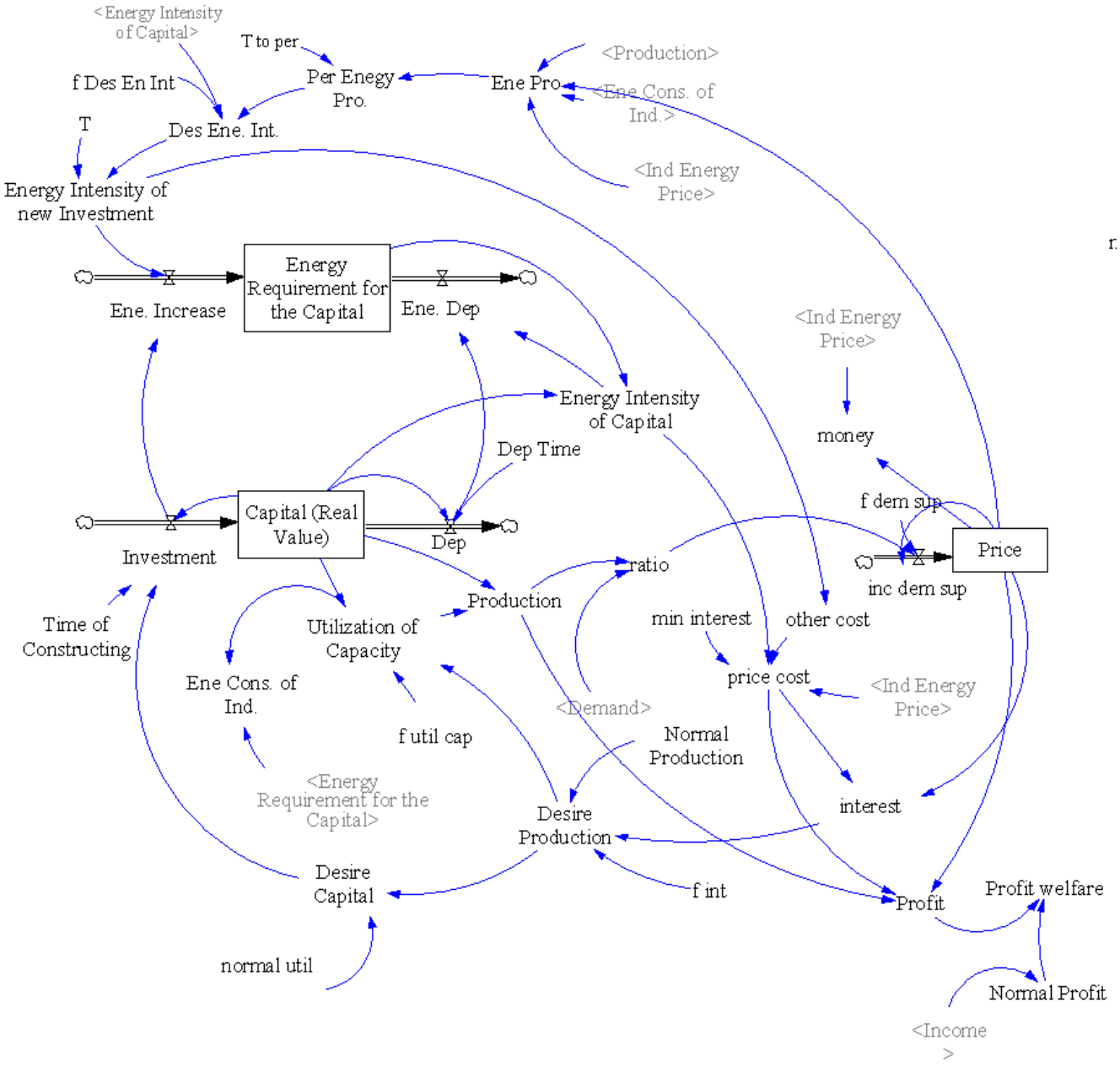

Fig. 7: Production Model

product sales (profit welfare). The amount of subsidy is also another source of pressure on the government which impedes the government from spending the budget on other plans rather than subsidy resulting in public dissatisfaction and government popularity shrinkage and eventually government discharge that is not desirable at all, hence paying subsidy is considered as a serious pressure for the government.

1) Validation: As it is illustrated in Figure. 10, budget growth will raise government's capability to pay subsidy, consequently the energy price will dwindle both for industrial and household usage.

Inspecting the Figure. 11 implicitly shows that as Goods utilization declines, the energy price for both group has risen up. This behavior can be explained as follow: reducing Goods utilization while keeping the number of products and industrial energy consumption unchanged, the fraction of the budget spent on energy subsidy will be allocated to less energy as a result of the demand decline. Thus, the energy price will diminish. As it can be seen the decline in People energy price is more conspicuous and this is because as Goods utilization decrease the people pressure increases more comparing to industrial pressure.

D. Sector3 : Consumption

In this sector people consumption paradigm has been modeled, besides, their budget allocation to the main expenses including: buy products, Energy purchase and the cost of optimization, is discussed.

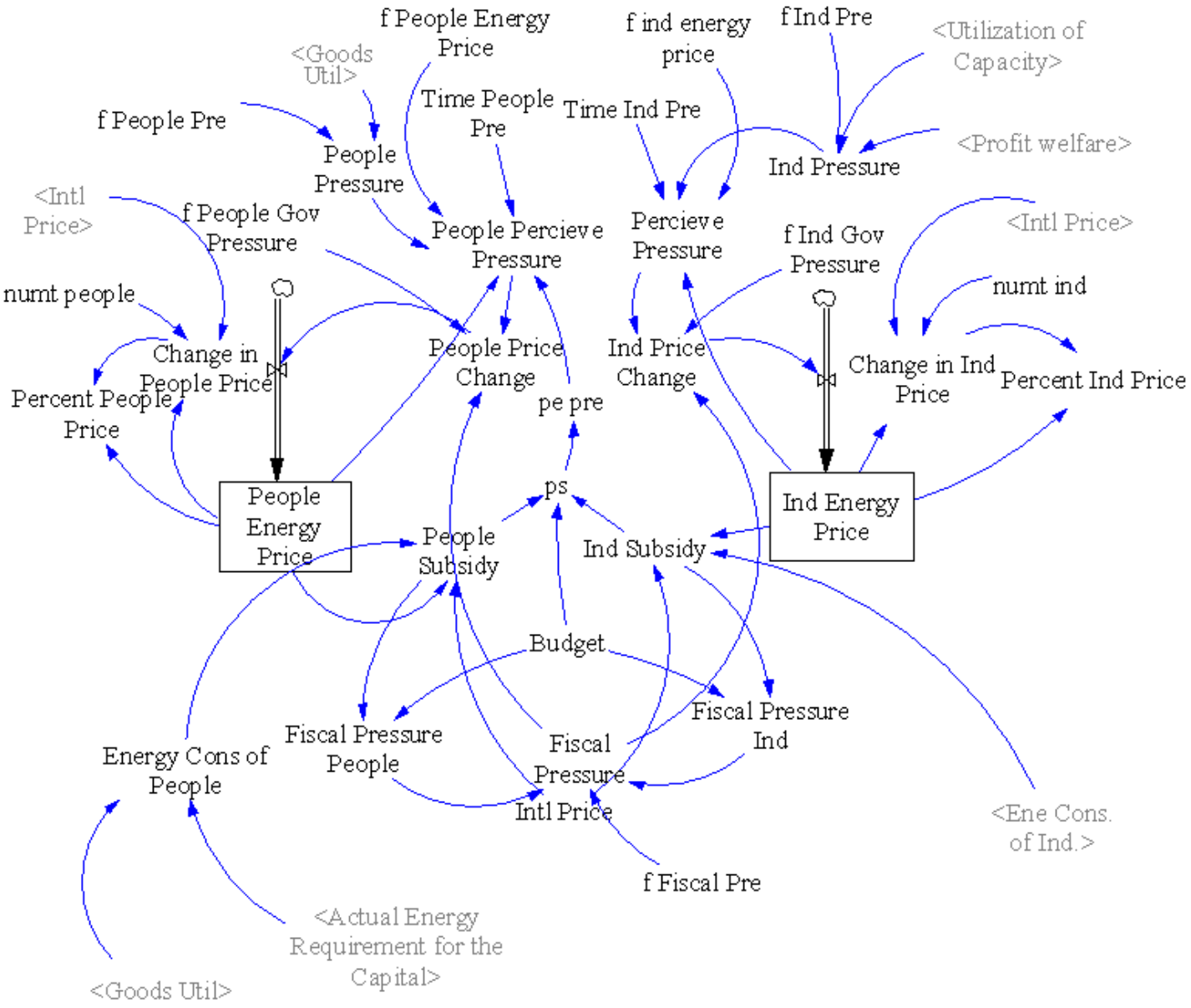

Fig. 9: Government Model

In this model (see Figure. 12)there are three key variables: Max energy cost, Des Cap Needed per month and Des Cost Retrofit. All of these variables have Money/Month unit. The amount of money paid for each aforesaid expense is determined by linear distribution of the monthly income (the variable "income") among these three expenses. For example:

$$REALER = \min(Income \times maxEnergyCost \setminus TotalDesCost, maxEnergyCost)$$

In the case (see Figure. 13) that a part of the income is left unused, that will result in increase in Income level. It means the quality of living will improve which may leads to an increase in the number of required product for example. In the model above for each bought product, the amount of monthly energy consumption is calculated and augments the corresponding stock (Actual Energy requirement for the capital). Meanwhile it is assumed that all of the products consume a certain amount of energy monthly (New EI), so it is also possible to compute the aforementioned variable (Original Energy Requirement for the capital) by multiplying the capital by New EI. But the reason to keep actual Energy as a stock lies in the ability to reflect retrofit policy in the model. Hence, it is assumed that each product can be retrofitted at most as the Potential Retrofit factor determines and the desired optimization in energy consumption is decided regarding to Goods utilization (It is crystal-clear that if goods utilization is high, the interest in optimizing energy consumption will

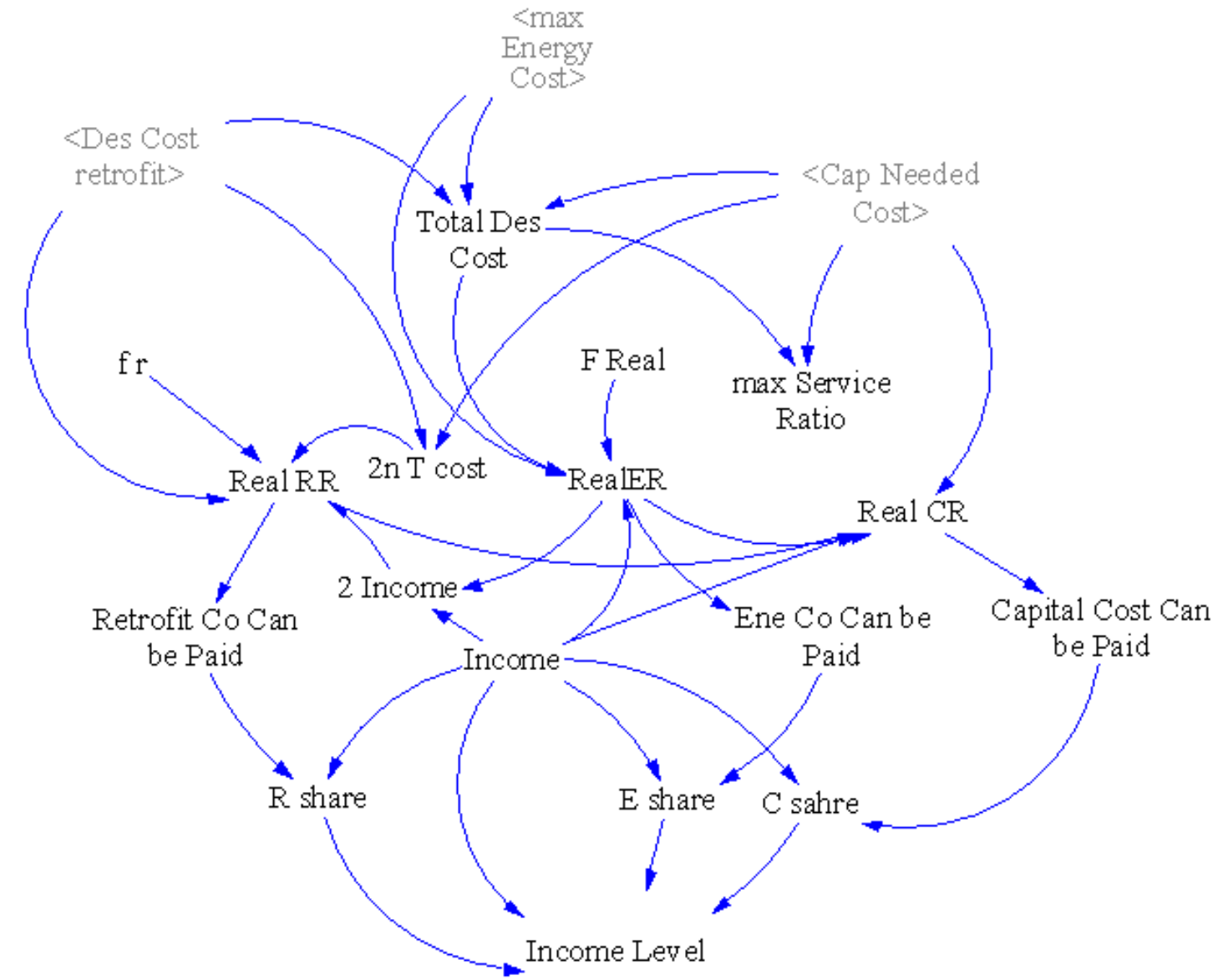

Fig. 12: Consumption Model-1

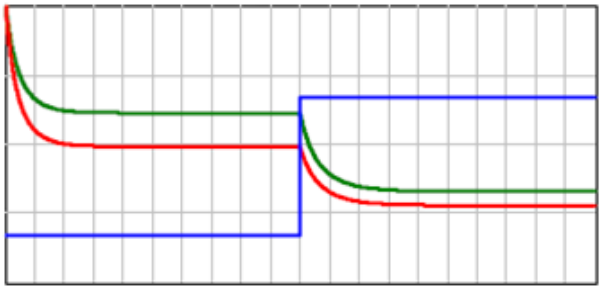

Fig. 10: Validation1;Budget(blue),Industrial-Energy-Price(red),People-Energy-Price(green)

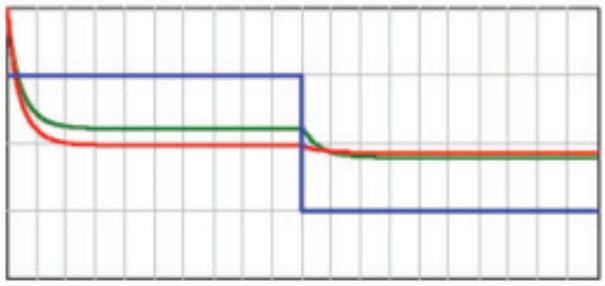

Fig. 11: Validation2;Goods-Utilization(blue),Industrial-Energy-Price(red) ,People-Energy-Price(green)

decline) and it will determine the cost paid monthly for optimization. Goods utilization as mentioned before is defined in what extent the goods are being utilized comparing to normal condition. Providing goods utilization = 1, the amount of monthly consumed energy by each product will be the same as New EI in general, the amount of monthly consumed

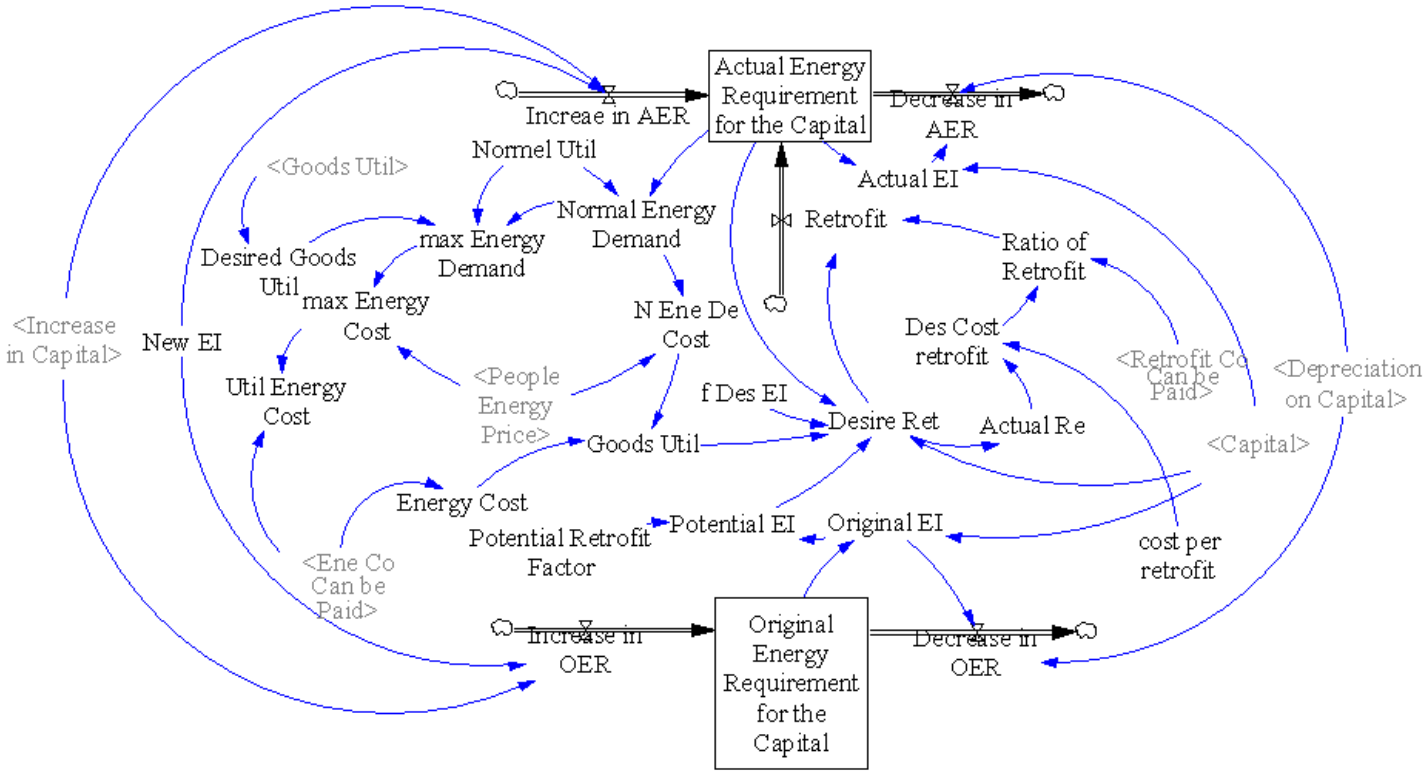

Fig. 13: Consumption Model-2

energy for each product is equal to Goods utilization * New EI. Goods utilization is equal to the ratio of monthly energy cost to energy cost in normal utilization and in the model it is formulated as the quotient of affordable energy cost (Ene Cost can be Paid) divided by Energy cost in normal condition(N Ene De Cost). Furthermore, the maximum desired energy used in cost allocation in previous part, is equal to the cost that should be paid monthly giving Goods utilization = 3. But as it was mentioned earlier, income level can change this number. In other words as the level of welfare increases, people's desired Goods utilization will also rise. For example people may prefer to keep lights on for 9 hours a day as they become better off while normally they would turn them on for 3 hours, in this case goods utilization is four times greater than normal condition (good utilization = 3)

In this part people's purchase pattern is modeled (see Figure. 14).The number of required products is determined in terms of income level and in the next step the cost of required capital is calculated (Cap Needed Cost). And regarding affordable cost and the product price, product demand is formed and eventually shipment is determined in terms of demand and supply.

1) Validation: As Figure. 15 illustrates, as income grows, the amount of good utilization also rises. It is worthy to mention that at the initial moments as Income increases, Goods utilization will also grow proportionally, whereas in the following, because income growth leads to purchasing more and newer products that needs energy, Goods utilization will decline, however the equilibrium is reached in higher level comparing to outset.

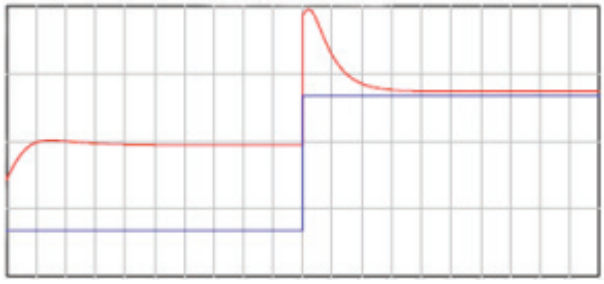

Fig. 15: Validation-1;Income(blue),Goods-Utilization(red)

According to Figure. 16, price drop will gradually release an amount of money leading to strengthening the purchase potential. Consequently Goods utilization is increased, however, since a fraction of the money is spent on buying new products it does not increase correspondingly.

E. Analyzing the Model

Having connected the three aforesaid sectors and calibrated the model, following result is observed.

It could be easily educed from the Figure. 17, that budget growth result in decline in both industrial and household energy price. At the outset the decrement is somehow intense while as time goes on energy consumption increases leading to a slight price growth and gradually reaching to equilibrium. According to Figure. 18 and as it was discussed earlier, increase in budget will result in energy consumption elevation that hinders initial price plunge.

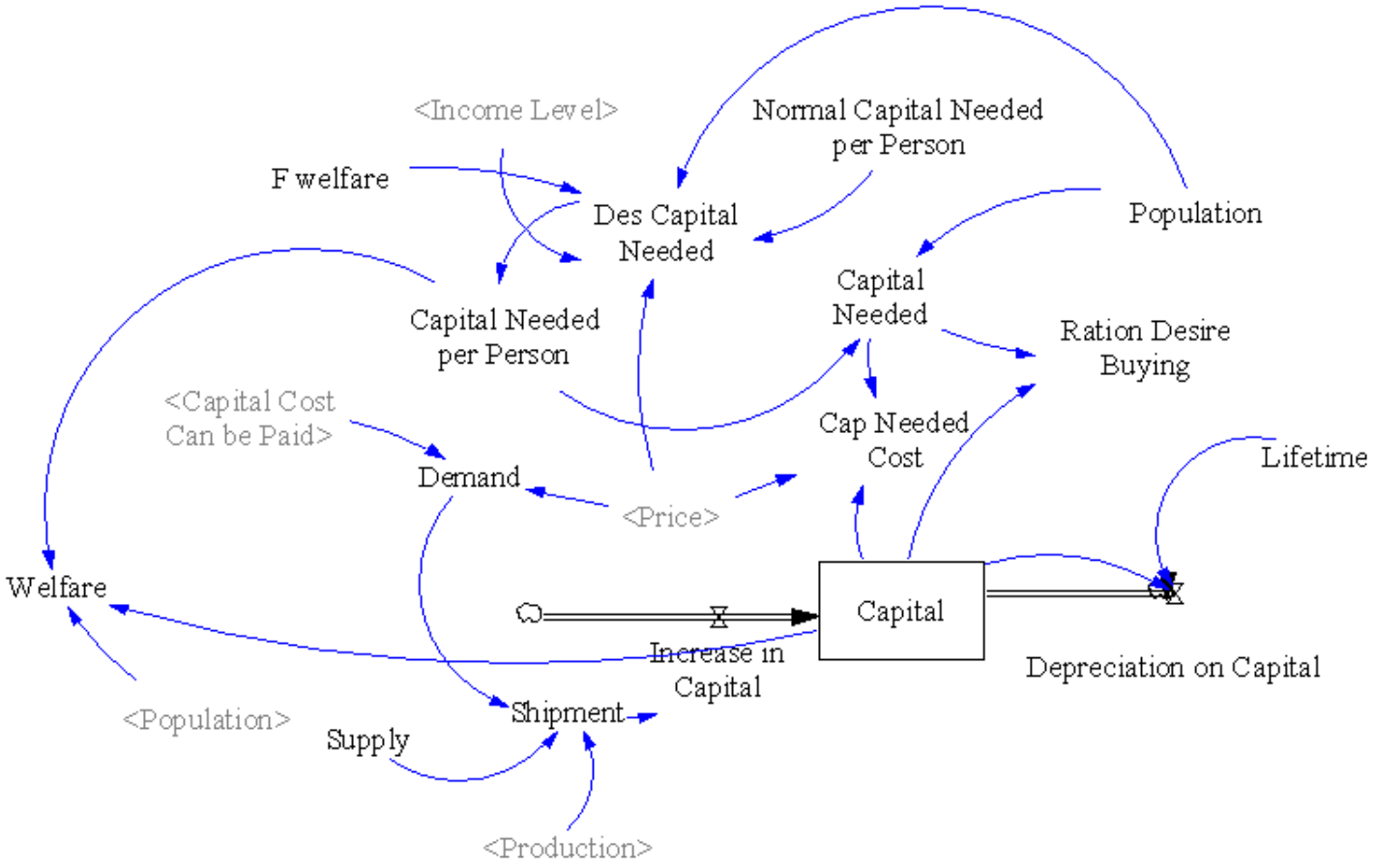

Fig. 14: Consumption Model-3

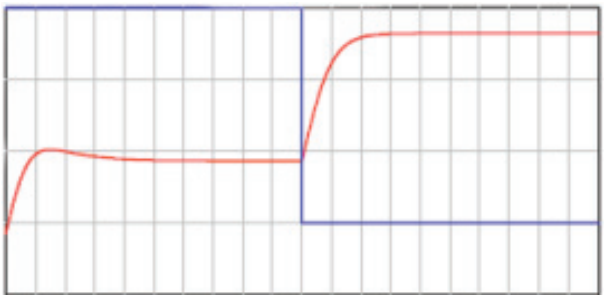

Fig. 16: Validation-2;Price(blue),Goods-Utilization(red)

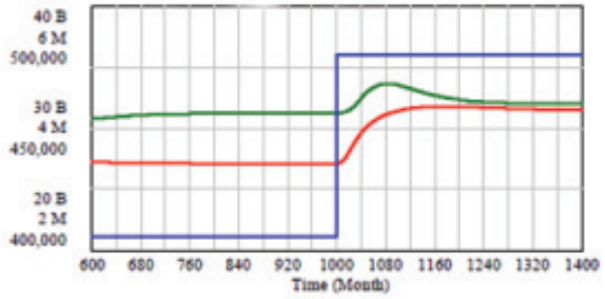

Fig. 18: Dependency Of Energy-Cons-of-industry(red) and Energy-Cons-of-People(green) to Budget(blue)

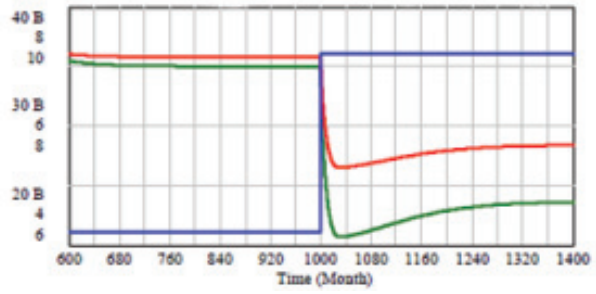

Fig. 17: Dependency Of People-Energy-Price(green) and Industrial-Energy-Price(red) to Budget(blue)

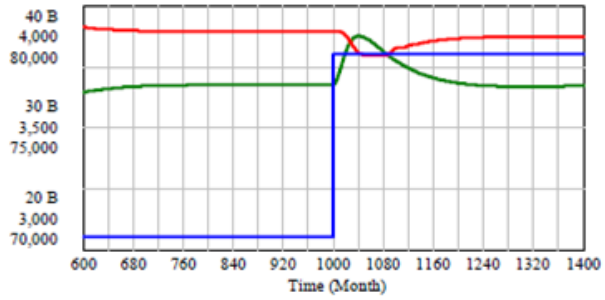

Fig. 19: Dependency Of Price(red) and Production(green) to Budget(blue)

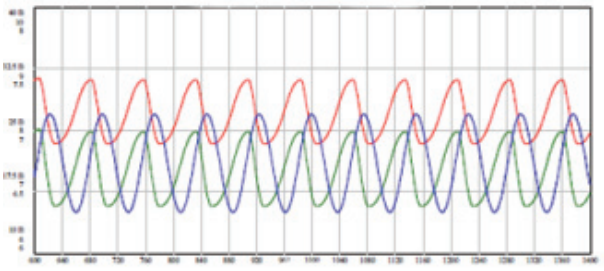

Fig. 20: Dependency Of People-Energy-Price(red) and Industrial-Energy-Price(green) to Budget(blue)

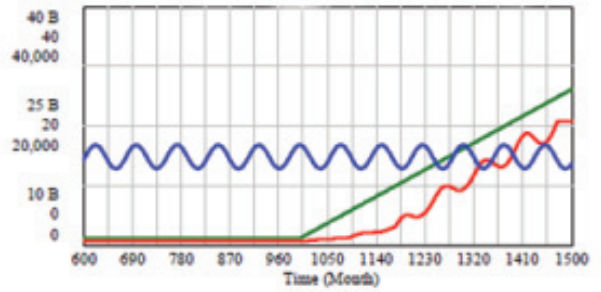

Fig. 21: Dependency of Fiscal-Pressure(red) to Budget(blue) & Intl-Price(green) if we use fixing price policy

In Figure. 19, at the outset because of budget increase and energy price downturn the primary product price is reduced, thus investors will be more interested in investing (the variable interest increases)and consequently the production also increases, however , since energy comprise a small fraction of people income, changes in energy price will not provide people with noticeable amount of money. As a result, there will be slight change in demand and so the price and production will return to their initial value.

In addition , budget vaccination, the prices will also fluctuate which is in accordance with previous research findings (Figure. 20). Another interesting insight that is investigated in the model is that if the government decides to stabilize the price while energy price is steadily increasing what will happen.

As you can see in Figure. 21 the burden on the government will turn out to become intolerable after a while, which means that there will not be any budget left to fulfill other government demand.

Based on Figure. 22 This policy will also stabilize the product price and production rate, leading to elevation in job security that will not last long as discussed earlier.

In this case (Figure. 23) the pressure on the government is dramatically less than previous conditions, leaving a large fraction of the budget to increase the public welfare level.

As it is shown in Figure. 24, discarding the production decline in the first years, it is returned to its initial rate while the price plunges and will not come back to its initial value. It also shows that even after a dramatic increase in energy price a stable equilibrium will be reached and the government pressure is endurable. Another interesting insight resulted by this model is inspecting direct subsidy policy which means the government decides to pay the subsidy directly to the people.

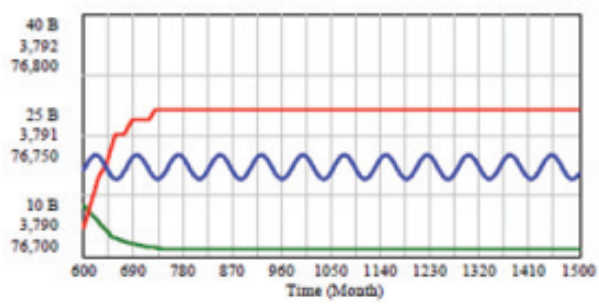

Fig. 22: Dependency of Price(red) And Production(green) to Budget(blue) if we use fixing price policy

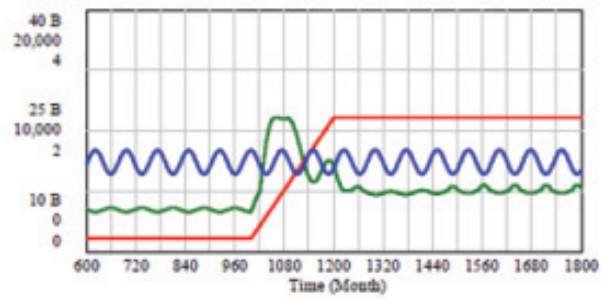

Fig. 23: Dependency of Fiscal-Pressure(green) to Budget(blue) & Intl-Price(red) if we don't use fixing price policy

In Figure. 25 and Figure. 26 the behavior in the equilibrium is depicted:

As it can be observed in figures above, in the case of direct payment the investment interest will not change noticeably. The prices will grow and production will roughly remain unchanged. it should be added that in this policy it is assumed that industrial energy subsidy is still being paid). Unquestionably the behavior depends on how the policy is implemented, while this policy cannot be investigated more in this model(I'm not sure I understand your last sentences).

VI. Acknowledgment

This research was supported by National Elite Foundation of I.R.Iran. We thank them and appreciate their support.

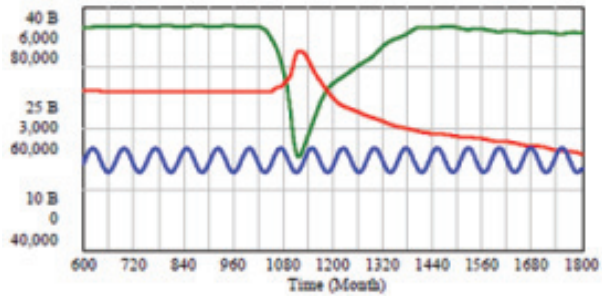

Fig. 24: Dependency of Price(red) And Production(green) to Budget(blue) if we don't use fixing price policy

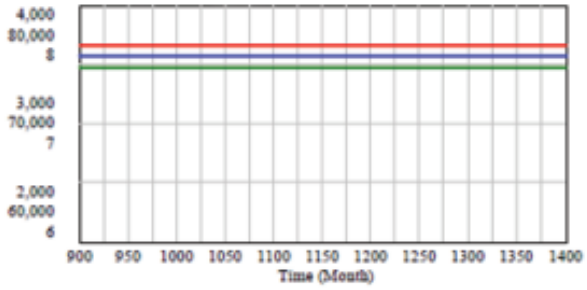

Fig. 25: Equilibrium Value of Price(blue) , Production(red) & Interested(green) In not paying subsidy to people condition

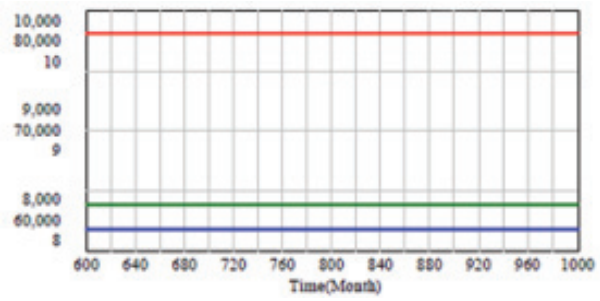

Fig. 26: Equilibrium Value of Price (blue) , Production (red) & Interested (green) In directly paying subsidy to people condition

VII. Conclusion And Suggested Policy

Regarding the model structure and also simulation results, it is clear that the government prefers not to pay subsidy as less as possible, in order to spent the limited budget on construction project and improving public welfare by providing better social services, free education, welfare facilities and enhanced transportation system. On the other hand public satisfaction and industrial development mainly depends on energy price and subsidy elimination will result in various problems in short-term as discussed earlier. Our suggested policy to pass this period prosperously, is that the total amount of industrial subsidy which is quite conspicuous should not be paid directly, instead it must be spent on adopting new technologies and providing suitable conditions for technological development in industries. In other words greater subsidy should be paid for adoption of modern and low energy consumptive technologies. this subsidy is paid for the products or equipment rather than energy. This policy has the following advantages:

- Industries will develop more than before resulting in becoming more self dependent. They will be able to enter international markets to progress dramatically and gradually become independent of the subsidies.
- Taking advantage of state of the art technologies will lead to producing low consumptive goods, as a result the household energy consumption as well as the amount of household subsidy will decline. Besides, implementing such policies will foster small businesses growth which is essential for industrial development.
- Implementing the suggested policy will hinder investors of lobbying with politicians which affects government decisions and their satisfaction will be provided by purchasing enhanced and modern equipments using governmental subsidy. To state the matter differently the rent seeking firms will turn into innovative ones playing a crucial role in country development.

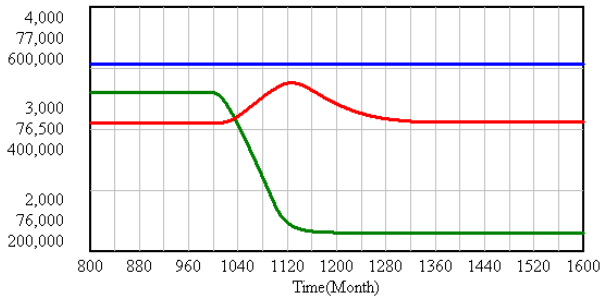

Fig. 27: result of Policy;Price (blue) , Production (red) & Energy Consumption of People

It may be helpful to mention that, the answer to the question"why this policy was not effectively implemented" lies in administrative and legal deficiencies that inhibit the execution of an integrated policy which stems from lack of short-term and long-term simulation showing the requirements and appropriate mechanisms. Another obstacle in the way of implementing the policy is its noticeable executional risk. It is obvious that the consequences of the failure in implementing the policy will be severe for the government and serious public dissatisfaction will be expected that may lead to government discharge. The other barrier is the huge amount of money required in the first step of fulfilling the policy to compensate the primary dissatisfaction pressure on the government. More often when government has such a great amount of budget, it will spend it on construction project and also on finishing the incomplete projects and will not risk the money in such long-term policy. Altogether the reasoned mentioned and similar reasons will prevent the policy from being implemented effectively. We are hopeful utilizing the scientific documents offered in this paper will provide better condition to fulfill this policy. In following, suggested policy is simulated for more inspection and its long-term behavior will be analyzed to identify the probable defects.

Implementing the aforesaid policy will lead to decrease in product energy consumption(See Figure. 27). Since the demand is roughly kept invariant, the production level and the price will approximately remain unchanged, whereas the energy consumption decreases which is totally the desirable future we are looking for.

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