An evaluation of the welfare effects of reducing energy subsides in Iran

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HIGHLIGHTS

◥ Reform of energy prices is an important element of the "Economic Reform Plan" for 2010–2014 for Iran.
◥ The implementation of this plan has affected both households' welfare and firms' profitability.
◥ Higher energy prices decrease energy consumption by Iranian households.
◥ Iranian household welfare will increase with a 100% or 200% rise in energy prices.
◥ Iranian household welfare will decrease with a 400% or 500% rise in energy prices.

ARTICLE INFO

Article history:
Received 27 February 2011
Accepted 4 May 2012
Available online 31 May 2012

Keywords:
Energy consumption
Energy prices
Household welfare

ABSTRACT

Energy prices in Iran have traditionally been heavily subsidized by the Government, and as a result, energy consumption per capita in Iran is close to the European Union level. The welfare effects of efforts to raise energy prices closer to world levels are examined in this paper. Reform of energy prices is an important element of the "Economic Reform Plan" (2010–2014) for Iran. We first analyze the relationship between energy consumption, energy and non-energy prices by estimating the household expenditure function. The results show that a higher energy prices will decrease energy consumption by Iranian households. Second, we evaluate the impact of a rise of energy prices on the household welfare by measuring the compensating variation (CV) in five steps with a compensating payment. The results show that Iranian household welfare will increase with a 100% or 200% rise in energy prices, if the government payment is 20%, 30% or 50% of the $20 billion income resulting from removing energy subsidies. While, in contrast, Iranian household welfare will decrease with a 400% and 500% rise in energy prices, if the government payment is 20% or 30% of $20 billion income.

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1. Introduction

The Iranian government has made a lot of efforts to reform the energy pricing mechanism and has tried to establish a market-oriented one. But the energy pricing mechanism in Iran is still not in line with international prices, because subsidies are paid by the government for energy consumption and energy prices have been completely controlled by the government since 1980. Therefore, Iranian energy prices are generally lower than international standard levels. These lower energy prices could not fully reflect the relationship between energy consumption and energy demand. Distortions in energy prices have caused serious challenges to the Iranian households’ energy consumption and economic welfare as well as the government budget. Nowadays, the government is attempting to reform energy pricing through reducing energy subsidies. Therefore, the relationship between energy prices, energy consumption and household economic welfare in Iran should be studied before reforming the energy pricing mechanism.

2. Literature review

International institutions and researchers have done a series of studies on energy subsides reform and analyzed its impacts on economy variables such as production, consumption, welfare and others.

A joint report of IEA, OPEC, OECD, and World Bank (2010) reviewed some case studies of subsidy reform in OECD and non-OECD countries. The case studies of consumer subsidy reforms in Poland, Indonesia, Malaysia, and the US show that they have all led to a decrease in inflation, an increase in household disposable income and a decrease in demand for energy. The case studies of product subsidy reform of coal mining in Germany (1995), in Poland (1990s), in the UK (1980s), in Spain (1995), and in France (2000) led to an increase in unemployment in coal mining, a
decrease in production, and improvement in the economic situation of some of the coal mining.

The results of other case studies of the impact of removing energy subsidies on the poor and on welfare such as ESMAP (2004); Oktaviani et al. (2007); and Aboulleinein et al. (2009), showed that the removal of energy subsidies induced a decrease in welfare for all income classes, an increase in poverty, the decline of household incomes, a reduction in inequality and average annual GDP growth.

Many researchers have studied the relationship between energy subsidies and economic welfare. Uri and Boyd (1997) examined the impact of an increase in prices of gasoline and electricity on the Mexican economy using a general equilibrium model. The results indicated that an increase in the prices of gasoline and electricity would result in a decrease in output, a fall in the consumption of goods and services, a reduction in total utility and higher government revenues. Templett (2000) showed that the States with large energy price disparities between sectors have statistically higher poverty, lower incomes, more pollution and use more energy but with less efficiency. Risschel and Smestad (2003) analyzed California’s electricity market deregulation process from a subsidy viewpoint. Their results showed that regulated retail energy prices combined with deregulated wholesale energy prices have caused high energy demand, skyrocketing wholesale prices, and electricity shortages. Areno et al. (2008) showed that deregulation in gas industry of US had a positive impact on both demand and supply in the industry, and had a negative and significant effect on the deadweight loss in the market. Walawalkar et al. (2008) analyzed the economic properties of the economic demand-response program in PJM electricity in the US and compared the social welfare gains with subsidies paid to price-responsive load using load and price data for 2006. The results showed that the social welfare gains exceed the distortions introduced by the subsidies. In Lin and Jiang (2011) study, a CGE model was used to analyze the economic impacts of energy subsidy reforms. The results showed that removing energy subsidies will result in a significant fall in energy demand and emissions, but will have negative impacts on macroeconomic variables.

For Iran, Shafie Pour Motlagh and Fariabi (2007) estimated the trend of total energy subsidies from 2003, running a model for analysis of changes at the level of social welfare that resulted from price reform policy. The results of their model running under two scenarios showed that reducing energy subsidies for each energy form is extremely beneficial. Further, an increase in prices can be a basis for redistribution of income within poor households and increase the government revenue and economic growth in long-term. Manzor et al. (2009) using a CE/GMPSGE model showed that removing energy subsidies results in shrinking output and the reductions in urban and rural welfare, respectively, by 13% and 12% as well as hyperinflation. Table 1 gives a summary of these studies.

These studies show some important viewpoints: (1) the economic output and energy prices affect energy consumption; (2) the removal of energy subsidies affects energy consumption, household income, and household welfare; (3) the relation between energy prices can reflect energy substitutions.

In this paper we will mainly study the impact of energy prices change on energy consumption, household income and household welfare in Iran.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Approach/Method</th>
<th>Location/Area</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aboulleinein et al. (2009)</td>
<td>Review some case studies of product subsidy reform of coal mining</td>
<td>Egypt</td>
<td>Increase in unemployment in coal mining, decrease in production, and improvement in the economic situation of some of the coal mining</td>
</tr>
<tr>
<td>ESMAP (2004)</td>
<td>Dynamic Computable General Equilibrium</td>
<td>Mexico</td>
<td>Decrease in total private consumption, increase in GDP, affect the welfare levels of all quintiles, the budget turns to a surplus</td>
</tr>
<tr>
<td>Oktaviani et al. (2007)</td>
<td>Dynamic Computable General Equilibrium</td>
<td>Indonesia</td>
<td>Decrease in welfare, increase in poverty, and reduction in inequality</td>
</tr>
<tr>
<td>Uri and Boyd (1997)</td>
<td>General Equilibrium model</td>
<td>Mexico</td>
<td>Increase in employment, decreases in output, decrease in household income, decrease in welfare</td>
</tr>
<tr>
<td>Templett (2000)</td>
<td>Cross-sectional simple linear regressions</td>
<td>50 states of USA</td>
<td>An increase in gasoline and electricity price would result in a decrease in output, consumption of goods and services, reduction in utility and increase in government revenues</td>
</tr>
<tr>
<td>Risschel and Smestad (2003)</td>
<td>Analysis of market deregulation</td>
<td>California’s electricity market, USA</td>
<td>The states with large energy price disparities between sectors have higher poverty, lower incomes, more pollution and use more energy, High energy demand, skyrocketing wholesale prices and electricity shortages</td>
</tr>
<tr>
<td>Areno et al. (2008)</td>
<td>Disequilibrium model of supply and demand</td>
<td>US natural gas industry</td>
<td>Positive impact of both demand and supply, and had a negative effect on the deadweight loss in market</td>
</tr>
<tr>
<td>Walawalkar et al. (2008)</td>
<td>Economic model of demand response market</td>
<td>PJM electricity market of USA</td>
<td>Social welfare exceed the distortions introduced by the subsidies</td>
</tr>
<tr>
<td>Lin and Jiang (2010)</td>
<td>CGE Model</td>
<td>China</td>
<td>Fall in energy demand and emissions, and negative effects on macroeconomic variables</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Iran</td>
<td>Shrinking output, reduction in urban, rural welfare, and hyperinflation</td>
</tr>
</tbody>
</table>
3. Structure and regulatory reform in the Iranian energy sector

In the Iranian energy market, the National Iranian Oil Products Distribution Company (NIOPDC) and the Tavanir Company are the major suppliers. NIOPDC supplies oil, gas, petroleum and gasoline and Tavanir Company supplies electricity. Energy prices in Iran are lower than in neighboring countries such as Turkey, Iraq, Afghanistan and Russia. The Iranian government pays almost $40 billion in energy subsidies in every year. This resulted in a budget deficit for the government and, in recent years, the budget deficit has increased. Also, firms in Iran used inexpensive energy for their products and this has caused increase in firms’ profits. While the energy use in firms is inefficient.

Energy subsidies have important implications for climate change, price distortions, energy consumptions and sustainable development. Energy subsidies have an effect on the level and composition of energy produced and used. For example, a subsidy lowers the price of a given fuel to end-users and ultimately would normally boost demand for that fuel and the overall use of energy. This can bring social benefits, but may also carry economic and environmental costs.

Iran has one of the largest subsidies in dollar terms from among Russia, China, Saudi Arabia, India, Indonesia and others. Subsidies in the Iranian energy sector have led the energy price to fall, and energy consumption has increased by 6.3% each year since 2000. So, energy prices reform has been an important issue in Iran.

Reform of energy prices constructs an important section in the “Economic Reform Plan” for 2010–2014. In this Plan, the government is required to liberalize energy prices within a period of 5 years. The Reform Act stipulated that prices should be adjusted to 90% of their fob Persian Gulf levels within five years, but did not specify the price adjustment path for the different products. The Reform Act stipulated that households would receive at least 50 percent of the increase in revenues derived from the reform. Initially, the benefits were to be paid in cash, while in a second phase, some of the additional revenues were to be used to support higher social benefits and public goods. 30% of the additional revenues were to be used to assist Iranian companies restructure to adjust to the new, dramatically higher energy cost. The remaining 20% of the additional revenues would go to the government to cover government’s own higher energy bill.

The government made long and careful preparations to ensure the success of the reform and its support by the public. In particular, decisions had to be made about the timing and speed of the price adjustment, the distribution-size and form-of compensatory payments to the population and the corporate sector. Macroeconomic policies prepared the ground for the reform by helping reduce inflation in the period preceding the reform. Ensuring that the banking sector could distribute the compensatory transfers was also a key aspect of the preparation of the reform.

Administrative policies were used to further stabilize prices. In the months leading to the reform, the authorities launched a campaign aimed at preventing producers and retailers from increasing prices in anticipation of the reform. Enterprises found violating the instructions were fined and ordered to reverse the price increase. In addition, the government built stockpiles of domestically produced and imported consumer goods, including many perishable good. The availability of the stockpiles was well advertised in the media to dissuade merchants from increasing prices. The authorities also prepared and discussed in public possible measures to distribute directly many of the basic staples and consumer goods to counter hoarding and panic buying (IMF, 2011).

The use of the multi-tier tariffs on electricity, natural gas, and water played an important role in moderating the impact of the price increases on small users, mostly the poor and accounting for regional disparities in availability of different heating fuels. The tariff schedules were further differentiated by region. Prices were set at lower rates in hot regions with relatively higher air-conditioning demand. Tariff schedule for natural gas and water were similarly differentiated by quantity used and region. In areas where natural gas was not available, heating costs were to remain closely monitored and regulated, and lower priced (at Rs 10001−3) rationed kerosene and lower electricity rates would be provided to ensure affordability of heating.

The use of the electronic cards system for gasoline rationing and quotas introduced in June 2007 also provided a de facto multi-tier energy pricing structure for gasoline, making the reform seem gradual, while accomplishing the main objective of sharply increasing “free market” prices. The price of rationed gasoline would be increased but remained well below the full price at which they could purchase unlimited amount of fuel.

Direct assistance to enterprises was to be financed by 30% of the additional revenue from the price increases envisaged under the Reform Act, and included various support packages, including interest subsidies on loans for the adoption of new, energy-saving, technologies, credit lines to mitigate the impact of higher energy costs on cash-flow, and credit lines to spread the costs of higher energy costs over a three-year period.

In addition, specific industries have benefited from reduced fees and taxes and special export awards. To protect and support demand for domestic industries, tariffs on selected imports were introduced or increased. At the same time, the authorities recognized that the adoption of new technologies would not be sufficient to reap the full benefits of the subsidy reform in terms of efficiency gains (IMF, 2011).

Reducing waste and improving the production process would also contribute to reduce energy intensity by increasing the amount of output per unit of energy consumed. Several initiatives were introduced to improve enterprises’ efficiency, such credit for the hiring of consultants to improve management.

Iranian Banks played a critical role in the distribution of targeted subsidies to households. Preparing banks for the reform involved a number of steps. First, an estimated 16 million new accounts had to be opened to ensure every eligible family could receive benefits. Second, banking infrastructure and the payment system had to be upgraded to guarantee seamless, possibly simultaneous access to the accounts by a large number of the beneficiaries. In the hours preceding the price reform, the authorities made it repeatedly clear that Iran’s ATM network was ready to withstand a possible onslaught of the population rushing to withdraw their targeted subsidies. Finally, the ATM network had to be expanded to the farthest corners of the country to allow Iran rural population access to the accounts.

Banks were also to play a critical role in the allocation of subsidies to enterprises, as the latter was given in part by reducing the interest rate on loans made for investment in energy-saving technologies, and banks receiving the interest rate differential from the government.

As in the case of the corporate sector, the authorities foresaw the need to assist Iran’s public sector institutions in dealing with the consequences of the sharp increase in energy prices by allocating additional revenue from the price increase to pay for the higher energy bill faced by the government sector. In particular, significant resources were allocated to provincial and local governments. However, it is not clear whether the allocation schemes provided the needed incentives to promote energy savings by government-funded organizations (IMF, 2011).

Iranian government had done a lot of actions for the reform of energy prices. Such as, preparation of protective projects for public transportation and agricultural sector, payment of loans...
The Reform Act stipulated that households were to receive 50% of the revenues raised in the reform, but not indicated who should receive the compensation. Now days, every person in Iran receive $45 for each month. In one hand, the increase in energy price resulting from this reform decreases households’ welfare. In other hand, the government compensates households through income from rising energy price that increases the households’ welfare. In this study, we analyze the effects of energy price increases only on households’ welfare under different price changes scenarios and different compensation scenarios on the base of Reform Plan.

4. Methodology and data used

4.1. Methodology

In this study, we assume that the Iranian agent household has a rational and continuous preference, and we take \( U(X_E, X_{NE}) \) to be a continuous utility function of energy goods consumption \( X_E \) and non-energy goods consumption \( X_{NE} \) that represent these preferences. The agent household's problem of choosing her/his most preferred consumption bundle given the energy price \( p_E \) and non-energy price \( p_{NE} \) and income level \( y \) can now be stated as the following Utility Maximization Problem (UMP):

\[
\begin{align*}
\text{Max} & \quad U(X_E, X_{NE}) \\
\text{S.t.} & \quad \sum_{X_E} p_E X_E + p_{NE} X_{NE} \leq Y \\
& \quad X_E \geq 0, \quad X_{NE} \geq 0, \quad y \geq 0
\end{align*}
\]

(1)

If the form of the utility function is known, the measurement of welfare change becomes a straightforward question indeed, for then it can be calculated from the change in the original levels of prices and income. If the Walrasian demand function of energy goods consumption is \( X_E(p_E, p_{NE}, y) \), it is a simple matter to determine whether the energy price changes make the agent household better or worse off: if \( v(p_E, p_{NE}, y) \) is the indirect utility function derived from utility maximizing, the agent household is worse off if and only if \( v(p_E^1, p_{NE}^0, y) - v(p_E^0, p_{NE}^1, y) < 0 \) and vice versa.

Although any indirect utility function derived from utility maximization suffices for making this comparison, one class of indirect functions deserves special attention because it leads to the measurement of the welfare change as expressed in money units. These so-called “money metric indirect utility functions” and are constructed by means of the expenditure function (Mas-Colell, et al., 1995). A money metric indirect utility function can now be constructed for any price vector \( p(p_E, p_{NE}) \geq 0 \). Two particularly natural choices for the price vector \( p \) are the initial price vector \( P^0(p_E^0, p_{NE}^0) \) and the new price vector \( P^1(p_E^1, p_{NE}^1) \). These choices lead to a well-known measurement of welfare originating in Hicks (1939), the compensating variation (CV). Formally, allowing \( u^1 = v(p^0, y) \), and \( u^0 = v(p^1, y) \), and noting that \( e(P^0, u^1) = e(P^0, u^0) = y \), we define CV as follows:

\[
CV(p^0, p^1, y) = e(p^1, u^1) - e(p^0, u^0) = y - e(p^0, u^0)
\]

(2)

The Compensating Variation (CV) measures the net revenue of a planner who must compensate the agent household for the energy price change after it occurs, bringing it back to its original utility level \( u^0 \).

---

1. The energy goods consumption include the oil, gas, electricity, gasoline and petroleum.

The compensating variation has an interesting representation in terms of the Hicksian demand curve. We suppose that the price of energy goods changes, so that \( p_E^0 \neq p_E^1 \) and \( p_{NE}^0 = p_{NE}^1 \). Because \( y = e(P^0_E, p_{NE}^0, u^0) = e(P^1_E, p_{NE}^1, u^1) \) and \( h_E(p, u) = c(e(p, u)/c(P_E)(Shepherd’s Lemma)) \), we can write:

\[
CV(p^0, p^1, y) = e(p^1, u^1) - e(p^0, u^0) = \int_{p_E^0}^{p_E^1} h_E(p_E, P_{NE}, u^0) dp_E
\]

(3)

Note that we now use the initial utility level \( u^0 \). See Fig. 1 for the graphical representation.

In this paper we assume that the homogeneity assumption in the demand system is true and we use an ad-hoc demand function for the agent household. The agent household ad-hoc demand function of energy consumption resulting from the utility maximizing problem is as follows:

\[
X_E = f(p_E, p_{NE}, y) = A p_E^p p_{NE}^0 p_E
\]

(4)

where \( X_E \) is the energy consumption; \( P_E \) is the energy price index; \( P_{NE} \) is the non-energy price index; \( y \) is the agent household’s income.

If the energy price \( P_E \) changes and a non-energy price is given, it would result from the budget constraint that \( dy = X_E dp_E \) and so,

\[
y / y^i = A p_E^p p_{NE}^0 p_E
\]

\[
1 - \frac{1}{y} = \frac{A}{1 + \frac{1}{y} p_E^p p_{NE}^0 + C}
\]

\[
C = v(p_E, P_{NE}, y) = \frac{1}{1 - \frac{1}{y} } \frac{A}{1 + \frac{1}{y} p_E^p p_{NE}^0}
\]

\[
y = \frac{1}{1 - \frac{1}{y} } (v + A p_E^p p_{NE}^0 ) = e(v, p_E, P_{NE}) \]

(5)

The Compensating Variation (CV) measure of welfare changes resulting from an increase in energy price for the agent household will be

\[
CV = (e(u^1, p_E^1, P_{NE}^0) - e(u^0, p_E^0, P_{NE}^1)) = \int_{p_E^0}^{p_E^1} c(e(v, p_E, P_{NE})) dp_E
\]

\[
= \int_{p_E^0}^{p_E^1} h_E(p_E, P_{NE}, u^0) dp_E
\]

(6)

In this paper, the energy price index \( p_E \) is used for energy prices including oil, gas, gasoline, electricity, and petroleum. We computed the energy price index for 1974–2008 using Laspeyres’s price index (1871), as follows:

\[
p_E = \frac{\sum_{q=2004} p_q Q_{2004}}{\sum_{q=2004} Q_{2004} Q_{2004}} \times 100
\]

Where \( p_q \) is the price vector of oil, natural gas, gas–oil, gasoline, electricity and petroleum for \( q \) the1974, …., 2008, \( q \) is the quantities of oil, natural gas, gas–oil, gasoline, electricity and petroleum consumed in the base year (2004), \( P_{2004} \) is the price...
vector of oil, natural gas, gasoline, electricity and petroleum in the base year (2004).

The consumer price index (CPI) is used as a proxy for the non-energy price index \( P_{NE} \); the energy consumption data is the energy consumed by Iranian households for 1974–2008. And the household expenditure \( Y \) is assumed to be distributed between energy and non-energy goods consumption.

4.2. Data

The data for Iranian energy prices, non-energy prices, energy consumption, and households' income have been collected from Ministry of Energy (Iran Energy Statistical Yearbook 2009, 2010a) and Central Bank of Iran (Iran Statistical Yearbook 2009, 2010b).

From 1970, the energy prices in Iran are determined by decision makers in Parliament for every year of the Budget Law and Five Year National Cultural, Social and Economic Development Plan. The Iranian Parliament has chosen to set energy prices at well below cost. The makers in Parliament for every year of the Budget Law and Five Year

5. Empirical results

We first analyze the relationship between energy consumption, energy and non-energy prices, and household's income. Following, we consider the relationship between the changes in the household welfare and the increase in energy prices (decreasing energy subsidies).

5.1. The relationship between energy consumption, energy and non-energy prices, and household income.

On the basis of econometric theory, the variables have been tested for stationary ones by testing for unit roots. Usually the ADF, PP, and KPSS tests are used to determine stationary variables at level and after one differentiation (prefixed by D) (Verbeek, 2004). Before testing, all the variables have been logarithmically transformed. \( L_X \) is the natural logarithm of energy consumption of Iranian households; \( L_{PE} \) and \( L_{PNE} \) are also the natural logarithm of indices for energy and non-energy goods, respectively.

The results of stationary tests, both at the levels and after one differentiation (prefix D), would be as shown in Table 2. The results of these tests do not indicate the stationary to be at the levels of the all series at the 5% significance level. So there are not sufficient reasons to reject the unit root null hypothesis for the level series. But, for all differentiated series, all the tests suggest the stationary to be at the 5% significance level. According to these results, we assumed that all the time series of \( L_{X} \), \( L_{PE} \), \( L_{PNE} \), and \( LY \) are stationary after one differentiation.

In econometrics, the Trace and Max-Eigenvalue test are used to determine the existence of Co-Integration and, the methods such as Ordinary Least Squares (OLS) or Maximum Likelihood are used for the estimation of a long-run relationship (Hamilton, 1994). If the results of Co-Integration tests show that there is a Co-Integrating relationship within the variables, this indicates that the variables co-move in the long run.

Table 3 presents the results of the Johansen Co-Integration test. There is one co-integrated vector according to the Max-Eigenvalue and Trace test at the 0.05 level. The estimation of a long-term relationship between energy consumption, energy and non-energy prices, and household income will be as follows:

\[
L_X = 2.70 - 0.25 L_{PE} + 0.10 L_{PNE} + 0.36 LY
\]

\[
(5.21) ( -5.42) (5.05) (1.8)
\]

where, the numbers in brackets are t- statistics.

Results of the estimation show that in Iran, non-energy prices and household income have a positive effect on energy consumption while energy prices have negative effect on energy consumption. The negative relationship between energy consumption and energy prices indicates that the rise of energy prices will decrease energy consumption in Iranian households. And the coefficient of the \( L_{PE} \), -0.25, indicates the price elasticity of energy consumption in Iran. When the energy prices increase by 1%, the energy consumption of Iranian households will decrease by 0.25%. The coefficients of \( L_{PNE} \) and \( LY \) are cross elasticity and income elasticity respectively.

The residual series in Eq. (7), \( e_t \) were tested for stationary by using the ADF, PP and KPSS tests. The results of these tests are
implementation of the Reform Act (2010–2014) by Government in the energy sector has affected both household welfare and firms profitability in Iran. The Iranian Government has carried out a number of actions to address this, such as: preparation of protective projects for public transportation, industry and agriculture, improving required fuel standards, cash payments to households and so on.

The Reform Act stipulates that households will receive at least 50% of revenues derived from the reform and, today, every person in Iran receives $45 per month. Through this, the Government compensates households through this payment, since increase in energy prices resulting from this reform has the effect of decreasing household welfare. This paper has measured the welfare effects of the increase in energy prices, on the one hand, and compensation by the government, on the other.

The results show that higher energy prices will decrease the energy consumption of households over the long run. The Iranian energy prices are lower than the international market prices, since the government provides subsidies for energy consumption. Iran pricing mechanism for energy ought to be reformed gradually, so that it should eventually be in line with international pricing levels. With the rise of energy prices, energy consumption and the welfare of households correspondingly decrease. According to these results, some recommendations for Iranian energy price reform are given as follows:

Nowadays the Iranian government should loosen the regulation on energy prices, and prices should be determined by the market, which will lead to more reasonable energy prices and the market will act more efficient. According to the relationship between energy price and energy consumption studied in this paper, a higher price will decrease energy consumption over the long run. Reform of the energy pricing mechanism will decrease the government deficit budget and will effectively save energy in long run. According to results of this paper, a rise in energy prices will have an effect on household welfare and the Iranian government should compensate households for their loss of welfare. The government should distribute a part of the income accrued from removing energy subsidies to compensate the households for loss of the welfare and the remainder for improving energy infrastructures.

### References


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The total of energy subsidies paid in Iran was $20 millions in 2009 (Ministry of Energy, 2010).

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### Table 4

<table>
<thead>
<tr>
<th>Variable</th>
<th>ADF</th>
<th>PP</th>
<th>KPSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>$e_t$</td>
<td>-4.14</td>
<td>-4.03</td>
<td>0.09</td>
</tr>
</tbody>
</table>

* significant at the 5% level

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### Table 5

Household welfare change with energy subsidy removal.

<table>
<thead>
<tr>
<th>Increase of energy price (%)</th>
<th>CV ($ billions)</th>
<th>Government payment ($ billions)</th>
<th>Household welfare change</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>$1.86</td>
<td>$4 $6 $10</td>
<td>+ + +</td>
</tr>
<tr>
<td>200</td>
<td>$3.72</td>
<td>$4 $6 $10</td>
<td>+ + +</td>
</tr>
<tr>
<td>300</td>
<td>$5.43</td>
<td>$4 $6 $10</td>
<td>- + +</td>
</tr>
<tr>
<td>400</td>
<td>$7.06</td>
<td>$4 $6 $10</td>
<td>- - +</td>
</tr>
<tr>
<td>500</td>
<td>$8.60</td>
<td>$4 $6 $10</td>
<td>- - +</td>
</tr>
</tbody>
</table>

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shown in Table 4. The results of the ADF, PP and KPSS tests separately indicate the stationary of $e_t$ at the 5% significance level. The results of these tests are sufficient reasons to reject the null hypothesis of unit root. So the residual series, $e_t$, are stationary, which indicates the existence of a long-term relationship between energy consumption, energy and non-energy prices, and household income in Iran.

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5.2. The household’s welfare and increasing of energy prices

On the base of the Economic Reforms Plan in Iran, energy subsidies will be removed within five years. One could expect that the increase in energy prices will decrease Iranian households’ welfare. In this section, we analyze the effects of removing, energy subsidies on the welfare of Iranian households.

We analyze the effects of removing energy subsidies by changing the energy price. We increase the energy price over 5 steps: at the first step, we increase the energy price by 100% and at the other steps by 200%, 300%, 400% and 500%, respectively. In every step, we measure the Compensating Variation (CV) of household welfare change. The results are shown in Table 4. If the Iranian government compensates for household welfare change by payment of 20%, 30%, and 50% of the $20 billion income$ resulting from removing energy subsidies, household welfare would be as shown in Table 5.

Table 5 shows that the Iranian household welfare increases by 100% and 200% with an increase the energy price in every three compensating payments levels. With a 300% increase in the energy price, the household’s welfare decreases with $4 billion compensating payment; while, if the compensating payment increase to $6 billion and $10 billion, it will increase. If the energy price increases 400% and 500%, the household’s welfare will increase only at $10 billion compensating payment level.

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6. Conclusion and policy implications

In this paper, the relationship between energy prices, non-energy prices and energy consumption has been studied. The


