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Economic and environmental analyses of Iranian energy subsidy reform using Computable General Equilibrium (CGE) model

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ABSTRACT

This study analyzes economic and environmental implications of the elimination of energy subsidies in Iran applying a CGE model. The subsidy reform was investigated under two scenarios namely, redistributing total subsidy revenue back to households (complete payment) and allocating it to households and producers (half payment) proportionally (50% and 30% respectively). The results show that elimination of energy subsidies via resource reallocation causes a fall in GDP relative to the initial equilibrium by at least 15%, while the general level of prices (CPI) tends to increase by more than 10% compared to the initial level. However, redistributing a part of the subsidies revenue back to households increases overall welfare. Eliminating energy subsidies induces emission reduction of most of the pollutants. Considering the economic, welfare and environmental aspects, half payment scenario is preferred compared to complete payment option.

Introduction

Subsidized energy is a measure to ensure low income groups' access to modern energy utilization (Liu and Li, 2011). Protecting a particular domestic industry against international competition, avoiding potential unemployment, and making modern energy services more affordable for specific social groups are some aims of subsidizing (Lin and Jiang, 2011; UNEP and IEA, 2002). However, energy subsidies cause the price of energy products to deviate from their true costs. Moreover, some studies suggest that many subsidies failed to make energy affordable to the poor, and non-poor household gains are significantly more than that of the poor (Dube, 2003; Gangopadhyay et al., 2005; Kebede, 2006).

Based on the literature, energy has a central role in economic growth. Positive impact of energy consumption in economic growth is indicated for China (Wang et al., 2011); South Africa (Menyah and Wolde-Rufael, 2010); the newly industrialized countries (NIC[1]) (Sharif Hossain, 2011); Russia (Pao et al., 2011) and Greece (Tsani, 2010). Furthermore, cutting energy subsidies and increasing prices of energy products cause economic production to shrink. Using multi-country general equilibrium, Burniaux et al. (1992) concluded that subsidy reform would reduce world annual real income by 0.7%. Liu and Li (2011) also demonstrated that removing oil and coal subsidies would trigger a fall in China's GDP by 3.80% and 0.52%, respectively. Lin and Jiang (2011) analyzed the impact of removing the energy subsidies in China; they concluded that, without redistribution of subsidy revenue, China's GDP would decrease by 1.56%. Empirical work of Jensen and Tarr (2002) also showed that energy subsidy reform in Iran would reduce output in most of the energy and manufacturing sectors. Contrary to the above-mentioned works, the International Energy Agency (IEA, 1999) demonstrated that removing energy subsidies in the eight biggest non-OECD countries would increase their GDP by 1%. It showed that the efficiency gain of subsidy removal in Iran was equivalent to 2.22% of the Iranian GDP. When energy is sold below its true opportunity costs, its use imposes a burden on the economy. This burden can be expressed as potential gains or increase in growth that would occur if subsidies are removed (IEA, 1999). Based on the literature, the negative impacts of energy subsidy elimination on output are more likely than its positive impacts. However, GDP is expected to fall during the adjustment period as industries respond to higher input costs and energy subsidy reform has the potential to provide substantial gains in economic efficiency (Anderson and McKibbin, 1997) since it can eliminate price distortion. Steenblik and Coroyannakis (1995) support reform in coal subsidies in Western Europe, based on promoting industrialization of the power sector and increase in coal production and exports.

In recent years, welfare and environmental concerns have become the focus of many studies on energy subsidy reform (Anderson and

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[1] Namely, Brazil, China, India, Malaysia, Mexico, Philippines, South Africa, Thailand and Turkey.

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McKibbin, 1997). However, the mechanism of the subsidy reform seems rather important. While removing energy subsidies without income transfer scheme may result in declining welfare (Lin and Jiang, 2011; Liu and Li, 2011) and increasing households' expenditure (Saboohi, 2001), redistribution of the subsidy revenue back to the households may increase their welfare (Jensen and Tarr, 2003).

In spite of economic growth and welfare, there is little doubt about the positive impacts of energy reform on pollutant emissions from energy consumption, since about 65% of the greenhouse gas (GHG) emissions are due to production and use of energy (Marrero, 2010). Moreover, the causal relationship between energy consumption and pollution has been the focus of many studies. Menyah and Wolde-Rufael (2010) found a unilateral causality running from energy consumption to CO_2 emission in South Africa and Zhang and Cheng (2009) demonstrated a unidirectional causality running from energy consumption to carbon emission for China. Similar conclusions are available for the USA (Soytas et al., 2007) and the newly industrialized countries (NIC) (Sharif Hossain, 2011). A bilateral relationship between energy consumption and CO_2 emission has been proved for Russia (Pao et al., 2011); Brazil (Pao and Tsai, 2011) and China (Wang et al., 2011). As Alam et al. (2011) pointed out for India, it is straightforward and intuitive that energy consumption drives CO_2 emissions because the main source of CO_2 emissions is the combustion of fossil fuels, however causality from CO_2 emissions to energy consumption should be considered in energy-emissions-income relation context (Pao et al., 2011). More CO_2 emissions are accompanied by higher income which in turn entails more energy use.

There are several studies which focus on the impacts of economic policies on energy consumption and emission. Liu and Li (2011) utilized a CGE model and suggested that cutting oil and coal subsidies in China would generate a fall in CO_2, SO_2, waste water and solid waste. Lin and Jiang (2011) argued that removing energy subsidies reduces CO_2 emission by 7% without the redistribution of subsidy revenue and by 4.7%–6% under alternative redistribution schemes in China. Increase in oil prices in Turkey is also expected to reduce CO_2 emissions (Aydin and Acar, 2011). Removing energy subsidies would reduce CO_2 emissions globally (Burniaux et al., 1992) as well as in OECD and non-OECD countries (Anderson and McKibbin, 1997; IEA, 1999).

Iranian consumers pay an artificially low and controlled price for energy products with the government making up the difference (subsidy) between subsidized and world prices. This energy subsidy is measured by price-gap approach. This approach has the advantage of conceptual and analytical simplicity, and is the most pervasive approach in analyzing energy subsidies (Lin and Jiang, 2011).

To the best of our knowledge, works referring to the Iranian energy subsidies scheme are limited, and the work conducted by Jensen and Tarr (2002) is unique in this context. They considered subsidy elimination under the assumption of redistributing subsidy revenue back to household, whereas the Iranian government may take an alternative option based on subsidy targeting program (STP).[2] Furthermore, environmental aspects of energy subsidy removal are not considered in this study. The IEA (1999) investigated the energy subsidy elimination in Iran and suggested that 49.45% reduction of CO_2 emissions is associated with an unexpected reduction of 47.54% in energy consumption. Subsidy rate of energy products, mechanism of the subsidy reform and analytical framework[3] could be responsible for such results. Contrary to the IEA study that expects a GDP growth of 2.22%, Jensen and Tarr (2002) and Khiabani (2008) indicate that outputs in most of the sectors decrease as a consequence of removing energy subsidies, resulting in a reduction in output of the Iranian economy as a whole. Recently, Khalili Araghi and Barkhordari (2012) have examined the welfare effects of energy price increase together with the government compensation payment applying a partial equilibrium approach. They chose three exogenous compensating payments of 4, 6 and 10 billion USD. The corresponding results show that under the above compensating payments, the Iranian household will be better off by a 100% or 200% rise in energy prices. However, their welfare will decrease with a 400% and 500% rise in energy prices, if the government payment is 4 and 6 billion USD.

Having the second largest oil and gas reservoirs in the world, Iran is the fourth largest producer and consumer of gas and holds the same position in the world in producing and exporting oil (Central Bank of Iran, 2009). The original intention of the Iranian government was to approach a higher level of employment and economic growth, stabilizing prices as well as achieving social equality. However, no compelling evidence exists to support achieving these objectives (Basranzad and Nili, 2005). From the environmental perspective, Iran faces tremendous pressures as pollutant emissions are higher than the global average. On average, per capita CO_2 emission in Iran is around 6.5 metric tons, much higher than the corresponding world figure, i.e. 4.5 metric tons (UN data, 2008). The considerable amount of energy subsidies in the country (12.42% of its GDP in 2009) has resulted in increasing government financial burden as well as GHG emissions due to years of overconsumption of energy (Iran's Energy Balance, 2009; UN data, 2008).

The average subsidy[4] rate in Iran was estimated to be 80.42% in 1997 (IEA, 1999), accounting for the highest energy subsidy rates among the eight largest non-OECD[5] economies. This figure reached nearly 75% in 2008. As shown in Table 1, subsidy at its lowest rate for electricity accounts for 58.2%, while the highest rate is attributed to kerosene, of which more than 96% of the international price is paid as subsidy.

Although the real prices of some energy products have slightly increased, those of gasoil, gasoline and electricity decreased between 1991 and 2008 (Iran's Energy Balance, 2009), leaving a significant gap between domestic and world prices. Energy use per USD 1000 output (constant 2000 PPP$) increased from 201 kg oil equivalent in 1990 to 269 kg in 2008. The corresponding value among all countries as a whole is also less than one-half of that for Iran (UN data, 2008).

Oil products, natural gas and electricity respectively account for 46.2%, 44.6% and 8.6% of total energy consumption in the country. The corresponding figures for transportation system and industrial activities are 26.5% and 22.1% respectively. The households, public sector, as well as business services consume 36.8% of energy in total, and 3.7% is devoted to the agriculture sector (Iran's Energy Balance, 2009).

As the Iranian government is facing greater challenges from the financial burden of the energy subsidies and pollutant emissions, energy subsidies have become a matter of great debate. The government has recently commenced reforming the energy subsidy system and redistributing it as a part of the STP. Two options are likely to be chosen for the additional revenue received by the government. The first choice is to redistribute it back to all households in equal absolute amounts similar to that assumed by Jensen and Tarr (2003). Another option is to redistribute the revenue based on the STP. According to the STP, 50% of the additional revenue is assumed to be received by the household in equal absolute amount and 30% transferred to producers as production subsidy. These options are respectively called hereafter *Complete Payment* (CP) and *Half Payment* (HP) scenarios.

Regarding the wide range of the energy subsidies and dependence of activities on low price energy, cutting energy subsidies is expected to exert some vague impacts on economic and environmental variables.

[2] This program was passed on February, 2010 by the Iranian Guard Council and it was started to perform from 2011. As a main part of this program it was supposed to eliminate petroleum product subsidies gradually. It was also supposed to transfer the subsidy revenue back to the households in equal amounts. This is examined in this study. However, it is important to note that the program failed to be performed completely since it faced some problems.

[3] IEA projections are derived from application of IEA's large-scale World Energy Model.

[4] Energy product prices are initially subsidized by the government such that the price to domestic consumers is fixed. Domestic consumers include both producers who use energy products as intermediate input in production process and consumers who demand it for final consumption. In the same way, energy subsidy elimination implies that subsidy will be abolished for these two groups.

[5] The eight non-OECD countries are China, India, Indonesia, Iran, Kazakhstan, Russia, South Africa and Venezuela.