



# The welfare effects of energy price changes due to energy market reform in Mexico

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## ABSTRACT

Despite being a large energy producer and exporter, Mexico may soon become a net total energy importer due to a decline in oil reserves and increasing domestic consumption. To increase efficiency in the energy market, Mexican authorities approved a constitutional amendment aiming to open the state-run energy markets to competition in 2013. The reform is expected to raise efficiency and to lower energy prices in the long run. However, it will take some time for the new institutional arrangements to settle and the reform objectives to materialize. The removal of subsidies, which is expected to take place after the reform, will also raise prices particularly in the short run. In this paper, we analyze the effect of likely energy price changes due to energy market reform on household consumption and welfare in different income groups. We estimate the QUAIDS model using the nonlinear SURE method and the Mexican household budget surveys for the period 2002–2012 to obtain elasticities. The results show great heterogeneity in elasticities across energy types and income groups. Specifically, energy demand is elastic with respect to income, but changes in prices have mixed effects among energy types. The welfare effect of the price changes on low-income households will be 9 times stronger than that on the mid-income households and 18 times on and the high-income households. This warrants a compensation package to make the reform socially acceptable.

## 1. Introduction

Historically, Mexico has been one of the important players in the international energy markets. The country is currently the world's 10th largest oil producer and the 3rd largest oil exporter in the Americas (EIA, 2016). Oil and gas account for 15% of the Mexican exports, about 40% of the government's revenue, and 7.3% of GDP (INEGI, 2013). Yet Mexico may soon become a net total energy importer. The combination of lower production and higher consumption as well as the recent oil price fall has caused the energy trade balance of Mexico to decline from \$25 billion in 2011 to only \$325 million in 2015 (IEA, 2016). More specifically, oil production has declined to levels observed in the 1980s after peaking in 2004, and natural gas production has also declined since its peak in 2010 (EIA, 2016). At the same time, total primary energy consumption has increased, on average, by 3% per year over the past three decades (Fig. 1).

The increasing inefficiency of the state-run oil company, its lack of investment towards improving the existing fields and increasing the

production capacity, and falling oil and gas prices have all contributed to declining production in recent years. The important driving forces behind the increase in energy consumption are economic growth and population and car fleet increases at the annual rate of 2.5%, 2% and 5%, respectively (SENER, 2013; INEGI, 2015). However, high levels of energy subsidies have also contributed to increasing energy consumption. According to the International Energy Agency (IEA, 2014), the value of the subsidies in 2013 was about \$11 billion and on average 1.8% of GDP spent on subsidies between 2006 and 2012 (Valdivia de Richter, 2013; Scott, 2014). The energy subsidies, intended to help industrial development and increase energy access by the poor, have also led to adverse outcomes on productivity, social spending, income distribution, and environment (Bella et al., 2015). In spite of availability of cheap energy for business activities, labour productivity in Mexico has grown only 2.1% for the period 1992–2009, which is far below economic growth in other emerging economies. The subsidized gasoline has also led to a rapid increase in personal car use rather than the expansion of public transportation in large cities, contributing to

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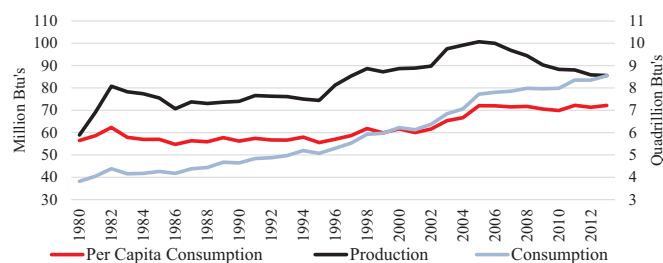


Fig. 1. Primary energy production & consumption in Mexico.

congestions, GHG emission and health problems.<sup>1</sup> The energy subsidies, which mostly benefit the rich because they use more energy,<sup>2</sup> have also taken away resources from social programs, which mostly benefit the poor. For instance, in 2012, the gasoline consumption subsidy was greater than the health expenditure of Mexican Social Security Institute and the main public poverty reduction program called Oportunidades (Scott, 2014, Parker and Todd, 2017). The nation-wide electricity subsidies, which have been on average 0.7% of GDP also benefits the rich disproportionately, as they spend about three times more on electricity than the poor (Table 1).

Since 1938, the state has been controlling the energy markets through the national oil company, *Petróleos Mexicanos* (PEMEX), the only firm with the right to produce and distribute hydrocarbon resources. The state utility company, *Comisión Federal de Electricidad* (CFE) has also been a monopoly in the power industry for an extended period. However, the new conditions, including a shortfall of public funds for investment in existing and new energy projects, low efficiencies, increasing energy consumption and growing environmental concerns have led the government to undertake major reform in the energy sector. In December 2013, Mexican authorities approved a constitutional amendment aiming to open the energy markets to competition (EIA, 2016). This will allow private firms to compete against the state companies for the production, distribution, and retail of energy.

The long-term impact of the Mexican energy reform will most likely increase efficiency and lower prices under proper institutional design. However, given the long-lived monopoly structure of the energy markets and the less-developed financial and credit markets in Mexico, it will most likely take some time for the new institutional arrangements to settle and the reform objectives of higher efficiency and lower prices to materialize.<sup>3</sup> New economic conditions such as the recent depreciation of the peso, falling oil and gas prices and slower local and global economic growth have also reduced investments in the oil and gas sectors, creating new challenges for the reform.<sup>4</sup> Furthermore, the removal of subsidies, which is expected to take place after the market structure reform, will raise prices particularly in the short run. This will have adverse welfare effects especially on low-income households and make the reform less popular.<sup>5</sup>

The main objective of this study is to analyze the effect of likely changes in energy prices due to energy market reform on household

<sup>1</sup> Mexico City is one of the most pollutant cities in the world, ranking first in the America (WHO, 2017).

<sup>2</sup> The average car ownership ratio for households in Mexico is 0.43 with a great heterogeneity across income groups. The ratio is 0.2 for the low-income households, 0.39 mid-income households, and 0.7 high-income households (see Table 1).

<sup>3</sup> The domestic credit to private firms in Mexico was 31% of GDP in 2016, compared to 51% in India, 69% in Brazil and 157% in OECD countries on average (Vitor and Sheldahl-Thomason, 2017).

<sup>4</sup> The reform was designed when oil price was above \$100 and the Mexican economy was growing at 4% (Vitor and Sheldahl-Thomason, 2017). The value of the peso also fell to 21 pesos per dollar in 2016 from 14.7 pesos per dollar in 2014.

<sup>5</sup> The empirical evidence on the effect of energy market reform on energy prices is mixed. However, privatization in the energy market has led to higher prices even in the longer time period in many developing countries with poor institutional qualities and inefficient regulations (Jamab et al., 2017).

consumption and to provide insights on the changes in welfare in different income groups. Specifically, we estimate a household demand system for Mexico, using the QUAIDS model (Banks et al., 1997) to evaluate the potential impacts of the energy market reform on the Mexican household consumption and welfare. The data is from the Mexican household income-expenditure survey and the sample period spans 2002–2012 with over 100,000 observations that represent almost 30 million households.

The study analyzes five expenditure categories (food, electricity, natural gas, gasoline and other expenditures) and uses a non-Linear Seemingly Unrelated Regressions (NLSUR) estimator, which provides consistent and efficient estimates. The paper contributes to the literature by estimating price and income elasticities for different energy types and analyzing welfare effects of the energy market reform on households across the rural and urban areas and income groups.

The results show great heterogeneity in price and income elasticities across energy types and income groups. Specifically, energy demand is elastic with respect to income, but changes in prices have mixed effects among energy types. Changes in prices will have stronger welfare effects on low-income households but almost no effect on the middle and high-income households. The rest of the paper is organized as follows. Section 2 reviews the literature of energy demand studies in Mexico and presents the theoretical background for consumer demand analysis. Methodology is discussed in Section 3 and the data in Section 4. The estimation results are presented and discussed in Section 5 followed by concluding remarks in Section 6.

## 2. Review of the previous studies

Unlike the myriad energy demand studies in developed countries, the studies in developing countries, particularly those focusing on energy market reform, are limited (Jamab et al., 2017). The energy market reforms in developing countries, specially energy-rich countries, have been recently advocated by international organizations such as IMF, World Bank, and IEA and are considered an important policy agenda in those countries (IMF, 2008; World Bank, 2010; IEA, 2014). The main objective of the energy market reforms is to increase efficiency and to reduce the energy consumption growth, although the reforms have important implications for government budget, income distribution, and environmental quality as well (Clements et al., 2014). However, the focuses of the energy market reforms and the policy mechanisms vary across countries. Some countries, such as Iran, have focused on removing direct and indirect subsidies for different energy types, without making any substantial changes to the market structure and regulations (Moshiri, 2015). Other countries such as India, Brazil, and Mexico have introduced more ambitious plans to reform the energy market structure. These plans aim to enable a transition from the traditional state monopoly in the energy production and distribution to a more competitive market structure. Despite the differences just noted, all energy market reforms will have important implications on energy consumption and household welfare in developing countries, but those implications are not well-studied in the literature. In the recent survey on electricity sector reform in developing countries, Jamab et al. (2017) cite only a few country or regional level studies focusing on energy reforms and their effects on energy prices, efficiency, and welfare.

Most of the energy studies in Mexico are also outdated and focus on estimating income and price elasticities for a single fuel type using time series models. For instance, Berndt and Botero (1985) analyze the demand for energy in the Mexican transportation sector using a two-stage method, and Galindo (2005) uses a co-integration technique to estimate the short-run and long-run elasticities for different energy types using data from 1965 to 2001. Berndt and Samaniego (1984) also use time series and pooled regional data to estimate income elasticities for electricity using a two-equation system. Chang and Martínez-Chombo (2003) use a time varying co-integration approach with income, price

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