Energy Policy 62 (2013) 780–787

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Long-term fuel demand: Not only a matter of fuel price

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HIGHLIGHTS

- We estimate two models of motor fuel demand, one without and one with housing price.
- The model with housing price is more robust than the model with fuel price only.
- The housing price variable has a significant positive effect on fuel demand.
- Impact mechanism occurs through household location and spatial organization change.
- Combining spatial policy lowering housing price to carbon tax enhances fuel savings.

ARTICLE INFO

Article history:
Received 3 March 2012
Accepted 8 May 2013
Available online 15 August 2013

Keywords:
Energy use
Housing price
Spatial policy

ABSTRACT

This paper analyzes the non-energy determinants of transport-related fuel consumption and in particular investigates the role of housing price trajectories in driving long-run demand for motor fuel. To this aim it develops a dynamic modeling framework and takes the next step of testing it for cointegration. French data spanning fifty years up to 2009 are employed. It is found that when facing an increase of dwellings' real price, fuel demand remains stable in the short term whereas it increases significantly in the long term. Our results reflect the role of spatial organization in the formation of energy demand through the trade-off between housing prices and commuting costs. The modeling framework is then extended to assess the potential interest of combining housing policies aiming to drive down housing prices with carbon taxes so as to achieve a wide range of fuel demand reduction targets. It is shown that the relative contribution of housing policies increases with the degree of ambition of fuel consumption reduction targets.

1. Introduction

Conventional motor fuel accounts for 30% of world energy consumption and this share is expected to grow at a rate of 1.5% per year up to 2030, which in turn would cause transport-related CO_2 emissions to increase by 1.7% per year (IEA, 2008).[1] This is all the more challenging for tackling issues such as climate change or energy security as the wiggle room to curb these trends seems limited. On the supply side, petroleum-based motor fuels have a competitive advantage (tax excluded) over alternative fuels. On the demand side, a meta-analysis by Goodwin et al. (2004) conducted over 175 studies reports short-run and long-run income elasticity of motor fuel consumption to be respectively 0.40 and 1.00. Since it gives −0.25 and −0.60 for short-term and long-term price elasticity, respectively, it turns out that every doubling of income would require more than a threefold increase of fuel prices to stabilize motor fuel consumption, and a tenfold increase to halve it.

As it is standard in the literature on energy studies, these surveys relate the dynamics of fuel demand only to income and fuel price (like Akinboade et al. (2008) and Hughes et al. (2008) among many others) whereas they neglect the role of space-related determinants of the demand for mobility. These spatial determinants are discussed by urban economics (Alonso, 1964) and the new economic geography (Krugman, 1991) in terms of the trade-off between commuting and housing costs to explain individual location choice, which ultimately affects their mobility needs. But only a few papers in this literature address the dynamics of the energy demand (Brueckner and Fansler,

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[1] The motor fuel category that we consider includes conventional crude oil-based fuels for transportation, and notably gasoline and diesel oil. This holds throughout the paper, but is not repeated.

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http://dx.doi.org/10.1016/j.enpol.2013.05.021

1983; Glaeser et al., 2008; Ingram, 1998). Because of the compartmentalization of energy, transportation and urban economics, pointed out as early as 1993 by Hourcade (1993), a comprehensive analysis of the relation between housing prices, fuel prices, mobility and transport-related energy use is still lacking despite the recent development of new theoretical modeling frameworks (Grazi and Waisman, 2009; Gusdorf and Hallegatte, 2007).

Within this context, this paper presents an empirical analysis of the interplay between housing prices and fuel prices and its role in driving the dynamics of fuel consumption in France. It does so by employing data covering 50 years (1960–2009) from different data sources, which required harmonizing the datasets (Section 2). We then develop two separate models and test them over the cointegration method (Section 3) that allows for testing the existence of long-term equilibrium relationship between variables considered. The first model only accounts for income and energy prices while the second introduces the price of housing as a third explanatory variable. Then we interpret these results and use them to assess the differences between an energy policy constituted of fuel taxation only and policy packages that include housing-related measures to curtail dependence on motor fuels (Section 4).

2. Long-term perspective on past trends

The time series used in this paper cover the period from 1960 up to 2009. They have been built by harmonizing three primary datasets: (i) motor fuel consumption and prices of the various types of fuel given by the 'Comité Professionnel du Pétrole' (CPDP); (ii) real sale housing prices derived from annual national housing accounts of French Ministry of Housing; (iii) population, national aggregate income, service housing prices and consumer price index (CPI) provided by annual accounts of the 'Institut National de la Statistique et des Etudes Economiques' (INSEE).

We then recomposed trends in final household consumption of a composite fuel (in millions of cubic meters) that encompasses diesel, leaded gasoline and 95 and 98 unleaded gasoline.[2] The price of this composite fuel is calculated using data on the price of the different types of motor fuels and weighting them by their market share at each point in time. As for the housing prices, we used two variables: (i) sale prices; and (ii) service prices which include all housing related expenses—rent or imputed rent for owner-occupied housing, and housing operating costs. All the prices are nominal prices deflated by the Consumer Price Index (CPI), using 2000 as the reference year. Fig. 1 displays the resulting fuel and housing price variation over the period 1960–2009. The revealed trends are discussed in the two following sub-sections.

2.1. Underlying causes of the ups and downs of fuel price

The graphical analysis of Fig. 1 shows that the composite fuel price steadily decreased between 1960 and 1973, increased after the oil shock, and stayed at a plateau up to 1986. All over the period, oil price accounted for 35–40% of fuel price, and fuel taxation between 50 and 55%, the remainder corresponding to transformation and distribution costs. Variations in the two former components of fuel price are the cause of the price decrease after 1986: first the counter shock in oil prices in the eighties induced a decrease in the oil cost component of fuel price; second the market penetration of less taxed fuels (diesel, unleaded gasoline) induced a decrease in the overall tax component of fuel price; third changes in the currency rate between dollar and euro/franc generally varied in advantage of euro/franc and, especially after 2003, contributed to contain the increase of the oil component of fuel price.

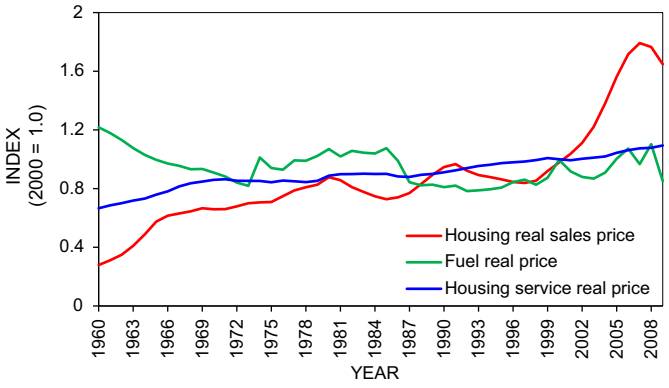

Fig. 1. Housing sales price, housing service price and fuel price (1960–2009).

2.2. Drivers of the evolution of the estate market

The two housing prices displayed in Fig. 1 reveal a steady increasing trend, with a very significant rise of sale prices after 2000. Actually this trend can be decomposed into three main periods. First, the rise in housing prices in the 1960's translated the scarcity of dwellings and triggered a wave of intensive construction which in turn slowed down this price increase. Second, the crash of the real estate market in Japan at the end of the 1980's induced an increase in capital flows invested in real estate markets throughout the world; part of it was invested in France, which contributed to maintain the raise of housing prices. Finally, after 2000, the worldwide housing bubble affected the French housing market, inducing another significant increase in prices. A stricter regulation of mortgage allowances in France than in other countries contained the raise of prices. But public economic actions to support the building sector since the 1990's promoted constructions that often failed to meet the demand in terms of location and dwelling quality and thus strengthened the soar in prices after 2000.

2.3. Overall dynamic and structural change in fuel demand

The relation between per capita income and fuel demand are far from being constant between 1960 and 2009. Hence we observed a steady increase of per capita disposable income over the overall period and fuel consumption showed a spectacular rise from 1960 to 1989, an almost stagnation between 1990 and 2003 and a decrease after that date. These evolutions are revealed in Fig. 2.

Over the first 30 years of the considered period, the rate of motorized households increased from 30.2% to 76.5% explaining the growing fuel consumption up to 1990 (Meot, 2009). The surprising stabilization in the absence of oil shock and the decrease after 2000 are easily explained by the time co-existence of three specific characteristics of the French context of this period:

- slowing down in the expansion of the automobile market which approached saturation: already 76.5 percent of households were motorized in 1990 and less than 5 percent more in 2000 (Meot, 2009);
- fast market penetration of diesel as revealed by the evolutions of the fuel market shares reported in Table 1. These shares

[2] Difference in fuel prices are mainly induced by difference in levels of French petroleum taxes according to the type of fuel considered. Historically, the tax was lower on unleaded gasoline and for long far lower on diesel. This difference in fuel tax and related price explains the rapid development of the diesel in France over the past twenty years.