Political Economy Obstacles to Fuel Taxation

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Abstract

Many studies have shown that fuel demand is quite elastic and that the best way to reduce fuel use (to reduce global warming) is by taxing fuel. Yet it seems almost impossible to do so, particularly in those countries with low prices and high demand. We show, by employing a Granger non-causality test using data on rich OECD countries, that the direction of causality is ambiguous. We find evidence that the causality runs from consumption to price rather than, or in addition to, the conventional causality from price to quantity. We believe that one of the reasons for this is that lobby groups influence the political decisions regarding taxation of gasoline consumption. Not only do low prices (low taxes) encourage high consumption but high levels of consumption also lead to considerable lobbying to defend those low prices (low taxes). Following our results we argue that it is essential to take into account the political environment as an important factor when designing environmental policy instruments such as gasoline taxes.

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1 Introduction

Global warming presents one of the major challenges when it comes to sustainable development. One difficult aspect is that effects and costs are unevenly distributed over time and space. There might be very significant damages in the distant future, particularly for people living in certain areas. One (but not necessarily the only) example is people living in lowland areas such as the Seychelles or, more dramatically, Bangladesh where flooding would affect many millions. The fact that there is a considerable distance in time and space does however not negate the fact that there is a clear connection between our use of fossil fuels and any ecosystem effects from increased ambient levels of carbon in the atmosphere.

One of the major sources of human-induced global warming is the use of fossil fuels in the transport sector. In the absence of a major breakthrough for non-fossil fuels, global warming must be dealt with by reduced consumption and as an economist it is natural to believe that this is most efficiently achieved by a higher user price. The US, with less than 5% of the World population, accounts for over 25% of crude oil consumption and more than two thirds of that consumption is by the transport sector. Many studies have shown that fuel demand is quite elastic in the long run and it is argued that the most efficient way to reduce fuel use (to reduce global warming) is by taxing fuel; see e.g. Dahl and Sterner (1991a and b) for an extensive overview.[1] The same tax would coincidentally reduce many other traffic-related externalities (but would

[1] Johansson and Schipper (1997) have looked in greater detail at the breakdown between responses in terms of kilometers driven and number and types of vehicles. In the transport economics literature, there has been more detailed work on the choice of travel mode, the complementarity of or substitutability between different modes of traffic in a city, and so forth. All of these have concluded that gasoline demand does have some degree of elasticity with respect to price.

however not generally be the most efficient way of dealing with these local externalities (European Commission COM(95)691).[2] Although fuel prices have been drastically increased in many countries, it is still difficult to increase gasoline taxes, particularly in those countries with low prices and high demand. The US consumer price of gasoline is about 30% of the European price and consumption of gasoline is about four times higher per capita than in Europe.[3] The US is in no way alone in having cheap fuel, but due to its size it is a good example. Other similar countries are Canada, Australia and many Third World oil-exporters such as Mexico, Nigeria or Saudi Arabia. Together these countries account for a dominant share of the global fuel consumption and the politics of fuel taxation (or other instruments intended to reduce fuel use) in these countries will thus be decisive for the implementation of global climate policies.

The former French foreign minister Jean-François Poncet was once quoted as having said: *"It's hard to take seriously that a nation has deep problems if they can be fixed with a 50-cent-a-gallon gasoline tax."* This statement captures the difference in political culture and perception of the problem across the Atlantic. It does however probably underestimate the underlying economic and political difficulties.[4] The purpose of this paper is to cast light on these difficulties of raising gasoline taxes by looking at the direction of causality in the relationship between gasoline taxes and gasoline demand. The conventional wisdom of studies on fuel demand is that higher taxes imply higher consumer prices, which

[2] Trading of carbon rights would in many respects have the same effect as carbon taxes: (fossil) fuels would become more expensive.

[3] The average price in the US 1999 was 0.3 \$/l while the average price in the major European economies (Germany, France, UK and Italy) was 0.99 \$/l (with purchasing power conversion of currencies). US gas consumption was 1,300 l/cap/yr compared to an average of 320 in the same group of major EU countries.

[4] Quoted in the Washington Post March 27, 1992.

imply lower demand. There is no doubt that this very intuitive result is, broadly speaking, true. Still, the measurement of the elasticities is complicated by the existence of long lags and other problems.[5] We want to point to an additional problem that affects both the estimation of elasticities and their interpretation and application in a policy context. Suppose that a high consumption level makes people adamant in resisting tax increases, and at lower consumption levels people encourage them – or at least find it easier to tolerate them. Part of what previously was estimated as demand elasticity would then in fact be confounded with a political tax response mechanism. In this paper we have chosen a parsimonious approach to the political economy of gasoline taxation. We use Granger non-causality tests to examine the strength of the forces that lead to low taxes in high consumption countries, and then proceed by testing our hypothesis in a simple political model of gasoline taxation.

This paper is organized as follows: First, obstacles to fuel taxation are discussed, and followed by a discussion of causality tests. We then carry out a test for causality and use the result to formulate a simple political taxation model by including consumption as a proxy for lobby strength. Finally, the results are interpreted and concluding remarks are made.

[5] The econometric studies that concentrate on long-run relationships using panel and cross-sectional country data tend to find price elasticities in the range of -0.8 and sometimes even greater than -1, while more short run studies find considerably lower values. Studies that attempt to capture the long run by using dynamic models with lag structure on time series data typically find intermediate values (Baltagi and Griffin, 1983). In comparison our data reflects a price elasticity of -1 (observe that this is the price elastictity for price one period lagged), estimated by a fixed effects model.

2 Obstacles to higher fuel taxes

As long as energy is a normal good (or factor of production) its demand will decrease as price increases. This in itself is sufficient to create the negative correlation that we normally identify as a demand elasticity. In this article we want to highlight factors that might provide an additional connection but with the opposite direction of causality; factors through which high fuel consumption leads to low taxes. In high-consumption countries the consumers own vehicles and property and have a lifestyle that hinges on high uses of fuel, and there is thus a perceived[6] risk of large losses from fuel taxes. A large number of businesses – from car producers to gas stations, from amusement and shopping centers to oil companies, etc., have interests in a society in which gas remains cheap. The employees of these institutions have the same interest to the extent that their job is dependent on the profit of their employer. Oil companies are generally recognized as a powerful lobby, and naturally oppose fuel taxes. The political representatives of all these people thus have a lot of popularity to gain from making the case against fuel taxes.

At the same time the people who would gain from higher taxes are either few or diffuse and unorginized, and thereby reducing the likelihood of forming such groups (Olson, 1965). To many laymen the very idea of any tax being "too low" may seem paradoxical. Some training in economics and general equilibrium thinking are necessary to realize that there is, at least notionally, an optimum level of each tax (Pigou, 1946). Tax rates above the optimum damage the economy, but so do tax rates below it – since they lead to sub-optimal levels of either public spending, budget deficits or taxation of other commodities. There are economic

[6] We say perceived loss since fuel taxes might well be a gain if general equilibrium effects are taken into account.

agents who directly gain from a fuel tax: On the one hand there are providers of alternative modes of transport who might gain from higher fuel taxes - conceivably those employed by, or with interests in, public transport, bicycles, etc. On the other hand, the general public may in principle gain from a better tax system and the resulting improvement in the allocation within the economy, but this is a very abstract concept and not likely to attract much support.[7]

One other important factor that deserves to be mentioned is population density. Few international studies of gasoline demand include this variable and it generally does not perform well statistically. One of the reasons for this is that the readily available measures of population density are defined over a whole nation's territory, while the most important determinant may be local densities within the relevant range of daily travel. Such a variable is however very hard to construct since it is partly endogenous. It is well known that most US cities have population densities that in fact are much lower than those in Europe. Cities with population densities around 10 persons/ha like Detroit[8] are not in the same situation as European cities like London or Paris with population densities in the 50-75 persons/ha range, not to mention many Asian cities with 100-500 persons/ha. It is not surprising that fuel consumption in the dispersed US cities, which often lack intensive public transport, is 4 times as high as in typical European cities. While a large

[7] Ironically, even the oil companies might benefit. In some high-tax countries like Norway, Sweden, Italy and Japan, the high taxes are combined with high pre-tax prices of gasoline. This seems odd (higher taxes should squeeze the margins of the oil companies) but a possible political explanation lies in an implicit acceptation of higher profits in exchange for high taxes. It is as if the environmental authorities are so keen on conservation that they accept high markups or other cartel behaviors from the fuel companies. Similarly one might imagine the oil companies not complaining too much about high taxes as long as their profit margins are not attacked. Thus, the politicians would in some sense be "sharing" the high rents caused by conservation with the fuel companies.

[8] Thomas Brinkhoff: City Population, http://www.citypopulation.de.

share of the difference is due to habits and vehicle characteristics that would adapt to changed fuel prices within 5-10 years, another large share is due to differences in urban architecture that would take considerably longer and be more painful to change. Therefore we focus, in this paper, on the lobby aspect of the possible “reversed” direction of causality.

2.1 The Economics of Lobbying

The main thrust of economic literature on policy making assumes an optimizing framework in which the government seeks to maximize social welfare while economists provide neutral, technical support to the calculations. True policies are however not necessarily designed to maximize welfare or GDP. In fact, such policies might even be rare outside the textbooks. Instead, real policies are presumably best seen as the result of a struggle between conflicting interests. Those who have a considerable stake in a particular policy may be willing to put considerable resources into lobbying. The gain to this group may in aggregate be small compared to the total loss to society from non-optimal policies, but the latter costs are borne by a much larger group of diverse people who find it difficult to organize themselves to further their interests.

There is growing literature that builds both on the realization of the fact that the entities threatened to be regulated can simply expend resources to influence policy decisions, and on the closely related notion that policy makers have interests of their own. One of the seminal articles in this area shows that economic interest groups can be successful by investing lobbying funds to influence the political process in their favor, and lobbying groups essentially seek to get advantageous trade policies passed, that tilt the relative prices in their favor (Grossman & Helpman, 1994). Another important contribution is Becker (1983) who sees competition among rival lobbies as a way of selecting efficient policy instruments.

Fredriksson (1997, 1998, 2001) and Aidt (1998) analyze lobbying in the area of environmental policymaking. Policymaking is not just the result of a neutral effort by the state to promote welfare; it also reflects the self-interest of some groups, and typically the most powerful, well established and concentrated groups will tend to have an advantage over other groups. Small numbers of polluters typically have more opportunity to band together as lobbyists than the much more numerous, dispersed and unorganized victims of pollution (Damania and Fredriksson 2000). One should however neither underestimate the capacity for NGOs to capture and represent the interests of these victims, nor forget the fact that there may be many "polluters" who are also unorganized and relatively powerless.

A large proportion of the articles on lobbying are concerned with the effect of lobbying on the political system or on trade related issues. The number of articles on taxation is more limited. Interesting exceptions include Doi et al. (2002) who study the choice between using increased tax revenues to either reduce the public debt or increase spending. Fredriksson and Gaston (1999) look at the role of trade unions as lobbyists and show that they can be in favor of eco-taxes for purely selfish labor-market reasons. Svendsen (1999) analyzes the distinct interests and preferences of environmentalists and of different categories of business (electricity producing and electricity consuming). All the strongest lobby groups in this study were found to prefer grandfathered permits to taxes.

In models of vote-maximization such as Hettich and Winer (1988), assumptions such that successful politicians will avoid over-taxing their voters are made. However, the state needs money and something has to be taxed, whether it is income, wealth, property or certain consumption goods. Clearly, consumers may resist any tax, and fuel taxes are likely to be resisted more if those who bear the greatest share have more political power than other groups. The political attitudes towards both mobility and environmental pollution may be decisive, and the costs and benefits depend, among other factors, on population density. Goel and Nelson (1998) is the only study, to our knowledge, that empirically studies the determination of fuel taxes within a vote-maximization framework. They find, consistent with Hettich and Winer (1988), that *nominal rates tend to be adjusted to inflation, and higher real (pre-tax) prices of gasoline lead to lower taxes.* Both these factors suggest that politicians "tend to seize the opportunity" to raise taxes whenever it is relatively easy – in these cases because the tax is masked either by the rise of other prices or by the fall in gas prices themselves. Their results also indicate that the presence of significant oil industries leads to lower gas taxes,that higher highway tolls are associated with lower taxes, that higher population densities appear to have resulted in higher taxes before 1981 and in lower taxes thereafter, and that higher compliance with environmental standards implies higher taxes. In the Empirical Results section below, we estimate a simple political model of gasoline taxation following from the work of Hettich and Winer (1988) and Goel and Nelson (1998).

3 Models of causality in the market for transport fuel

A full-scale model of the demand and supply of transport fuels is fairly large and difficult to estimate for a number of reasons. There are long time lags involved on both the supply and demand side. Energy demand and supply both require heavy capital with a long lifetime and with fairly fixed technology once it is in place. This creates inertia and long processes of adaptation to changing market conditions. Furthermore, there are complex patterns of joint production among the petroleum products and substitutability between these and other energy carriers. To build a model of energy taxation that takes lobbying properly into account requires a great deal of institutional knowledge of each specific country and time period. Both of these sets of models need to deal with highly imperfect competition and considerable power (economic and political) among the suppliers and perhaps among some of the consumers too. To build a joint model is beyond the scope of the present paper, in which we are merely paving the way for such future work by providing a measure of the relative strength of the different forces at play. We will however carry out causality tests – or more formally, Granger tests of non-causality – to ascertain the existence of a "political" effect of consumption levels on taxes.

One may see this as a simple means of testing our hypothesis on a strongly reduced form of the ideal model. There is a large body of literature that tests for causality among economic variables. A number of articles, such as Hooker (1996), Chang et al. (2001), Asafu-Adjaye (2000) and Stern (1993) test the directions of causality between energy variables (consumption or price levels) and a series of macroeconomic variables such as income, growth, employment or inflation. All these studies show that the energy variables can cause changes in the macroeconomic variables.

4 Data

For practical reasons (space and data availability) we have chosen the most parsimonious model, and data that is reasonable given our purpose.

We have restricted our sample to 22 rich OECD countries, as classified by the World Bank,[9] and have used data on price and tax (weighted price/tax of unleaded and leaded gasoline), total gasoline consumption (IEA, 1994, 1997, 1998, and 2000) and GDP (World Bank Indicators 2002) for 1978-2000 (when testing for causality we exclude 1978-1981 from the data due to the oil crisis). Prices, taxes and GDP series are adjusted for purchasing power.

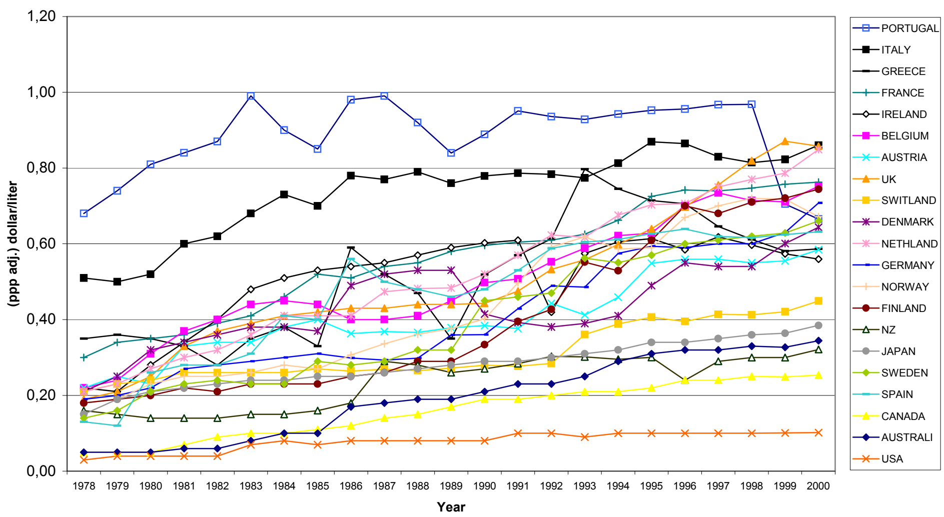

Figure 1. Tax on gasoline - development over time.

The development of gasoline taxes over time can be seen in Figure 1.[10] Almost all of them increased, except in Portugal where the tax varied,

[9] World Development Indicators (2002) in this category include Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and USA, of which we exclude Iceland due to lack of data, and Luxembourg due to its special character (Luxembourg has a large inflow of cars coming from adjacent countries to fill up with cheaper gasoline).

[10] The countries are listed in descending order according to initial tax in 1978. The initial taxes for the respective countries were: USA 0.03, Australia 0.05, Canada 0.05, Spain 0.13, Sweden 0.14, Japan 0.15, NZ 0.16, Finland 0.18, Norway 0.18, Germany 0.19, Netherlands 0.19, Denmark 0.21, Switzerland 0.21, UK 0.21, Austria 0.22, Belgium 0.22, Ireland 0.22, France 0.30, Greece 0.35, Italy 0.51, and Portugal 0.68.

although at very high levels (the highest in the sample, which of course is partly due to the purchasing power conversion). Italy is another high tax country, while the US had the lowest gasoline tax over time together with Canada and Australia. The corresponding consumption pattern (gasoline consumption as a share of GDP) decreased over time for all countries except Portugal and Greece (their consumptions as a share of GDP were fairly stable). Hence, the trend is an increasing gasoline tax over time, but the levels differ significantly among countries. We present the data on consumer prices and consumption levels in Figure 2 (summary statistics are provided in Table A1 of the Appendix).

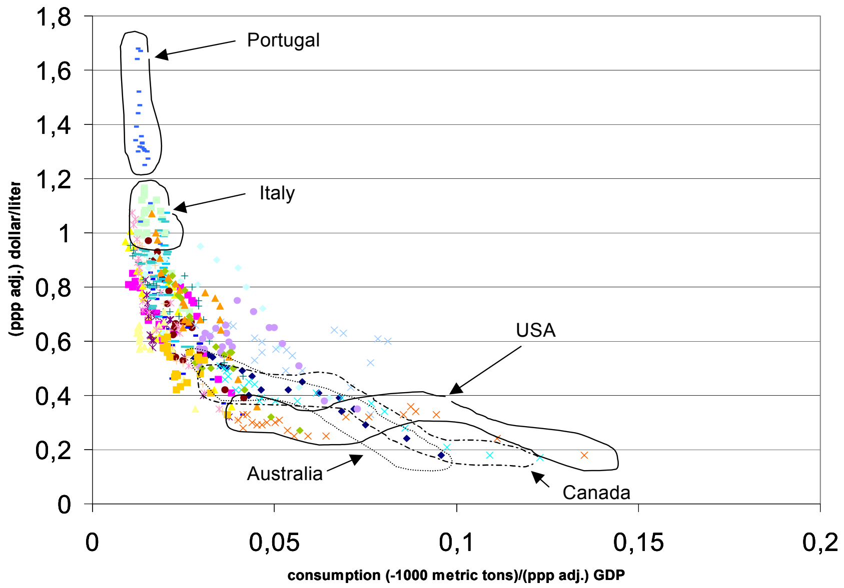

Figure 2. Consumption as share of GDP and price of gasoline (1978-1999).

One attractive feature of Figure 2 is that it shows explicitly the connection - but also the distinction - between the cross-sectional and temporal dimensions of our data. For all the countries in our data set there is a general movement in our figure towards lower consumption intensities and higher prices. This is of course captured by the negative price elasticities in the time series data. A large part of the variation is however between countries, which implies that panel data analyses may give higher price elasticities (which is reflected in our data by a price elasticity of around minus one).

5 Empirical Results

5.1 Granger causality for gasoline consumption

The Granger non-causality tests are based on the simple notion that cause precedes effect. The reason the tests are referred to as non-causality tests is that non-causality is the only hypothesis possible to test in an econometric framework (see Bishop, 1979; Kennedy, 1992; and Greene, 1993). This is also the reason that we refer to *Granger-causing*, rather than just causing.

The Granger non-causality tests are based upon Granger's (1969) original idea that a necessary condition for causality is that the *lagged* parameter of the independent variable must be able to predict the current dependent variable – measured by the significance of the parameter and whether adjusted R^2 increases when including the lagged value of the independent variable. The original Granger non-causality test was developed for time-series data. In this paper we use panel data, which complicates our econometric analysis (discussed further below). We estimate for the original Granger non-causality test Model (1) and (2), where i=country and t=year.

Q as dependent variable:

$$Q_{i,t} = \alpha_i + \beta_1 Q_{i,t-1} + \varepsilon_{i,t} \tag{1a}$$

$$Q_{i,t} = \alpha_i + \beta_1 Q_{i,t-1} + \beta_2 P_{i,t-1} + \varepsilon_{i,t} \tag{1b}$$

P as dependent variable:

$$P_{i,t} = \alpha_i + \beta_3 P_{i,t-1} + \varepsilon_{i,t} \tag{2a}$$

$$P_{i,t} = \alpha_i + \beta_3 P_{i,t-1} + \beta_4 Q_{i,t-1} + \varepsilon_{i,t} \tag{2b}$$

In Models (1) and (2) we analyze the causal relationship between the price of gasoline (P) and the specific consumption of gasoline (Q). The specific consumption of gasoline Q is defined as gasoline consumption divided by income, $Q = G/Y$. In most models of the market for transport fuel, demand is assumed to be a function of price and income, $G = f(Y, P)$. The models of Granger causality we are dealing with here are however difficult to estimate in a model with two right hand side variables, since the symmetry is then lost. Fortunately, we know from a very large number of studies that have been carried out, that the long-run income elasticities of gasoline demand are close to unity.[11] We have therefore assumed, for the sake of this test, that they are unitary, in which case the function $Q = G/Y = f(P)$ can serve as a reduced form of the true function $G = f(Y, P)$. Our model is thus one of demand intensity rather than of fuel demand *per se*, but if the assumption of unitary income elasticity is accepted then there is no important distinction between the two. All of the variables mentioned are in logarithms and the models are thus constant elasticity models.[12]

A necessary condition for Q (or P) to cause P (or Q) is that lagged values of the independent variable Q (or P) must be able to predict P (or Q), i.e. that the parameters are significantly different from zero. From the tests we can conclude that *(i)* price Granger causes consumption, *(ii)*

[11] See Dahl and Sterner (1991a and b) and Sterner and Franzén (1994).

[12] This is the most conventional assumption in fuel demand models as shown by the surveys mentioned above.

consumption Granger causes price, *(iii)* there is no causal relationship, or that *(iv)* a bi-directional relationship exists.

When estimating a dynamic panel (i.e. we have a lagged dependent variable on the right hand side), the estimators and significances are biased upwards (Verbeek, 2000). One way of dealing with such a problem is to estimate an instrumental variable for the lagged dependent variable. Following this, we have estimated two instrumental variables: one for lagged price, and one for lagged consumption.[13] Using this approach we "save" observations compared to estimating the instrumental variable as a function of the dependent variable two periods lagged.[14] The instrumental variable estimation yields consistent estimates, even though the estimates are not efficient (Baltagi, 2001). Using the instrumental variables, we estimate a fixed effects model.[15] We disregard the years 1978-1981, due to the special characteristics of that period (the oil crisis). The presented estimations do appear to have some autocorrelation, but given the purpose of this simple model (to get an indication of whether or not causality could run in the direction from consumption to price), we refrain from using more sophisticated econometric methods.[16] The development in recent literature on panel data using techniques from time series analysis is fairly limited. Problems concerning unit

[13] The instrumental variable for lagged price is estimated as a function of general taxes, specific taxes on services and goods, CPI, and a time trend. The instrumental variable for lagged consumption is estimated as a function of total amount of passenger cars, income and a time trend. (The tax data is collected from OECD, Revenue Statistics, Ed. 1999; and passenger cars from World Road Statistics 2000).

[14] Still, if the lagged dependent variable (one period) is estimated as a function of the dependent variable (two periods), then the estimates are roughly the same as when using the instrumental variables described in Footnote 14. Using the lagged dependent variable (two periods) as an instrumental variable yields a price elasticity equal to –0.92 for long run gasoline demand.

[15] Individual country intercepts are not presented in this article, but are available from authors upon request.

[16] The estimated autocorrelations of order one e(i,t) were: Model 1a): 0.47, 1b) 0.53; 2a) 0.71; 2b) 0.74. Values close to zero imply low autocorrelation.

roots, spurious regressions and cointegration could arise in panel data estimations, especially when data is available for long time series. Still, literature and tests for these problems are scarce (Verbeek, 2000). For a thorough overview of dynamic data models, see Baltagi (2001). The results are as follows (t-values are displayed in parentheses).

Price Granger causes Consumption:

$$
\begin{aligned}
Q_{i,t} &= \alpha_i + \underset{(7.29)}{0.57} Q^{iv}_{i,t-1} \\
Q_{i,t} &= \alpha_i + \underset{(6.01)}{0.48} Q^{iv}_{i,t-1} - \underset{-6.07}{0.52} P_{i,t-1}
\end{aligned}
$$

Consumption Granger causes Price:

$$
\begin{aligned}
P_{i,t} &= \alpha_i + \underset{(4.67)}{0.33} P^{iv}_{i,t-1} \\
P_{i,t} &= \alpha_i + \underset{(2.24)}{0.14} P^{iv}_{i,t-1} - \underset{-8.08}{0.26} Q_{i,t-1}
\end{aligned}
$$

Our results show that the conventional model cannot be rejected (that price causes consumption). There is however also evidence of the "reverse" causality, shown by the significant parameter on consumption. Furthermore, as can be seen we find an increase in adjusted R^2 in both models. The results thus point to a bi-directional relationship between gasoline price and gasoline consumption.

5.2 Political model of gasoline consumption

Since we have found indications that gasoline consumption Granger causes the price of gasoline and since taxes are the most obvious component of the price for this type of effect, it is natural to continue by investigating whether gasoline consumption is a determinant of gasoline taxation. Furthermore, given our descriptive and empirical evidence, we argue that consumption of gasoline could be used as a lobby indicator. Following the work by Hettich and Winer (1988) and Goel and Nelson (1998), we test the hypothesis that the tax on gasoline is dependent on the price of gasoline (net of tax), and add consumption of gasoline as a crude measure of lobbying (we also include a time trend). The Granger non-causality test indicates that price affects consumption, but also that consumption affects price. Following this, tax is not just a function of consumption, but consumption is also affected by taxation i.e. we have an endogeneity problem when including gasoline consumption as an explanatory variable for gasoline taxation. Therefore, we use the same approach as in the preceding section to estimate an instrumental variable for consumption (gasoline consumption is estimated as a function of number of passenger cars). Another way to deal with this would be to expand the analysis of lobby groups and the determinants of gasoline taxation by including population density, road tolls, oil refinery capacity, number of public buses, road expenditures and other variables that probably better reflect the power of lobby groups and political economy. This is left for future research.

The model is estimated as a panel with fixed effects, with ppp adjusted prices and taxes, which means that we do not include the possibility of "money illusion" (the specific country effects are available from the authors upon request, but they do not differ significantly from the results presented here). The model to be estimated is (all the variables mentioned are in logarithms, except years):

$$Tax_{i,t} = \alpha_i + \beta_5 (net\ price)_{i,t} + \beta_6 (gasoline\ consumption)_{i,t} + \beta_7 (year) + \varepsilon_{i,t}.$$

Note that the consumption variable is consumption per capita.

Our results are as follows:

$$Tax_{i,t} = \alpha_i \underset{(-1.48)}{-0.73}(net\ price)_{i,t} \underset{(-7.82)}{-0.97}(gasoline\ consumption)_{i,t} \underset{(24.57)}{+0.62}(year).$$

The estimation results[17] show that net price has a negative effect on tax. This lends support to the hypothesis that policy makers raise taxes "opportunistically" in moments when prices (net or World Market) fall, and that they tend to appease protests against high fuel prices by lowering taxes when net prices rise. Of particular interest for this paper is the fact that consumption of gasoline has a negative significant effect on gasoline tax for all countries, i.e. the higher the consumption, the lower the gasoline tax. Since we are interpreting consumption as a proxy for lobbying, this again lends some support to the notion that higher (lower) levels of consumption lead to more lobbying in favor of lower (higher) taxes, and thus, to some extent the policies become self-reinforcing since higher (lower) consumption leads to lower (higher) taxes, lower (higher) prices and higher (lower) consumption.

6 Interpretation and discussion

The US (together with Australia and Canada) has a very high consumption (relative consumption intensity) per capita together with low fuel prices. This suggests that the most efficient strategy for improving fuel efficiency, and at least for reducing carbon emissions, would be to increase fuel prices in these countries. Yet after all these studies, a number of attempts to increase gas taxes in the US and oil taxes at a general level in the EU, have failed. One should also note that a country such

[17] Adjusted R-square=0.94, and the estimated autocorrelation of order one e(i,t)=0.74.

as the US indeed experienced very significant reductions in fuel intensity during the observed period. The reason is that the fuel efficiency of US vehicles were influenced by many factors. In addition to actual local prices, there are the "expected prices" which were very significant, at least during the oil crises of the 1970s. International prices may also have affected the development of more energy efficient engine technology, and finally, some quite severe regulatory measures and other policy instruments such as the CAFÉ standards and the fines for manufacturers, have also helped reduce fuel use by the US vehicle stock.

It is, however, still true that US gas consumption is high and it is natural and quite well known that there is quite a vociferous popular opinion against fuel taxes. We have mentioned a number of factors that are probably important in this context: the overall negative attitude to "big government" and taxation, the existence of strong automobile and oil industry lobbies and the low population densities of many regions making long distance commuting common even at the "local" level. The fact that public transport is less common is related to this low density and serves as both a cause and an effect of the dominance of the private car. This is self-reinforcing since the small number of people traveling by and working in public transport leads to weak lobbies and opinions in favor of public transport. Since the private automobile is such a necessity and public transport sometimes is unavailable, it is likely that the US is one of the countries where fuel taxation is somewhat regressive[18] which of course makes many politicians wary about the issue.

[18] According to Poterba (1991) it is regressive in the US although this has been criticized by Chernick and Reschovsky (1997) who show that there is almost no regressivity even in the US if expenditure rather than income data are used. In addition, a full analysis should consider the fact that it is frequently the poor who are more affected by the pollution such as smog since they tend to have less means of self-protection (medical expenditures and screening, choice of domicile in areas with cleaner air, etc.).

In countries such as Italy and Portugal however, the balance of interests may be rather different. For example, there is little oil production in Italy itself. A reasonable strategy to keep oil imports down is to conserve energy by raising its price. The fact that this strategy happens to derail some of the resource rent from foreign producers to the national treasury can hardly be a problem. Most motorists have smaller vehicles and live closer to their jobs compared to the US. They have had high fuel prices for a very long time and have adapted accordingly,and therefore have not much to lose from even higher taxes. Furthermore, the owners, employees and subcontractors of Fiat should know that the market share of the small Fiats depends positively on high fuel prices. The employees of the public transport sector benefit as well. In Italy, income taxes have proven notoriously difficult to collect, and this is perhaps the real, pragmatic reason for high gasoline taxes. Gasoline has to be controlled anyhow (since it is flammable, etc.) making gas taxes an easy and important source of tax revenue for the state. Thus implicitly, anyone who feels that the state needs its revenues - either because they appreciate the state's services or maybe bacause they are employed by the state - may feel some degree of understanding if not sympathy for the fuel taxes.

The tradition of earmarking gas taxes is also quite distinct in different countries and probably influences the support for or opposition against a tax. In the US most fuel taxes are in fact earmarked for highway construction. This may appear odd to economists used to preaching the virtues of not earmarking, but has general political support in the US. In the UK efforts to "hypothecate" the petrol taxes are regularly vilified, and in France too, the principal of the unified budget has dominated political and economic thinking[19] and the ministry of finance regularly uses transport related taxes for other purposes. In the US when Nixon sought to impound some highway funds in 1972, the states challenged this in a lawsuit and won.[20] Two years later Congress enacted legislation forbidding such impoundments.

It is common that countries with important auto manufacturing firms like the USA, Germany, France, Italy, Sweden and the UK have low or zero excise taxes on motor vehicles, while countries like Denmark, Finland, Greece, Ireland, and Portugal that lack such industries have very sizeable excise taxes (e. g. a 100% or more tax in Denmark and Finland). We find a similar, strong variation in yearly registration fees. One of the strongest lobbying groups is the auto industry, and of course in countries where registration fees are low and the number of vehicle owners is large they are even stronger. In the countries lacking a vehicle industry and where prohibitive vehicle taxes restrict the number of vehicle owners, the lobby is weaker. Presumably this means that the demand for public transport is higher, and that also has consequences.

The empirical evidence shows the relevance of looking into the political features of gasoline pricing in more detail than has previously been done. Naturally, there is simultaneity in the determination of price and consumption of any good, and the parsimonious approach chosen in this paper does not do this fact sufficient justice. Acknowledging the shortcomings of our model and the Granger-test, we still argue that by using non-causality tests, we have provided new evidence of the rationale and importance of studying the political environment in the taxation of gasoline.

The conventional wisdom of the hundreds of studies on fuel demand

[19] See Hayward (1983), Dunn(1981) and Nivola and Crandall (1995).

[20] State Highway Commission of Missouri v. Volpe (1973).

is that demand is driven by prices which in turn are driven by politically decided taxes together with international oil prices, both of which can be treated as exogenous. Our results have a number of consequences both for the way we ought to model fuel demand and for the political economy of instrument design in the area of vehicle fuels. Our empirical results indicate that standard demand theory is not sufficient for insightful policy making.

What conclusions are we to draw from this that might also apply in more general terms to a number of other areas of environmental and energy policy? Clearly the fuel market has both a demand side and a supply side. The supply side is technically and politically complicated as we have mentioned, and on top of this we are now arguing that there is most likely a politically and endogenously determined tax rate. The ideal would perhaps be to model this as a joint political-economical supply and demand model, which may be a goal for future research. Our results suggests that the cross-sectional studies, which provide the highest price elasticity estimates, might be somewhat overstated. The conclusion of this would not be that demand is inelastic, but just that it might be a little less elastic than some of the cross-sectional data suggests. Furthermore, taking the endogeneity of the tax rate into account would help reconcile the cross-sectional evidence with the time series evidence mentioned earlier.

Unfortunately, our results also imply that we are beginning to understand the difficulties of implementing higher gasoline taxes in those countries where they are most needed – the countries with high consumptions. However, small tax increases in these countries have two positive effects: First, through the demand side, even though they are small they cause some demand side response. Second, they may actually weaken the resistance to future increases in tax by starting to build some form of constituency supporting higher prices, and by weakening those who are very heavily dependent on low fuel prices.

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7 Appendix

Table A1. Summary statistics.

	Mean	Std.Dev.	Skewness	Kurtosis	Minimum	Maximum
Data used in testing for casuality (Years 1982-1999)						
Price* (ppp adj.) dollar/litre	0.73	0.25	0.80	4.44	0.25	1.68
Consumption of gasoline (-000 metric tons)	23510.9	64240.5	4.12	18.52	810	348715
GDP (ppp adj. Dollars, 10^{11})	7.27	13.35	3.54	16.68	0.1	84.27
Number of observations						357
Data used in "political model" (Years 1978-1999)						
Tax* (ppp adj.) dollar/litre	0.44	0.22	0.41	2.60	0.04	0.99
Net price* (ppp adj.) dollar/litre	0.28	0.10	2.12	9.18	0.15	0.79
Number of observations	388					

*All prices and taxes are weighted using the consumption shares for leaded and unleaded gasoline.