The complementary use of qualitative and quantitative methods in the assessment of public policies: France's environmental bonus/malus programme

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ABSTRACT

In 2008 France's environmental bonus/malus programme was applied for the first time to passenger vehicles. The programme consists of a credit for vehicles with low CO_2 emissions coupled with a tax on those with high CO_2 emissions. The amount of the credit or tax varies with the vehicle's CO_2 emissions. The scheme is calibrated to ensure that the credits are funded by revenue from the tax; as a result, in theory the programme has no impact on public finances.

The ex-ante and ex-post assessments that were made and continue to be made for the various bonus/malus schemes combine both quantitative and qualitative assessments. In this paper, we analyse the relationship between these two primary methods in the case of the bonus/malus for passenger vehicles. We will show that both methods, when applied to the passenger vehicle bonus/malus programme, provide highly complementary contributions to an assessment of the programme. For instance, quantitative methods (economic models and econometrics) are helpful in calibrating the scheme, evaluating its efficiency (its cost-effectiveness in particular) and proposing adjustments. Qualitative methods (qualitative interviews) are useful for profiling a buyer's decision-making process and perceptions (especially with regard to the respective contributions of environmental awareness and price data), and for improving the communications strategy or even the economic models.

Introduction

France's bonus/malus programme for automobiles, which came into effect at the start of 2008, was probably one of the firsts of its kind. It involves a bonus (credit) for the purchase of new vehicles that generate low levels of CO_2 and a malus (tax) on the purchase of high-emission vehicles. There is also a middle category of CO_2 emissions defined as neutral (neither bonus nor malus). The innovative nature of the scheme derives from the combination of a credit and a tax and the fact that the programme should normally be calibrated to ensure that the credits paid out are offset by the tax revenue generated; in other words, the programme should be revenue-neutral for the government. Having played a critical role in the programme's development, ADEME continues to monitor its progress and is currently considering the possibility of extending it to other product families.

Several assessments of the system have been conducted, yielding a bounty of information. First, the programme was examined from a quantitative standpoint both prior to its adoption (the economic model for sales trends) and subsequently. In addition, a qualitative survey was performed in early 2009 to enhance our insight. The purpose of this article is to show how these various assessments can mutually shed light on the programme's effectiveness and efficiency, as well as its impact and its limitations.

After a technical description of the programme, the various assessment methodologies used will be presented, along with their principal results. A summary of the various approaches and the lessons gained from each will show how they can prove mutually enhancing.

Description of the public policy initiatives described in this article

Vehicle bonus/malus programme

The bonus/malus programme was created by France's decree 2007/1873 of 26 December 2007 and implemented in January 2008. The principle behind the bonus/malus programme is to group new vehicles on the market by category of CO_2 emissions, corresponding roughly to the European Union's energy label. The French government offers a bonus (credit) for the purchase of low-emission vehicles; the amount of the credit increases as the vehicle's level of emissions decreases. Similarly, the government assesses a malus (tax), gradually incremented as CO_2 emissions increase, on the purchase of high-emission vehicles. Between these two categories there is a third group of neutral vehicles, those that entail neither a credit nor a tax. The aim is to calculate the system to ensure that the credits paid out are offset by the taxes collected: the programme should be revenue-neutral for the government.

In practical terms, the credits are paid by a special government body (the *Agence de Services et de Paiement)* after the vehicle is purchased, on the basis of supporting documentation, either to the purchaser or (as is more common) to the seller, if he or she advanced the amount of the credit. The tax is collected from buyers when they register their vehicle (added on to the registration fee).

Under the original legislation, the initial rate was to be incremented by 5 gCO_2 at the start of both 2010 and 2012 (i.e., every two years), in tandem with advances in technology. However, in light of the programme's significant budget deficit (too many credits paid out in relation to the tax collected), the level of the bonuses was also adjusted from 1st January 2010 (Table 1).

Scrapping bonus

From 2009, the bonus/malus programme cannot be considered in isolation from the scrapping bonus programme adopted in 2009 to boost production by carmakers in the face of the economic crisis. The scrapping bonus, established under France's decree 2009/66 of 19 January 2009, is paid to any purchaser of a new vehicle that emits less than 160 gCO_2/km (i.e., vehicles in the bonus and neutral categories of the bonus/malus programme) who turns in a vehicle that is at least 10 years old. Unlike other countries (Germany, the US), there is no limit on the number of participants. The amount of the bonus in 2009 was 1000 euros; it was reduced to 700 euros for the first half of 2010 and 500 euros for the second half. Beyond its economic effect (sustaining demand for cars) the scrapping bonus programme also has a significant environmental impact: especially the emission of local pollutants is decreased by shifting from an old vehicle to a new one.

Table 1. Vehicle bonus/malus rate based on CO_2 emissions level

Energy class	Emissions bracket (gCO2/km)	2008 bonus/malus	2010 bonus/malus	2008 Market share
A	Emissions rate ≤ 60	-5000	-5000	
A	60 < emissions rate ≤ 90	-1000	-1000	
A	90 < emissions rate ≤ 95	-1000	-1000	
A	95 < emissions rate ≤ 100	-1000	-500	0.00%
B	100 < emissions rate ≤ 105	-700	-500	
B	105 < emissions rate ≤ 110	-700	-500	
B	110 < emissions rate ≤ 115	-700	-500	
B	115 < emissions rate ≤ 120	-700	-100	35%
C	120 < emissions rate ≤ 125	-200	-100	
C	125 < emissions rate ≤ 130	-200	0	
C	130 < emissions rate ≤ 140	0	0	28%
D	140 < emissions rate ≤ 150	0	0	
D	150 < emissions rate ≤ 155	0	0	
D	155 < emissions rate ≤ 160	0	200	23%
E	160 < emissions rate ≤ 165	200	750	
E	165 < emissions rate ≤ 190	750	750	
E	190 < emissions rate ≤ 195	750	750	
E	195 < emissions rate ≤ 200	750	1600	11%
F	200 < emissions rate ≤ 240	1600	1600	
F	240 < emissions rate ≤ 245	1600	1600	
F	245 < emissions rate ≤ 250	1600	2600	2%
G	250 < emissions rate	2600	2600	1%

Quantitative assessments

Quantitative assessments of the bonus/malus programme were made both before and after its implementation. The programme was initially calibrated in late 2007 using a preliminary version of the economic model for ex-ante assessment that we describe below (see Callonnec & Sannié 2009), although the level of the bonuses and maluses that was finally chosen at the political level did not match the recommendations of the economic analysis. In addition, ex-post assessments have been conducted on a regular basis; in particular we should cite the very comprehensive assessment conducted by the Economics, Evaluation and Integration of Sustainable Development Service of France's Ministry of Ecology, Energy, Sustainable Development and Maritime Affairs (MEEDDM/SEEIDD 2009). With the aim of presenting the current state of the art in evaluations of the bonus/malus programme, we begin with a description of the ex-post assessment of the measure and then go on with the description of the last ex-ante assessment model currently available, which was continuously improved by its initial author; this ex-ante assessment provided the basis for the most recent legislative revisions implemented in January 2010.

Ex-post quantitative assessment: impact on the energy efficiency of new vehicles, the translation into environmental impact and overall socio-economic impact

In its first year, the bonus/malus programme had a very clear impact on the distribution of new vehicle sales among the various categories (Figure 1). As it was implemented in January 2008 but announced from December 2007 the level of sales of higher-emission vehicles increased dramatically in December 2007. In 2008 (the first year of the programme) however, sales of new Class B vehicles rose from 20% to 35% of the total, at the expense of Class C vehicles (which fell 2% from 30% to 28%, deviating from an average annual upward trend of 2% in previous years) and especially Class E and F vehicles (whose sales declined 7% for Class E and were halved for Class F). While the transition from Class C to Class B vehicles, for example, could certainly be the result of marginal adaptations made by carmakers on the vehicles they sell (e.g., the elimination of certain options or alternate configurations), the impact on new-model energy efficiency was real: average unit emissions of new vehicles fell by 9.3 gCO_2/km, to 144 gCO_2/km in 2008, and half of this decline could be attributed to the bonus/malus programme (MEEDDM/SEEIDD 2009).

However, the move from taxable vehicles to neutral or credit-earning vehicles was such that for 2008, a programme that was projected to be revenue-neutral in fact ran a deficit of 235 million euros (and not all of those who were eligible for the credit claimed their bonus); the deficit for the first half of 2009 alone climbed to €300 million, excluding the scrapping bonus. Thus, the bonus/malus programme in fact represented a net subsidy for the purchase of smaller vehicles, and this outcome was somewhat contrary to the stated environmental goal. However, a portion of this subsidy was captured by the automobile manufacturers.

Despite this unforeseen deficit, and the growing use of diesel vehicles (which generate a higher volume of local pollutants but less CO_2), the overall environmental impact remains positive. Assuming a service life of 15 years and an average annual mileage of 13,000 km, the CO_2 emissions prevented by the improvement in energy efficiency of vehicles sold in 2008 amount to 1.8 million tonnes of carbon dioxide (MEEDDM/SEEIDD 2009). Using a pessimist hypothesis of 34,000 supplementary vehicles in 2008 due to the deficit (MEEDDM/SEEIDD 2009), these vehicles would have caused the emission of 1 million tonnes of carbon dioxide at most over a service life of 15 years. A complete socio-economic assessment of the programme (with monetization of environmental externalities) excluding the rebound effect yields a positive socio-economic impact of €140 million; the rebound effect (which is very difficult to calculate) could total €157 million (based on an elasticity of traffic with respect to price per km of -0.2, MEEDDM/SEEIDD 2009).

Figure 1: Change in market share among energy classes from 2004 to 2008 (source: ADEME)

Ex-ante quantitative assessment: projected changes in market share following a modification of the bonus/malus rate

The data collected in 2008 and the first half of 2009 made it possible to update the economic model used for conducting an ex-ante quantitative assessment of the programme. That model was originally calibrated in 2007 on the basis of data in the literature and expert assertions. A new calculation, based on observed trends in sales, was performed by Gaël Callonnec for the purpose of assessing the new bonus/malus rate that came in effect in January 2010. Beyond the fact that the level of the bonuses and maluses that was chosen at the political level did not match exactly the recommendations of the economic analysis for a balanced budget, it is striking to observe the discrepancy between the forecasts of the initial ex-ante models and market shares in 2008; this discrepancy could be the result of the increase in petrol prices, which at the time were treated as constant in the model (and explain 50% of the discrepancy); the start of the economic crisis; and the difficulty at that time in assessing the parameters for the model. In this report we will only consider the 2009 version of the model, which was used to evaluate the new rate for 2010.

Description of the model. The model used is the interclass switch model, previously described in (Callonnec & Sannié 2009). It was adapted for the purpose of simulating trends in the price of petrol as well as the impact from the scrapping bonus. Its primary constitutive hypotheses are as follows:

- Supply is independent from quantities.
- Demand for a given new vehicle varies solely on the basis of its total cost (purchase price, cost of use).
- Demand adapts to relative variations in total cost among emissions classes by shifting from one vehicle emissions class to another.
- Fluctuations in demand for a given vehicle in a given class are estimated on the basis of elasticity of total cost. This variation is allocated among adjacent classes using a decreasing spillover factor.
- Total vehicle demand, all classes combined, is affected only by price elasticity with respect to the scrapping bonus (to take into account the latter's substantial stimulus effect). In particular, the effect of a deficit or surplus of the programme on the total vehicle demand is not taken in account.

The principle behind the model consists of segmenting the market for passenger vehicles into CO_2 emissions classes of 5 gCO_2/km (this fine level of granulometry provides a means of assessing every conceivable bonus/malus rate) and modelling marginal shifts among adjacent or nearly adjacent classes following a change in price. The criterion for these shifts is the total cost of using the vehicle. The total cost considered for each emissions class includes the purchase price, to which is added the variation in price resulting from the bonus/malus and scrapping bonus programmes, and the actual net value of fuel expenses over the life of the vehicle. Fuel expenditures are estimated on the basis of a unique lifespan of 13 years and a unique average annual mileage for all vehicles of 13,000 km. The potential rebound effect (the increase in annual mileage for more fuel-efficient vehicles) is not taken into account.

The variation in total cost for a CO_2 emissions class for a given year with respect to the previous year (including modifications to the bonus/malus and the scrapping bonus) results in a variation in demand for that emissions class, with a given proportionality (elasticity) factor. A decline (or increase) in sales of the given class is then offset by an increase (or decline) in sales of lower (or higher) CO_2 emissions classes. This is justified by the fact that the total cost of a vehicle increases with CO_2 emissions classes. The spread of fluctuations in sales into adjacent classes is progressive and linearly decreasing (buyers show a preference for classes adjacent to the class whose price has changed).

At this stage, the model assumes that total sales volume, all classes combined, is not affected by relative variations in vehicle price, which at first glance seems justified with regard to the putatively revenue-neutral bonus/malus programme. However, the scrapping bonus has a significant impact on the total volume of vehicle sales. Consequently, the overall effect of the scrapping bonus on the market is taken into account as well, using the elasticity of total vehicle sales to the scrapping bonus programme (see below).

Source data. The market share data for each vehicle model comes from the *Comité des Constructeurs Français d'Automobiles* (CCFA). The pricing data (2009) was based on each car maker's list prices. The number of scrapping bonuses paid in the first half of 2009 was provided by France's Ministry of Finance, which also supplied the number of vehicles scrapped in return for payment of a green bonus. The windfall effect (that is, the number of scrapped vehicles that would have been scrapped in any case, without the programme) was estimated at 30% based on assessments and analyses of similar programmes in the past (under Edouard Balladur's government in 1994 and Alain Juppé's in 1996, MEDAD/SESP 2007), taking the nature of the current programme into account (e.g., its restrictions on the bonus and neutral categories so as to limit the windfall effect, the longer lifespan of the programme).

The average life expectancy of the vehicles and the average number of vehicle kilometres travelled were supplied by the Ministry of the Environment. In the absence of data on diesel or gasoline vehicle ownership, fuel consumption was deducted from CO_2 emissions using an average of CO_2 emissions per litre of diesel and petrol fuel, weighted according to their respective share of the market for new vehicles. The average price of fuel (diesel + petrol) was set at €1.1/L, consistent with market observations in 2008. The discount factor was set at 5%.

Elasticity of total vehicle sales with respect to the scrapping bonus was also calculated. This provides a link between total sales volumes in 2009 with and without the scrapping bonus (sales without the scrapping bonus were deducted from the assumed windfall effect).

Calibration of the model. The model was calibrated using the sales data from 2008 and the first half of 2009, provided by the CCFA, and manufacturer list prices. The variations in total cost include both incentive programmes (bonus-malus and scrapping bonus); the simulated variations in sales were for the period 2008-2009 and were subsequently compared with market data compiled for 2009. The parameters to be set were the price elasticity of demand for a given emissions class prior to substitution with an adjacent class (identical for all classes), the spread of fluctuations in sales for

one class into adjacent classes (one spread function for substitution with lower-emission vehicles and one spread function for substitution with higher-emission vehicles), and the distribution of the scrapping bonus among the various emissions classes (and thus its impact on average pricing).

Results of the model. The model was generated once for each successive year. The change from 2008 to 2009 was used to calibrate the model. The model could then be used to simulate the move from 2009 to 2010, with the variations in total cost between the years n-1 and n attributable to the incentive programmes as input data for each year, and the variations in market share between the years n-1 and n as output (Figure 2). The model yields robust results with regard to the price of fuels and the discount rate. It is more sensitive to price elasticity of demand for a given emissions class prior to substitution with an adjacent class and to the distribution of spillover into adjacent classes, parameters that were calibrated for the year 2009.

Figure 2 shows the simulation performed for 2010, reflecting modifications to the bonus/malus rate and the scrapping bonus programmes enacted in decree 2009-1581 of 18 December 2009. This simulation indicates that the reduction in the credit has a relatively limited effect on the programme's overall environmental impact while generating a budget deficit of "only" €150 million (compared to a deficit of €280 million, still according to the model, merely by adjusting the emissions figure by 5 grams, as envisioned in the initial decree 2007/1873 of 26 December 2007).

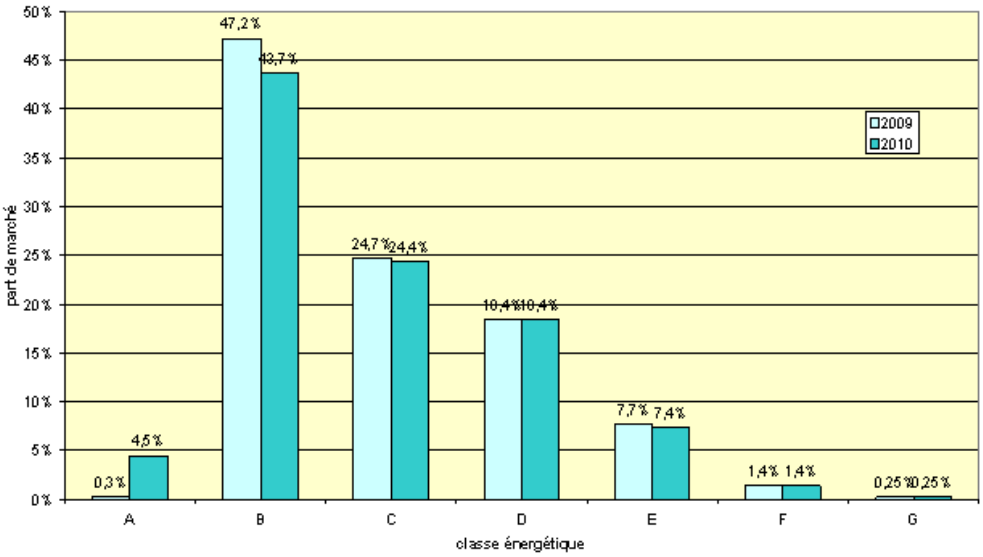

Figure 2: Simulated vehicle sales for each energy class in 2010, taking into account the reduction in the scrapping bonus and the modification to the bonus/malus rate enacted in decree 2009-1581 of 18 December 2009 (source: ADEME)

The qualitative assessment survey for the bonus/malus programme: a tool for measuring the programme's social impact

The qualitative assessment survey measures the results of the bonus/malus programme in terms of understanding, perception and impact on new vehicle purchases/requirements. The purpose of the study was to obtain qualitative feedback from both buyers and sellers regarding the bonus/malus programme at the time a vehicle is purchased:

- their understanding of the programme: the procedure used to calculate the amount, the connection with pollution and more specifically CO2 emissions, exacerbation of the greenhouse-gas effect and climate change;
- how they learned about it: for buyers, whether they were informed at the point of sale or beforehand (through what medium?); for sellers, what information they received and how they informed their customers about the programme;

- its impact: what role did the bonus/malus programme play in the choice of vehicle? Are the programme's benefits financial or environmental? How much weight do these benefits carry with respect to the other criteria for deciding on a purchase (notably the price of petrol) and, for sellers in particular, what influence has the programme had on sales?

Methodology for semi-structured interviews

The methodology used is based on the performance of a qualitative survey, i.e., the use of semi-directive individual interviews. This was found preferable to a methodology based on focus groups for two reasons.

First, with regard to purchasers, actual experiences differ quite substantially from one individual to another, depending on their level of knowledge about the issue, the model they purchased (whether it came with a credit, a tax or neither), the seller's sales pitch (sellers are often opportunistic and, logically, will tailor their talking points to the model sold). In this context, individual interviews are preferable to focus groups, since they allow researchers to obtain a more accurate sampling that reflects a range of circumstances. This provides a more complete picture of each individual's experience and a fuller understanding of the various scenarios.

Second, with regard to sellers, competition in the automotive market, plus geographical constraints, make individual interviews the method best suited for surveying sellers and compiling data.

Semi-structured interviews are among the most commonly used qualitative techniques. They can be used to focus the attention of interview subjects on the various topics defined in advance by the interviewers and enumerated in an interview guide. This type of interview provides a means of collecting a wealth of detailed information, thanks largely to the suggestive power of the interviewer's statements and the possibilities for follow-up and interaction in the communications between the interviewer and interviewee.

Interviews conducted for this survey

In the survey at hand, 30 individual, semi-directive interviews were performed during the months of January and February 2009[1] as shown in the following sampling.

- 20 interviews with recent car buyers (within the previous year), broken down further by the type of vehicle purchased and the vehicle's category within the bonus/malus programme (Table 2).

[1] In other words, the survey was conducted following a year (2008) in which petrol reached peak prices during the summer, and just a few months after the start of the "crisis". The bonus/malus programme had been in effect for one year.

Table 2. Breakdown of interviews among 20 purchasers

	Urban	**Compact**	**Touring car / minivan**	***Total***
Credit	3	3	X	*6*
Neither credit nor tax	3	2	3	*8*
Tax	X	3	3	*6*
Total	*6*	*8*	*6*	*20*

- 10 interviews with sellers selected on the basis of the brands sold and their occupation (dealer or sales representative, Table 3).

Table 3. Breakdown by brand for the 10 sellers selected:

	Dealer	**Sales Rep.**	***Total***
PSA	1	2	*3*
Renault	2	1	*3*
Foreign brands	3	1	*4*
Total	*6*	*4*	*10*

The interviews lasted approximately one hour. They were strictly confidential and were conducted in a variety of geographical regions: Lyon, Toulouse, Aix/Marseille, La Rochelle and Lille.

Interview guide

As noted above, the interviewers were provided with an interview guide. This serves as a written reminder of the interview for later use. It is prepared prior to the interview and includes a list of topics or aspects of a particular topic to be covered during the course of the interview. The topics are ordered in a sequence that foreshadows how the interview might play out, as part of a likely, logical progression.

At the start, this semi-directive interview will proceed in the same way as a non-structured interview, with an initial, very broad observation on a broad topic using a non-structured approach. Then each topic will be introduced in succession, this time in a more structured fashion. Once a new topic is broached, the interviewer switches once again to a non-structured technique.

The guide used in this survey is shown in Figure 3.

Brief overview of the interviewer, the study and the principles behind it ***(the study is described as a general study of vehicle purchases with no mention of the bonus/malus programme)***

1. Use made of the car and replacement interval

2. Motivation and vehicle considered prior to visiting the dealer

- **a) The "story" of the purchase**
- **b) Motivation with respect to the purchase of a new vehicle**

3. The purchase process and the vehicle purchased

- **a) Description of the visit / seller's sales pitch**
- **b) Final decision**

4. Focus on environmental criteria

- **a) Familiarity with environmental criteria before and after the purchase process**
- **b) Importance of these criteria in selecting a vehicle**
- **c) Familiarity with potential methods for evaluating these criteria**
- **d) Degree to which these criteria were actually taken into consideration at the time of the purchase**

5. Focus on the bonus/malus programme

- **a) Knowledge of the programme and the method used for calculation**
- **b) Objectives attributed to the programme**
- **c) Perception of the programme and its validity from a social and environmental perspective**
- **d) Impact on the choice of vehicle** ***(only for subjects who were aware of the programme prior to the purchase)***
- **e) Evaluation of the programme and priority areas for improvement**

6. Profile of the interview subject

- Age
- Profession
- Marital status
- Place of residence

Figure 3. Interview guide used for the evaluation of the bonus/malus programme.

The issue of the bonus/malus programme itself is not raised at the start of the interview. The challenge for the interviewer is to refrain from influencing the subject's opinion. If the study is presented to interview subjects at the outset as an evaluation of the programme, their tendency will be to overestimate its impact. In other words, their response will in most cases be guided by acceptable views of the bonus/malus programme, based on the broadest consensus within the community at large. This methodological point is especially important with regard to environmental issues that carry a very strong normative weight: members of the public find it difficult to assert that they are knowingly doing harm to the environment.

And the primary purpose of the survey is to measure the effect of the bonus/malus programme on actual decisions made by participants, not what can appropriately be said about it.

Processing of the data

The interview guides are designed to serve as uniform collections of information, organized in a sequence conducive to comparison.

The aim of the content analysis is to:

- isolate discrete thematic elements, identifying topics and subtopics;
- for each one, choose the keyword that best summarizes it;
- record the document's reference data;
- assign these extracts to the corresponding thematic categories.

These topics, identified and grouped, constitute an analytical grid. Two analytical methods can then be used:

- A horizontal analysis, i.e., a comparative analysis of the statements that fall within each topic. The extracts compiled within each category are compared in order to

identify similarities and differences, on the basis of which they are recompiled with the aim of defining types and typologies. This is the method that was used in this survey.

- A longitudinal analysis, by contrast, involves a comparative study of the sequential organization of each document: it investigates the path by which each interview proceeds, including the sequence in which topics arise and develop and lead from one to the next.

Results of the survey[2]

The measure's environmental component is not a factor in the purchase, but it does enter people's minds nonetheless.

No spontaneous suggestion that environmental considerations entered into the purchase of a car

Car buyers do not spontaneously cite environmental factors among their criteria in making a selection. Their decisions are based on several factors, primarily comfort, aesthetics, engine type and brand name, all of which are ultimately secondary to the end price. The price should also be understood in a broad sense: not only the purchase price, but also the operating cost.

"The decisive factor was the price and having the feeling of getting a good deal; these days people are watching their wallets; it's always the price, if you tell them about the features that set the car apart, it's always the price, even if it comes down to €100 you can lose the sale; even long-time Renault buyers made a decision based solely on price." a seller

"These days people think about how they use the car." a seller "It's the fuel consumption that's in people's minds." a seller

"With the price of fuel, people look at fuel consumption first and foremost and so they go straight away for a car that uses less; it's the fuel consumption that's in people's minds; first they go to look at the fuel consumption; what customers are interested in is the vehicle's fuel consumption, that, they're interested in!" a seller

Two factors distinguish buyers of credit-earning vehicles from buyers of vehicles subject to the tax: comfort with the vehicle engine and driving pleasure. Not surprisingly, buyers in the first group are much more indifferent to these two factors than buyers in the second group.

"To enjoy the car I need horsepower, torque..." a purchaser (M)

"I went from a 110hp to a 90hp...on the motorways, you can't go any faster, for 120 kph that's adequate" a purchaser (B); "I'm a laid-back driver, I don't need a powerful vehicle" a purchaser (B)

A growing level of concern about the environmental issue... the new focus on CO2 within society

When interview subjects are queried about the programme itself, it is clear that they have a fairly strong grasp of both the principle by which it assigns a credit or tax to the vehicle based on its CO_2 emissions, and its purpose in environmental terms: to combat climate change.

"It was established to get people more conscious of the environmental aspect, it helps to make us more aware" a purchaser (N)

"It should help raise public consciousness" a purchaser (M)

"That contributes to making people more aware" a purchaser (B)

Thus, even though the environmental element is absent when the purchasing decision is made, overridden by more important considerations, there is a growing awareness among the interview subjects of automobiles as a source of CO_2 emissions. As a result, it can be said that the programme has an educational benefit as well. Moreover, in some cases those who purchase cars that earn a credit congratulate themselves on the civic-mindedness they have shown with their purchase.

"Being green-minded really made me feel good; when I saw that it was a car that doesn't pollute, that was a bonus; I was pleased not to be polluting too much." a purchaser (B)

[2] Verbatim statements from the interviews are shown in italics. The letters B, N and M indicate whether the buyer purchased a bonus, neutral or malus vehicle respectively.

But take note of the rebound effect...

The credit also has the perverse effect of making buyers think that, if they buy a vehicle that comes with a subsidy, they won't be polluting at all!

> *"It means rewarding customers who will purchase a so-called non-polluting vehicle; you have the big 4x4s that pollute, they pay a surtax, and for the small cars that don't pollute, they're given a credit." a seller*

For dealers, the credit is a financial selling point that helps them close the sale of a small car.

The credit is a benefit that is incorporated into the sales pitch…

Given the typical practices of automotive sales representatives, constantly negotiating with buyers over the price, the existence of a credit, immediately equated with a price reduction, is seen as an additional asset in the dealer's favour in closing the sale. Although buyers are generally aware of the credit, it has become widely used among sellers as a selling point, one that can be coupled with other carmaker discounts.

> *"He was the one who told me about a credit." a buyer (B)*
> *"I only talk about it during the negotiations over the price, that's an important factor, that's all." a seller*
> *"He described it to me as an added bonus, he gave me the exact amount, that's all." a buyer (B)*
> *"I don't think he talked about a credit but rather a discount, it was grouped in with all the vendor discounts." a buyer (B)*
> *"He emphasized the 750-euro credit, I told him that didn't interest them...They pass that off as a discount so you won't ask for any other discounts." a buyer (B)*

…whereas the tax is attributed to the government or shunted aside until it's time to register the vehicle

For cars that are taxed, buyers and sellers alike gloss over the programme. Unlike the credit, which sellers routinely highlight, the tax is generally not paid as part of the sale. In these cases, sellers leave it up to the customers to register the vehicle, so as not to assume direct responsibility for the resulting cost.

> *"I knew that from the description but I didn't think it made sense that he didn't talk about it." a buyer (M)*
> *"No, since I didn't steer him towards that topic, he didn't want to go there." a buyer (M)*
> *"With that, you take a more cautious approach, you convey to them that it isn't the manufacturer, it's the government that's making you pay that." a seller*

The sales breakdown is changing and these changes are not winning unanimous support within the industry.

The desired effect, that of changing the market, is now being observed...

Dealers are selling more small cars and a relatively larger number of diesel models versus the equivalent gasoline models.

> *"They've been selling vehicles in smaller categories, more vehicles that qualify for the green credit, you see it with all the carmakers; the people who were driving with petrol now want diesel for the credit; Renault, Peugeot, Citroën are all selling a lot more small diesel cars, there are very few petrol models that come with a credit." a seller*
> *"It sometimes happens that they switch from a vehicle that doesn't get the credit to one that does, so as to pay less; I've seen that before, someone who was in a bracket that didn't pay the credit, between 130g and 160g, who made a different purchase." a seller*
> *"We see a lot of customers who get a 105hp diesel instead of the 130hp in order to get the credit; he's going to take a diesel for the credit; for the equivalent model, they're going to take the one that has the credit; it was on the same model, they changed the engine, if I remember it was a 308." a seller*
> *"The gentleman before you, he's buying Lagunas, he had 5 or 6 of them, but that one, he's not going to buy a Laguna because if he buys it there's a €750 tax; the customers to whom we might have been able to sell a Focus ST, they give up; sometimes, if they see there's a tax, either they start looking at a used car of the same make, or they don't purchase anything.*

In their view, the changes in the market are also the result of a combination of other factors: the credit reinforces an existing and growing concern with the overall price (the purchase price and the operating cost). And this is attributable in part to the marked increase in the price of petrol in 2008 and the uncertainty generated by the crisis that emerged towards the end of that year.

...but to a certain extent they are appreciative

All of the sellers view the programme as a stimulus for a lagging automobile industry, but from the point of view of their financial interests, the benefits are muted. A programme that emphasizes the smallest models on the market causes them to lose money overall, since their margin is smaller. At least their sales volume is good.

"That costs us a lot, with the small cars we don't make as good a living." a seller
"It's a good programme to the extent that it helps me sell cars; it's true that you sell more cars." a seller
"20% drop in income" a seller

Dealers who sell brands with a more limited selection of smaller vehicles are blunter in their criticism.

The value of blending the qualitative and quantitative approaches

Enhancing how the programme is perceived

The primary reason for crossing the qualitative and quantitative approaches involves the very different type of information that these two approaches yield: market trends on the one hand and evolution of the social perception on the other hand.

Each method corresponds to a different way of grasping and defining the issue at hand. When a range of methodologies is used (here, quantitative and qualitative), each sheds light on the others and provides the basis for a multi-dimensional perspective, in which the pictures sketched in by various points of view can be superimposed in pursuit of a wider array of objectives; multiple methodologies provide a greater volume of information and offer more opportunities for comparing and objectivizing data, especially when each method has been developed in depth according to its own internal logic.

Thus, the quantitative assessments focused on the financial and environmental (monetization of externalities) aspects. From this standpoint, the bonus/malus programme emerges as an initiative that improves energy efficiency in new vehicles at a much faster rate than was previously the case. It provides a substantial net (monetarized) socio-economic benefit (€140 million) if we overlook the rebound effect (which remains difficult to measure). A rough estimate of the rebound effect leaves a slightly negative balance of -€17 million.

The economic model used for the ex-post assessments also provided a means of estimating the programme's projected budgetary impact and helping making adjustments accordingly. This is a key step for a programme that is supposed to generate adequate revenue to offset the cost to the central government, even though the final political decision does not only take the results of the economic analysis into account.

However, this data does not provide us with any information about the programme's effect on public attitudes and individuals' behaviour. The qualitative survey showed how the programme has been received by both sellers and buyers: sellers have treated the credit as a discount like any other and have reduced the programme to nothing more than a financial benefit, or have even tried to appropriate the credit for themselves in order to avoid offering other discounts. For their part, although they are sometimes aware of the environmental objective behind the programme, buyers treat it as just one of many factors in choosing a vehicle, ultimately secondary to the final price (which will depend on whether a credit or tax is applied).

The qualitative survey also revealed an unexpected and undesirable effect of the programme that was not envisioned at the outset: vehicles that qualify for the credit are perceived to be

completely non-polluting. This highlights the importance of a quantitative assessment of the potential rebound effect. On the other hand, although the bonus or malus may be of only relative significance when the purchase is made, the survey has shown the programme's educational value in subsequently raising a relative awareness of how vehicle traffic is having a negative effect on our climate—something of which the interview subjects were not necessarily aware beforehand.

The automobile bonus/malus programme was conceived from the start as a purely financial tool, which would reach its environmental impact through purely economic mechanisms (response to vehicle prices). The qualitative survey has revealed the programme's other effects by highlighting both its strengths and weaknesses, such as, on one hand, the power of the price factor as a tool in changing behaviours, and the long-term impact in terms of raising environmental awareness. On the other hand, the programme has been reduced to little more than a financial incentive (bonus) or even concealed or denied at the time of the vehicle's purchase (malus).

Proposing recommendations to improve the programme and its impact

Similarly, with regard to future changes to the programme, the two modes of assessment yield different and complementary recommendations: while the quantitative assessment can be used to modify the credit/tax rate in order to balance the programme's budget while maintaining its role in improving energy efficiency, the qualitative survey suggests that the measure's environmental impact should be enhanced. Thus, it might be possible to delineate the measure and its environmental (as opposed to economic) aims more effectively by systematically distributing an informational booklet on sustainable mobility to everyone who purchases a vehicle at the time of sale.

The two approaches both show that the bonus/malus programme should be seen as just one element of a more comprehensive package of measures to promote more sustainable transport, including both financial measures (mileage tax, carbon tax, congestion charges, etc.) and non-financial measures (buyer information at the time of purchase, training in ecodriving, etc.). Making new vehicles more energy-efficient is merely one part of the problem and can only be viewed within an overall context. Such a package of measures aiming at a unique target (here sustainable mobility) should be implemented together as such for households to make the connection among these various measures. In this way, the bonus/malus scheme—a programme of proven popularity—could serve as a Trojan horse for a broader informational and educational campaign regarding sustainable mobility and ambitious economic measures.

The quantitative and qualitative studies have shed light on this issue from multiple directions, in a way that helps us better understand how the programme actually works and enables us to place it within a broader context.

Mutually enhancing quantitative and qualitative analyses

In addition to complementing each other, these two types of assessment and analysis can be mutually enhancing. For example, the qualitative analysis can be used to validate some of the assumptions used in the quantitative model.

A central premise of this model is that households use the variation in total cost as one criterion in their decision to make a purchase. This premise is not immediately self-evident: it would have been possible to use a cruder method that was based solely on the variation in the purchase price. However, the qualitative survey has shown that, according to both vehicle buyers and sellers, fuel consumption is becoming an essential decision-making factor.

Similarly, the interview results highlight the importance of price as the main criterion in the purchase of an automobile, one that can prompt buyers to make a different choice, and show that the credit can push buyers towards a model or engine type that falls within a different bonus/malus bracket. This confirms that the approach used in the model is an appropriate one, in which the credit

or tax applicable to one category of vehicles can generate marginal variations within adjacent categories.

Conclusion

In conclusion, this article shows, on the basis of a concrete example, the value of combining quantitative and qualitative methodologies in public policy assessments. Above and beyond concerns about the programme's effectiveness and the potential windfall effect, the combination of these two approaches provides government decision-makers with a clearer perspective on the social and economic impact of such an initiative. This clear-sightedness is especially critical with regard to a policy measure that is unique and innovative in comparison with the typical tools of public policy.

Finally, the range of perspectives on the bonus/malus programme offers a more nuanced assessment of its impact and reveal the need to place the programme within a broader context of government intervention. Although the programme is intended to target energy efficiency in new vehicles, we must not lose sight of more expansive goals for sustainable mobility and reducing CO_2 emissions in the transport sector.

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