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Outlining policy responses to stimulate automotive car demand by environmental impact reduction

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The aim of this paper is to propose an alternative approach for outlining policy responses to stimulate the automotive industry. The scientific community has developed and employed the Delphi method to collect and convey perspectives and impressions, and also define a number of financially viable proposals. The panel of experts takes the view that traditional industrial policy measures denote limited effects to stimulate car demand, in a context of a macro-economic downturn. By contrast, the panel also believe incentives for car demand are important for environmental purposes, for safety and for the diversification of energy sources. The policy measures proposed are fundamental from the viewpoint of overturning path dependencies in the automotive industry which impede the diffusion of alternative vehicles, with respect to business models and consumer attitudes.

Keywords: automotive; industrial policy; air pollution reduction; alternative vehicles; Delphi method

1. Introduction

In 2008, car sales around the world crashed simultaneously; in particular, passenger car sales had fallen across the European Union by more than 25% with an annualised loss of over four million units (IHS Global Insight 2010). Car manufacturers were unable to react in time, inventory built up, and the scene was set with radically deep cuts in vehicle assembly, plant shutdowns and extensive lay-offs. In 2012 the crisis in the automotive industry was mainly focused in the European Union, but data show a non-homogeneous evolution between member countries (European Union, with respect to 2011, −6.3%; Italy −19.7%; France −14.4%; Spain −8.2%; Germany +0.7%; UK +2.7%).

In spite of the difficult situation, the crisis brings with it a unique historical opportunity to break the existing path dependency of the industry (Wells 2010). Three main chances for change can be detected:

- The financialisation of economies has prompted a pattern of accumulation in which profit making occurs increasingly through financial channels rather than through trade and commodity production (Epstein 2005; Krippner 2005; Froud *et al.* 2006). Many carmakers kept up their mainstream business operations, but also offered credit and leasing facilities to promote sales to insufficiently solvent buyers. The dramatic slump was mainly due to a collapse in consumer and business confidence, compounded by difficult access to consumer and corporate finance and serious concerns about the stability of the global financial system. The evidence is in the

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fact that the financialisation view of the world is coming unstuck (Jetin and Freyssenet 2011).

- The automotive industry has been accused of affecting environmental and public health. The question of how the industry is integrating the demands of sustainable development is still fundamentally tied to the question of how this activity is positioned in societies that produce and use cars (Jullien 2008). Carmakers and countries have experimented with specific historical trajectories in terms of the strategies and production policies that create trade-offs in the interpretation of the requirements of sustainable development.
- Increasing competitive pressures resulting from globalisation, and excess capacity in the old industrial economies, have been changing relationships both between continents and at regional levels (Bailey, Coffey and MacNeill, 2010), with the result of reducing profit margins in those areas unable to restructure the industry.

These radical transformations require a return to questions of policy and the importance of regulation and taxation. These issues are likely to play a major role in determining outcomes for the whole automotive supply chain and regions.

Whereas countering financialisation calls for the restoration of policy controls to reduce the increasing importance of financial markets in the operation of the economy and its governing institutions, both at the national and international levels (Palley 2008; King *et al.* 2012), the diffusion of sustainable development and the restructuring of the sector is more a matter of industrial policies to stimulate and promote structural change.

In periods of crisis, vigorous and costly intervention has usually been undertaken by many governments to strengthen domestic demand for cars, whereas measures to engender sustainable development have usually followed a contrasting path, with the institution of regulatory requirements that increasingly restrict the sale of new vehicles, the setting of specific limits on emissions, and the provision of direct support to basic research (Calabrese 2009).

In the European Union today, main policy interventions must tackle the reduction of overcapacity and accelerate the substitution of the vehicles on the road. The only promising 'new' car demand able to increase investments and counterbalance plant closures seems to be alternative vehicles, instead of petrol/diesel engines, to reduce pollutants, that is, gas – Compressed Natural Gas (CNG is made by compressing natural gas, which is mainly composed of methane) or Liquefied Petroleum Gas (LPG) –, biofuel, hybrid electric, full electric or fuel cell vehicles. However, rather than achieving a continental reach, policy responses to these issues have remained for the most part at a resolutely national level, with the peculiarity that governments are reluctant to close plants because of the inevitable social impacts. Moreover, measures to support domestic car demand must be technology neutral and guarantee that competition is not distorted in the internal market (European Union competition policy).

For these reasons the focus of this paper is on the measures that can be adopted by a European Union country state, specifically Italy, to foster domestic car demand, and as a consequence national car production. The aim is to outline a process of industrial policy responses in the belief that the Italian automotive industry faces deeply structural problems, and that the key to recovery lies in encouraging growth by long-term stimulus programmes.

The methodology adopted follows the Delphi method that was chosen because common surveys try to identify 'what is', whereas the Delphi technique attempts to address 'what could/should be' (Hsu and Sandford, 2007). Indeed, instead of highlighting and proposing a contextualisation of different policy responses, the approach taken has

been to involve the Italian scientific community, collecting and conveying perspectives and evaluations from those who have been analysing the automotive industry, including those who have been working in institutions abroad.

This paper is organised as follows: Section 2 briefly describes the automotive policy framework with regard to sustainable development at the European Union level and for member countries; in particular, some assessments of scrapping schemes are reported. Section 3 illustrates the Delphi method adopted as the methodology of investigation in this paper, to outline policy responses to stimulate automotive industry, and Section 4 reports the results of the first round of the Delphi method. Section 5 proposes some policy measures based on environmental impact reduction, and Section 6 reports the results of the second round of the Delphi method. The final section presents conclusions and recommendations for further investigations.

2. Sustainable development policy framework in the automotive industry

At the European Union level, three major policy areas impact on sustainable development in the automotive industry: common standard regulations on exhaust and CO_2 emissions,[1] safety[2] and re-cycling.[3] This barrage of increasingly rigid regulations is driving substantial change and presents a challenge for the global auto industry, although regulatory regimes for cars around the world remain differentiated. Some markets have specific safety tests and others distinct cycles for the testing of emissions (Ryan and Turton, 2007; Sperling and Cannon 2007). Even more pronounced are the differences in the fiscal regimes.

At the national level, it is worth pointing out that by the end of the twentieth century France and Italy were the main countries in Europe involved in alternative vehicles in terms of all car sales, while in other European countries alternative sales were almost absent.[4] In the last few years, however, these other countries have begun to concentrate their efforts towards this, based on their own specific carmakers and energy strategies.

From a global perspective, the most likely short-term scenario seems to be one of diversity (Freyssenet 2011). Italy is mainly focused on LPG and CNG vehicles and the same is true for Russia, which counts on its large amount of natural gas reserves, and Sweden on bio-methane (NGVA 2012). Outside Europe, Brazil is the traditional leader in biofuel in terms of all car sales. The large amount of nuclear power installed has led France to focus on electric vehicles, whereas Germany promotes electric and hydrogen vehicles.

Denmark, France and Israel, which are now establishing attractive incentive schemes for electric vehicles, could potentially generate a huge competitive edge for their domestic automotive and power industries. However, unless other governments act promptly to provide adequate incentives for consumers, and the necessary infrastructure, alternative vehicles may be off to a false start. The isolated and top-down experience of California is particularly significant and it shows the ineffective power of imposed environmental strategies (Sperling and Gordon 2009). California implemented a legislation that made it compulsory for carmakers to sell at least 2% Zero Emission Vehicles by 1997, and then 15% in 2003, but the mandate was gradually reduced until it disappeared in 1998.

Most of the considerations related to the development of electric vehicles, and their successful placement on the market, undoubtedly depend on fuel prices. If the oil price is low, customers will tend to buy internal combustion engine vehicles; in the contrary case, and assuming that other conditions are also met (battery prices decrease, public utilities provide suitable infrastructures, and the European Union keeps to its 95 g/km CO_2

emissions target for 2020), the future of electric vehicles will be much brighter. In this context, the proposal to add extra excise taxes on oil prices to reach a lasting and fixed level seems sensible. In fact, according to simulation by the Boston Consulting Group (2009), hybrid electric vehicles are more attractive than petrol/diesel vehicles when the price of oil reaches approximately $70 per barrel, and then advanced diesel vehicles when it reaches about $170 per barrel. However, electric vehicles remain relatively unattractive unless they are subsidised or unless battery costs drop sharply ($500 per KWh assuming an oil price at approximately $120 per barrel). Another aspect that must be considered in the comparison between traditional vehicles and electric vehicles is usage cost. Prices show an apparent competitiveness for electricity with respect to petrol, but the gap does not yet seem to be appealing enough if excises are equalised (Calabrese 2012). Nevertheless, the main obstacle is the dependence of electric vehicles on hefty infrastructural investments to foster green technologies, which only state planning can afford (Volpato and Zirpoli 2011).

For this reason, in the short term the most promising alternative vehicle able to reduce local air pollution seems to be the CNG type, particularly when old vehicles are equipped with CNG devices (Stocchetti and Volpato 2011). Policy makers should intervene by implementing regulations (exploiting environmental and safety benefits as opposed to supporting traditional vehicles) through technology (improving energy performance, and incorporating CNG into hybrid cars), and by supporting car demand (not adjusting excises and promoting the conversion of cars already in use). The fundamental issue involves the extension of the distribution network, which is limited in Italy, where CNG filling through a home network has recently been allowed, but it is almost non-existent in other European countries. This will break the vicious circle that has been created between CNG distributors, who do not want to expand the network due to scarce car demand, and consumers, who are not willing to buy CNG cars due to the lack of filling stations.

In addition, the transition to safer and more eco-friendly automotive systems often evokes a new vision of mobility (Wells 2010). Policy response to sustainable development should aim at the implementation of measures capable of the following (Ceschin and Vezzoli, 2010):

- encouraging companies to shift their business models by adopting use-oriented (e.g. leasing, sharing, pooling) and result-oriented (e.g. pay per service unit schemes, integrated mobility schemes) services;
- changing agents' behaviours (e.g. public procurements, consumer awareness);
- supporting demonstrative pilot projects (e.g. promising business models without direct market pressure);
- involving universities and research centres in supporting knowledge transfer and disseminating information.

In this context, a number of noteworthy public policies are being put forward by local authorities (Calabrese 2012). An increasing number of city councils are promoting electric urban mobility systems, renewing their fleets with electric vehicles and installing charging stations. To name a few of these: Better Place in Israel, Denmark and Australia; E-mobility in Berlin; Zen.car in Brussels; E-vai in Milan; Car2go in Ulm and in Austin, Connected car in Galicia, and so on.

The most promising initiative seems to be the 'Autolib' electric car-sharing system in greater Paris, which is marking a step in the diffusion of a new mobility system by the quantity of electric vehicles made available to urban users (3000) and the number of

cities (46) associated with the project. The City of Paris entrusted the deployment of an electric car sharing system to a mixed transport syndicate set up in 2009, which includes vehicles, services, an economic model and risk-sharing conditions. The Autolib service, run by Groupe Bolloré who won the tender, should create approximately 1500 jobs and employ 250 advisors available to motorists 24/24h through a communication system embedded in the vehicle. Autolib should contribute a step forward in the spread of electric vehicles and to improve acceptance by car users.

One of the most popular schemes pursued by industrial policies is to launch fleet renewal programmes, including market incentives and car scrapping schemes.

In 2009 the most extensive and highest density of market support measures was adopted. Scrapping incentives have been temporarily enacted in 13 European Union member states, which together represent 85% of total vehicle sales in this region. The primary objective was to provide general economic stimulus; the secondary was renewal of the European car park and benefits for road safety.

According to IHS Global Insight (2010), scrapping schemes have been remarkably successful for all three targets. The €7.9 billion of funding, less €5.6 billion of tax return, supported 4.443 million cars, of which without incentives 2.164 million cars would not have been sold in Europe. IHS Global Insight (2010) also estimated GDP growth of between 0.15 and 0.2%.

Scholars and practitioners have different opinions on the matter. Scrapping incentives are seen as a measure to modify customer requirements and distort the market, leading only to limited short-term benefits due to pull forward effects.

However, a pull forward effect depends on many variables such as the type of scheme, the economic cycle and the subsequent trade policies of car makers. For example, the 1994–1996 French scheme showed a pull forward rate of 87% (Adda and Cooper 2000) which nearly wiped out the incentives, whereas in the case of the 1994–1995 Spanish scheme the pull forward rate was 20% (Licandro and Sampayo 1997); and for the 1997–1998 and 2002–2003 Italian schemes the pull forward rates were 10% and 25%, respectively (IHS Global Insight 2010).

Based on these estimations, IHS Global Insight (2010) has estimated the pull forward effect in Europe as being equal to 0.695 million cars, which therefore implies a real increase of 1.469 million cars.

In addition, the scrapping incentives (IHS Global Insight 2010):

- avoided the loss of approximately 120,000 direct jobs in the automotive supply chain and the failure of many small and medium suppliers;
- ensured that the use of plants did not fall below the critical capacity limit of 60% for a prolonged period of time;
- assisted the application of other forms of support for public finance in crisis situations, by giving more time to possible restructuring;
- helped reduce CO_2 emissions in 2009 by 1.05 million tonnes, with cumulative effects in the following years, and with a reduction of NO_x and PM as well. This was due to rejuvenation of the fleet, segments downsizing and the enhanced possibilities for buying alternative vehicles.

Significant incentives for alternative vehicles in Italy notably increased the percentage of green vehicles over total new passenger car registrations from 3.8% in 2007 to 22.1% in 2009.

On the other hand, the distortion of the market is the main negative effect, with the incidental impact of having disproportionately supported some of the weaker players in the European industry. Despite seeing the deepest crisis in the European automotive industry for decades, only two assembly plants were closed (1.7% of European Union capacity): the Fiat plant at Termini (Italy) and the Opel factory in Antwerp (Belgium). More recently, PSA announced the closure of Aulnay in France and General Motors in Bochum (Germany). As a result, there has been no net improvement in the problem of long-term excesses in installed industry capacity, and the resulting long-term pressure on sustainable operating margins.

It is worth mentioning the French scheme due to the innovative bonus/malus proposal, in which cars are taxed (malus) or credited (bonus) if their carbon emissions are above or below certain targets. It has three objectives: reducing CO_2 emissions, especially those generated by the transportation sector; supporting a large economic impact on the car industry, since most of the vehicles produced by French manufacturers are small and environmentally-friendly; and finally, because the law was supposed to be financially neutral for the state budget, remaining fiscally balanced. Regarding the first two objectives, the scheme has been a success. In contrast, the intended financial neutrality was not achieved and the total cost was, for the period 2008–2010, more than €1.200 million.

3. Methodology

The assessments listed in the above section highlights the question as to why it is necessary to identify instruments and measures, including innovative ones, which can support the automotive market in Italy. For this purpose, instead of highlighting and proposing a contextualisation of different policy responses, the Italian industrial expert economists in the automotive sector have been involved through the Delphi method; this is in order to collect and convey perspectives and evaluations from those who have been analysing the sector and industrial policies, including those who have been working in institutions abroad.

The Delphi process is a structured technique developed as a systematic and interactive forecasting method which relies on a panel of experts with the objective to achieve an exhaustive representation of opinions relating to a theme. In the standard version, the experts answer questionnaires in two or more rounds (Linstone and Turoff 2002; Lippi 2007). More precisely, the method adopted was 'Policy Delphi', which is more suitable for normative and explorative use and particularly in the area of social and public policy (Turoff 1972). In Europe, more recent web-based experiments have used the Delphi method as a communication technique for interactive decision making (Bolognini 2001) and environmental scenarios (Kuo and Yu 1999; Greiving, Fleischhauer, and Lückenkötter 2006; Bailey *et al.* 2012).

The panel of experts was composed solely of Italian academics and researchers in industrial economics belonging to state and private institutes, and were not connected to professional associations or trade unions. Specifically, the panel of experts was asked to participate in two rounds aiming to collect opinions on the demand slump in the Italian car market, and possible public interventions. Overall, 30 Italian scholars were contacted, of which 26 gave their availability and 22 responded to both rounds of the Delphi method. Ludwig (1997) documented that the majority of Delphi studies have used between 15 and 20 respondents.

The series of questions has followed a path of progressive insights proceeding from general comparisons looking at the need to intervene with economic policies (labour

market, fiscal policy, trade policy, etc.) and/or industrial policies. Specifically, the focus has been on measures that can indirectly favour car demand (improvement of infrastructure, reduction of taxes on car use and change of regulations) or measures that can directly increase the demand for conventional and alternative vehicles through short or long-term incentives. It has also focused attention on some of the peculiarities of car demand, such as that coming from companies or used cars, or inherent new forms of use such as electric car sharing or the microcar[5] that could be a less expensive way in stimulating a change in the business model of the Italian automotive industry. The first column in Table 1 reports the schematic series of questions/measures posed to the panel, structured in measures for economic policies or industrial policies, and the latter questions about demand support, improving infrastructure, changes in taxation and in regulation.

A key characteristic of the Delphi method is the structuring of information flow. The contributions are collected in the form of open answers to questionnaires and their comments to these answers. The experts are not compelled to respond to each question. The person co-ordinating the Delphi method controls the interactions among participants by processing the information and filtering out irrelevant content.

4. First round of the Delphi method

Table 1 shows the responses obtained for each specific topic, the number of positive responses and the respective percentages when measured against the total for responses and the total for the panel of experts.

Given the nature of the survey, related more to industrial organisation and structured with open questions, the measures about economic policy have been in part ignored, while the personal contribution of the experts was ample for the remaining questions.

The panel of experts considers that industrial policy measures to stimulate car demand can have extremely limited effects from the perspective of a macro-economic downturn. In addition, these tools denote certainly greater effectiveness within the context of a policy of concerted action at the European level, as happened in 2009.

At the same time, the panel believe incentives for car demand are important for environmental purposes, for safety and for the diversification of energy sources.

Table 1. First round responses.

Measures	Total answers	Total positive answers	Positive answers on total answers	Positive answers on total panel
Economic policies	10	8	80.0%	36.4%
Industrial policies	22	22	100%	100%
Demand support	22	16	72.7%	72.7%
- for alternative vehicles	16	13	81.3%	59.1%
- for business fleets	16	9	56.3%	40.9%
- for used cars	16	8	50.0%	36.4%
- for electric car sharing	16	6	37.5%	27.3%
- for microcars	16	3	18.8%	13.6%
Structural support	10	9	90.0%	40.9%
Improve infrastructures	22	12	54.5%	54.5%
- For CNG	12	11	91.7%	50.0%
- For EV	12	5	41.7%	22.7%
Change in taxation	22	9	40.9%	40.9%
Change in regulation	22	11	50.0%	50.0%

In fact, as can be seen from Table 1, 72.7% of the panel of experts believe that incentives for car demand are a valuable tool. However, 81.3% of the total answers suggest that incentives should be directed only to alternative vehicles (59.1% of the panel); panellists who also take traditional vehicles into consideration suggest that scrapping scheme incentives must reward the outcomes with the best environmental balance (e.g. downsizing) and exclude vehicles that due to their weight, consumption and size exceed certain parameters.

The outlook suggested a strict relation between individual mobility, with the aim not only to reduce polluting factors and increase safety, and the development of new industrial activities. Industrial policy should influence carmakers' strategies with a mix of tools based on emission standards, energy efficiency, R&D support and scrapping schemes. This is intended to direct the industry towards alternative forms of motorisation and also the production of single purpose vehicles (e.g. for a downtown), as is happening in France.

In this sense the panel of experts encourage, specifically for Italy, a further development of the CNG infrastructure and indirectly the purchase of this class of alternative vehicles (91.7% of total answers, and 50.0 of the total panel). The benchmark could be the French scheme for the electric car put in place to support Renault's strategy. Moreover, the introduction of new technologies for methane extraction should shortly allow a further reduction of prices which today are still related to oil, without forgetting the development of technologies for the local production of bio-methane from organic waste or through processes of biomass conversion.

The focus on alternative vehicles needs long-term measures to create a path of change by helping businesses to reorganise the supply chain, and to avoid temporal distortions in car demand that could generate situations of moral hazard (90.0% of total answers, and 40.9% of the total panel).

With regard to specific targets, the panel of experts placed its focus specifically on:

- Business fleets (56.3% of total answers, and 40.9% of the total panel). It has been observed that a public policy focused on public and private fleets can increase production volumes that are essential for encouraging investment in key areas for all alternative vehicles. Companies should be more likely to adopt new technology than private individuals; in particular, it is crucial to target initiatives aimed at the reconversion of light vehicles for the transport of goods. The number of such vehicles is particularly large, with a range of particularly polluting emissions.
- Used cars (50.0% of total answers, and 36.4% of the total panel). Objectives relating to the reduction of polluting emissions and to improving safety standards can be obtained by also intervening on used cars, above all by eliminating old cars that pollute by their presence in the environment. A significant role could be played by dealers in the relocation in the market of at least Euro 4 and 5 models, with the scrapping of up to Euro 3 models. If the transactions of the used car market are locked, as is the case in Italy by huge taxes, the consequence is an impasse in the new car market (Coffey and Thornley 2012).
- Electric car sharing to a lesser extent (37.5% of total answers, and 27.3% of the total panel). This solution, as well as encouraging a different organisation of urban space, can be configured as a possible response to the need to reduce the cost impact of cars on personal income. In addition, if the measures are linked to the supply of single purpose cars or electric microcars and improving the EV infrastructure (41.7% of total answers, and 22.7% of the total panel), the effect could be multiplied by enabling producers to expand in this market.

Finally, with regard to the tools for intervention, particular attention was paid to the French systems bonus/malus, with its target of setting a parallel policy of disincentives vis-à-vis the use of more polluting vehicles, whose tax revenue may then be used for supporting the use of less polluting vehicles.

5. Towards policy responses based on environmental impact reduction

According to Onida (2010), while a single industrial policy intervention with the role of 'panacea' does not exist in the automobile industry, it is possible to identify numerous targeted measures that also support car demand.

The evidence reported in the previous section highlighted the need to suggest measures to support the Italian automotive industry. There is a risk that the whole supply chain becomes too lean and thereby compromises production levels and technology due to the weaknesses in the domestic production of cars, which decreased by 72.1% in the period 2000–2012, and are partially offset by increases in exports. Simultaneously, the panel of experts has suggested that policy interventions should intently encourage the emergence of a paradigm shift on individual mobility, and thereby break with traditional measures to support car demand.

On the basis of the questions most voted for, and of the contributions emerging from the panel of experts, three plus one[6] 'financially viable' measures were proposed that could in various ways support the Italian automotive industry, thereby addressing the necessary changes. Financial viability, in this context, refers to the type of fiscal procedures already adopted in Italian public policies. These could be applied in the automotive field in much the same way as the bonus/malus in electricity tariffs for the benefit of the photovoltaic[7] or exploiting European Union Funds.

The objective is twofold, both to encourage environmentally-friendly and safer vehicles and to rejuvenate the vehicle fleet. The four measures in question were submitted to the panel of experts for the second round. While the whole assessment is shown in the next section, these measures were as follows.

- *Cash-for-replacement of business fleets with new alternative vehicles*. The voucher is aimed only at companies, and with the intention of delimiting this policy measure to those actors that in this economic cycle have greater financial resources and are better able to assess and realise the potential economic advantages of replacing their vehicles with alternatives that are less polluting (LPG, CNG, hybrid or pure electric). The incentive should be long term and reward progressive solutions for the best environmental balance on the basis of the differential between emissions for vehicles scrapped/replaced and emissions for vehicles purchased. At the same time, by following the French bonus/malus scheme, the financial coverage of this tool could be designed in order to act as a disincentive for the purchase and use of more polluting vehicles.
- *Cash-for-scrapping of private individual cars and replacement with less polluting used vehicles*. The voucher is aimed only at private individuals, with the intention of fostering the scrapping of more polluting and unsafe vehicles by replacing them with less polluting used vehicles, which require less financial resources to obtain them than the purchase of a new vehicle would. The incentive should be long term and reward progressive solutions for the best environmental balance on the basis of the differential between emissions for vehicles scrapped and the emissions of the used vehicles purchased. On the basis of this measure, by following the French

bonus/malus scheme, the financial coverage could again be introduced in a way that would act as a disincentive for the purchase and use of more polluting vehicles.

- *Incentives for home filling systems for CNG vehicles*. The main obstacle to the diffusion of CNG vehicles is due to the poor and not widespread number of filling stations (approximately 900 in Italy). In addition, they basically operate during working hours and self-service is forbidden. The home filling systems for CNG vehicles allow cars to be refuelled directly in home garages, to avoid the problems caused by lack of filling stations and the queues that frequently occur.[8] The same reasoning is applicable as for business fleets where fleet drivers have the chance of refuelling vehicles at their own base. The natural gas price for household use is broadly the same as at filling stations, although companies can benefit from significant price discounts, paying as much as 40–50% less, depending on the supplier company.
- *Car sharing of experimental electric vehicles*. Italy is experiencing a significant delay in the development of pure electric vehicles and hybrids. The delay is due more to the architectural content of sharing schemes than to individual electric vehicle components, as many Italian suppliers are positioning themselves on this supply chain. At present, only two electric car sharing systems are running in Italy (Milan and Pordenone). This policy measure could extend these experiences to other urban areas, with the constraint of prototype experimentation, in order to encourage R&D projects in Italian companies in co-operation with universities, and the exploitation of European Union funds.

6. Second round of the Delphi method

As specified in the methodology section, the Delphi method requires that the panel of experts should be involved in at least two phases of inquiry, through the administration of questionnaires. With respect to building on the first phase of interviews, the second round of the Delphi method was required only to make an assessment of the four policy proposals to emerge from the first round, as described above. Ultimately, every expert had to express their greater or lesser appreciation or disappointment with respect to these hypothesised policy interventions.

Table 2 reports response rates. The results are reported both in the bivalent mode, in favour or against, and in the disaggregated mode, on a four-point Likert-type scale.

It is possible to infer that the panel of experts expressed significantly favourable opinions for all the policy proposals. However, listing them in order, the measures which obtained more positive opinions in favour were: eco-incentives for businesses fleets (81.0%), home filling systems for CNG vehicles (81.0%), electric car sharing (76.2%) and incentives for used cars of private individuals (61.9%).

Table 2. Second round responses.

	Business fleets	Used vehicles	CNG home filling systems	Car sharing
Very against	4.76%	19.05%	14.29%	14.29%
Less against	14.29%	19.05%	4.76%	9.52%
Against	*19.05%*	*38.10%*	*19.05%*	*23.81%*
Less favourable	23.81%	38.10%	38.10%	14.29%
Very favourable	57.14%	23.81%	42.86%	61.90%
Favourable	*80.95%*	*61.90%*	*80.95%*	*76.19%*

The analysis of the extreme assessments, 'very favourable' versus 'very against', shows a partial differentiation of opinions. The policy measures 'Cash-for-replacement of business fleets with new alternative vehicles' and 'Car sharing of experimental electric vehicles' show the larger gaps, at 52.4 and 47.6 percentage points, respectively; thus there is evidence of a greater preference for these tools. On the contrary, the proposed 'Incentives for home filling systems of CNG vehicles' and 'Cash-for-scrapping of private individual cars and replacement with less polluting used vehicles' recorded a more uniform distribution; here, the gaps are 28.6 and 4.8 percentage points, respectively, a sign of more attenuated opinion.

It is noteworthy that the policy proposal to obtain the highest percentage of 'very favourable' assessments was a diffusion of 'Car sharing of experimental electric vehicles' (61.9%).

By observing the individual responses of participants in the second round Delphi it is also interesting to find that only one member of the panel expressed an opinion against all of the policy proposals, and always with the more extreme evaluation. In contrast, nine respondents pronounced favourably on all the measures, although only one of them always displayed the maximum approval.

Finally, it was reiterated by the panel that isolated policies will not solve the structural factors that are problematic for the Italian automotive industry.

A coherent ecological policy set must be defined in order to encourage a rapid renewal of the 'car park' or existing vehicle fleet, with unfavourable taxation for the more polluting vehicles, in particular for private fleets, and active support for the development of CGN. The spectrum of action must be broad, including policies for access to urban centres and traffic lines according to the types of vehicles.

In particular, eco-incentives should be built on a long-term basis and with a level of progressively increasing environmental performance. This would give carmakers and customers a framework that would allow rational decision making.

7. Conclusions

This paper has proposed an alternative approach for outlining policy responses to stimulate the automotive industry that constitutes the backbone of the world's economy and employs a very significant share of the working population, even in Italy.

In general, government intervention is characterised by a traditional approach that privileges scrapping schemes, but mainly to prevent companies in the whole supply chain from facing financial crisis or bankruptcy. Only recently, and as a secondary issue, has the renewal of the car park with alternative vehicles been taken into account.

In this paper, instead of highlighting the state-of-the-art and assessing the effectiveness of all-round policies adopted to support the automotive industry, the approach has been to involve the scientific community in order to collect and convey perspectives and impressions and define a number of 'financially viable' proposals.

The Delphi method has been the methodology adopted, and the accompanying panel of experts takes the view that traditional industrial policy measures denote limited effects to stimulate car demand, in a context of a macro-economic downturn. In addition, these tools certainly possess greater effectiveness within the context of a policy of concerted action at the European level, as happened in 2009.

By contrast, in the first round of the Delphi method the panel of experts suggested that car demand can be stimulated mainly by environmental impact reduction and this response was investigated in the second round.

The panel of experts described a list of possible interventions: measures to support environmentally-friendly vehicles, and in particular CNG; measures, with a longer or more prolonged time frame, to change the productive structure and avoid short period effects; measures in favour of companies that might be most interested in alternative vehicles; measures for experimentation with electrical car sharing; infrastructure projects in favour of environmentally-friendly vehicles; measures that discourage the use and the purchase of the more polluting vehicles.

The policy measures proposed are fundamental from the viewpoint of overturning path dependencies in the automotive industry which impede the diffusion of alternative powertrains, with respect to business models and consumer attitudes.

Carmakers' business models are generally characterised by risk aversion and by a return to optimisation through continuous improvement and cost cutting. However, the industry is characterised by a lack of profitability (Nieuwenhuis and Wells 2003), given that profits come mainly from the sale of automobiles and not from the use of them. The traditional automotive business model should be changed and the relationship between producers and users should not end after purchase but continue over time (Ceschin and Vezzoli 2010), through the offer of services.

Most consumers are satisfied with the fact that the internal combustion engine performs as they expect it to, and at a predictable cost. Those who prefer clean and fuel-efficient engines and are willing to pay slightly higher purchase prices represent only a niche market. In sum, consumers favour internal combustion engine innovations over alternative vehicles, and in particular over electric engines (Dijk and Kemp 2010). Consumers care a great deal about fuel consumption but very little about vehicle emissions. They seem more interested in paying extra charges for sustainable car components in the interior (Hetterich *et al.* 2012).

For this reason, consumer attitudes as well as business models must be tackled by means of carefully designed and properly targeted policy measures.

Notes

1. The legal framework consists of a series of Directives, each being amendments to the 1970 Directive 70/220/EEC which are compulsory in all member states. Since the Euro 2 stage, EU regulations have introduced different emission limits for diesel and petrol vehicles. Diesels have more stringent CO standards but are allowed higher NO_x emissions. Petrol-powered vehicles are exempted from particulate matter (PM) standards through to the Euro 4 stage, but vehicles with direct injection engines will be subject to a limit of 0.005 g/km for Euro 5 and Euro 6. A particulate number standard (P) or (PN) is part of Euro 5 and 6. Carmakers will have to reduce CO_2 emissions from new cars to 130 grams per kilometre by 2012/15, with an additional 10 gram reduction coming from 'complementary measures' including a greater use of biofuels. A new objective of just 95 grams per kilometre was fixed for 2020. This will be conditional to an impact assessment. Penalties will be imposed on a sliding scale. Manufacturers that exceed their target by more than 3 grams will pay €95 per excess gram. Lesser transgressions will be charged between €5 and €25. From 2019, penalties will always be €95.
2. EURO NCAP tests which originated in the UK but are now backed by the European Commission, seven European governments, as well as motoring and consumer organisations in every EU country.
3. End-of-Life Vehicle Directive came into force at the beginning of 2007.
4. In 2000, according to ACEA (www.acea.be), 17,283 alternative vehicles were sold: 61% in Italy, 27% in France, 8% in Germany and 1% in UK.
5. Microcars are motor vehicles with four wheels defined by limitations in terms of weight, power and speed. In many European countries such as France, Italy, Belgium and the Netherlands,

these vehicles can be driven without a full motor car or motorcycle driver's licence, and in some countries without any licence at all (*vehicules sans permis*). Their short dimensions could be a way of reducing traffic jams and pollution.

6. This refers to car sharing that had fewer votes but it was taken into account to propose a new vision of mobility.
7. This converts solar radiation into electricity and is credited (bonus), while those who use traditional electricity are taxed (malus).
8. These devices draw the methane from the home network to 0.02 bar and compress directly into the tanks of the car. Charging times are considerably longer than those of the gas stations, where the time for this operation is about 2–3 minutes for a vehicle with a medium-sized tank of 80–100 litres; for the devices without domestic storage require times from 45 minutes to 5 hours. The domestic installations with storage denote recharge times similar to those of the gas stations.

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