Energy Saving and Emission Reduction Policy for Chinese Automobile Traffic: The Constraints and Solution[1]

Associate Prof. Dr. Lin Sun
Shanghai Academy of Social Sciences Institute of National Economy
7/622, Huaihai Zhonglu, Shanghai 200020
China

PhD Candidate Yong-hua Wang
Shanghai Academy of Social Sciences Institute of Economy
7/622, Huaihai Zhonglu, Shanghai 200020
China

Abstract

This paper presents the features of energy saving and emission reduction in automobile traffic. Implemented technical standards and fiscal and tax policies in China are surveyed and clarified, and the particular policy background and corresponding constraints in the policy are analyzed. A solution characterized by a "limit the new, expel the old" strategy is proposed: 1) Dominant technological standards should be gradually promoted in new automobile markets with traditional gasoline and diesel vehicles, and fiscal and tax subsidy policies should not be implemented. 2) A hybrid fiscal and tax "incentive and punishment" policy should be implemented in the ownership market. This solution not only considers the pace of technological development of "self-owned brands," but also avoids preferential treatment in subsidizing transnational brands while favoring the development of "self-owned brand" automobiles. In addition, the proposed solution facilitates the improvement of energy saving and emission reduction in both new and ownership markets. In the meantime, old models will be phased out more quickly, in turn increasing the demand for new automobiles and ensuring a steady development of the automobile industry.

Key words: Automobile Traffic, Energy Saving and Emission Reduction, Policy Constraints, Solution Analysis

1. Introduction

Since 2002, the shift from the prevailing demand from business and government to civilian family passengers marked a new era in the rapid growth of the Chinese automobile market (over 24% annually). Compared with the car expansion in the US and Japan, the present Chinese new car market has a better growth rate. In 2010, China's sales peaked at a volume of 18.06 million new cars, more than the US's 17.40 million in 2000. The growth rate of China's new car sales slowed down in 2011, but kept at around 18 million. Based on the ownership volume, the number of vehicles sold in June 2011 was 78.02 million (excluding 20 million agricultural vehicles). This value is second in the world only to the US's 285 million. However, the per capita ownership is 120/1000 persons worldwide and 60/1000 persons in China. Therefore, from the middle- and long-term perspective, the growth of car ownership has a relatively large potential.

Cars bring traffic convenience. However, too many of them increase fuel consumption significantly, and the resulting waste emission is mainly responsible for polluting the atmosphere and city air. Meanwhile, the explosive presence of cars in big cities has given rise to regular congestion and the frequent occurrence of traffic accidents. The observed "externality arising from automobile traffic," which was disused decades ago in developed countries (Parry, 2007), is now becoming apparent in China.

[1] This work was supported by a Grant-in-Aid for Scientific Research (B) No. 21310099 from the Ministry of Education, Culture, Sports, Science and Technology of Japan, and the Fund of Shanghai philosophy and Social Science (2008BJB031). The views presented in the paper are authors' personal, and they need not be ascribed to the organizations with which they are associated.

In recent years, Chinese governments designed and implemented a series of policies and measures to relieve this externality based on the experience of developed countries. Nevertheless, an efficient and overall policy system is yet to be established. China will have to take on the economic and social challenge posed by the "externality arising from automobile traffic" in the near future. Wu (2008) analyzed China's traffic policy, and pointed out the importance of designing policies incorporating both technological regulation and fiscal and tax measures. Sun (2011) surveyed and evaluated the policies regarding the externality in energy saving and emission reduction in automobile traffic, congestion, and safety. He also explored the problems and directions in building up a systematic policy. Yao et al. (2011) also discussed the development of low-carbon vehicles in China.

No country can avoid the distinct features related to energy saving and emission reduction in automobile traffic. In China, in particular, the recognized special policy background can deter the creation of an efficient and overall policy system. The present paper focuses on one of the issues on "externality of automobile traffic," energy saving and emission reduction in automobile traffic; articulates its distinct features; surveys and clarifies implemented technical standards and financing/taxing policies in China; analyzes the special Chinese policy background and major constraints hindering the efficient and overall policy system; and explores the corresponding policy suggestions.

2. Distinct Features in Energy Saving and Emission Reduction in Automobile Traffic

Massive automobile traffic means mobility convenience. More than that, its features bring unavoidable multi-level environmental problems. Policies to relieve environmental problems are highly related to the automobile life cycle and the extensive concern caused by automobile traffic.

2.1 Multi-Level Environmental Problems Arising from Automobile Traffic

The environmental externality caused by automobile traffic can be pinpointed on multi-levels and in various forms. Environmental protection concerns the approaches to saving energy and developing an energy substitute. Local and regional environment concerns are about the air pollution caused by auto-produced emission, such as nitrogen oxides, hydrocarbon, carbon monoxide, particulate matters, and acid rain caused by sulfur dioxide. Global environment concerns are about the effects of global warming due to the carbon dioxide from automobile traffic.

2.2 Relationship of Energy Saving and Emission Reduction and Vehicle Life Cycle

The environmental problems of automobile traffic stem from fossil fuel consumption, which is associated with the volume of car ownership, fuel consumption, emission performance, activities related to automobile products, including R&D, production, owning, driving and scrapping, and the stages covering the automobile's life cycle. During driving, automobile traffic is the key step in which fuel is consumed and emission is produced. Therefore, energy saving and emission reduction in automobile traffic should cover every stage in an automobile's life cycle, technically and managerially. Qualitative and quantitative measures should be pooled together to construct and evaluate an overall policy on energy saving and emission reduction in automobile traffic (Yang et al., 2009).

2.3 Extensive Coverage of the Effect of Automobile Traffic

Massive automobile traffic means a large prosperous automobile industry with an integrated system, including R&D, production, sales, owning, driving, and repairing and scrapping. It also means great demand on upstream industries such as steel, chemistry, and electronics. In the meantime, automobile traffic is widely related to social and economic aspects. Automobile traffic has great implications in the Chinese economic growth, employment, and taxation. The abovementioned issues can be found extensively worldwide. Thus, in the past years, developed countries have been spending much effort on constructing an overall policy system, including laws, technical standards, fiscal and tax measures, and so on, in a bid to obtain a balance among economical property, convenience, and environmental externality of automobile traffic for sustainable development.

3. Already Implemented Measures for Energy Saving and Emission Reduction in Automobile Traffic in China

In recent years, the Chinese government has designed and implemented a series of measures that will relieve the "externality in automobile traffic" with reference to the experience of developed countries. Relevant technical standards of energy saving and emission reduction are still underway, whereas the specific policies targeted for fiscal and tax concerns are not well established. Generally, China still has no overall policy system.

3.1 Technical Standards of Energy Saving and Emission Reduction in Automobile Traffic

3.1.1 Technical Standards

In May 2004, China published a development policy for the automobile industry that initially came up with a numerical goal of automobile oil consumption; that is, "by 2010, the standard of oil consumption for passenger cars shall be promoted by over 15% against 2003." In October 2004, for the goal to be met, a standard of "Limits on Fuel Consumption for Passenger Cars" was published toward the first and second stages. For new certified cars, the first stage would take effect on July 1, 2005 and the second stage was set for August 1, 2008. For cars being manufactured, the first stage took effect on July 1, 2006 and the second stage was on January 1, 2009. In July 2007, a standard of the "Limit on Fuel Consumption for Light Commercial Vehicle" specific to the first and second stages was published. Newly certified basic types and their variants should comply with the limit values of the first stage starting February 1, 2008. All vehicles to which the standard applies should comply with the limit value of the second stage. The publicity of fuel consumption was institutionalized for newly certified and already certified vehicles. After the implementation of the limit value for the first and second stages, by the end of 2009, over 800 types were canceled for not complying with the standard.

As for the third stage standard of limit value, the Chinese authority made a substantial adjustment that shifted the single-type fuel consumption standard to a corporate average fuel economy (CAFÉ) adopted by the US. The adjustment aimed to control car fuel consumption and avoid interfering with the production of different car types and fuel consumption levels. This system has a prerequisite in that car companies may produce different sizes and types that, as expected, would be introduced in 2012 and put into full use in 2015. In June 2007, China also published the "National Plan to Deal with Climate Change," which emphasizes the greenhouse gas mitigation and sets out basic principles, key mitigation fields, total mitigation goal, and corresponding measures. Therefore, the third stage standard of car fuel consumption limit value considered CO_2.

3.1.2 Emission Standard of Vehicle Pollutants

The vehicle pollutant limit standard came before the fuel consumption standard. In the 1990s, the law on atmosphere pollution protection and the pollution aversion policy for motor vehicles were established and implemented. However, the European emission standard system for specific vehicle types was not introduced until 1999. In April 2001, an equivalent of the European vehicle emission standard was published as the "Limits and measurement methods for emissions of pollutants from light duty vehicles (I)." In July 2004, its second stage version (II) was published. In July 2005, its third and fourth versions (III, IV) were published. In January 2007, the "Limits and measurement methods for exhausts from compression ignition and gas fuelled positive ignition engines of vehicles" (III, IV, V) gradually replaced the preceding versions. Later, the time tables of implementation for middle and heavy duty, heavy duty, motor cycle, agricultural vehicles were published on a case to case basis. On implementing the scheduling of time tables, big cities such as Beijing, Shanghai, and Guangzhou were picked as pioneers. Other cities and regions then followed suit. As of 2011, the passenger car standards were positioned differently, such as the fifth stage in Beijing, the fourth stage in Shanghai, the fourth stage in Guangzhou, and the third stage in other areas. In general, China started the vehicle emission limit later than developed countries, but proceeded at a faster pace. Europe took 27 years to reach standard III, whereas China is expected to do the same in 17 to 19 years. In addition, the emission standards between China and Europe had a gap of nine years in 2001, which was expectedly shortened to six years by 2010 (Sun, 2011). Among the developing countries, the Chinese emission regulation standard was moving forward fast.

3.2 Perspective of Fiscal and Tax Policies toward Energy Saving and Emission Reduction in Automobile Traffic

To date, except for the small quantity of hybrid electric vehicle (HEV), electric auto (EV), fuel battery auto (FEV), and so on left out of mass production, China has not established institutionalized and systematic fiscal and tax measures that dwell on incentive and punishment for traditional internal combustion engine vehicles. Before the implementation of the second stage emission standard, the Chinese government initiated a consumption tax cut for light vehicles complying with the second stage standard ahead of the deadline.

Specifically, from January 2000 to December 31, 2003, light vehicles complying with the European II standard had a 30% consumption tax exemption rate. A total of 42 companies and 1043 vehicle types enjoyed the tax cut, which amounted to 8 billion Yuan.

In 2006 and 2008, an automobile consumption rate reform was executed to add tax to big emission vehicles and reduce tax to small emission ones. In April 2006, a consumption tax rate was readjusted for the first time by reducing the tax rate for emissions below 1.5 L, retaining the tax rate for emissions between 1.5 and 2.0 L, and increasing on a large scale those with big emissions, especially those above 3.0 L. The second amendment happened in September 2008, featuring a bigger scale of increase in the tax rate against emissions above 3.0 L and a certain degree of reduction against emissions below 1.0 L. Nevertheless, the abovementioned measures are not general cases, with most of the fiscal and tax policies mainly intended to prompt the automobile industry as a stimulus or to streamline the tax system. Thus, only an indirect effect may be attributed to these polices for the purpose of energy saving and emission reduction in automobile traffic.

Meanwhile, the financial crisis was taking the world by storm and affecting China, too. The sustainable development of the Chinese automobile market slowed down and even experienced negative growth. Under such circumstances, in which both export and domestic demands were weak, the government put forward a series of active policies to maintain the economic growth and employment in early 2009. These policies included an increase in the domestic demand, an adjustment of the industry structure, and an assurance of economic growth. A quantitative ease of monetary and credit policy, and industry motivation plans, among others, were notable. As one of the pillars of major industries and as the workhorse that drives domestic demand, the automobile industry became the object in the plan for motivating industries. The automobile industry, therefore, gained relevant support for policies such as the one between March 1 and December 31, 2009, in which small emission vehicles below 1.6 L were levied a purchase tax of 5% (originally, 10%); rural residents were subsidized an especially assigned fiscal fund 5 billion Yuan in lump sum for purchases of minivans below 1.3 L or for swaps from tri-wheeled or low-speed cargo vehicles to light cargo vehicles; and the increasing fiscal subsidy was adjusted to abandon clunkers faster. All these policies lasted until the end of 2010. Thanks to these polices, the Chinese automobile market became the biggest worldwide, exceeding that of the US's when the market was extremely sluggish in 2009. In 2010, China had a sales volume of 18.06 million vehicles over the peak sales in the US. With the stimulus policies fading out, however, the growth of the Chinese automobile market began to slow down in 2011.

3.3 Policy Assessment

The above fiscal and tax policies were aimed to stimulate the development of the automobile industry. As a side effect, they also promoted small emission vehicles and caused the abandonment of older types of vehicles. From the technical standard perspective, the automobile average fuel consumption in China has been increasing very fast in recent years. The emission limit regulation has been on the right track, narrowing the gap with that of developed countries. The average fuel consumption, however, is still very high compared with that of developed countries (David et al., 2009).

From the long-term perspective, the widespread development of clean energy vehicles such as hybrid, electric, fuel cell, bio-fuel vehicles, and others, is the most effective measure to reduce automobile pollutants. However, the development and market penetration of new technology are quite time consuming. The short-term perspective has the following alternative measures: 1) the most straightforward measure to cut fuel consumption and pollutants of mainstream automobiles in the market is to speed up the technical standards of energy saving and emission reduction of traditional automobiles; 2) guaranteed improvement of relevant technical standards will urge fuel producers to promote quality fuel and reduce its harmful ingredients; 3) major aid measures for energy saving and emission reduction in automobile traffic will boost the level of automobile traffic management, alleviate congestion in city streets, increase the average running speed, and raise the input to automobile traffic and efficiency; 4) the indispensable part to promote energy saving and emission reduction in automobile traffic will encourage consumers to buy low-emission new vehicle types, and establish institutionalized fiscal and tax policies to convey incentive or punishment. This way consumers will opt to abandon old vehicles with higher fuel consumption and emission. According to the "cost and benefit" assessment method, the abovementioned measures of necessity and appropriateness may be verified by the developed countries' experience (Greene et al., 1997; Litman & Eric, 2009).

As a matter of fact, these policies imply difficulty in design and practice caused by the different policy background of energy saving and emission reduction in automobile traffic China from that in key developed countries.

4. Special Policy Background of Energy Saving and Emission Reduction in Automobile Traffic in China

According to the experience of developed countries (Parry et al., 2007), the policy system of energy saving and emission reduction in automobile traffic mainly consists of two parts. The first one is the legalized and statutory rules and technical standards of the regulation policy. The second part consists of the fiscal and tax policy, including incentive and punishment. The two sets of policies well supplement each other. For example, in the US, companies that fail to match the CAFÉ standard will be fined, and consumers who purchase new vehicles with low technical standards will be charged with consumption tax. In Japan, companies that fail to match technical standards will be fined, and consumers who purchase new vehicles with a "low emission" certificate will be exempt from the tax purchase and owning (Liu, 2010). How these policies are formed is highly related to the policy background in developed countries. First, governments will not pay much attention to the technical difference among automobile companies because the technical gap is narrowing down; second, apart from the very fundamental future technology, companies apply the R&D of technology of energy saving and emission reduction in their automobiles. Therefore, in developed countries, the technical standards and fiscal and tax policies can be executed in a fast and efficient manner. A synchronous and high level of technical standards and active fiscal and tax policies must be taken to promote energy saving and emission reduction in Chinese automobile traffic. However, Chinese policy makers still face the following special background.

4.1 China is still an Extension of the Automobile Industry

In recent years, notwithstanding the dramatic extension of the automobile market volume, the automobile industry per se in China has remained in a stage of industry predevelopment. As mentioned earlier, the effect of the automobile industry on the Chinese economy is eminent and grows more important, regardless of whether it is considered to spur economic growth, tax, employment contribution, and technical improvement on the industries. China is a major manufacturing country, and its automobile industry needs to be cultivated to a comparatively large-scale and high technical level. Thus, the radical policy system, which is prejudicial to the development of the Chinese automobile industry, can hardly be formulated.

4.2 China Needs to Cultivate and Develop its "Self-Owned Brands"

China has a so-called extremely competitive automobile market, an effect of the early policy orientation of the "market for technology," All the large state-owned automobile companies are involved in joint ventures with the main world automobile giants. In the meantime, in response to the "self-development" policy, in recent years, an urgent concern for the government and the companies is to cultivate and develop "self-owned brand" automobiles. This problem implies the pursuit for the market of Chinese automobiles and the control over technology, as well as the hope for cultivating important export products in the future. The issue of how to reinforce "self-owned brand" automobiles within the WTO framework is avoidable for the current Chinese automobile industry. No policy can build a bigger and stronger automobile industry at the expense of its "self-owned brands."

4.3 Special Property of Development Mechanism of the Automobile Industry

For some historic reasons, a special property in the development mechanism of the Chinese automobile technology exists, including energy saving and emission reduction in automobile traffic (together with new energy automobiles). In China, generally, the national research institutes and universities as well as their joint programs (e.g., 863 programs) with state-owned companies assume the R&D of automobile technologies with their own intellectual properties, including fundamental and future technologies in which the government gives financial support.

5 .Constraints Binding the Formation of an Overall Policy System in China

From the perspective of the combination of the special property of energy saving and emission reduction in automobile traffic, and the Chinese policy background, the process of formation of energy saving and emission reduction in automobile traffic incorporates relevant administrative departments, foreign parties, and Chinese parties of automobile industry joint ventures, private companies, automobile owners, and consumers of public traffics. Thus, this is a gaming process with constraints on the formation of an overall and effective policy system.

5.1 Balance Between "Automobile Development" and Environmental Problems

The progress taken by government departments is different. The departments strongly related to the automobile industry pay more attention to its driving force in the Chinese economy.

They are committed to building a stronger and larger automobile industry, and are inclined to solving the energy saving and emission reduction problem while upgrading the industry and technology, promoting technical standards, and implementing fiscal and tax policies where "self-owned brands" are advanced. In contrast, the departments related to environmental protection are more concerned about environmental improvement. They tend to raise the technical standards and fiscal and tax polices of energy saving and emission reduction. In addition, the departments closely related to R&D give more emphasis on technologies with their own intellectual property because they take the middle- and long-term strategic vision on the policies. One notable example is the difference among these departments in influencing the definition and subsidy standard of Chinese new energy automobiles, particularly on how to treat the transnational companies' dominant hybrid automobiles. Naturally, these departments differ in their influence regarding the progress of policies.

5.2 Environmental Problems

Compared with transnational companies, Chinese "self-owned brands," particularly the brands of private companies, have experienced extensive drawbacks in technology and the recognition attributed to endowment. They may supersede to some extent due to some late mover advantage (Tian, 2010), but the disadvantage against the transnational companies in technology and brand cannot be ignored. In China, R&D with its own intellectual property is dominated by governments via the funded state and university institutes, and main state-owned automobile industries in the form of important scientific research programs. In the absence of the discussion of how the "market for technology" strategy performs, transnational companies clearly dominate R&D and the products launched in their joint ventures with Chinese state-owned companies. Thus, they are able to produce new products with the same technical standards of energy saving and emission reduction as those in their home countries. However, local companies with poor endowment, especially private companies, may find it a challenge to acquire the independent development of new technology. Therefore, similar to that in developed countries, regardless of the property of capital of the research entities and companies, the simple fiscal subsidy based on the technical level will face objections. Disregard of the technical gap between "self-owned brands" and transnational brands, and fast implementation of technical standards, especially in cases where only fiscal and tax policies are decided, as per the technical level, are unacceptable. The national strategy that insists on developing "self-owned brands" is notably influential in addressing the issues of environmental problems from automobile traffic.

5.3 Balance Between the Focal Point of Fiscal and Tax Policies and Environmental Problems

Based on the life cycle of automobiles, fuel consumption and pollutant emission happens mainly in the process of driving. Thus, the most efficient and reasonable fiscal and tax policies should demonstrate the cost of driving. Increasing the cost of automobile use can make consumers buy energy-saving and environmentally friendly automobiles, and also stabilize the technical effort paid by automobile companies. Generally speaking, the focal point of the automobile-related tax of developed countries is placed on fuel tax in the process of use. In China, however, the focal point is placed on manufacturing and sales. This tax system does not have due efficiency on the development of the automobile industry and the energy saving and emission reduction of automobile traffic. Further increasing the cost of driving may also be difficult.

5.3.1 Conflict between social vehicles (e.g., transport, private vehicles) and business vehicles

The cost incurred by the purchase, use, and upkeep of business vehicles is borne by the fiscal budget. The increase in cost of driving can neither change the pattern of business vehicles nor motivate energy saving and emission reduction. Therefore, the further addition to the cost of driving will increase the expense of fiscal fund given the big scale of business vehicles. Certainly, while the business vehicles are reduced steadily and gradually, the percentage of "self-owned brand" business vehicles can be managed to show the support given to "self-owned brands."

5.3.2 Cost of use of social vehicles

Currently, social vehicles pay extra charges, e.g., road toll, apart from fuel expenses. The per kilometer cost for a social vehicle is high. Hence, the excessive cost of driving not only increases the traffic cost of families with vehicles, but also places more pressure on logistics and, therefore, on the cost of traffic and non-traffic for all residents. Further increase in the cost of driving must be accompanied with a simultaneous reduction in the cost of purchase, upkeep, and other activities. In other words, the focal point of automobile-related tax should gradually transfer from manufacturing, selling or purchasing, and upkeep to the process of using.

5.3.3 Conflict between residents with and without vehicles

Energy saving and emission reduction are helpful in improving the environment, and the residents without vehicles benefit from this, too. However, as a country with a large low-income population, the direct subsidy from the fiscal budget for energy-saving vehicles, notwithstanding new energy vehicles, is not fair to the low income population who do not buy vehicles and only take public transportation. The policy does not conform to the principle of the "environmental externality cost taken by polluters." At present, it may not be regarded as a simple environmental problem in which increasing the cost of driving or subsidizing low fuel consumption and low emission vehicles is used to adjust the fuel consumption of vehicles and increase the efficiency of energy saving and emission reduction in automobile traffic, but a political economic problem involving multiple parties.

6. Policy Solution Analysis

Based on the above discussion, China has many constraints influencing the fast progress of its overall policy system for energy saving and emission reduction in automobile traffic. The task of forming an effective overall policy system and increasing the actual efficiency will test the intelligence of the decision design departments and administrative departments. In recent years, focus has been given to new energy vehicles, to which the increment of support is necessary. However, the support policy for new energy vehicles cannot avoid the constraints discussed by this present paper. Meanwhile, subject to technical constraints, new energy vehicles cannot easily take a position in the mainstream in the short and medium time horizon (this issue will be analyzed in another paper due to space constraints). Here, the policy and measures that may increase the efficiency of energy saving and emission reduction in automobile traffic for China are explored on the basis of traditional vehicles as mainstream as well as the above constraints.

This paper argues that, under the existing constraints, a policy of "limit the new, expel the old" may be considered for new and current owner markets. Effort from multiple sources will be needed. Automobile companies should not only be encouraged to conduct R&D of new energy automobiles and speed up the pace of industrialization and commercialization, but also to improve the technical level of traditional inner combustion engines in the sense of energy saving and emission reduction. Consumers should be encouraged to buy vehicles with low fuel consumption and low emission. Older types of vehicles in use should be abandoned soon to lower fuel consumption and emission as a whole. Certainly, one indispensable way to relieve city congestion and improve the average driving speed is to make policies for developing public traffic and reducing the average mileage of private vehicles. However, given the ineffective control of the total quantity of automobiles, the inability to change preferences in automobile consumption in a short period, and the impossibility of increasing the percentage of new energy vehicles, the efficiency of energy saving and emission reduction in automobile traffic will directly hinge on the improvement in average fuel consumption and emission levels from existing vehicles, for the time being. Based on the constitution of the emission share in 2010, 20.2% of the oldest vehicles in China emit 70.4% nitrogen oxides, 64.2% hydrocarbon, 59.3% carbon monoxide, and 91.1% particulate matters (Note 1). Therefore, based on the special policy background and market environment, the policy "limit the new, expel the old" is plausible. "Limit the new" means gradually promoting technical standards of energy saving and emission reduction for new vehicles, and keeping out the types not in compliance with standards. "Expel the old" means speeding up the pace of abandoning old types of vehicles, and realizing the rolling improvement in average fuel consumption and emission levels for the existing ones.

Stated specifically, in the new automobile market, only energy saving technical standards are adopted and will be gradually improved according to the technical progress of "self-owned brands," whereas fiscal or tax policies that stress on incentive and punishment measures against technical levels will not be considered. In the new automobile market, these policies will gradually improve the energy saving and emission reduction technical levels. The preferential subsidy on transnational companies that own superior technical standards can be avoided, thus favoring "self-owned brands." The incentive fiscal policy, one of the policies in many developed countries, adopted in the new automobile market with energy-saving technology is effective, such as the subsidy program for hybrid vehicles in Japan and the US. In addition, the combined policy of "incentive and punishment" works more effectively. Sun (2011) used a mixed CGE with an automobile quantity to analyze and simulate the "incentive and punishment" fiscal policy. The quantitative findings show that, from the perspective of macro-economy and overall benefit of the automobile market and energy saving and emission reduction, simple incentive and punishment are far less effective than the combined policy.

However, considering the features of the Chinese automobile market, parallel care should be given to "self-owned brands," and the combined policy is better suited to the owner market. Therefore, the worn older-type vehicles should be subject to the policy of "incentive on banishment, punishment on owning." This way, the policy will be regularized and institutionalized, older vehicles will be phased out step by step, and the energy saving and emission reduction level will be improved steadily.

Regarding the feasibility of the policy, the technical standards of energy saving and emission reduction in the new automobile market have been regularized and institutionalized. All that is needed now is an adjustment of the pace of increasing the standards. In the owner market, the combined policy of "incentive and punishment" is now mature. Existing vehicles that entered the market during the rapid growth period from 2002 up to now (over 10 years) are being abandoned, and will continue to be abandoned year by year. Out of 200 million vehicles in the US, 12 million (6%) are abandoned every year. Out of over 60 million vehicles, 0.5 million (1%) were abandoned in 2008 due to legal formalities. The actual abandoned quantity is dramatically different from the percentage of abandoning (Note 2). The direct subsidy against clunkers should be given to consumers buying new vehicles, the punishing tax should be levied on owning vehicles of excessive age, and the tax revenue should be used in subsidizing new buyers.

Ensuring the steady development of the automobile industry and promoting "self-owned brands" portray the special background of the Chinese automobile market, under which the "limit the new, expel the old" policy aims to improve the technical level of energy saving and emission reduction in the new automobile market. Moreover, it aims to upgrade the overall social level steadily in energy saving and emission reduction. Again, the policy will not give preferential subsidy to products of transnational companies and suppress "self-owned brands." Finally, increasing the abandoning of old vehicles will result in a new demand for new automobiles and bring steady development to the market.

References

DL. Greene, DW. Jones and MA. Delucchi (Ed.), 1997. *The Full Costs and Benefits of Transportation: Contributions to Theory, Method, and Measurement*. Springer, New York.

Lan-jian, Li, 2010. The Comparative Research on Automobile Energy-saving and Emission Reduction Policies among China, United States and Japan. *Forum on Science and Technology in China*. No. 6: pp. 155–160 (in Chinese).

Lin, Sun, 2011. *Automobile-related Energy, Environment and Transportation Policy Research—Construction and Application of a Hybrid CGE Model*. Shanghai Academy of Social Sciences Press, Shanghai (in Chinese).

Lin, Sun (2011). Transportation Problems and Policy Solutions in China. In Hiroaki, Miyoshi & Masanobu, Kii (Eds.), *Technological Innovation and Public Policy*, Palgrave Macmillan, London, pp. 171–198.

Parry IWH, Walls M, Harrington W., 2007. Automobile Externalities and Policies. *Journal of Economic Literature* 45 (2), 373-399(27).

Mingfa Yao, Haifeng Liu, Xuan Feng, 2011. The Development of Low-carbon Vehicles in China. *Energy Policy* 39 (9), 5457–5464.

Todd Alexander, Litman & Eric Doherty, 2009. Transportation Cost and Benefit Analysis: Techniques, Estimates and Implications. Second Edition 2 (http://www.vtpi.org/tca/tca01.pdf)

Wagner D.V., An F., Wang C., 2009. Structure and Impacts of Fuel Economy Standards for Passenger Cars in China. *Energy Policy* 37 (10), 3803–3811.

Wen-hua, WU et al., 2008. Transportation Energy Efficiency, Energy Saving Potential and the Countermeasure Analysis. *Macroeconomics,* No. 6: 28–33 (in Chinese).

Yan-ping, YANG et al., 2009. Research on the Comprehensive Assessment of Automobile Energy Saving in China. *China Soft Science*. No.1: 15–19 (in Chinese).

Zhi-long, Tian et al., 2010. The Operation Strategy of the Weak Late Comers in China s Auto Markets: a Study Based on the Cases of China s Auto Companies such as Jili, Qirui, Huacheng, BYD and Hafei. *Management World*. No. 8: 139–152 (in Chinese).

Note

Note 1. See *China Vehicle Emission Control Annual Report*, released by the Ministry of Environmental Protection of the People's Republic of China (http://www.envir.gov.cn/info/2011/12/1220300.htm) (accessed March 3, 2012).

Note 2. See http://finance.sina.com.cn/roll/20090817/00033014113.shtml (accessed March 3, 2012).