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Can Vehicle Scrappage Programs Be Successful?

In many cities, a small fraction of vehicles have been found to contribute disproportionately to total vehicular emissions. Repairing, upgrading or else scrapping gross polluters in urban centers with serious vehicular air pollution can improve air quality at relatively low cost to society compared to other air pollution control measures. Experience suggests, however, that it is difficult to design a cost-effective scrappage scheme. The guiding principle is to concentrate on high usage, high emission urban vehicles that still have a significant residual life in the absence of a scrappage scheme. For the scheme to be effective, an understanding of the local vehicle market, including the impact of the scrappage scheme on it, is important. Essential elements of a scheme include a reliable and up-to-date vehicle registration system, a good emissions inspection system, effective enforcement of scrappage, and appropriate vehicle import and registration policies.

Eliminating gross polluters can be an important instrument for reducing transport-generated air pollution because of their disproportionately high contributions to pollution. In practice, however, environmentally motivated scrappage schemes have not always been cost-effective. This note discusses the role and design of government initiatives to accelerate vehicle scrapping in the light of that experience.

Scrap or Upgrade?

In targeting gross polluters, a reasonably accurate method of identifying gross polluters is needed. The identification of gross polluters poses a challenge. Some vehicles visibly pollute more than others, but some pollute without showing visible signs. Even among the visible polluters, which ones actually pollute the most cannot be determined by visual inspection alone. Moreover, the method for identifying gross polluters needs to be inexpensive and simple to carry out. In principle, the cost of identification plus the market value of the vehicle being scrapped (or the repair cost, as appropriate) should not exceed the environmental benefit of removing or repairing the vehicle. While environmental benefits are difficult to calculate precisely, some estimate is logically necessary in deciding how much it is worth paying to get a vehicle replaced. A good emissions inspection system that accurately measures emissions is an important pre-requisite for selecting highly emitting vehicles for scrappage. In practice, in the absence of adequate infrastructure for measuring emissions, or simply to save costs, vehicle age is often used as a proxy: only vehicles older than a certain age are considered.

Once gross polluters are identified in some fashion, the next question is whether they should be repaired or scrapped. If the cost of repairing the vehicle to reduce emissions to a reasonably low level exceeds the market value of the vehicle, then the vehicle should be scrapped.

In the case of repairing, rather than simply repairing to the original vehicle specifications, retrofitting with more recent technology engines and parts is often an effective strategy. Such retrofitting can be mandatory or driven by tighter emission standards. Fitting catalytic converters is the most obvious retrofit for which incentives have been offered in Germany and Hungary for many years. Engine retrofitting is especially suitable for buses and heavy goods vehicles. An example is the Urban Bus Retrofit/Rebuild Program in the United States which targets buses in major cities for retrofitting with a combination of modern engines and exhaust treatment systems (certified to reduce particulate emissions) at the time of engine rebuild or replacement.

The remainder of this note discusses three main types of scrappage schemes: (1) incentives to scrap without replacement *(cash for scrappage)*; (2) incentives to replace with new, or less polluting, vehicles *(cash for replacement)*; and (3) other fiscal and administrative devices which, although not offering direct financial incentives to scrap, operate through their impact on the scrapping decision *(indirect scrappage incentives)*.

Designing a Scrappage Policy

The total cost of a scheme is the cost per vehicle (C) multiplied by the number of vehicles scrapped (N). The environmental benefit is the difference between

(1) the product of the emission rates per kilometer (km) traveled (ER) and the number of vehicle kilometers traveled (VKT) for the old vehicles, and (2) the same calculation for their replacements, all multiplied by (3) the number of vehicles replaced and the length of period over which benefits continue (L).[1] In principle the distance driven may not be the same for the old and replacement vehicles: replacements may be more comfortable and consume less fuel than the originals and hence attract greater use. But the empirical evidence is that this effect is likely to be very small.

Based on the above, benefits per dollar spent increase as the following variables increase:

- The emission levels of vehicles scrapped
- The cleanness of the replacement vehicles
- The number of replacement vehicles attracted per dollar of incentive
- The residual life of the vehicles scrapped
- The annual km traveled of the vehicles replaced.

This leads to a number of important guidelines for the design of scrappage schemes. It is sensible to concentrate on high usage, high emission urban vehicles that still have a significant residual life in the absence of a scrappage scheme. In practice these criteria are not independent of each other and hence it is necessary to understand the complexity of the vehicle and service supply markets in order to ensure the cost-effectiveness of a scrappage scheme.

The cost-effectiveness of vehicle scrappage policies should be compared with that of other options for reducing air pollution. The cost efficiency indicator defined above gives a measure of cost per unit of pollution reduced, and is directly comparable with the cost-effectiveness of other air quality management alternatives—whether enforcing tighter emissions standards across all vehicles, mandating cleaner fuels or new vehicle technologies, or some other measure affecting other, non-vehicular sources of pollution such as industry or refuse burning. Estimating the comparable cost of available alternatives is important to ensure that the proposed way forward is, in fact, cost effective.

The Market for Vehicles

Vehicle owners and operaters, whether individual or commercial, are motivated by private financial costs and benefits. Their response to financial incentives in turn affects the entire vehicle market and hence even the decisions of those who do not directly respond to the initial financial inducements.

Even where a scrappage grant is not in cash (for example in Canada, one option offered was a free family public transport pass rather than a cash grant), experience with schemes throughout the world has shown that few owners choose not to replace their scrapped vehicles. The critical questions then are (1) what they replace the scrapped vehicle with, and (2) what other effects the process might have on vehicle usage.

For car and motorcycle replacement, the market appears to be segregated into two categories. The first, consisting of individual or business users of relatively high income, tend to replace existing vehicles with new vehicles every few years. The second, normally purchasers of second vehicles or lower income households, buy used vehicles and replace them with younger, but still used vehicles.

Even the bus and truck markets are often effectively segregated into large fleet operators at the top end of the market using newer vehicles, and smaller operators supplying parts of the market demanding lower quality of service with older, secondhand vehicles. For example, the bus industry in Bangkok is segmented by vehicle quality: private sector sub-contractors to the publicly owned Bangkok Mass Transit Authority (BMTA) supply basic, low-fare service with old vehicles—often very polluting—sold on to them by BMTA.

Considerations in Designing Scrappage Schemes

Ideally, qualification for a scrappage incentive should be based on the actual emissions of vehicles scrapped (and those replacing them). This approach, however, creates the moral hazard of owners increasing their vehicle emissions in order to qualify. It is common, therefore, for scrappage schemes to use vehicle age as the qualifying criterion, even though this can have perverse results if the minimum age is relatively low (say 10 years) and the premium relatively high. The reason for that is that the scrappage premium effectively sets the minimum price of a secondhand vehicle. Insofar as there remains a group of consumers that demands, and can only afford, a very cheap old vehicle, this may actually encourage them to hold on to their old vehicles even longer, because replacement vehicles now cost more than before the introduction of the scrappage scheme. It also invites imports of cheap old vehicles from other areas or countries. This may have the perverse result of vehicles being replaced by those that are older or dirtier than would

[1] A cost efficiency indicator can thus be simply written as:

$$\frac{C \cdot N}{(ER_{old} \cdot VKT_{old} - ER_{rep} \cdot VKT_{rep}) \cdot L \cdot N}$$

More sophisticated indicators would discount benefits and costs appearing at different points in time to a common base date, and/or sum across different vehicle types associated with different values of the various parameters.

have been the case without the scheme. To prevent such an outcome, the government may thus need to accompany a scrappage scheme with strong emissions testing as well as an age limit on vehicle imports.

Offering incentives also introduces the danger that cars no longer in use will be presented as qualifying for a scrappage incentive. This can be countered at the very least by requiring that vehicles must be driven to the scrappage center in order to qualify [1]. Another danger is that vehicles not operating in polluted urban areas migrate in order to take advantage of the incentive. The chances of such migration may be reduced by limiting schemes to vehicles registered in specific targeted area.

Lastly, unless vehicles traded in for cash or replacement are actually scrapped, the scheme merely increases the total vehicle population. In the extreme case, "scrapped" vehicles can be sold outside the targeted area, only to migrate back and "scrapped" again, collecting cash several times over.

All this points to the importance of having a reliable and up-to-date vehicle registration system, effective enforcement of scrappage and vehicle import and registration policy. All these requirements present a serious challenge in South Asia. In the process of strengthening the registration and enforcement systems, environmental non-governmental organizations and industrial associations can play an important role in monitoring the execution of scrappage schemes.

Cash for Scrappage

In cash for scrappage, the size of the incentive is an important variable. The larger the bonus, the more vehicles that are likely to be scrapped. However, if the oldest and most polluting vehicles are the first to respond, there will be diminishing returns as the scrappage bonus increases. A U.S. study [2], based on a pilot scrappage study in Delaware, concluded that a scheme with a very low incentive by U.S. standards ($250) would be more cost-effective than schemes with higher bonuses designed to have higher take-up rates. The cost-effectiveness of vehicle scrappage schemes may also fall sharply as the average environmental quality of vehicles improves.

Scrappage schemes must therefore be carefully designed and coordinated with other public policies affecting the workings of the vehicle market. A scheme implemented in Norway in 1996 gave a bonus of the equivalent of US$880 (1997) for the scrapping of any vehicle over 10 years of age and secured a net increase of 150,000 in scrapping (above those that would have been scrapped without the scheme). The scheme, however, did not impose any limits on the replacement vehicle, and an ex-post analysis showed a poor benefit-to-cost ratio of 0.5 [1].

Cash for Replacement

If cash is to be offered for replacing scrapped vehicles, it may seem reasonable to insist that a new vehicle be bought. New vehicles embody cleaner technology than those of older vintage, and moreover the cleaner technology is likely to be longer-lasting.

Cash for scrappage schemes may have the perverse effect of increasing pollution unless coordinated with other vehicle market policies.

However, any attempt to force replacement by a new vehicle will tend to be attractive to those who are replacing relatively young vehicles, such as high income households and users of cars for business. Experience in Denmark, France and Italy shows that only 10 percent of annual replacements involves replacing a car more than ten years old by a new one. It will require a very large inducement indeed to bring about the direct replacement of a significant number of very old vehicles. A scheme in Hungary which targeted old, highly polluting, two-stroke engine models and required their replacement by new models failed to attract many replacements.

Cash for replacement schemes may attract a higher take-up rate if replacement by secondhand vehicles also qualifies for grant. But this would be of environmental value only if the emissions of the replacement vehicle were also tested and shown to be significantly lower than those of the vehicle being scrapped. In Greece the bonus was paid only if the replacement vehicle had a catalytic converter.

Despite these caveats, scrappage schemes can be effective in stimulating replacement technology for commercial operators, many of whom respond to economic signals and replace old vehicles (with deteriorating fuel economy and increasing maintenance costs) with newer, cleaner and more efficient vehicles. Large fleet operators of buses and trucks may be especially responsive, as they keep their vehicles for a long time, but are accustomed to buying new replacement vehicles.

Indirect Incentives

A number of incentives other than direct scrappage grants can be used to affect vehicle life.

Vehicle taxes are the most obvious. For example, the German and Hungarian governments give tax advantages for the purchase of lower pollution vehicles. A variation is a reduction in import duties for cleaner vehicles and engines. Nepal reduced import duties on component parts for electric mini-buses to replace diesel equivalents which were banned in the Kathmandu Valley.

Box 1. Bus replacement in Bogotá, Colombia

In preparation for implementing Transmilenio (see Briefing Note No. 3, [3]), Bogotá's bus rapid transit system, the government of Bogotá took a series of measures that included the replacement of old buses by new. More specifically, the government

- Required that operators bringing in new buses licensed to operate in Transmilenio demonstrate that the equivalent number of old buses had been scrapped and their licenses canceled. For each new articulated bus operating in Transmilenio, 3.6 executive buses, 2.7 regular buses, 5.3 medium-size buses or 10.7 microbuses had to be scrapped. The operators were required to produce a document certified by an international auditor proving that old buses had been scrapped.
- Suspended in the early 1990s registration of additional public transport vehicles for two and a half years, later extended to 31 December 2000 when Transmilenio became operational. However, the bus population continued to increase rapidly due to illegal entry.

Source: World Bank staff

The introduction of *environmental and safety standards and strict enforcement* through an inspection and maintenance program has a similar effect. Not only does this encourage owners to keep their vehicles in good condition, it also encourages replacement of vehicles for which it becomes increasingly expensive to meet the standards.

Public transport franchising policies can also be very important, particularly where buses are a significant part of the urban air pollution problem. Both Santiago, Chile and Bogotá, Colombia have incorporated environment objectives in their public transport policies (see Box 1). The important element of both schemes was that they recognized the need to maintain affordable public transport service. Environmentally oriented vehicle replacement requirements were therefore incorporated in a broader scheme which ensured the continued financial viability of the operating agencies. The Bogotá case illustrates that forced scrappage of public transport vehicles can be effective in the context of well regulated franchise systems, but can be very damaging outside such a context because of lack of financial sustainability.

Conclusions

- Scrappage schemes need to be very carefully targeted at proven high polluters.
- The cost-effectiveness of scrappage incentive schemes should be compared with that of other fiscal and administrative instruments.
- Scrappage schemes will be successful only if introduced in the context of a strong enforcement of operational emission standards.
- Scrappage without replacement schemes may be effective for private cars, but replacement schemes for private cars are recommended only if carried out on a relatively small scale, with careful policy measures in place to screen the vehicles for replacement adequately.
- Scrappage with replacement schemes are most appropriate for public transport vehicles, especially in the context of service franchising.

References

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