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The principal–agent problem and transport energy use: Case study of company lease cars in the Netherlands

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ABSTRACT

Barriers exist for improvement of energy efficiency, of which the principal–agent problem is considered an important one. The principal–agent problem is a potential barrier for energy policies based on economic instruments, as the decision maker may be partially insulated from the price signal given by such policies. We estimate the size and the impact of the principal–agent problem for cars provided by companies as a benefit to employees in the Netherlands. Of all passenger cars in the Netherlands, 11% is classified as company cars, which consume 21% of the total energy consumption by passenger cars. As company cars are newer, operate more diesel engines, but are also larger, the fuel efficiency is slightly worse than that of private cars. Company cars seem to drive longer distances for commuting than the national average of private cars. Together, this might result in a net 1–7% increase of all fuel use of passenger cars in the Netherlands. This indicates that there is potential to reduce energy consumption of company cars and a need for policies aimed at improving energy efficiency of company cars.

1. Introduction

Most, if not all, recent scenario studies show that in the next decades energy-efficiency improvement is the key option to mitigate greenhouse gas emissions, and that a considerable potential exists in any sector and economy. However, realization of this potential is subject to various barriers. Many studies have demonstrated the existence of market barriers for energy-efficiency improvement (IPCC, 2001; DeCanio, 1993, 1994; Koomey et al., 1996; Sorrel et al., 2004), of which some are market failures, i.e. barriers that may lead to increased (energy) costs and hence a sub-optimization. One of the market failures is the so-called the principal–agent problem (Howarth et al., 2000). The principal–agent problem arises from asymmetric information, uncertainties and risks in the relationship between a principal and an agent. In this market failure, the stakeholders have split incentives that may lead to inefficiencies, i.e. the principal (e.g. tenant) has the interest to keep the energy costs of a home or office low as he/she pays the energy bills for the property, while the agent (e.g. the property owner) has a different incentive, i.e. keep investments as low as possible at a given rental income (IEA, 2007).

In the context of this research, the principal–agent problem is a combination of two cases of split incentives, one concerning usage (demand for energy services) and the other concerning the technical efficiency of the end-use device. The principal–agent problem can be categorized according to the two-by-two matrix as given in Table 1, which classifies the technology according to the user's ability to choose the technology and the user's responsibility for paying associated energy costs.

Similarly, the principal–agent problem does play a role in the market of leased company cars. We examine a specific example of the principal–agent problem that is hypothesized to exist in fleets of vehicles owned by organizations/companies and operated by individuals who do not pay the full cost of ownership and use, including fuel use. The hypothesis is that since individual operators are not responsible for either vehicle selection, and operation, which both affect fuel economy, the principal (fleet owner or payer of fuel bills) would like to minimize fuel costs, but the agent (vehicle operator) may have no incentive to conserve fuel.

In the Netherlands, company lease cars are often provided to employees as an attractive co-benefit besides salary. The offer of a lease car is based on an employee's salary and work description; if an employee has to travel or has a high position, he or she might be offered a lease car. The car can be used for both professional and private use, while fuel costs are often paid for by the company. Often a domestic fuel card or one that can be used across Europe is provided with the car. This structure results in a situation where employees operating a company car have no

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Table 1
Principal–agent classification of energy end users

	Chooses technology	Does not choose technology
Pays energy bill	Category 1: potentially no principal–agent problem	Category 2: efficiency problem
Does not pay energy bill	Category 3: usage and efficiency problem	Category 4: usage problem

financial incentive to limit fuel consumption and costs that are fully covered by the company. While the income tax system in the Netherlands taxes the use of a company lease cars to the extent it is used for private use, a company car is still considered an attractive co-benefit of a given job, especially as enforcement of the taxation is difficult. A share of the book value of the car is added to the taxable income of a household. This is done to reduce the advantage of company cars in terms of private use. If the mileage for private use remains below 500 km/yr (to be proven with a detailed travel administration) no amount is added to the taxable income. If the mileage is above 500 km/yr, 22% (Belastingdienst, 2005) of the book value of the car is added. This leads to an increased income tax of €2000–2500, depending on income level and an average book value of €20,000. The increased income tax is roughly equivalent to 11,000 km driving (or €0.2/km). Commuting is not considered private use of the company car by the Netherlands tax authorities. For some households it may therefore be more economic to use their private vehicle for private travel and stay below the 500 km/yr threshold value for private travel with the company car. The share of households staying below 500 km/yr is however likely to be small. The average mileage for private use of company cars was found to be 8700 km/yr, so most company cars are expected to exceed the threshold. Only recently (2008) have the Netherlands tax authorities started to enforce the taxing of the private use of company lease cars through photosurveillance.

In this particular case study, categories 3 and 4 of the principal–agent problem are applicable (see Table 1). In the Netherlands, vehicle fuel costs of company cars are paid by companies but operated and sometimes selected by individuals with no motive to save fuel. Fig. 1 depicts the financial relationship between the actors for company lease cars.

Sometimes employees are allowed to choose their own car, sometimes from a number of given options, in which category 3 applies. In other cases, cars are selected by companies themselves, in which category 4 apply. Sometimes these companies have an entire car fleet of the same or a few types of vehicles. The share of company cars that is selected by employees (category 3) versus the share of cars selected by companies (category 4) is unknown. The principal–agent problem may have two effects:

1. company cars are larger, more powerful and less fuel efficient than driver-owned cars and
2. the distance travelled by company cars is higher than the distance by driver-owned cars, because of more private travel and/or higher travel distance for commuting (see discussion above).

In the analysis, we make a distinction between company cars, i.e. cars that are owned and financed by companies, and used by individuals employed by the company, and driver-owned cars, which are privately owned and operated by individuals (hereafter named private cars). There are two types of company cars. The first is leased cars that are owned by car lease companies.

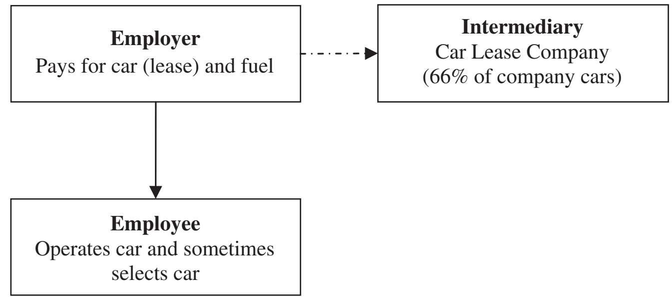

Fig. 1. Schematic representation of the relationship of various stakeholders in the analysis of company (lease) cars.

The second is cars administered and financed by companies themselves, i.e. company-owned fleets; we do not distinguish between the latter two groups, as we lack sufficient data to do so. This may affect the results.

This study was done as part of a larger study coordinated by the International Energy Agency (IEA) to study the extent of the principal–agent problem. The IEA study used case studies from many sectors in a number of countries (e.g. Australia, Japan, Netherlands, Norway, and the United States), which resulted in the book ‘Mind the Gap’ (IEA, 2007). In this article we report on a case study that was not included in the book due to the specificity of the case study. However, we believe that important lessons can be drawn from this case study, despite the specificity for the Netherlands, for the analysis of the principal–agent problem and for (energy) policy design.

In this paper we report on the methodology and data sources used. We discuss the energy use by the different types of cars, the magnitude of the principal–agent problem, as well as the net impact on energy use by passenger cars in the Netherlands. We end with a discussion of the results and conclusions with respect to the principal–agent problem, as well as policy implications.

2. Approach and data sources

In this paper we take three steps to estimate the impact of the principal–agent problem on energy use by passenger cars in the Netherlands (see also IEA, 2007):

1. Estimate the population of end-users affected by the principal–agent problem.
2. Estimate the energy consumption affected by the principal–agent problem.
3. Estimate the impact of the principal–agent problem on energy use (or the potential energy savings if the barrier would be removed).

The energy used by passenger cars is affected by a number of factors, including fuel efficiency of the car and the distance travelled. The fuel efficiency of the car is affected by the type, weight, age, and fuel/technology (e.g. internal combustion, hybrid, diesel, gasoline). While fuel efficiency is also affected by the driving style (e.g. tyre pressure) there is insufficient data to include these in the analysis, and there is no reason to assume a difference in driving style due to the principal–agent problem observed.

Based on surveys and model calculations, there is a rich dataset in the Netherlands that allows to study a number of characteristics of the passenger car fleet in the Netherlands and to distinguish between privately owned cars and company lease cars. This allows addressing the three steps of the analysis.

The data sets are provided by the Netherlands Central Bureau of Statistics (CBS) as well as the Netherlands Environmental Planning Bureau (MNP, formerly named RIVM). These datasets make it possible to analyze the following factors:

- fuel mix and fuel consumption
- mileage
- fuel intensity of car fleet and car weight
- total number of company cars
- fuel mix and consumption of company cars
- age distribution of cars
- car size
- travel purposes.

Also, in the Netherlands, the transport sector is one of the fastest growing energy using sectors and sources of greenhouse gas emissions due to a rapid increase in fuel use by cars. The total fuel consumption by passenger cars has increased from 184 Peta Joule (10^{15} Joule, PJ) in 1980 to 260 PJ in 2000, and has not stopped growing since. In 2000, passenger cars consumed around 260 PJ of fuel, or 8% of the total energy use in the Netherlands. The share of diesel in total fuel consumption has increased from 19% in 1991 to 24% in 2000, while the share of LPG in total fuel consumption has decreased from 16% in 1991 to 8% in 2000. The 2000 passenger car fuel consumption consists of 24% diesel, 8% LPG and 68% gasoline. Fig. 2 shows the total fuel consumption by passenger cars in PJ for the period 1991–2000.

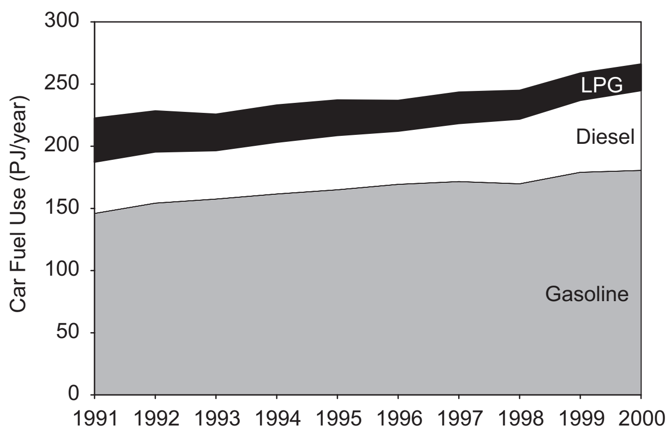

Fig. 2. Total fuel consumption by passenger cars in the Netherlands for the period 1991–2000 (in PJ/year). *Source*: CBS, 2005.

Fig. 3 depicts the development of transport service provided by passenger cars in the period 1992–2003, expressed as person-kilometres. The label "Driver" refers to the number of vehicle km (v.km) made by cars. The label "Passenger" refers to the distance travelled by passengers other than the driver in cars. The total is the number of passenger km (p.km) made by cars. The total transport distance in vehicle km has increased by 13% in the period 1992–2003. For the period 2003–2020 an increase is expected of 34%, from 146 p.km in 2003 to 172 billion p.km in 2010 and 195 billion p.km in 2020 (RIVM, 2000). The average number of car occupants has decreased slightly from 1.63 persons per car in 1992 to 1.57 persons per car in 2003.

Remarkable is that the fuel intensity has not decreased in the period 1992–2000, and that over the period 1980–1995 it actually increased (Farla and Blok, 2000), see Fig. 4. Engines and power trains have become more efficient, but this efficiency gain is compensated by an increased car weight, resulting in no net improvement in fuel efficiency. The average weight of new cars has increased from around 1050 kg in 1996 to around 1200 kg in 2004. The average weight of cars in the current car fleet is around 1080 kg. In 1996 this was 963 kg (Wilmink et al., 2002). This is an increase of 12%. The share of new cars per category of car weight is shown in Fig. 5. The share of new cars with a weight above 1150 kg has increased from 30% in 1996 to 60% in 2004. Moreover, engine power has risen faster than car weight to increase acceleration,

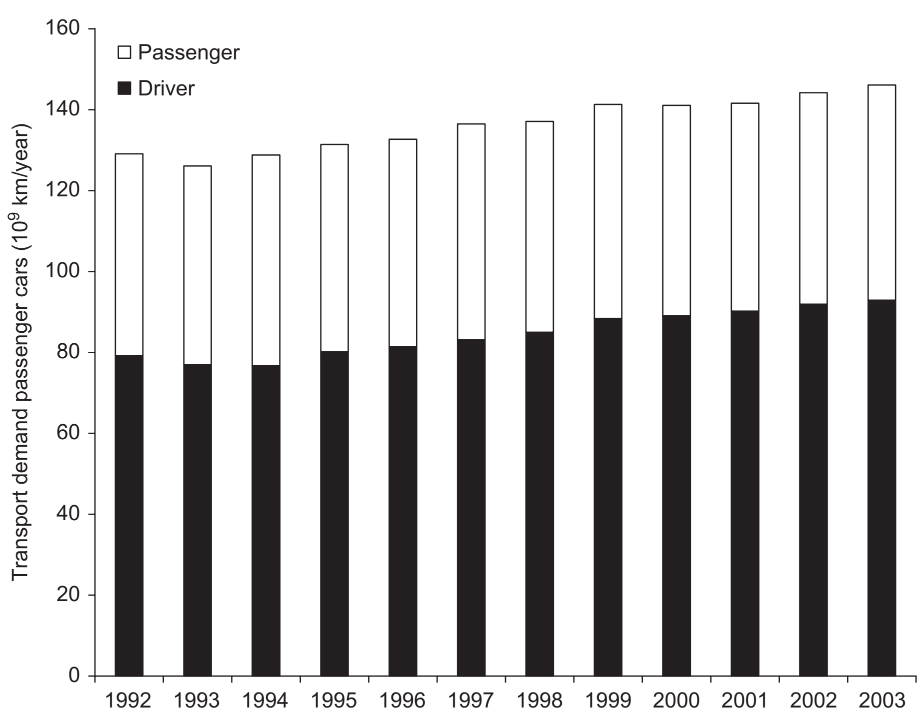

Fig. 3. Transport volume of passenger cars in the Netherlands for the period 1992–2003, expressed as 10^9 person km/year. *Source*: CBS, 2005.

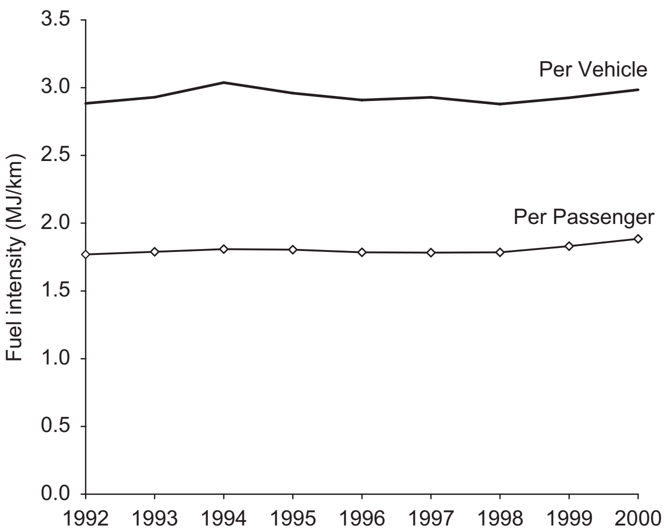

Fig. 4. Average fuel intensity of passenger cars in the Netherlands, expressed per vehicle km and passenger km in MJ/km *Source*: CBS, 2005.

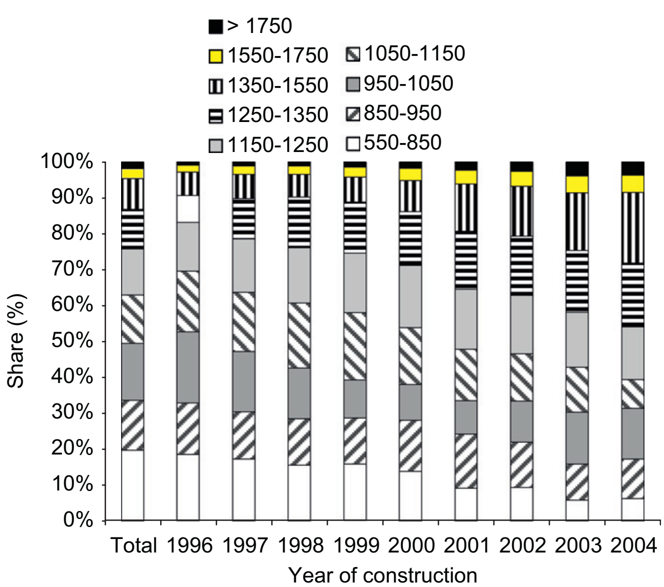

Fig. 5. Distribution of car weight (kg) in the Netherlands by year of manufacture *Source*: CBS, 2005.

which further reduces engine efficiency as part-load use of the engine increases.

3. Population affected by the principal–agent problem

In this section we assess the population of the passenger car fleet, and assess the part of the fleet affected by the principal–agent problem. We also analyze the characteristics of the overall fleet of passenger cars and those specifically of company cars, and the use of the car (business use versus private and commuting use). Understanding the characteristics and the use of the cars is important to correctly estimate the energy consumption affected by the principal–agent problem (Step 2).

Between 1995 and 2005, the total number of cars increased by 24%. The number of company cars has increased by 41% (from 548,000 to 771,531 cars). The share of company cars in the overall car fleet increased from 10% in 1995 to 11% in 2005. The increase in the number of company cars was especially large in the period 1995–2002, from 548,000 to 787,994 cars. In the period 2002–2005 the absolute number of company cars has remained equal at around 770,000 cars. The total number of cars increased by 4% in this period. The share of company cars in the car fleet decreased slightly from 11.7% in 2002 to 11.0% in 2005. Fig. 6 shows the total number of cars in the Netherlands in the period 1995–2005, divided in company cars and private cars. For the period 1996–1998 no data was available.

Company cars that are owned by lease companies number to 509,000 in 2004 (VNA, 2005). This corresponds to 7.2% of the total car fleet. The largest lease companies in the Netherlands in 2004 are LeasePlan Nederland NV, ING Car Lease, Athlon Car Lease and DaimlerChrysler Services BV (VNA, 2005).

3.1. *Vehicle fuel mix*

Company cars consume more often diesel than gasoline, and also the share of LPG as fuel of choice is for company cars larger than for private cars. Of the company cars, 47% consume diesel, 10% consume LPG and 43% consume petrol in 2002 (Wilmink et al., 2002). For private cars these shares are 10% diesel, 86% petrol and 4% LPG. Fig. 7 depicts the breakdown of private cars and company cars by fuel type in 2002.

3.2. *Vehicle age distribution*

The age distributions of company lease and private cars are also interesting, as company cars are generally younger. Fig. 8 shows that of the total car fleet, 31% is more than 10 years old and 12% are more than 15 years old. Most company cars, 90%, however are less than five years old. Company cars are most bought new, and sold on to the second had market after a few years. Fig. 8 shows the number of cars by year of manufacture at the beginning of 2004.

3.3. *Vehicle size*

The share of small cars (e.g. Fiant Punto) is 32% for private cars. For company cars this is only 12%. The share of small medium-sized cars (e.g. Volkswagen Golf) is 31% for private cars and 26% for company cars. For large medium-sized cars (e.g. Toyota Avensis) the share for company cars is 34% and for private vehicles 22%. The share of large cars (e.g. BMW 5 series) is 12% for company cars and 8% for private vehicles. For multi-purpose vehicles (MPVs) (e.g. Chrysler Voyager) the share for company cars is 10% and for private cars 3.5%.

The top 10 of most newly registered leased cars in 2004 is Renault, Volkswagen, Peugeot, Opel, Volvo, Ford, Toyota, BMW, Audi and Citroen (VNA, 2005). The top 10 of most sold car brands in the Netherlands in 2004 is Opel, Volkswagen, Ford, Renault, Peugeot, Toyota, Fiat, Citroën, Nissan and Volvo (CBS, 2005). Fig. 9 depicts the size of private vehicles and company cars divided in five categories in 2002.

3.4. *Vehicle use*

The total travelled distance by passenger cars in the Netherlands was 92.9 billion v.km in 2003 (see Fig. 3). In 2001, 22% of the total travelled distance by passenger cars is done by company cars and 78% is done by private cars (Wilmink et al., 2002). However, as shown above, company cars represent only 11% of the overall car fleet. This demonstrates that company cars on average drive nearly twice as much per year than private cars. The annual

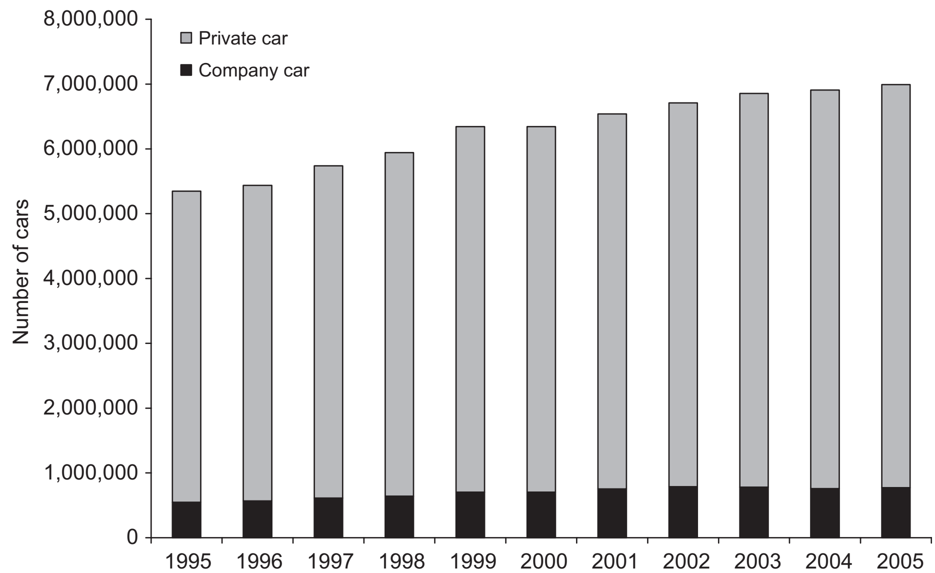

Fig. 6. Number of passenger cars in the Netherlands, subdivided in private and company cars. *Source*: CBS, 2005.

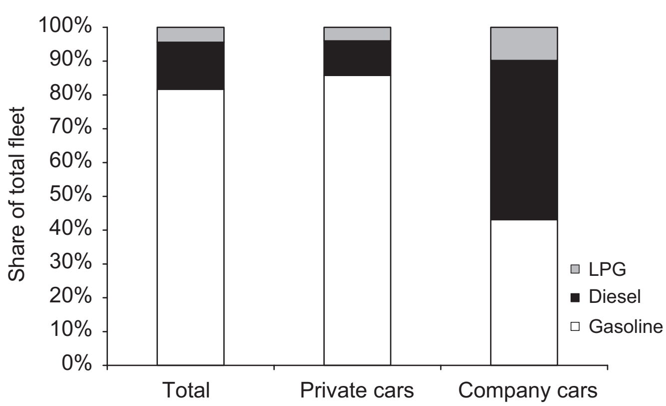

Fig. 7. Distribution of fuel mix by category of passenger cars in the Netherlands in 2002. *Data sources*: Wilmink et al., 2002 and CBS, 2005.

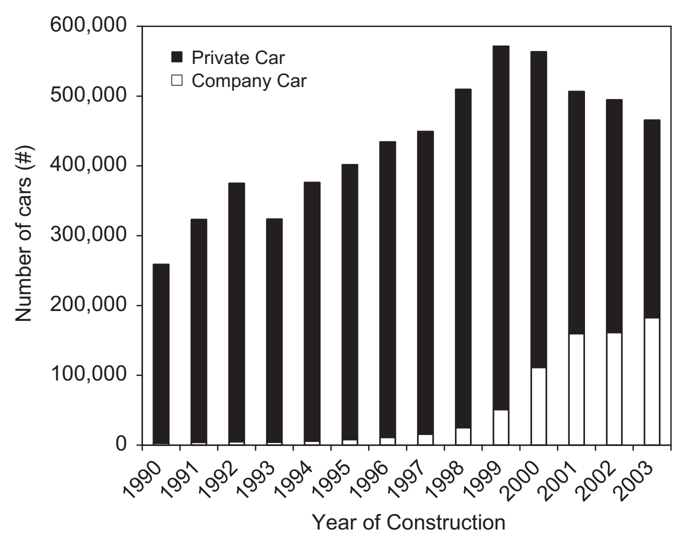

Fig. 8. Composition of the passenger car fleet in the Netherlands at the beginning of 2004, by year of manufacture. *Source*: CBS, 2005.

mileage of company cars is around 90% higher than the mileage of private cars. Fig. 10 shows the annual mileage for the period 1995–2001 for the company and driver-owned cars.

In 2001, the average mileage for company cars is 31,348 km and for private cars 16,435 km. The mileage for company cars has decreased by 3.4% in the period 1995–2001. Fig. 11 shows the breakdown of travel distance by purpose in terms of commute, business and private travel. Especially a difference is visible for commute and business travel.

The mileage for private use is nearly the same for private cars and company cars. Since 1995 the use of company cars for commuting has increased slightly from 11,500 to 13,000 km/yr (Wilmink et al., 2002). The use of company cars for business has decreased from 13,000 in 1995 to 10,000 km/yr in 2001. The private use of company cars has remained equal at around 8500 km/yr. The total mileage of private cars has remained equal at around 16,400 km/yr. The commuting travel for private cars has increased slightly from 5000 to 5500 km/yr while the use for private use has decreased slightly from around 9250 to 8750 km/yr. The average commuting distance for company car owners and private car owners is given in Fig. 12.

While the average commuting distance for private car owners has remained equal, the average commuting distance for company

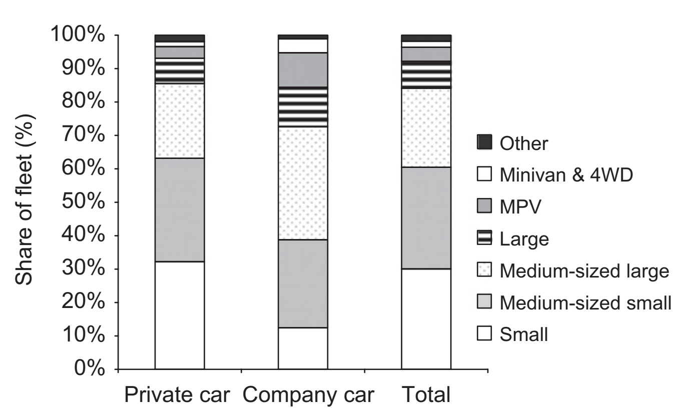

Fig. 9. Car size expressed in different categories for private and company passenger cars in the Netherlands. *Source*: Wilmink et al., 2002.

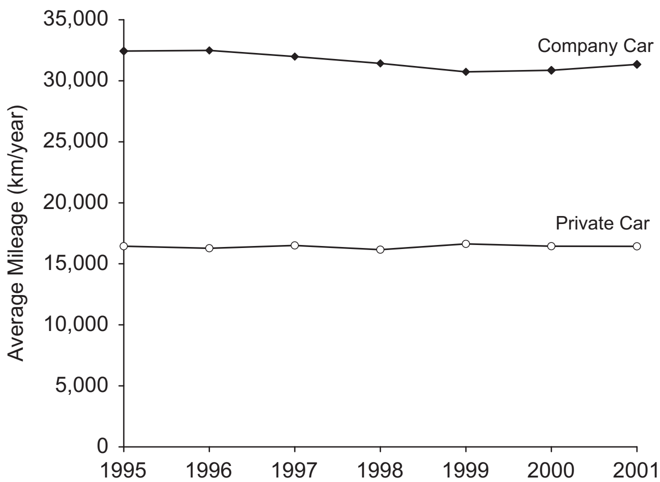

Fig. 10. Average annual mileage (expressed km/year) for company and private cars in the Netherlands for the period 1995–2001 *Source*: Wilmink et al., 2002.

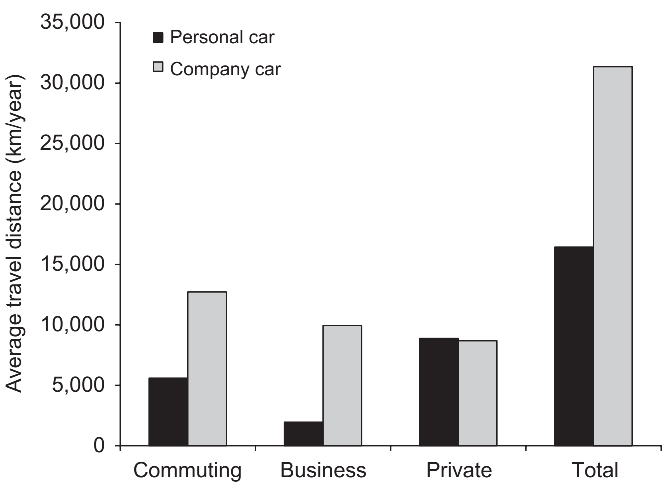

Fig. 11. Breakdown of average travel distance by trip purpose for private and company cars in the Netherlands in 2001 *Source*: Wilmink et al., 2002.

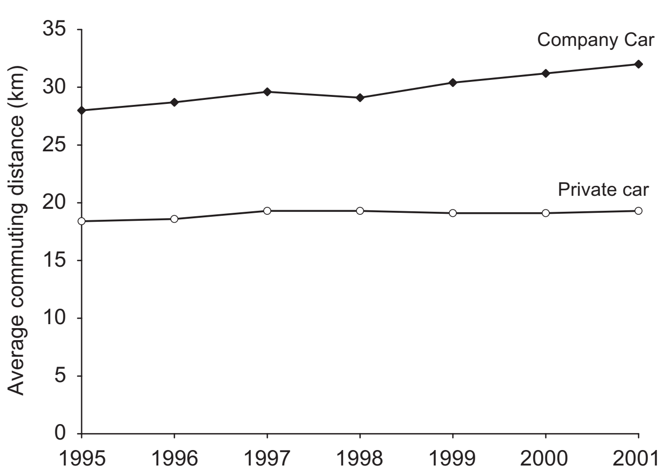

Fig. 12. Average commuting distance (expressed in km) for company and private cars in the Netherlands. *Source*: Wilmink et al., 2002.

car owners has increased by 14% in 2001 in comparison to 1995. The average commuting distance for company car owners is nearly 66% higher in 2001 in comparison to the average

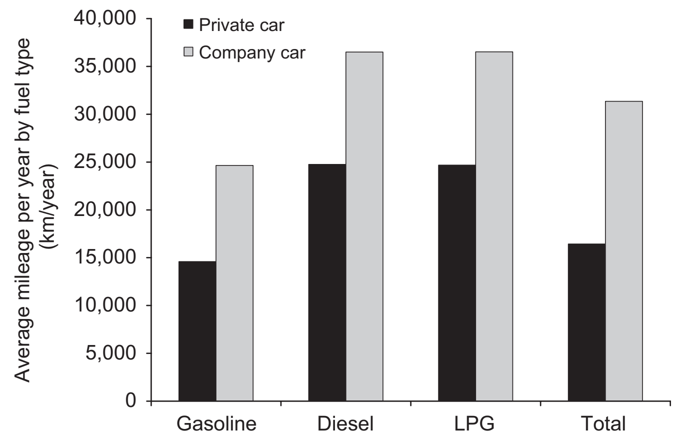

Fig. 13. Breakdown of mileage by car ownership category and fuel type in 2001 in the Netherlands. *Source*: Wilmink et al., 2002.

commuting distance for private car owners. Fig. 13 shows the annual mileage by fuel type. Diesel and LPG cars have the highest average mileage; around 36,500 km/yr for company cars and around 25,000 km/yr for private cars. Petrol cars have an average mileage of 24,500 km/yr for company cars and 14,500 km/yr for private cars.

In summary, considerable differences exist in the characteristics of the average car fleet and company (lease) car fleet. The characteristics influence the energy efficiency of the company car fleet in a positive sense, i.e. on average newer cars and a larger share of diesel cars that are more efficient, and in negative sense, i.e. company cars are larger and heavier. Interestingly, annual distance driven of company cars is found to be nearly twice the mileage for private cars; 31,348 km in comparison to 16,435 km. Not surprisingly, business travel of company cars was found to be approximately 5 times larger (~10,000 km/year) than that of the average fleet of driver-owned vehicles (~2000 km/year). However, also the average annual commuting distance was found to be larger for company cars; 12.700 km in comparison to 5600 km for driver-owned cars. It was found that the mileage driven for private purposes is equal for company cars and private cars; around 9000 km. The latter two effects are important to estimate the share of the energy use affected by the principal–agent problem and the net impact of the principal–agent problem.

4. Estimating the impact of the principal–agent problem

In this section we will first estimate the share of the energy consumption affected by the principal–agent problem, followed by the estimated net impact of the problem. We will (1) estimate the increased consumption of energy that is caused by the larger average size of company cars. Also we will look at (2) the effect of decreasing the commuting distance by company cars to the average commuting distance by private cars.

Table 2 shows the share of the total travel distance by passenger cars by fuel source. This is based on the data of Figs. 7 and 13. As can be seen, the share of km travelled by diesel cars is larger (23%) than the share of diesel cars in the total number of cars (14%).

Table 3 shows the average fuel consumption for new standard cars by fuel source. The fuel efficiency for diesel cars is found to be approximately 20% better than the fuel efficiency of petrol cars.

The figures are derived from VROM (2005) and are typical figures for standard driving conditions. In practice, the energy consumption depends on driving style, congestion and infrastructure, e.g. share of travel on highways and urban roads,

Table 2
Share of total travel distance (billion v.km) by fuel type

	Petrol	Diesel	LPG
Private cars (%)	78	16	6
Company cars (%)	34	55	11
Total (%)	69	23	7

Table 3
Fuel consumption for new standard cars in MJ/v.km

	Petrol	Diesel	LPG
Small	2.0	1.7	1.9
Medium-sized small	2.4	1.9	2.2
Medium-sized large	2.7	2.1	2.5
Large	3.0	2.4	2.7
MPV	3.3	2.6	3.0
Minivan and 4WD	3.3	3.0	3.0
Other	2.7	2.4	2.5

Sources: VROM (2005) and OECD/IEA (2004).

number of traffic lights, roundabouts. The figures are only used relatively, in order to calculate the difference in fuel consumption between company cars and passenger cars. This assumes that there are no differences in e.g. driving styles between company cars and private cars. Although company cars are generally larger, the specific fuel consumption (2.34 MJ/v-km) for new company cars is slightly lower than that of new private cars (2.38 MJ/v-km). This is caused by the fact that the share of diesel cars is much higher in company cars. In this analysis we assume that the relative difference in fuel consumption for new private and company cars is the same as for all private and company cars. This is based on the fact that the fuel intensity for cars has remained equal in the period 1992–2000.

Table 4 shows the results for the calculation of (1) the extra energy consumption that is needed because company cars are larger than passenger cars and (2) the effect of decreasing the commuting distance by company cars to the average commuting distance by private cars.

The fuel consumption on a per km basis for company cars is slightly lower than the fuel consumption for private cars. The reason is that company cars more often consume diesel fuel than gasoline. 47% of the company cars consume diesel in comparison to 10% of the private cars in 2005. Diesel cars are currently more energy efficient than gasoline cars. This effect is largely compensated by the fact that company cars are larger; 60% of the company cars can be referred to as large cars in comparison to 35% of private cars. If the average size of company cars is the same as the average size of private cars the energy savings amount to 4 PJ or 1.5% of the total energy consumption of passenger cars.

The average annual mileage for company cars is 31,348 km in comparison to 16,435 km for private cars. The breakdown of the mileage for 2001 shows that the travel distance for private purposes of company cars is roughly equal to the distance for private cars; around 8800 km/year. The travel distance for commuting is much larger for company cars: 12,717 in comparison to 5598 km/year for private cars. Also, not surprisingly, the travel distance for business purposes is much higher 9949 versus 1952 km/year. In this chapter we calculated the extra energy consumption needed for the higher commuting distance. This corresponds to 16 PJ or 6% of the total energy consumption for passenger cars.

Table 4
Estimating the overall impact of the principal–agent barrier on energy use by passenger cars in the Netherlands and the contributing factors

		Value	Unit
1.	Average fuel consumption by passenger cars	2.98	MJ/v.km
	Average fuel consumption company cars	2.94	MJ/v.km
	Average fuel consumption private cars	2.99	MJ/v.km
2.	Transport by passenger car	93	10^9 v.km
	Transport by company car	20	10^9 v.km
	Transport by private car	73	10^9 v.km
3.	Energy consumption by passenger cars	277	PJ/year
	Energy consumption company cars	59	PJ/year
	Energy consumption private cars	218	PJ/year
Energy savings potential			
Reducing average size of company cars to average size of private cars		4	PJ/year
Reducing commuting distance company cars to average commuting distance of private cars		16	PJ/year
Combining both measures		19	PJ/year

Table 5
Principal–agent classification of end users

Chooses technology	Does not choose technology
Pays energy bill	
6.2 million cars (89%)	No data (included total fleet of lease cars)
218 PJ/yr (79%)	
Does not pay energy bill	
0.8 million cars (11%)	
Energy use that may be affected by principal–agent problem, 59 PJ/yr (21%)	
Potential savings:	
• Reducing size of cars, 4 PJ/yr (1%)	
• Reducing commuting distance of cars, 16 PJ/yr (6%)	
• Both measures, 19 PJ/yr (7%)	

Table 4 shows that the largest potential for energy savings is present with reducing the commuting distance for company car owners. The possible reduction could result in a reduced energy consumption by 16 PJ/year. Reducing the average size of company cars to that of driver-owned vehicles could result in a reduction of 4 PJ/year. The total reduction when combining the two measures would be 19 PJ/year. This corresponds to 7% of the total fuel consumption of passenger cars and to 32% of fuel consumption by company cars.

Our analysis has shown that the principal–agent problem might affect almost 800,000 cars, or 11% of the total fleet of passenger cars in the Netherlands, while it may affect 21% of the energy use by passenger cars in the Netherlands (see Table 5).

The analysis has also shown that removing this barrier to energy-efficiency improvement could lead to fuel savings between 1% and 7% of the total energy used by passenger cars in the Netherlands. The savings are due to a reduction in the size and weight of the car (1%) and a potential reduction in commuting distance (6%). The latter effect may be harder to realize, but the increased energy use may be an (indirect) long-term impact of the principal–agent problem. Removing the barrier may hence only be realized in the longer term.

5. Discussion and implications

Our calculations merely show what the potential energy savings are when the size and commuting travel of company cars is the same as for private cars. It is unknown whether the higher commuting distance and larger size of company cars is the result of solely the principal–agent problem. Other factors may affect the commuting distance and choice of vehicle. For example, company cars may be larger for representative reasons or safety concerns and unrelated to the principal–agent problem.

In order to determine the exact size of the principal–agent problem we need to know the fuel efficiency and the mileage for commuting and private travel of company cars would be when the vehicle and fuel costs would not be paid by the employer. This, however, cannot be discerned from the data available for this study. Looking in more detail at the underlying factors that may influence fuel consumption of company cars is outside of the scope of this study. This study merely shows the sensitivity of the company car sector to the principal–agent problem, and gives an indication of the possible size of the problem. This will require more study.

Furthermore, the commuting pattern may require more study. Various factors could contribute to the larger commuting distance, e.g. distance to the office, or travel to multiple destinations, other than the office (e.g. commercial travellers or service engineers). The available data to this study does not allow analyzing this pattern in more detail.

We were not able to distinguish between lease cars and company fleets as the data did not allow this. This may result in different estimates of the potential impact of the principal–agent problem in this case study.

This study does not address any indirect or secondary impacts other than those discussed above. A secondary impact may be that the larger and heavier lease cars end up in the used car market after the end of the lease. Of all new cars purchased in the Netherlands, nearly 40% are company cars. Most company lease cars are leased for a period of 3–4 years, and then sold off to the second hand market. As company cars are generally larger and heavier, this may mean that the overall car fleet in the Netherlands may move to higher overall weight and size, resulting in additional fuel use. The net impact is the result of similar factors as discussed in this analysis, as well as the efficiency of the car displaced. This is hard to estimate, and is excluded from the analysis.

Hence, this paper provides a first indication of the potential size of the principal–agent barrier in the case of leas cars in the Netherlands. As discussed, above more data on company fleet versus leas cars, commuting patterns, and impacts of sales of lease cars to the second-hand market (i.e. impact on total passenger car fleet over time).

The study demonstrates that there might be a pervasive principal–agent problem with respect to company passenger cars that may have a significant impact on the energy consumption of the sector. It may even have secondary impacts (e.g. commuting distance, composition of car fleet) that may have a long-lasting impact on energy use. There are important policy lessons to be learned from this. This study and other case studies (IEA, 2007) demonstrate the pervasive nature of the principal–agent problem in many sectors, and the overall impact it has on energy use and attempts for energy-efficiency improvement. Only tailored policies can help to remove the barriers, as blanket measures as increasing fuel prices may not directly affect the responsible stakeholders.

Starting in 2008, the Netherlands government has not only started to improve the surveillance on the use of company cars for private use, it has also changed the tax status of fuel-efficient lease cars (using the European energy labels for cars). The latter have been made more attractive for leasing, as the addition to income tax for fuel-efficient cars has been strongly reduced from 22% to 14%. Fuel-efficient cars are those cars that have a European A-label. It may be interesting to repeat this study in a few years to study the impact of these policies on the composition of the company car fleet and energy use.

6. Conclusions and recommendations

In total 11% of the passenger car fleet in the Netherlands can be classified as company cars, which consume in total 21% of the total energy consumption by passenger cars. This relatively large share is a result of the longer travel distance of company cars in comparison to passenger cars, and larger company cars than private cars.

While the exact magnitude of the principal–agent problem is hard to estimate, we estimate that roughly 20% of the passenger car energy use in the Netherlands is affected by the principal–agent problem. The net impact of the barrier is estimated at a potential net increase in the energy use of passenger cars by 1–7%.

Together this indicates that there may be a need and potential for reducing energy consumption of company cars and a need for policies aimed at improving energy-efficiency of company cars. In 2008, the Netherlands government has introduced a revised tax system for company cars, with much lower taxes for fuel efficient cars. It is expected that this will affect the choice of new lease cars for more efficient models. A repetition of this study in a few years may be able to demonstrate the impact of this policy change.

This study (and the larger study in other sectors) demonstrates the pervasive nature of the principal–agent problem in energy efficiency. However, the case studies have only focused on a number of sectors and countries. It is likely that these problems are an important factor hampering the impact of energy policies to improve energy efficiency and reduce related greenhouse gas and air pollutant emissions. Further and more systematic analysis of the principal–agent problem is recommended, to help improve the design of efficient and economic policy instruments.

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