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THE DRIVING FORCES BEHIND TRANSPORT GROWTH AND THEIR IMPLICATIONS FOR POLICY

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1. The success story of transport: faster and cheaper

If we want to manage the fundamental drivers of transport demand, we first need to identify what the fundamental drivers are. Next, we can discuss how these driving forces can be managed and whether the benefits of these policy options are larger than the disadvantages.

To gain insight into the fundamental drivers of transport demand, long term developments need to be analysed. This paper takes a look into the history of transport over the last two centuries and investigates the future for the coming half a century. This focus on the long term reveals the fundamental drivers, while neglecting all sorts of temporary and minor influences.

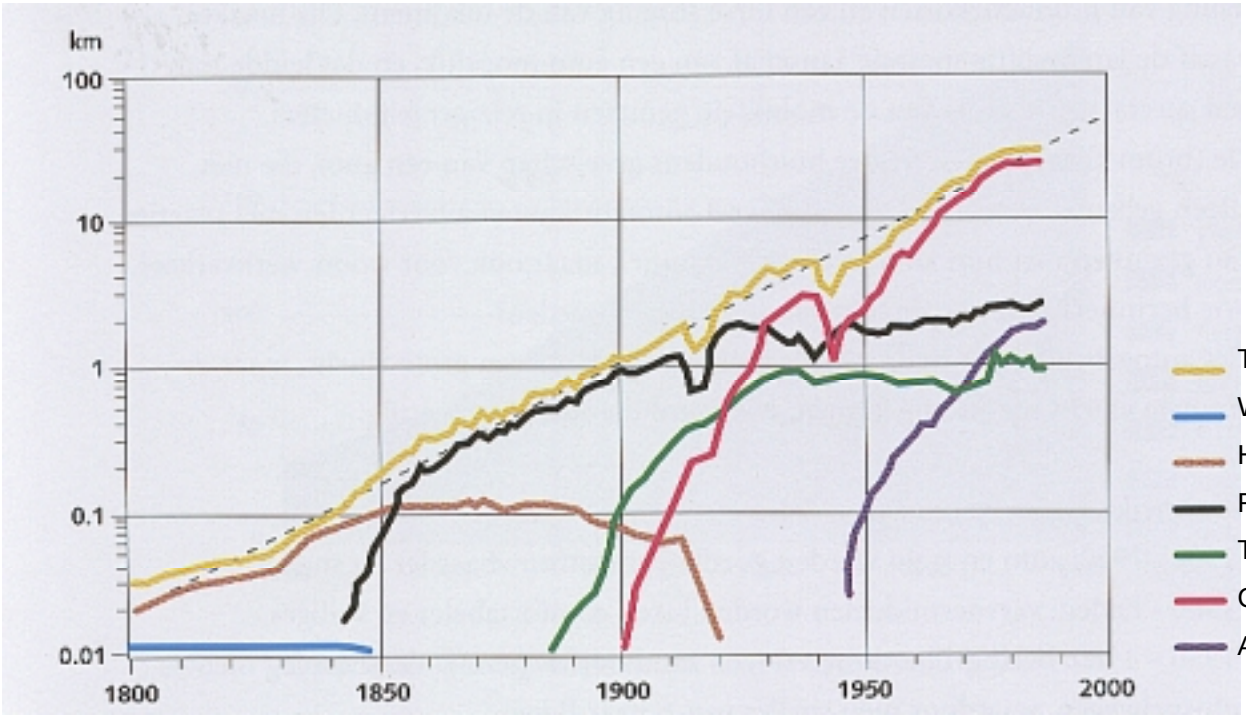
The paper illustrates what we all know: The history of transport can be described as a continuous reduction in the friction of distance. Travelling or transporting goods, has become faster, cheaper, more comfortable and reliable. This allowed for the impressive mobility growth we have experienced. In addition, it is likely that new improvements in the price-quality ratio of transport will shape the future.

2. Passenger transport

2.1 Trends

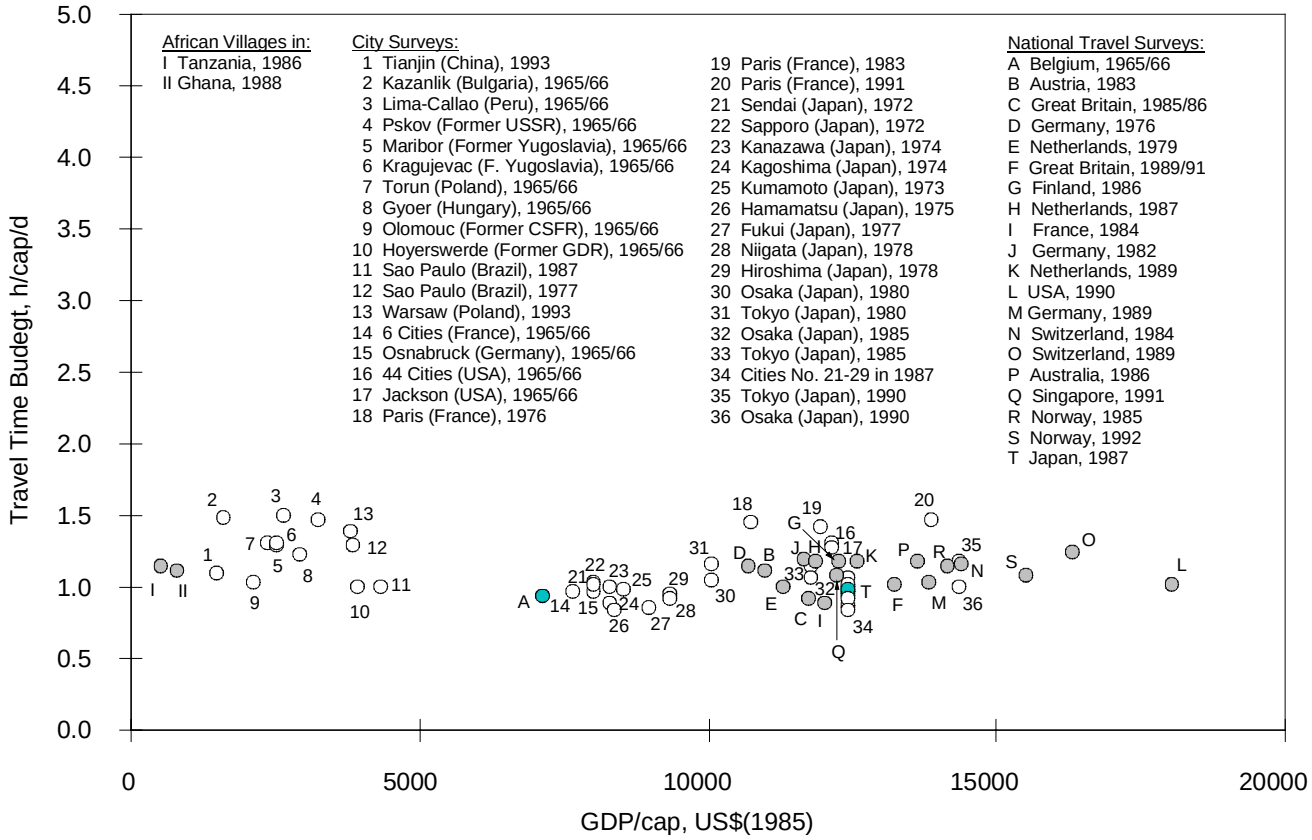
The average distance travelled per person per day increased from a few kilometres to 40 kilometres in the period form 1800 to 2000. The dominant mode of transport shifted from walking and horse power to the train and then to driving by car. Technological developments, such as the internal combustion engine, in combination with growing income, allowed people to buy faster modes of transport over time. Figure 1 shows this history of transport: two centuries of exponential growth in distance travelled.

Figure 1. **Daily distance travelled per person 1800-2000 (excluding walking ; France)**



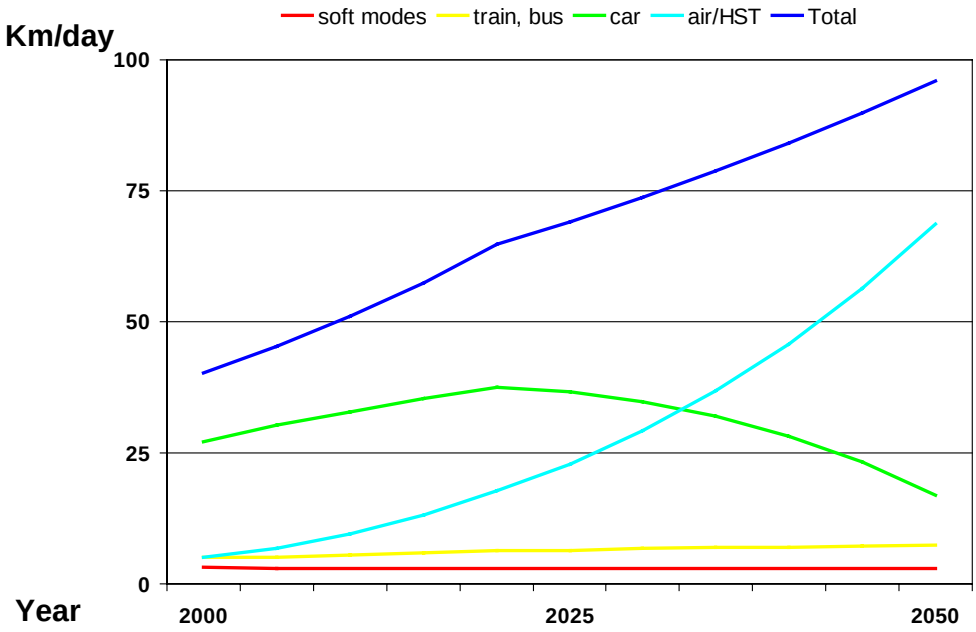
Next, we know that the daily amount of time spent on travelling only slightly changed over time. We use as much time for travelling as medieval people and there is also no substantial difference between the average travel time between individuals in industrialized countries and developing countries. Figure 2 shows that the average time budget lies around 1,1 hour a day and more importantly this does not depend on income level or historic period. The investigated values differ roughly between 0,8 and 1,2 hours a day. Because total mobility (pkm) equals travel time (h) multiplied by travel speed (km/h), the impressive growth in mobility can only be explained by an equally impressive growth in speed.

Figure 2. **Constant Travel Time Budget**



Following this approach a projection for the future can be made (see figure 3). Mobility will continue to grow and aviation will become the dominant transport mode between 2030 and 2040. Again we will see a shift to a faster mode of transport.

Figure 3. **Projected mobility growth 2000-2050 (Western Europe)**



2.2 Driving forces

Travelling speed has increased from between 5 and 10 kilometres an hour – horse power – to an average of close to 70 km/h now. Figures 4 and 5 illustrate this development. The train with steam engines reached a speed of around 30 km/h and replaced horse power in the second half of the 19th century. Next, the passenger car improved its speed from 15 km/h in 1900 to an average of 45 km/h now at which level it seems to stabilize. This improvement is achieved by building an extensive network of motorways and by the manufacturing of more powerful and convenient cars. The car became the dominant mode of passenger travel around 1960.
After 1980 the continuing increase in travel speed is mainly caused by aviation. The modal share of aviation has increased to around 10% and at the same time the average door-to-door speed of air travel is improving.

Figure 4. **Average door-to-door travel speed for different modes (The Netherlands)**

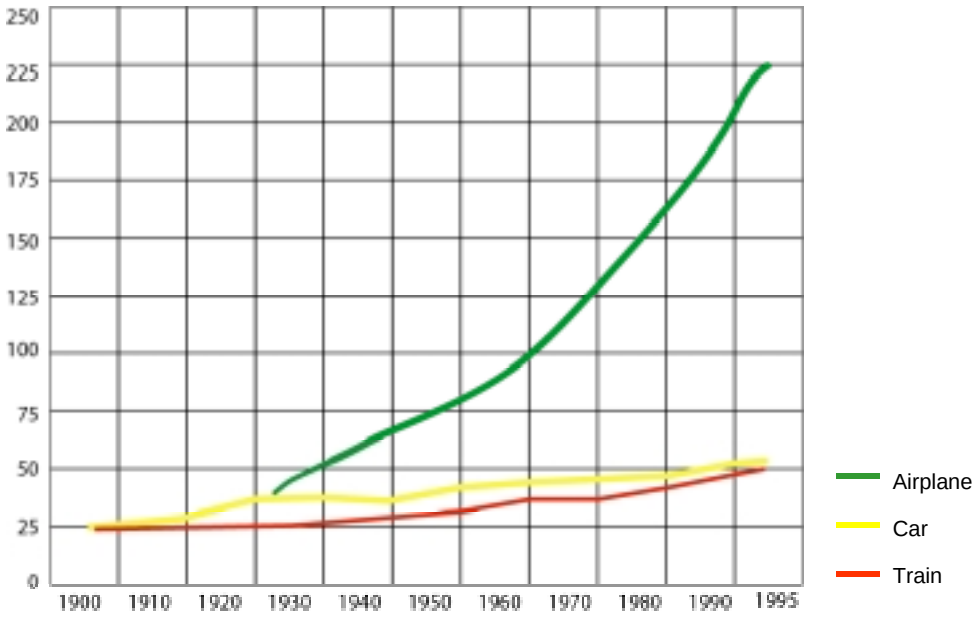
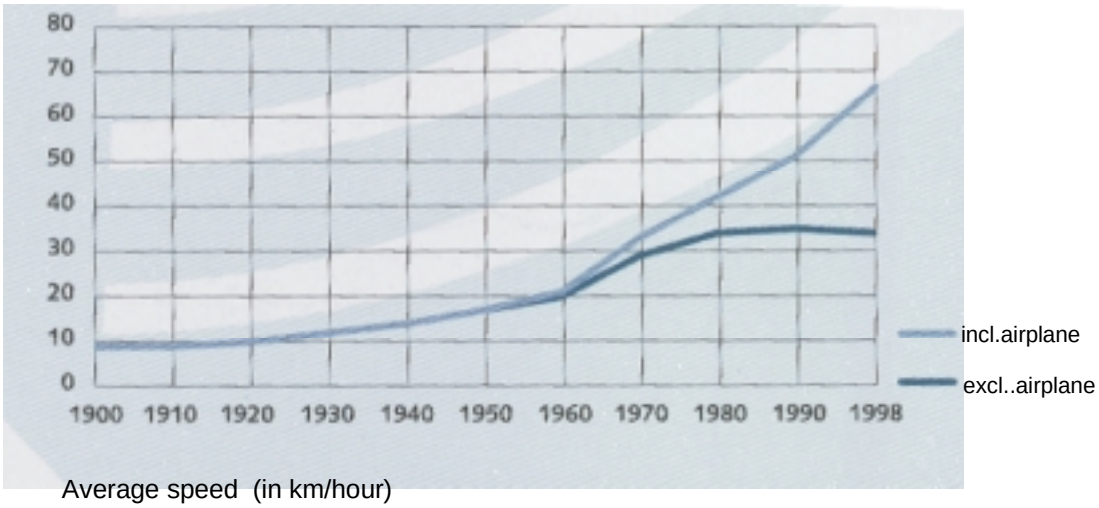


Figure 5. **Weighted average door-to-door travel speed for all modes, both including and excluding aviation (The Netherlands)**



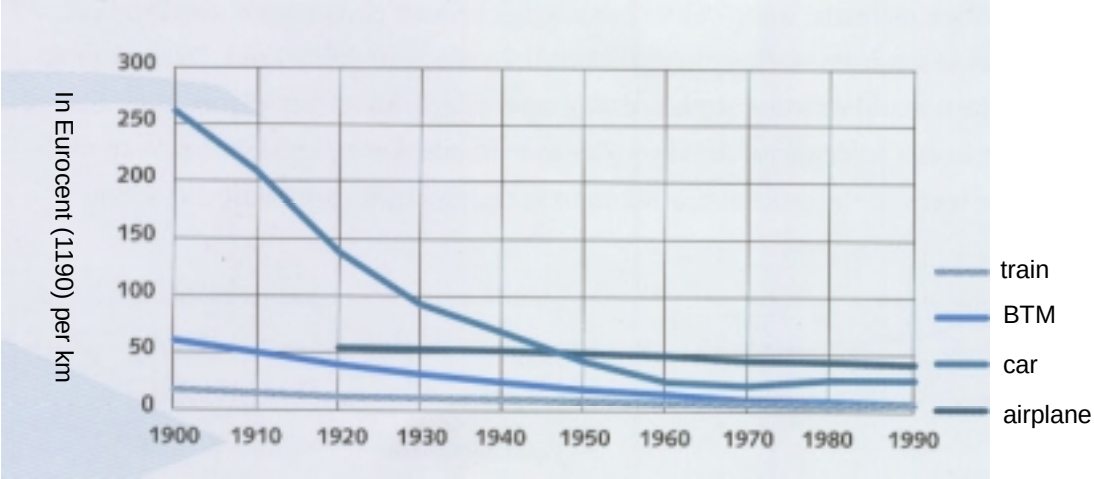
So, the main driver of the growth in passenger travel is the increase in average speed. However, this shift to faster transport modes in its turn is caused by different forces. The first is technological improvements. Each travel mode has become faster, cheaper and more comfortable by innovations such as the internal combustion engine, airplanes and building motorway networks. Note, however, that since the first flight with an aircraft in the beginning of the 20th century, no major technical breakthroughs have occurred in the transport field. Trains, cars, planes and related infrastructures are not new technologies. It is true, however, that these "old" technologies have been improved tremendously by e.g. mass-production, new materials and lately by the break-through of new information and communications technology and applications.

In addition to this technological driver, there is a strong economic driver. Increasing purchasing power, as a result of economic growth, allowed people to buy faster transport modes. In 1960 only 1 out of 20 people could afford to own a car. Car ownership in the Netherlands is currently 8 times higher than in 1960. Rising incomes generate also the current increase in the modal share of air travel. Nowadays, many people can afford to fly long distance.

Not only economic growth, but in addition a reduction in costs of travelling, promoted the shift to faster modes. Figure 6 shows this reduction in costs for the past century. Especially car driving experienced a sharp cut in costs in the period 1900-1960. This explains partly the success of the car.

Finally, social forces influence the shift to faster travel. It generally takes time before new (transport) technologies are accepted and fully adopted. For example, we are still witnessing an increase in the numbers of people with a driving license. In addition, the social acceptance and emotional attitude might influence somewhat the modal choice of people, mainly when speed and costs differ little between modes.

Figure 6. **Average costs of passenger travel (in 1990 Euro per km)**



2.3 Policy implications

The analysis presented above leads to the conclusion that influencing the door-to-door travel speed will influence both total mobility and modal choice. Slowing down car travel will reduce car driving, as can be witnessed in congested urban areas where people look for ways to shorten their commuting distance. Policies towards infrastructure (density and capacity of networks) and travel speed could be designed to reduce door-to-door speed. However, such policies will inevitably also reduce the benefits of travelling, e.g. the benefits derived from visiting distant places, and the economies of scale and economies of scope industry benefits from through transport. Therefore, policies which reduce travel speed often lack public and political support.

An often promoted policy is to invest in public transport. According to the analysis presented here this will only have a substantial effect if the door-to-door speed of public transport at least equals that of the car. And this seems only feasible in large cities where car driving slows down to an average of 10 or 20 km/h and on longer distances between city centers, where public transport can reach a speed of 100 km/h.. On other medium distances the car is unbeatable. Policy makers should avoid illusions about the effectiveness of promoting public transport as an instrument to reduce car mobility.

Part of the negative effects of the car are concentrated in urban areas. Occupation of scarce space, noise nuisance and negative health impacts are mainly urban problems. Allocating more of the scarce space to people living and working in the city can increase the spatial quality but reduces the available road and parking space for cars. As a counterpart, mass transport systems are needed to safeguard the accessibility of our metropolitan area's. Congestion charging, on the other hand, will promote better use of existing roads, which also increases accessibility.

Another often promoted policy to reduce car travel through spatial planning, with planners locating houses closer to jobs, or more generally locating travel destinations closer to origins. However, this line of thinking conflicts with the analysis in this paper. It is not the fault of planners that average travel distances have grown tremendously. Instead, it is the increase in average travel speed that caused the growth in travel distances. This can be further illustrated by looking at the impact of a new motorway. In the short run people will gain time, because they can travel faster. However, in the long run people might chose a more pleasant place tot live, outside the city, or look for a more suitable job located further away. In general, people will gain "distance" in the long run, as a result of a new motorway. So, policy makers should avoid illusions about the effectiveness of spatial planning as an instrument to change mobility patterns.

Pricing policy can be effective, if it diminishes the use of fast transport modes. Congestion charges will spread the traffic more equally over the day, and will thus increase the benefits of existing infrastructure. Introducing variable user charges instead of fixed charges (such as taxes on the possession of vehicles), will stimulate a more selective mobility. Finally, will targeted charges to internalise external costs should reduce externalities such as accidents, noise nuisance and air pollution.

Following the assessment of the policy instruments above, there is not much hope for substantial changes in people's travel behaviour. The fundamental driving forces appear to be strong. Effective policy measures are not easily accepted. How can sustainable mobility then be achieved? The answer lies in the further development and mass application of safe and clean technologies. The introduction of the three-way catalyst has thus far contributed most to reducing air pollution from cars. All sorts of safety techniques – both on vehicles and roads – have effectively reduced fatalities and injuries. New technologies will be developed and some are waiting for mass introduction. However, making transport much safer and cleaner can not be left to market forces. Strong policies are required, of which setting and enforcing strict standards and a variety of financial incentives are the most important.

These new technologies will impose additional costs to travelling. These costs need to be accepted as the price for making mobility sustainable.

Finally, the future of air travel must be addressed. As figure 3 showed, air travel will become the dominant transport mode somewhere between 2030 and 2040. Although this forecast is rather uncertain, policies should anticipate the strong growth in air travel, as well as the associated decline in car use. The geographical density of airports will most likely shape the future of mobility to a large extent, because this density will largely determine the future door-to-door speed of air travel. Developing safe and clean air travel will require strong policies, as is the case for other transport modes.

3. Freight transport

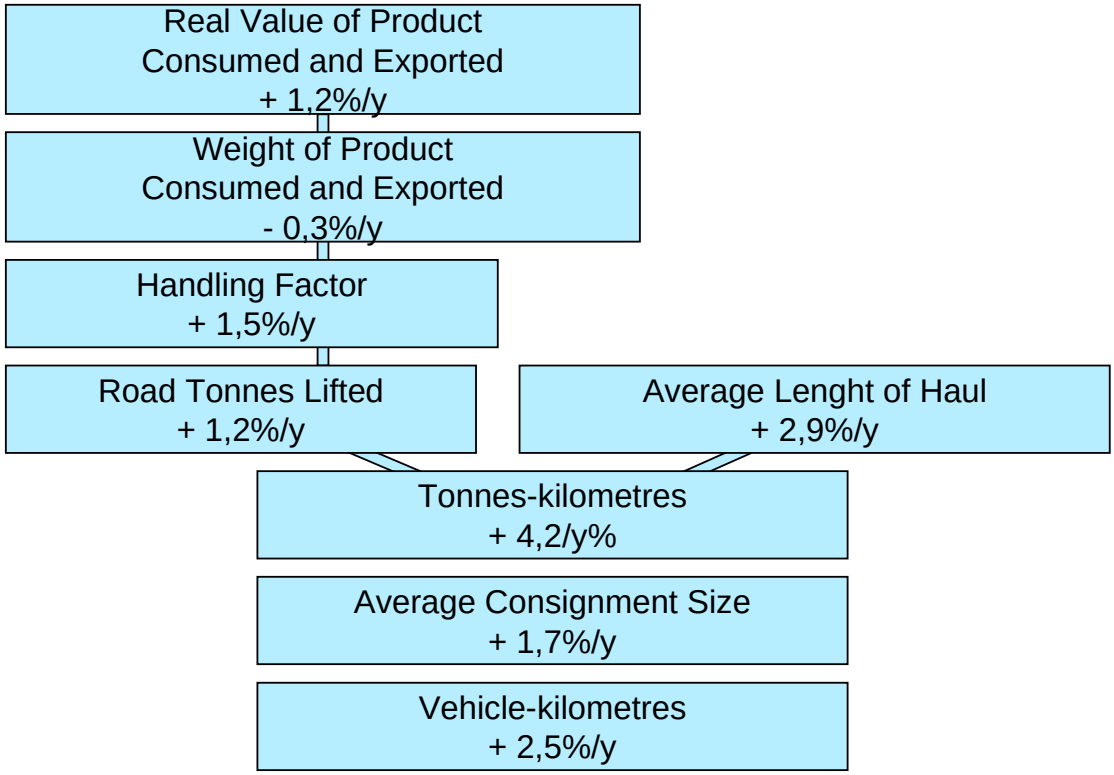
3.1 Trends

It is often assumed that the growth in freight transport is directly linked to economic growth. Because governments strive for high economic growth, equally strong growth in freight transport is then inevitable. However, this is at most half of the story.

Our economies grow on the long run with an average 2,5% a year in money terms. This, however, does not equal the growth in physical terms (tonnes). The physical growth of our economies is roughly estimated at 1% a year. The divergence between economic growth and physical growth reflects the structural changes in our economies: from industrialization towards services and a knowledge based economy.

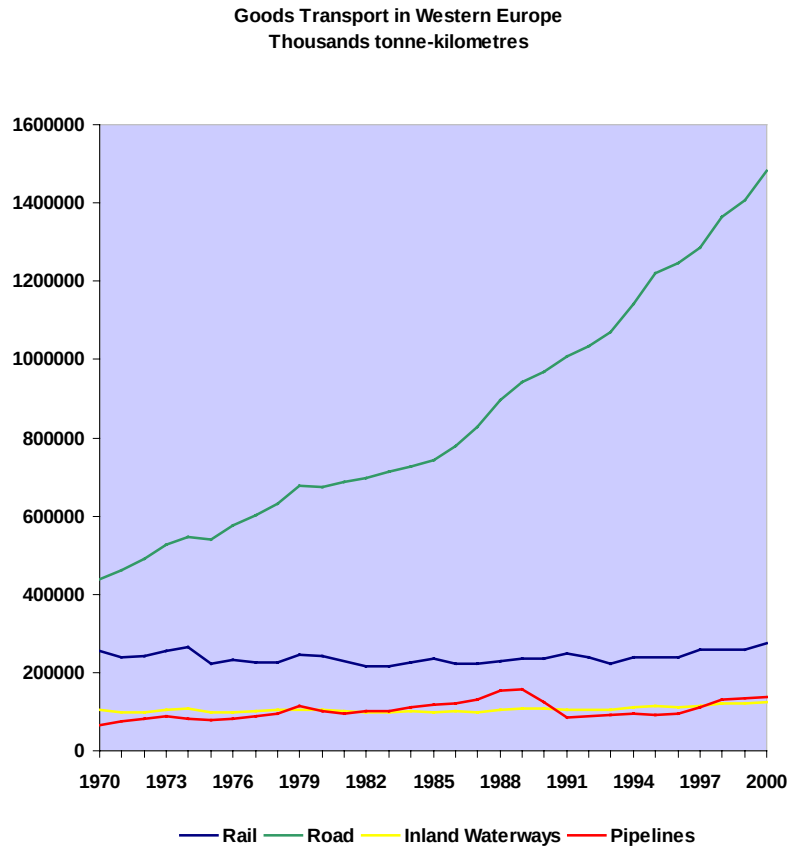
If it is not the physical growth of our economies that cause the high growth rates in freight transport, what is then the cause? Two separate factors explain the growth: each tonne of final product is moved more often in the production chain leading to more hauls and at the same time the average length of haul has increased. These are the logistics of what is called the network economy. Figure 7 presents the results of a quantitative study into these mechanisms for the UK food an drink sector. The handling factor - number of links in the production chain - increased by 1,5% per year and the average haul length by 2,9% a year.

Figure 7. **Logistical changes in the food and drink sector 1983-1991 (United Kingdom)**



Next, figure 8 shows the total growth in tonne kilometres in Western Europe and the split over different modes. The figure clearly shows that road freight transport has become the dominant mode.

Figure 8: **Growth in freight transport (tonne kilometres) and modal split (Western Europe)**



3.2 Driving forces

What are the driving forces behind these changes in logistics resulting in the strong growth in freight transport?

One driver is the increased purchasing power (income growth) to choose from a large variety of consumption goods. We see 20 brands of beer in the shelves and 10 brands of mineral water. Furthermore, we can buy exotic products originating from all over the world. Both reflect economies of scope for the consumer and lead to more freight transport.

The second driver lies within the logistics of the production process. Firms will minimize their total production costs, which might lead to more - or less - transport. The economic benefits of freight transport consist of:

- Economies of scale in production and distribution.
- Locational advantages (or comparative advantages according to the neo-classical theory on international trade)
- Reduced costs for warehousing (stimulates just-in-time deliveries)

Companies weigh the economic benefits of more freight transport against the additional transport costs, in search of minimal production costs. If transport becomes cheaper, they will use more transport in the optimum and thus save money on warehousing and production costs. And this is exactly what happened: freight transport has become cheaper, faster and more reliable over the past centuries. The figures 9, 10 and 11 show this cost reduction for domestic transport, continental transport and for intercontinental transport. In addition to these cost reductions, road and air transport have managed to increase their speed substantially at the same time, thus lowering the generalised costs even more strongly.

According to a rough estimate, the reduction in the costs of freight transport caused half of the growth in freight transport (tonne kilometres) over the last decades. So, the realized reduction in transport costs is an important driving force behind the growth in freight transport. The reduction in costs of freight transport stimulated logistical changes resulting in lower total production costs while transport volume increased.

Figure 9. **Price of domestic freight transport 1800-2000 (The Netherlands)**

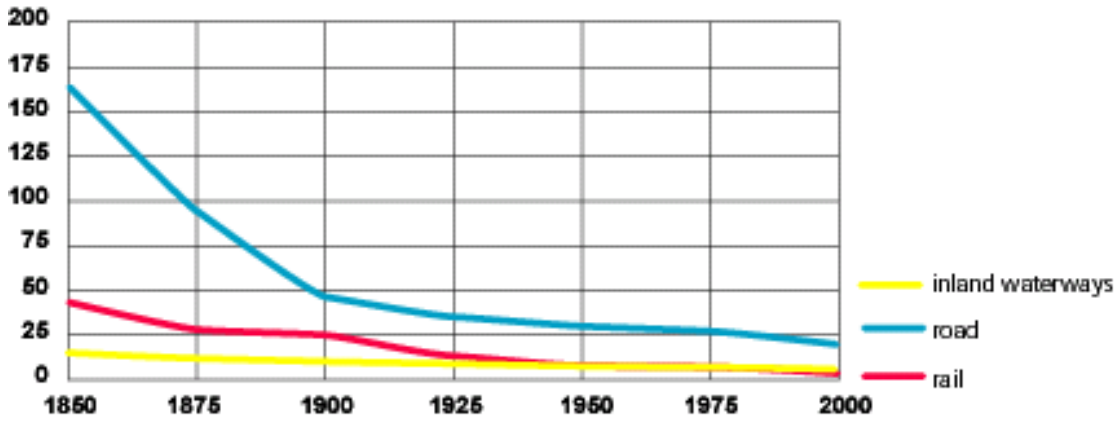


Figure 10. **Price of continental freight transport 1850-2000**

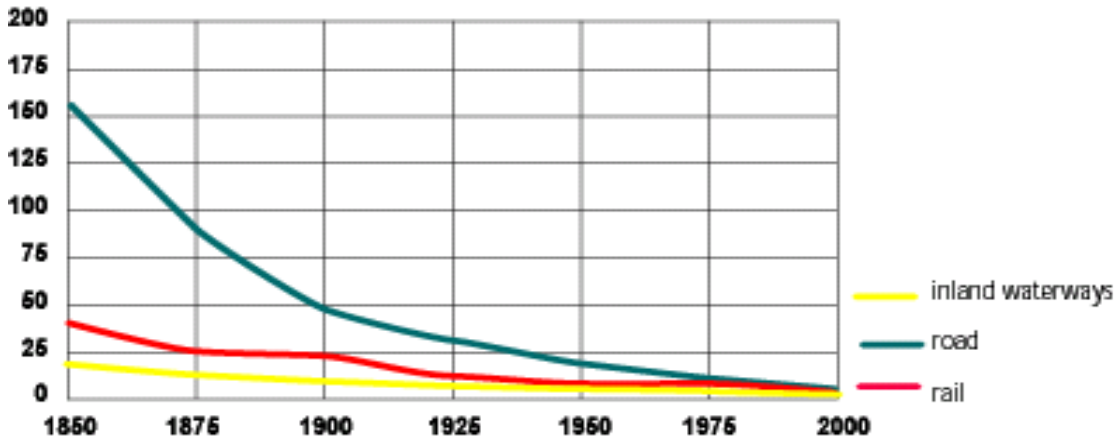
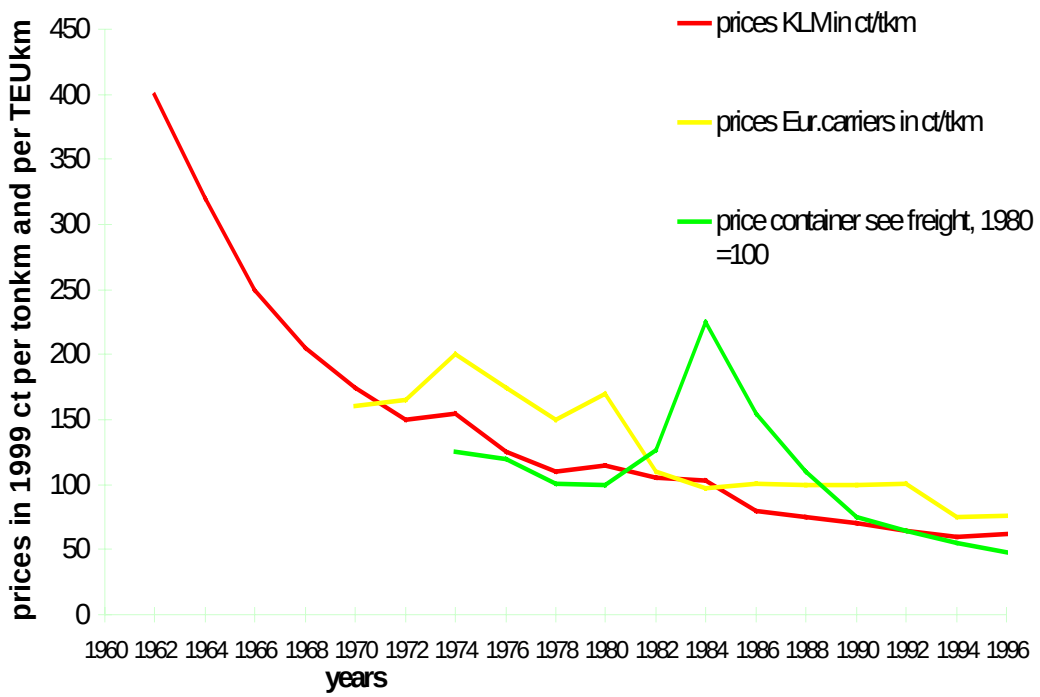


Figure 11. **Price of intercontinental freight transport 1960-1996 (KLM, TEU Rotterdam)**



3.3 Policy implications

The analysis above reveals four driving forces behind the growth in freight transport:

- Population growth
- Income growth, resulting in a demand for a wide variety in available consumer goods and for exotic products from all over the world.
- Reduction in the costs for production and distribution, caused by economies scale, locational advantages and warehousing.
- Reduction in the (generalised) costs of freight transport, including risks and reliability.

Of these four drivers, only the last seems relevant for policy making. Indeed, the price of freight transport is a rather effective policy instrument. A recent review study of international findings concluded that the price elasticity for road freight transport lies around –0,8. So, a 1% higher price per tonne kilometre, results in a 0, 8% reduction in vehicle-kilometre transported volume. And this is mainly the result of more transport efficient logistics.

In addition, many studies indicate that freight transport currently does not pay its full marginal social costs. Combining these observations suggests that if targeted correctly, policies that increase the price of freight transport can thus improve the overall efficiency of our economy.

It is quite common that government policies aim at a shift from road freight to rail and water transport. This should reduce pollution, accidents and congestion in urban areas. Such policies try to reverse the current trend towards an increasing market share for road freight transport (see figure 8). However, it will be difficult to reverse this trend. The analysis above showed that the performance – or price-quality ratio - of each transport mode determines its competitive position. Costs, speed and reliability are the most important factors. So, the question is whether rail freight and inland waterways can improve their performance strongly, to catch up with the quality road freight can offer. During the last decades the opposite has happened. Road transport has improved its price-quality ratio (or generalised costs) substantially by technical and logistical innovations. In the same period rail freight and inland waterways did not improve their performance so much and they managed to follow the price cut of road freight by concentrating on long distance and large volume hauls, thus loosing market share (see figure 8 and 10).

Additional to the price and quality each mode can offer to the shippers, two other factors reduce the likelyhood of a strong shift away from road freight. First, the growth in bulk transport – with a high market share for rail and water – is lower than the growth in containers and packed goods. Second, it seems that the costs of goods transfer are not declining at the same rate as the transport of goods. This makes it harder for inter-modal transport to compete with road freight. So, policy makers should avoid illusions about the feasibility of a substantial modal shift in freight transport. It is mainly the price-quality ratio of the different modes for freight transport, that will determine the future modal split.

If modal shift is not a likely route, how can sustainable freight transport than be achieved? As stated before, pricing policy is effective and will reduce negative externalities through more efficient logistics. In addition safe and clean technologies – for each mode – are a promise for the future. However, as stated before, strong government policies are required to force the further development and application of these technologies and the additional costs need to be accepted.

Finally, if it is true that half the growth in the past decades was caused by reduced generalised costs, an important question for the future is whether the costs of freight transport will continue to decline. If this is not the case, future growth rates will be smaller than the historic growth in freight transport.

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