Long-term structural decline of railways

Zdenek Tomes, Masaryk University

The paper focuses on the market share decline of railway transport in developed countries. The paper starts with a basic analysis of economic history of railways. The idea of product life-cycle is then applied to interpret a long term economic development of railways. The decline of railways is understood as a period in a structural life-cycle of the industry. The key determinants of the decline are identified as road transport competition, changing patterns of the economy and railways internal inflexibility.

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Zdenek Tomes
Masaryk University Brno
Faculty of Economics and Administration
Brno Lipova 41a
Czech Republic
tel: +420 723 735 876
E-mail: tomes@econ.muni.cz
1. Short history of railways

Railways have emerged in the second quarter of the 19th century as a new transport mode. Shortly thereafter they became the main inland transport mode. Openings of the first railways lines were important turning points in the economic history of countries. It also reflected their general level of economic development. Railway opening happened in following succession: UK (1825); USA (1827 horse, 1830 engine); France (1828 horse); Belgium (1835); Austria (1837); Saxony (1837); Prussia (1838); the Netherlands (1839); Switzerland (1844); Denmark (1844); Russia (1851); Norway (1854); Sweden (1856). (Garratt 2000).

The emergence of railways brought about big changes in transport, economy and society. This revolutionary change had its roots in technological innovations that enabled to construct large networks of transport infrastructure and run high volumes of traffic on it. Railways operators were able to offer transportation of goods and people with formerly unimaginable speed, comfort, capacity and reliability. Railways operations generated huge profits that attracted further investment. As railway’s networks expanded, so did their value for existing and potential customers. By offering valuable service and operating it on a big scale, railways operators were able to decrease unit transport costs considerably. Many cities and regions were opened for trade because only due to railways they became accessible for commerce. Railways connected fragmented regional markets and expanded market for agricultural and industrial goods. Competition consisted of canal companies and stage coaches. As R.C. Puth comments in American Economic History: “It was soon clear that the railroads had advantages possessed by no other form of transportation. They could traverse land with too many hills or too little water for canals and carried far more than wagons. Railroads were easier and cheaper to build than canals….above all else, however, the railroads were faster than other forms of transportation. Speeds over the ground were greater than those of canals or most steamboats, routes were more direct, and the railroads ran all year….Initially, most railroad business was passenger traffic, but as technology improved, freight accounted for a growing portion of revenues. By 1850, freight constituted the majority of railroad business.” (Puth 1993, p. 171-172)

It is possible to distinguish three periods of railway’s construction. The first one was the construction of early routes when pioneers of the industry made the first steps in creating railways networks. The second phase was railway fever, when there was a substantial effort to build lines connecting main centres of economic activity. Last big period in construction of railways was typical by the construction of smaller, interconnecting lines usually supported by local authorities and enterprises. The substantial share of such lines were unprofitable from the very beginning and the decision to build them was very often based more on optimism and public subsidies than on economic rationale. The precise timing of this development differed among countries but roughly it is possible to date these periods by years 1825-1850; 1850-1875; 1875-1900.

The period of railways construction in the 19th century was very dynamic. “By the end of the 19th century, the revolutionary impact that railways had made on the world had become fully apparent and their use as a form of mass communication was firmly established.” (Garratt 2000; p. 15). The evolution of railways networks was based mainly on economic reasons because revolutionary changes brought about by railways generated attractive profits and lured capital into the industry. But also military aspects were important and state intervened and subsidized railways construction. Local interference was also important, as Swiss authors comment: “Remember that the first railway lines were typically financed by local investors..."
with the aid of state and local governments for the purpose of increasing commerce. Consequently, investors and government officials had a proprietary expectation that "their" company would primarily serve local interests. To give a short explanation for that, this was mainly due to the conviction that railways would stimulate both the economy and the growth of the population all over the country and especially in remote areas by keeping freight rates low.” (Steinmann – Kirchhofer 2006, p. 16)

The 19th century was the century of railways construction. However, only very few new lines were constructed in the 20th century. The focus shifted on operation of the railway business and on a process of mergers and acquisitions. The aim was to consolidate the business, to combat ineffective lines and to achieve network economies in the process. The operation of the business was quite satisfactory until the break up of WWI. The war brought about big changes in railways operation. Many European lines and rolling stock were destroyed, and the demand after the war changed. Railways had to face a very strong competition from road transport with the spread of cars and buses. “The period of certainty and dominance enjoyed by railways before 1914 were brought to an abrupt end when war broke out in Europe. Until the outbreak of the conflict they had enjoyed something of a “Golden Age”. After 1918, the certainty that railways were the profitable premier form of transport was gone for ever.” (Garrett 2000, p. 22)

Railways companies in developed countries during interwar period struggled with growing road competition. Rail transport although still in dominant position began to lose its positions. After WWII there was an acceleration of the railway transport decline. Dynamic performance of road transport as well as air transport led to a shrinking market share of rail transport. Once dynamic railway companies which were able to feel market demand and responded to customers needs had changed into beaurocratic and inflexible organizations that were unable or slow to change their behaviour. The market shares have been falling continually. The US railways had been harder hit on passenger market and EU operators on freight market. “Rail passenger car inventory has declined alarmingly. Total U.S. passenger cars have declined from 61.728 in 1929 to 6.842 in 1971.” (Norton 1974, p. 382). “By 1965 it had become almost impossible (in US) to travel substantial distances by trains since those remained had few connecting lines still available.” (Norton 1974, p. 379). “Between 1970 and 1998 the share of the goods market carried by rail in Europe fell from 21.1 o 8.4 % (down from 283 billion tonnes per kilometre to 241 billion), even though the overall volume of goods transported rose spectacularly. But while rail haulage was declining in Europe, it was flourishing in the USA, precisely because rail companies were managing to meet the needs of industry. In the USA, rail haulage now accounts for 40 % of total freight compared with only 8 % in the European Union, showing that the decline of rail need not be inevitable.” (EC 2001, p. 27-28). “For the last 30 years, in the presence of steady passenger and freight transport growth of 2.5-3% annually in Europe, EU railway transport has been in steep decline. It is estimated that during the period 1990-2001, measured in tonnes/kilometres, freight transport in general rose by 25%, and road transport increased by 35% while rail freight transport decreased by 6%. During the period 1970-2001, rail’s market share collapsed from 21% to 7.8%.” (DiPietroantonio-Pelkmans 2004, p. 4)
2. Product life-cycle theory

Product life cycle theory states that products on the market are going through a process of the development. The life cycle consists of periods of Introduction → Growth → Maturity → Decline. The basic idea of the theory comes from biology as an analogy with life cycle of an organism. Curiously, this idea is not firmly included in formal economic theory and it is applied mostly in marketing and business techniques as a tool for product management. As Vernon states in extensive Palgrave Dictionary of Economic: “No one will deny that products come into existence, change in character, and eventually disappear or became altered out of all recognition. Archaeologists, historians, businessmen and ordinary people have no difficulty in recognizing that fact. Economists, at least since David Hume, have occasionally acknowledged the phenomenon. But until a decade or two ago, the disposition of economist to use that process as a basis for formal inductive or deductive analysis has been extraordinarily limited.” (Vernon 1998, p. 986)

The theory reflects marketing and business approaches, so the focus is especially on the development of sales, profits, advertisement, product awareness and customer loyalty. Product life cycle theory distinguishes following periods:

**Introduction** – The product appears on the market. Customers are not aware of its potential benefits so advertising is usually necessary. Investments are needed to cover sunk costs and to build up market. Risk is high because it is not clear if the product succeeds. Profit is negative due to high costs and low sales. Level of competition is low.

**Growth** – The product has been successful and there is a rapid spread of awareness and use of the product. Sales are growing quickly, unit costs are decreasing and profit starts to be generated. Investments are still high. The product is promising and new competitors are attracted into the industry.

**Maturity** – The product reaches limits of the market size. Sales and profits are high but there is limited possibility to expand them. Marginal sales are growing only very slowly or even starting to stagnate. Investments are mainly renewable. Competition is very intensive on the market, because the product is highly profitable.

**Decline** – The product is starting to be obsolete. Customers have been attracted to other products. Advertising or brand loyalty can slow down it but not for long. Sales are falling and unit costs are increasing as output falls. Profit is low or negative and competitors leave the market.
I have tried to apply product life cycle theory on the history of railways. The theory relates to the life cycle of the product. As railways industry produce basically one product (point to point transportation), product life cycle can be applied to the entire industry. There are of course risks and shortcomings connected with this approach. Products can change in time making them the different, so we don’t have the same product at the beginning and at the end of the process. Railways transport in 2006 really differs from railway transport in 1830. But I suppose that the railways product essence has stayed basically unchanged and it is possible to apply product cycle theory. Based on the history of railways, I have tried to identify main periods of railways development and to construct life cycle curve of the railways industry.

Table 1: Railways development periods

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Graph 1: Product life cycle curve (Railways, Europe and USA, based on sales in real terms)
3. Determinants of the decline

The determinants causing life cycle of the product are basically changes in microeconomic demand and supply. They are caused by any factor affecting cost structure or consumer utility. The most important are changes in technology and in consumer preferences. If we concentrate on the determinants of the decline of railway transport, the most important have been road competition, changing pattern of the economy and railways internal inflexibility.

Road competition
The evolution and the spread of both rail and road transport are stories of success. Railway transport was successful in the 19th century and road transport in the 20th. There is an interesting discussion, why road transport hadn’t succeeded already before. Some authors argue, that evolution of rail transport was mainly due chance or heavy investment: “With millions of dollars invested in new railroads annually and with virtually each new extension of the system embodying some technological advance, the efficiency gap between the railroad and the horseless carriage became increasingly great – perhaps to the point that the latter no longer appeared to be a practical alternative…..Thus, motor vehicles were perfected and put into commercial production when the developmental potential of railroads had more or less run its course.” (Fogel 1966, p. 42)

Anyway, railways in the 19th century were the only transport mode able to offer a reliable and complex service. There was limited competition of canals and stage coaches, but there were no cars, buses and good roads to compete with them. Railways were in dominant position in transport because other modes of transport were weak. This has changed substantially after the evolution of road transport. Railways stopped to be the only option and the possibility of choice was given to customers. The important advantage has been on the side of road transport. With the increasing length of roads, road operators were able to offer point to point delivery, both in freight and passenger transport. Railways transport, limited by its costly track, cannot do this. Economics of railways requires having high and concentrated flows of traffic to use economies of density. This has led to situation that from many market segment railways were driven out. Currently railways strongholds are only in three market segments: freight transport of bulky materials, inter-city passenger transport (300-800 km) and commuting passenger transport in heavily populated areas.

Changing patterns of the economy
The economic development in the 20th century was not very prospective for railway transport. The core of economic activity has been slowly shifting from industry to services. This hurt railways freight business because main customers were industrial producers dealing with heavy raw materials such as steel, coal and lumber products. The economy has started to be weightless: “In 1999 the total output of the American economy weighted roughly the same as it did 100 years earlier. Yet the value of that output in real terms was 20 times greater. Output is increasingly weightless, produced from intellectual capital rather than physical material. Production has shifted from steel, heavy copper wire and vacuum tubes to microprocessors, fine fibre-optic cables and transistors. Services have increased their share of GDP.” (Bishop 2000, p. 243). Also transportation costs decreased substantially: “The average cost of moving a ton a mile in 1890 was 18.5 cents (in 2001 dollars; USA). Today, this cost is 2.3 cents. At their height, the transportation industries represented 9% of GDP. Today, if we exclude air travel, they represent 2% of national product.“ (Glaeser – Kohlhase 2003, p. 4). Changing patterns of the economy is hurting railways because they are losing competitiveness in comparison with road transport. Railways were designed to transport high volumes of output
alongside a few routes connecting main economic centres. This pattern is not very useful in modern world where economic activities are decentralized and important is point to point delivery.

**Railways internal inflexibility**

The decline of the railway industry was accelerated by some unique factors that are present in this sector. In the 19th century railways operators used to be progressive and dynamic firms. But subsequently as a result of concentration and nationalization process, railways in the 20th century have emerged as big, monolithic structures with bureaucratic behaviour. Bureaucratic structure enables to manage big and complex scope of business. On the other side it lowers flexibility. The lack of flexibility was the reason of low market oriented behaviour and slow reaction to challenges posed by the road transport. Already in 1934 H.M. Hallsworth noticed lack of incentives in railways operations in a following sentences which sounds surprisingly up to date: “It must, I think, be admitted that until the last few years the railways either did not realise the extent to which road transport was likely to develop or, at least, were slow to take steps to meet the competition which was arising. Prior to the advent of road transport the railways relied too much on their established position. They were inclined to wait for traffic to come to them, since in most cases no other mode of transport of equal efficiency was available. It is true they employed canvassers, but canvassing for traffic was not undertaken to the same extent or with the same zeal as it is to-day. The needs of their customers were not made a special subject of study. There was a tendency to wait for complaint to arise before altering an existing mode of operation or the kind of service offered.” (Hallsworth 1934, p. 551).

European railways are even more affected than US railways because due to historical development, railway markets and operations in Europe are strictly national and border divided. This is very curious in a situation of single market and very handicapping comparing to road transport. This situation leads to fragmentation of markets, low level of competition and poor efforts in service improvements or costs cutting. In an analysis of EU rail policy DiPietroantonio and Pelkmans have identified no less than ten shortcomings resulting from such situation:

- Limited attention to customer care
- Weak reliability and punctuality of shipments
- Limited flexibility in trans-shipments
- Fragmented cross-border services with delays at the frontiers (lack of interoperability)
- Absence of cross border cabotage
- Lack of service integrators for optimised logistical chains
- Traffic priorities allocated to passengers (unclear slot allocation management)
- Lack of one-stop-shop in path allocation, cargo tracing and handling
- Lack of competition
- Non transparent cost structure on international corridors

(DiPietroantonio-Pelkmans 2004, p. 4)
4. The European policy of railway’s revitalization

Railways life cycle is specific, because it was influenced many times by public intervention. In various periods of railways life cycle, public policy either promoted the growth or blocked the decline. The governmental influence began usually with support of new lines construction. The governments were interested in railways and usually supported their growth. Afterwards from many reasons railways were under direct control of public authorities and it was usually beginning of their stagnation. After WWII there was an attempt to use railways to fulfil socially oriented goals by subsidizing passenger traffic especially on the regional lines. Unsatisfactory general results of railway performances in the second part of 20th century lead to the reform attempts. The reforms path differed enormously in various parts of the world. In the Europe railways has been in a state of chronic losses covered usually by public finances. The official policy is to promote competition through vertical unbundling and to deliver sustainability through massive investment from public finances.

European transport strategy is formulated in White Paper on Transport Policy (EC 2001) basically a manual for transport policy making. Key objectives for combating railway decline are formulated in following manner: “What is needed, therefore, is a veritable cultural revolution to make rail transport, once again, competitive enough to remain one of the leading players in the transport system in the enlarged Europe. The priority must be to resolve the problems holding back its development: the lack of infrastructure suitable for modern transport and of interoperability between networks and systems, the constant search for innovative manufacturing technologies, the non-transparency of costs, and the patchy productivity and shaky reliability of the service, which is failing to meet customers’ legitimate expectations.” (EC 2001, p. 27-28); “Unless competition between modes is better regulated, it is Utopian to believe we can avoid even greater imbalances, with the risk of road haulage enjoying a virtual monopoly for goods transport in the enlarged European Union. The growth in road and air traffic must therefore be brought under control, and rail and other environmentally friendly modes given the means to become competitive alternatives.” (EC 2001, p. 24) “objectives by 2020: for rail to increase its market share of passenger traffic from 6 to 10 % and of goods traffic from 8 to 15 %” (EC 2001, p. 27)

Railways have important function in EC transport strategy. EC view this mode of transport as preferable and seeks how to promote it. This standpoint is based on the mix of environmental, political and social reasons. The preference for railways is believed to change decline pattern of the railway industry through state financing of railway investment, covering railway losses and probably by increased taxing of road transport. From the position of railways life-cycle is such policy questionable. If railways really are following life cycle pattern, than any public intervention can hardly reverse it. Road transport overran rail transport not due to unfair competition or due to government neglect but due to changes in supply and demand resulting in better services.
5. Conclusions

Railways story is a dramatic history of the rise and the decline. Railways emerged in the second quarter of the 19th century and underwent dynamic process of construction. The process of construction peaked around the year 1860. The largest extent of railways network was achieved around 1900 and at the beginning of 20th century railways dominated transport in developed countries. The first half of 20th century was still the age of rail transport dominance, but the positron was eroded by quickly growing road transport. The trend accelerated in the second part of the 20th century and contemporary position of railways on the transport market is very weak.

Railway history in the past two centuries is possible to view as an application of the theory of product life cycle. I have tried to apply it to explain the rise and the decline of railways. Product life cycle theory states that products on the market are going through a process of development. The life cycle consists of periods of introduction, growth, maturity and decline. The theory relates to the life cycle of the product. As railways industry produce basically one product, product life cycle can be applied to the entire industry. In the case of railways we can apply this theory as an explanation why railways once surpassed horse carriages and water canals just to be later overcome by cars, trucks and buses. Based on the history of railways, I have tried to identify main periods of railways development and to construct life cycle curve of the railways industry. This life cycle curve reaches its maturity phase in the first quarter of 20th century and divides the rise and the decline period of railways life-cycle.

The determinants causing decline of railways were identified as road competition, changing patterns of the economy and railways internal inflexibility. Especially road transport has some important advantages over railway transport in today’s world. Point to point delivery, ability to operate on smaller scale and flexible approach. Changing patterns of the economy with the inclination towards lighter and more diversified production also hurt railways business, which is based on transportation of heavy output in a row. Railways also have their own share. Their lack of flexibility particularly accelerated the process.

Government has been very often involved in the area of railway policy. The support and laissez faire policies in different times influenced dynamics of railways life cycle. Today’s railways are in a situation of long term decline, market shares are substantially lower than 100 years ago and many railway companies accumulate huge losses. Those losses are usually covered from public subsidies and without state finances railways would not be probably present in many developed countries. Railways are under fierce competition of road and air transport. The policy of major railways revitalization by huge public investment seems to have little chance to succeed.
6. References:


In the railway technical standards, therefore, the items concerning structure of facilities and rolling stock, train operation handling and so forth are stipulated for ensuring safety. (2) Maintaining of railway network and ensuring of railway transport characteristics. To establish a railway network which enables through operation in the entire country or within large cities and to ensure advantageous railway characteristics such as large-volume, stable, and high-speed transport, it is necessary to maintain the conditions of facilities and rolling stock at a specific level. In the railway technology.com profiles the 10 largest railway networks in the world based on total operating length. United States: 250,000km. The Indian nationwide rail network, the fourth longest in the world, is owned and operated by state-owned Indian Railways and includes an operating route length of more than 65,000km. The network carried about eight billion passengers (the highest in the world) and 1.01 million tonnes of freight (fourth highest in the world) in 2013. But the decline of profits and the rise of highway construction in the subsequent decades reduced the network to the 36,000km of line that exists today. The railway companies operating on the network were nationalised in 1948 with the creation of the state railroad corporation Ferrocarriles Argentinos. Rail transport is one of the structural industries which give an impulse to the various adjacent sectors and a large number of companies across the country. This is why its development should be one of the nation-wide priorities. Demand for products of railway engineering companies began to decline in 1993 as a result of the significant reduction in investment. Investing in fixed assets remained extremely low almost until 2007 (Figure 1). Long-term state lending for innovative projects; tax incentives for scientific and design organizations to promote new railway machinery; accelerated depreciation opportunities for high tech products.