*Transport & Economic Growth in Western Europe 1830-1914**

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The Growth of the Economy and the Development of Transport

European economic growth, which accelerated in the second half of the XVIIIth century, was accompanied by an expansion in the supply of transportation. Demand for transport services increased when industrialists and farmers purchased their inputs from a resource base which widened in space and as they sold a growing proportion of their output on markets at an ever greater distance from their enterprises. As commodity output went up, the share marketed increased even more rapidly because impro-

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vements in transport made it possible to sell further afield and because specialisation (a major impetus to economic growth between 1789 and 1914) led to more trade between firms, farms and industries. In the traditional economy of early modern Europe production tended to occur within integrated forms of enterprise geographically concentrated in well defined regions. But over the XIXth century the co-ordination of production came to be achieved through organised commodity and input markets serviced by extended and increasingly efficient transport and distribution networks. Adam Smith's twin processes of market penetration and specialisation implied increased demands for transport.

At the same time a series of innovations raised the efficiency of Europe's transport systems which lowered the costs of inputs used by farmers and manufacturers and the prices of their outputs. Such innovations which were diffused gradually throughout the continent included: surfaced roads, improved water and railed ways, the embodiment of new materials such as iron, and later steel, in the capital stock of national transport sectors and, above all, the replacement of wind, water, animal and man power by steam power. These innovations, chronicled by historians of transport, provided producers with speed and continuity of delivery, and lowered the costs of transporting almost all goods across time and space. They were particularly important for commodities heavy or bulky in relation to value — transport intensive goods such as coal, mineral ores, building materials, grain and metal goods. The effects of innovations within the transport sector appeared as changes in price differentials between commodities sectors and regions of the European economy. Such "forward linkages" operated upon the structure of relative prices and fostered regional specialisation and trade. The concomitant effects on the allocation of resources, labour migration, urban development and rates of capital formation were complex and, for some economies, profound.

Furthermore, the new and expanded transport networks made direct demands for the products of several industries which supplied the companies responsible for the carriage of goods and people by rail and water, with their iron, steel, coal, construction materials and engineering products. To appreciate the force of these connexions (or " backward linkages ") economic historians have measured the share of total output delivered by particular industries to the transport sector, and have attempted to analyse the degree to which the pressures of such demand promoted economies of scale and generated more rapid diffusion of technical progress in supplying industries.

Accelerated rates of capital formation which took place in transport sectors throughout Europe in the XIXth century also gave rise to a range of externalities, or spin-offs, which are not captured either in the declining real price for transport services or changes in the structure of relative prices. For example, railways (but also canals) trained labour — engineers, foremen and managers — whose skills (initially acquired in transportation) contributed to the development of other industries. First canals and later railways made voracious demands for capital over relatively short periods of time which prompted the expansion and improvement of financial intermediaries for the mobilization of domestic and foreign savings. Once established such institutions continued to meet the needs of other sectors of the economy. By tapping and mobilizing new sources of finance the railways pushed up average rates of saving and investment over the long run. And in some countries where the construction of railways occurred in a contra-cyclical manner, the timing of their expenditures on capital goods reduced instability which presumably encouraged more investment and a greater willingness to assume risks throughout the economy.

Economic historians must do more than simply point out the range of interconnexions between transport and economic growth. By looking at the history of transport across several

nations they can compare output for the whole transport sector country by country for bench mark years from the late XVIIIth century through to 1914. That output should be broken down into intermediate output (ton kilometres of freight per capita) and final output (passenger kilometres per head of the population) for major European economies. The latter is not only an index of how rapidly the idea of travel diffused among Europeans but it is a useful indicator of labour mobility.[1] Personal travel (kilometres per passenger) grew more rapidly than services to producers, and a rising percentage of receipts from the provision of the entire range of transport services emanated from the sale of this "new good".[2] For example, in France it rose from under 10% of transport revenues in the 1830's to over 30% by the end of the century.[3] Almost the whole of the addition to passenger output came from railways and the railway systems of Europe consistently derived more than half of total receipts from the purchase of travel for business and pleasure. They supplied a novel, safe, comfortable and speedy service for which there was no real alternative before the development of the internal combustion engine. Demand for travel seems to have been both price and income elastic. Even the Dutch, who had enjoyed the most efficient mode of passenger transportation by water in Europe, switched to rail as soon as that facility became available.[4]

Levels of intermediate output also provide historians with a useful index of market penetration in different economies which also cross checks on levels of commodity output across Europe. There is a fairly close correlation between the growth of

[1] Relevant data are contained in B. Mitchell, *European Historical Statistics* (London, 1975), section G.

[2] A. de Foville, *La transformation des moyens de transports* (Paris, 1880), pp. 141-147 and L.G. McPherson, *Transportation in Europe* (London, 1910), pp. 69-78.

[3] J.C. Toutain, *Les Transports en France* (Paris, 1967), p. 286.

[4] J. De Vries, *Barges and Capitalism: Passenger Transportation in the Dutch Economy* (Wageningen, 1978), p. 236.

commodity output and the increased volume of goods handled by the transport sector, and it may be possible to estimate a range of coefficients to link the two series. For countries which lack adequate statistics on movements in output, cautious and qualified inferences might be drawn about possible rates of growth from transportation data, if that happens to be available. French, British and Belgian data indicate that freight output expanded at more than double the rate for commodity output as a whole between 1830 and 1913.[5] For other countries (such as Germany and Spain) less favourably endowed with roads and waterways in the early XIXth century, the growth of freight transported was probably even more elastic with respect to output.[6]

Two kinds of influences should be distinguished when we try to explain why the share of transportation to gross domestic product more than doubled in most European countries over the XIXth century. First the income effects are reasonably clear and the high income elasticity of demand for travel has already been mentioned. Furthermore, rising incomes in particular regions and countries had for centuries generated demand for more varied consumption and stimulated international and interregional trade. Foreign and internal commerce expanded much faster than output as the diversified produce of remote countries and regions entered the consciousness and consumption patterns of new social groups. Studies of diet, dress and taste by historians suggest that the XIXth century was a century when European families found spice and variety by incorporating the products of alien cultures and remote regions into their traditional consumption. In this process the demand curve for transport and distribution shifted to the right.

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[5] See chapters by Caron, Hawke and Higgins and Laffut in P.K. O'Brien, ed., *Railways and Economic Development in Europe, 1830-1914* (forthcoming Macmillan-St. Antony's, 1983) and Toutain, *Les Transports en France*, p. 298.

[6] See chapters by Fremdling and Gomez-Mendoza in O'Brien, ed., *Railways and Economic Development*.

Two sorts of price effects also stimulated demand for transport. First improvements in economic efficiency depressed the prices of final outputs to consumers and the costs of inputs to producers markets widened. Furthermore, regional specialisation, based initially upon natural but increasingly upon uneven rates of capital formation and technical innovation widened the gaps in productivity and altered price differentials between the regions of Europe. Lags in the diffusion of technology, the accumulation of capital and organisational improvements between countries and regions generated greater demands for transport. New techniques reduced costs of production for several commodities such as iron, coal, building materials and grain, which could then afford to carry the transportation markups involved in marketing goods, heavy or bulky in relation to their retail or final sales prices.

Secondly, technical progress within the transport sector also widened the market and stimulated additional demand for freight and passenger services. Although indices of changes in total factor productivity have been constructed for British, French and German railways, almost no econometric research of a similar kind has been undertaken for transport along European waterways and roads.[7] But it is certainly evident that real costs per passenger kilometre and per ton-kilometre of transport services fell sharply with the diffusion of railways and steam locomotives. British and French data testify to the considerable reductions in price per kilometre, which the railways offered to travellers. For example, in the XIXth century France it was two to three times more expensive for passengers to travel by

[7] See chapters by Hawke-Higgins, Caron and Fremdling, in O'Brien, ed., *Railways and Economic Development*; G. Hawke, *Railways and Economic Growth in England and Wales* (Oxford, 1970), Ch. XI; F. Caron, 'Recherches sur le Capital des Voies de Communication en France au XIXe Siecle,' in *Colloques Internationaux du C.N.R.S.*, No. 540, L'Industrialization en Europe au XIXe Siécle (Lyon, 1970), pp. 256-61; R. Fremdling, *Eisenbahnen und Deutsches Wirtschaftswachstum, 1840-1879* (Dortmund, 1975), pp. 35-51.

road than by rail.[8] And in the 1860s a British Royal Commission compared first class coaching at two shillings per mile with first class rail fares of between two and three pence a mile.[9] When and where trucks drawn by steam-powered locomotives competed with carriages and carts pulled along roads by horses, oxen and mules, railways offered producers a far cheaper service per ton kilometre of freight carried. Thus between 1855 and 1913 it was three to four times more expensive for French firms to send merchandise by road.[10] As early as 1850 on average it cost nine centimes a ton-kilometre to despatch freight by road in Belgium compared to five centimes by rail.[11] And in the 1860s, coal was carried by British railways at about one twentieth of the cost by road.[12]

Whenever the new technology competed with water-borne transport the decline in costs per ton kilometre of freight carried was, however, much less obvious, particularly where steam powered boats competed with locomotives by carrying heavy and bulky commodities along inland and coastal waterways.[13] In France and Belgium and Italy (but not in England) costs per ton kilometre were lower by boat.[14] Railways competed with waterways by offering producers a speedier and more reliable service but at a comparable or even higher tariff per ton kilometre. If speed was necessary (for example in the carriage of perishable produce) this service could be described as indispensable. Furthermore, the diffusion of railways compelled carriers who used waterways to lower their prices in order to compete; and by

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[8] TOUTAIN, *Les Transports en France*, p. 277.

[9] HAWKE, *Railways and Economic Growth*, p. 44.

[10] TOUTAIN, *Les Transports en France*, pp. 277-9.

[11] See chapter by Laffut in O'BRIEN, ed. *Railways and Economic Development*.

[12] HAWKE, *Railways and Economic Growth*, pp. 179-80.

[13] DE VRIES, *Barges and Capitalism*, pp. 245-8 and 359-61.

[14] See chapters by Caron, Laffut and Fenoaltea in O'BRIEN, ed., *Railways and Economic Development*; TOUTAIN, *Les Transports en France*, pp. 277-8 and HAWKE, *Railways and Economic Growth*, pp. 85-6, 173, 187-8.

eroding the rents or monopolistic profits of carriers by water (and road) the railways made a further contribution towards extending the market and promoting economic growth.

The precise impact of the rise in total factor productivity in transport can only be properly assessed when it becomes possible to compare movements in the prices of transport services with trends in wholesale prices. More price indices are required to measure how far the relative price of transport declined between 1789-1914. The evidence for Britain, France and Germany suggests that this decrease was really singificant.[15] A significant decline implies that the increase in total factor productivity in the European transportation sectors was sufficient not merely to meet rising demands for its services from other sectors of the economy, at constant real prices, but made an "autonomous" contribution to economic growth. Here lies the difference between transport operating to complement productivity growth achieved by industry and agriculture; and transport acting as a leading sector in the process of widening markets and altering the structure of relative prices for commodity output and inputs. The degree to which such an autonomous contribution occurred would be reflected in a fall in the average share of the transport margin in the selling price of goods and services marketed throughout the continent. Such effects would vary from commodity to commodity, region to region, and sector to sector. They would depend on the share of transport embodied in the market price (and would thus be more significant for transport intensive commodities). The effects also depended upon the price elasticity of demand for particular goods. For example, although the transport margin embodied in the retail prices of flour and sugar is similar, a fairly small cut in sugar prices could perhaps widen the market far more than a comparable cut in the price of flour.

[15] TOUTAIN, *Les Transports en France*, p. 283; and FREMDLING, *Eisenbahnen und Deutscher Wirtschaftswachstum*, pp. 57-60.

Although prices fell, studies on the pricing policies pursued by enterprises concerned with transport by road, rail and water, reveals how the monopolistic nature of the industry and government intervention (in many cases more concerned with public revenue than consumer welfare) operated to hold the prices charged by transport companies at levels which were sub-optimal for the overall growth of the economy. For example, Fenoaltea's analysis for Italy reveals how the high tariffs charged by Italian railways constrained specialisation and the extension of the market while the more efficient French and German companies set their prices closer to marginal costs and were not burdened by onerous obligations to transfer a high percentage of their operating revenues to the state.[16] But in other countries, including Britain, Belgium and the United States, actual and incipient competition from waterborne transport probably kept railways tariffs closer to competitive norms.[17]

To conclude: transportation grew more rapidly than national output because demand for travel was income and price elastic and because the sector was called upon to carry a rising proportion of commodity output across greater and greater distances. For example, in France in the 1830s the average lead or distance travelled by freight from the point of production was 50-60 kilometres by road. By 1905-13 this average had risen to 190 kilometres by rail.[18] Technical progress with rising factor productivity occurred in all forms of transport: in surfacing roads, improving inland waterways, in laying down railed ways but above all in the application of steam power to carriers by rail and water.

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[16] See chapter by Fenoaltea in O'BRIEN, ed., *Railways and Economic Development*.

[17] R.M. HARTWELL, 'The Railways and the British Economy in the Nineteenth Century. Growth and Regulation'. Unpublished paper delivered to the first Madrid Conference on the History of European Railways, December 1979; L. GIRARD, 'Transport' in M. POSTAN and H.J. HABAKKUK (eds), *Cambridge Economic History of Europe*, vol. VI, part. 11 (Cambridge, 1966); H. PARRIS, *Government and the Railways in Nineteenth Century Britain* (London, 1965).

[18] TOUTAIN, *Les Transports en France*, p. 244.

Over the XIXth century the growth of European output was not constrained as it had been in past centuries by increasing costs of transportation. On the contrary, extensions to and improvements in the transportation networks in most European countries made a positive and autonomous contribution to national rates of growth. Without the revolution in transport which raised its productivity a greater volume of scarce resources would have been diverted into that sector in order to cope with the rising demand for freight services (and for travel) between 1789 and 1914. *If* European economies had been confronted with rising real costs of transport, trade and specialisation would have been constrained and the overall growth of output would have been slower. *If*, in turn, historians could answer the question how much slower, then they would be in a position to measure the contribution to the growth rate made by improvements in the efficiency of transport networks. Inter-connections between transport and other sectors of the economy can be specified, but historians are still a long way from "measuring" the contribution of transport to economic growth between 1789 and 1914. They have not and perhaps cannot quantify the decline in the rate of growth of gross national product which would have occurred if total factor productivity in transportation had remained constant over time.

2. *The Significance of Railways: Social Savings*

New economic historians have, however, attempted to measure something more restricted, namely the impact of the diffusion of railways on economic growth. In focussing upon railways they selected the core element in the transport revolution of the XIXth century. Although technical change occurred throughout the transportation sector and steam power was also utilised by waterborne carriers, the construction of networks of lines across Europe rising from nearly 3,000 kilometres of track

in 1840 to 362,000 kilometres by 1913 placed railway companies in a position to provide nearly all the additional passenger kilometres sold to consumers of travel between 1840 and 1910.[19]

They also met the demand for an extremely high proportion of the extra ton-kilometres supplied for the transportation of freight around Europe over the XIXth century. For example, French statistics show that while output of roads, canals, and coastal shipping remained roughly constant between 1830 and 1914 the ton kilometres of transport services supplied by railway companies expanded to a point where they supplied nearly 70%

TABLE 1

EUROPEAN RAILWAY DEVELOPMENT

	(Territory and Population in Relation to kilometres of lines)			
	1860	1880	1900	1910
U.K.	44	66	69	69
Belgium	30	60	88	102
France	18	44	77	87
Germany	21	54	70	75
Sweden	3	32	61	76
Switzerland	28	63	79	88
Russia	1	10	21	24
Spain	6	23	40	58
Italy	6	23	38	38

Source: P. BAIROCH, 'Niveaux de developpement economique de 1810 a 1910', *Annales, ESC*, December, 1965.

of total freight transportation in 1914.[20] No doubt statistics for other economies would also reveal the dominance of railways in the expansion of internal transportation over the XIXth century. Thus in Belgium, railways moved from a position where they supplied 7% of freight transportation in 1845-46 to where

[19] P. BAIROCH, *Commerce extérieur et developpment economique de l'Europe au XIXe Siecle* (Paris, 1976), p. 32.

[20] TOUTAIN, *Les Transports en France*, p. 248.

they provided 77% in 1908–13.[21] Although railways clearly met most of the additional demand for transport which emerged after 1840 it cannot be assumed that railways alone possessed the techniques and capacity to obviate a potential "transport bottleneck" to the growth of output over the XIXth century. But can their contribution be measured or quantified?

One well-known approach to answering this question is to estimate social savings from railways some decades after national networks had been in full and efficient operation. This approach postulates that the importance of railways to any economy could be measured as the *costs* of coping without them over one year.

The method envisages a counterfactual situation in which a given national network is closed down for twelve months but producers continue to despatch exactly the same volume of freight to the same destinations as before by using roads and waterways. But, in order to maintain a constant level of transportation when denied access to railways farmers and industrialists would clearly incur extra costs because:

(*a*) freight despatched by road and water had to pay higher tariffs per ton-kilometre;

(*b*) their goods would usually move along more circuitous and longer routes;

(*c*) the time taken between despatch and delivery would lengthen;

(*d*) transportation by waggons and boats was more risky, more subject to delay and loss than transportation by rail.

Assuming that the extra costs of sending commodities by water and road (instead of by rail — the preferred and cheaper method) could be estimated, new economic historians have ostensibly measured social savings which they define as equal to the

[21] See chapter by Laffut in O'Brien ed., *Railways and Economic Development.*

extra or marginal benefit derived by a society from the normal operation of its railway system.[22]

Estimates of social savings on ceteris paribus assumptions, first formulated for the United States, have now been manufactured for several European countries (including Tsarist Russia) and the statistics expressed as a ratio of Gross National Product are set out in Table 2 below:

TABLE 2

ESTIMATES OF SOCIAL SAVINGS
ON FREIGHT TRANSPORTED BY RAILWAYS

Country	Date	S.S. Expressed as a Share of G.N.P.	
England and Wales	1865	4.1%	(a)
England and Wales	1890	11.0%	(a)
U.S.A.	1859	3.7%	(b)
U.S.A.	1890	8.9%	(c)
Russia	1907	4.6%	(d)
France	1872	5.8%	(e)
Germany	1890s	5.0%	(f)
Spain	1878	11.8%	(g)
Spain	1912	18.5%	(g)
Belgium	1865	2.5%	(h)
Belgium	1912	4.5%	(h)
Mexico	1910	25%-39%	(h)

Note: These estimates all based on the ceteris paribus assumption are comparable.

Sources:

(a) G.R. HAWKE, *Railways and Economic Growth in England Wales*, 1840-70. (Oxford, 1970) p. 196. The 1890 estimate has been calculated from the data presented on p. 89 and an estimate for the National Income of England and Wales for 1890 based upon the assumptions specified on p. 196.

(b) Calculated from A. FISHLOW, *American Railroads and the Transformation of the Ante-Bellum Economy*. (Harward, 1965), pp. 37 and 52.

(c) This is Fogel's unadjusted estimate based on ceteris paribus assumptions and calculated from data in R. FOGEL, *Railroads and American Economic Growth* (Baltimore, 1964), chapters 2 and 3.

(d) J. METZER, 'Railroads in Tsarist Russia: Direct Gains and Implications', *Explorations in Economic History*, 13 (1976), p. 90.

(e) to (h) See papers by Caron, Fremdling, Gomez-Mendoza and Laffut in P. K. O'Brien, ed. *Railways and the Economic Development of Western Europe, 1839-1913*, (forthcoming Macmillan-St. Antony's, 1983).

(i) J.H. COATSWORTH, 'Indispensable Railroads in a Backward Economy: The Case of Mexico', *Journal of Economic History*, XXXIX (1979), p. 952. This estimate is expressed as a share of GDP.

[22] P.K. O'BRIEN, *The New Economic History of Railways* (London, 1977), Chs 2 and 3.

Of course there are formidable problems connected with the quality of the data deployed to estimate social savings and a major theoretical controversy has arisen around the extent to which historical records of prices charged by road hauliers, inland waterways and railway provide adequate proxies for the "real" or opportunity costs of the resources employed by transportation networks of Europe and America.[23] Formidable index number problems inherent in the concept are also still unresolved. For example, what are the implications of assuming that enterprises would continue to despatch the same volume of freight with and without railways? If the cost differences between railways and other modes of transport are large and the derived demand for transport is price elastic the volume of freight transported is not independent from the introduction of railways.[24]

Finally social savings estimates are sensitive to the assumptions made about the real opportunity costs of the resources "released" to the economy from the transport sector through the operation of railways. If the rise in labour productivity simply adds to the volume of unemployment or to emigration (pace Italy) then the gains to the national economy are reduced.[25] For Spain the availability of seasonally underemployed agricultural workers reduced the social savings from railways from 11.8% to a feasible 7.5% of GNP.[26] Debate over the new economic history of railways continues and has been reviewed and summarised elsewhere.[27] Let us presume that the available estimates of social savings provide rough outer-bound measures of the

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[23] R. FOGEL, 'Notes on the Social Savings Controversy', *Journal of Economic History*, XXXIX (1979), pp. 13-38.

[24] J.G. WILLIAMSON, *Late Nineteenth Century American Development: A General Equilibrium History* (Cambridge, 1974), pp. 184-87.

[25] See chapter by Toniolo in O'BRIEN, ed., *Railways and Economic Development.*

[26] See chapter by Gomez-Mendoza in O'BRIEN, ed., *Railways and Economic Development.*

[27] O'BRIEN, *New Economic History of Railways*, Fogel, 'Notes', and T.R. GOURVISH, *Railways and the British Economy*, 1830-1914 (London, 1980).

percentage falls in gross national products which might have followed from the closure of railways during the years specified in table 2 above. It then becomes instructive to analyse the variations in social savings attributed to railways across countries and over time.

With all their theoretical and empirical imperfections estimates of social savings do enable historians to dispose of claims that railways were "vital" or "indispensable" for economic progress, because they show that (apart from Spain and Mexico) closure of a fully operational railways network would have led to a fall of less than one tenth of national outputs. Nevertheless a fall of 10% of GNP (or even 5% for that matter) is still a very large magnitude. Railways were clearly important (and in the Spanish case very important) for the growth and maintenance of commodity production at observed levels. Just how important can only be assessed by comparing the social savings achieved by railways with the social savings for other major XIXth century innovations, such as steel, power looms, canals, chemicals, etc.

The increase over time in the benefits derived from railways (the rise in the ratio of social savings to national income) reflects the continuous improvement in the efficiency of railways which occurred through the steady diffusion of better techniques in railway engineering, the replacement of iron by steel rails and in business organisation.[28] Thus freight rates on German railways declined over the XIXth century to one quarter of their level for 1845.[29] In Belgium the rates per ton kilometre declined from 10.8 centimes in 1845 to 3.6 centimes in 1913 and in France they fell by 50% over the same decades.[30] Improve-

[28] HAWKE, *Railways and Economic Growth*, ch. XI; A. FISHLOW, 'Productivity and Technological Change in the Railroad Sector' in National Bureau of Economic Research, *Studies in Income and Wealth*, 30 (New York, 1966), pp. 583-646.

[29] FREMDLING, *Eisebahnen und Deutsches Wirtschafts Wachstum*, 1975, pp. 18-19 and 57.

[30] TOUTAIN, *Le Transports en France*, 1967, p. 278 and see O'BRIEN ed., *Railways and Economic Development*, 1983, chs. 2 and 6.

ments in productivity helped railways to hold their own against competition from waterborne transport which also became more efficient over the XIXth century and which (in those countries well endowed with rivers or coastal shipping lanes) enjoyed advantages in the form of lower track costs per ton kilometre carried. Over longer distances railways competed by offering producers speed and regularity of delivery. For large countries like Russia, the Austro-Hungarian Empire and the United States railways did not provide a much cheaper service than waterways per ton mile carried over long and comparable routes, and the social savings on that account could be fairly small, even negligible. Thus where trunk lines were constructed to compete with waterways over long distances, and the track accommodated to existing locations and patterns of internal trade, the initial gains to the economy would be positive but not dramatic. Belgium, France and Germany continued to build canals during the second half of the XIXth century.[31] Furthermore, it is difficult to speculate ("counterfactually") how waterborne transport might have developed without railways. It is not unreasonable to assume (pace Fogel) that without railways the efficiency of waterborne and road transport would have improved more rapidly than it did with competition from railways.

As time went on gains increased because railway companies expanded their lines outside and beyond the networks of trade already serviced by waterways. And they helped to create more trade and production in new locations. Social savings really went up when railways captured an ever increasing share of freight carried along roads over medium distances. The differential in average costs per ton kilometre between railways and roads was already considerable in the 1840s and that differential widened

[31] TOUTAIN, *Les Transports en France*, pp. 68-9 and see chapters by Caron, Laffut and Fremdling in O'BRIEN, ed., *Railways and Economic Development*; R. PRICE, *The Economic Modernization of France, 1750-1880* (London, 1975), p. 16; TOUTAIN, *Les Transports en France*, pp. 68-9.

over time because productivity in road transport failed to go up very much over the next seven decades.[32] Although road networks expanded at a high rate, technical progress in that subsector of transportation was minimal before the internal combustion engine provided a substitute for animals and manpower used for cartage. Moreover, the opportunity costs of the principal inputs used to carry goods by roads (labour, animals and animal feed) rose with the development of agriculture and industry.[33] For example, 32% to 43% of the hectares devoted to the cultivation of bread grains would have been required to cope with the extra demand for animal feedstuffs generated by the hypothetical shutdown of Spanish railways in 1878.[34] Thus the "savings in resources" which emanated from the shift of freight from roads to railways was far greater than from the reallocation of merchandise from boats to trains and it increased over time. Considerations of this kind explain the relatively low ratios of social savings to national income for 1859 in the United States, 1865 in England and 1907 in Russia (see table 2). Three or four decades later when the output of the transport sector had increased the ratio nearly trebled in Britain and America and the same tendency was certainly more pronounced in Russia because estimates for 1907 relate to the early stages of development. Between 1907-1939 ton kilometres supplied by rail multiplied four times to account for 82% of Soviet transportation output. In 1907 84% of freight services supplied by Russian railways could have been provided by waterways and that ceas-

[32] In France, the differential was roughly 2.4:1 in 1845-54 and widened to 4.6:1, 1905-13 — See TOUTAIN, *Les Transports en France*, p. 279.

[33] P.S. BAGWELL, *The Transport Revolution from 1770* (London, 1974), pp. 145-49 and F.M.L. THOMPSON, 'Nineteenth Century Horse Sense' in *Economic History Review*, XXIX (1976), p. 78.

[34] See chapter by Gomez-Mendoza in O'BRIEN, ed., *Railways and Economic Development*.

ed to be true when transportation output expanded very rapidly over subsequent decades.[35]

Similar observations follow from comparisons of social savings across countries. Thus the higher the percentage of freight taken off the roads and onto railway networks the greater the gains to an economy from its investment in railways. Countries badly endowed with navigable rivers, afflicted with a terrain hostile to the construction of canals, and with poor natural facilities and opportunities for coastal trade gained most from their investment in railways. Railways alleviated the adverse economic effects on internal trade of an unfavourable natural endowment. Thus over the long run Mexico, Spain, Russia, certain regions of France, the Upper Po valley in Italy and Germany obtained higher returns from the diffusion of railways than Britain, Italy, Holland, Belgium or the United States. The significance of this point can be measured by the percentage of freight which would be diverted from rail to water in the counterfactual case of a shutdown of the railway network. For example, during hypothetical closure of Spanish railways in 1878 coastal shipping and inland waterways supplied only 10% of the ton kilometres required to maintain a constant level of transportation; in France (1872) waterborne carriers provided 30% and in Britain (1865) they took about half of the traffic. The reason why Italian trunk lines were unprofitable was the availability of coastal shipping.[36]

To a more limited extent the relative significance of railways for different economies can also be discerned in terms of their effects on the levels of stocks held by farms and industrial firms before the construction of national networks. Railways supplied producers with transport which was faster, safer and far more immune to seasonal and geographical obstruction than roads or

[35] Unpublished paper delivered by A. Aslund to St. Antony's Seminar in International Economic History, 1978 and Metzer, 'Railroads in Tsarist Russia', pp. 88-96.

[36] See chapters by Gomez-Mendoza, Caron, Hawke-Higgins and Fenoaltea in O'Brien, ed., *Railways and Economic Development*.

waterways. In the middle of the XIXth century a barge took no less than 86 days to carry a load of coal from Mons to Paris and to return to its mooring.[37] Where and when transport by road and water was both slow and irregular, firms could partially insure production against costly interruptions to inputs and sales by holding inventories of raw materials, finished goods and work in progress. Railways obviated the need to invest in stocks, and thereby enabled producers to convert circulating into fixed investment. This saving could be particularly important for economies like Spain and Russia where traditional transport of goods by road and water was highly seasonal.[38] Nearly a quarter of the social savings achieved by Russian railways in 1907 came from a reduction in the cost of inventories.[39] In Britain with its temperate climate, gentle terrain and specialised road and waterborne services, the gains from additional speed and regularity supplied by railways was less than 4% of the social savings for 1865.[40]

To sum up: it appears that the traditional inefficiency and rather limited technical progress achieved in transportation by road made railways important in countries badly endowed with waterways. Over long and medium hauls road transport utilised more capital, labour and other inputs per ton kilometres than the two alternative modes of production; although road transport continued to dominate short-distance transportation, particularly within cities it lost freight (first to waterways and then increasingly to railways on long and passenger hauls).[41]

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[37] See chapter by Laffut in O'BRIEN, ed., *Railways and Economic Development.*

[38] See chapter by Gomez-Mendoza in O'BRIEN, ed., *Railways and Economic Development.*

[39] METZER, 'Railroads in Tsarist Russia', pp. 95-6.

[40] See Chapter by Hawke-Higgins in O'BRIEN, ed., *Railways and Economic Development.*

[41] In France in 1830 80% of the receipts for transport of merchandise accrued in the road system; by 1895-1904 the proportion had fallen to 41% — See TOUTAIN, *Les Transports en France*, p. 286; DE VRIES, *Barges and Capitalism*, pp. 223-30, and FOGEL, 'Notes on the Social Savings Controversy', pp. 49-51.

3. *Railways and Long Run Growth*

Nowhere in Europe did railways make the difference between development and stagnation and economic historians are still a long way from measuring their contribution to the rates of growth for particular economies. Although the social savings methodology represents a big step forward, static equilibrium analysis cannot deal effectively with the dynamic effects of railways over time. For such influences the relevant counterfactual is not the shutdown for one year (used with illuminating effect by Fishlow, Hawke, Metzer, Caron and Gomez) but a hypothetical refusal by a national government to eststablish a railway net work at any time between 1830 and 1914. In this context and with the aid of general equilibrium models the entire range of influences exercised by railways on savings and investment, location patterns, markets, the product mix, scale, technical progress and innovation, labour training, Government policy, urbanisation, international flows of capital and labour, etc. could *in theory* be quantified. But even if models could be designed to capture the complex inteconnexions of railways to economic growth through time, empirically the task of quantification seems impossible — a point exemplified by the recent debate between Fogel and Williamson.[42] Historians can, however, write more or less rigorously about the impact of railways on economic growth. They can also quantify some of the more important backward and forward linkages.

For example, several economic historians have analysed and measured the "feedbacks" derived from the establishment and extension of railways. The great bulk of investment expenditures

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[42] FOGEL, 'Notes on the Social Savings Controversy'; J.G. WILLIAMSON, 'Greasing the Wheels of Sputtering Export Engines: Midwestern Grains and American Growth', *Explorations in Economic History*, 17 (1980), pp. 211-12, and see S. FENOALTEA, 'Railroads and Italian Industrial Growth', 1861-1913, *Exploration in Economic History*, IX, (1972).

fed back to the construction industry. For example, between 1861-95 Italy's engineering and metalmarking industries absorbed only a tiny percentage of railway investment.[43] For industry as a whole, even at peak levels of demand, railways absorbed far too low a percentage of total output to qualify as a "leading sector" in the growth process. Industry normally delivered well over 90% of its output to other producers and consumers.

Deliveries to railways did, however, exercise an important influence on the development of particular industries — including iron and steel, coal, bricks, timber and engineering. Of course

TABLE 3

PERCENTAGES OF OUTPUT DELIVERED TO RAILWAYS

Country	Pig Iron	Steel	Coal	Bricks	Wood	Transport Equipment
U.S.A.	5-21% (1840-60)	50-87% (1867-80)	2-20% (1840-90)	—	3-10% (1840-60)	25% (1859)
England & Wales	5-13% (1835-69)	—	2-14% (1865)	30% (1840s)	—	—
Spain	6.0% (1890-1914)	8.5% (1890-1914)	18-29% (1865-1914)	—	—	—
Germany	22-37% (1840-59)	—	3% (1860s)	—	—	—
France	—	12-18% [a] 1845-85)	—	18-18% [b] 1865-1914	1% (1875-84)	—
Italy	—	12½-13% [c] (1861-1913)	—	16-23% [d] (1861-1913)	—	5-11% [e] (1861-1913)
Belgium	6% (1860-1913)	—		4-10% (1865-1913)	—	—

Notes: Iron and Steel output delivered has been defined as a net flow of output.
(a) iron steel; (b) building materials; (c) all ferrous metals; (d) construction materials; (e) engineering products.

Sources: See Table 2, O'BRIEN, *New Economic History of Railways* ch. 5 and *Railways and Economic Development*, chs. 2-6.

[43] See Chapter by Fenoaltea in O'BRIEN, ed., *Railways and Economic Development*.

the relative significance of railway demand hinges entirely on the level of disaggregation used to define an industry. Thus for Italy: " the growth in railway-related production seems to have represented significant growth for the machinery and metal making industries but relatively unimpressive growth for the entire metalworking group ".[44]

Even for industries strongly stimulated by the establishment and maintenance of a railway system, the significance of " feed-back effects " was never extraordinary. Backward linkages were, moreover, concentrated over particular cycles of production, when a large proportion of the *increment* to output was delivered to railways. Thus demand for iron and steel, engineering products and other manufactured commodities could be important for the growth of a small range of industries over fairly short periods of time in the XIXth century when the boost from the establishment or large scale extensions to a national networks pushed production up onto a higher plateau. Thereafter normal demand for replacement and extensions to the network and its stock of equipment accounted for a tiny proportion of the annual additions to industrial output.

During these boosts to total demand firms and industries supplying railways might realise economies of scale and introduce improved technology more rapidly. Railway expenditures could even accelerate technical progress, particularly in metals and engineering. Historians have traced such influences on the South Wales iron industry; on the development of locomotive production and bar iron in Germany; on the steel industry in France and the United States, and upon specific sectors of the engineering industry in Belgium, Russia and Germany.[45] Feed-

[44] Ibid.

[45] See chapter by Laffut in O'BRIEN, ed., *Railways and Economic Development*; HAWKE, *Railways and Economic Growth*, pp. 215-30; CARON, ' Researches sur le Capital Des Voies ', pp. 239-47; J.N. WESTWOOD, *A History of Russian Railways* (London, 1964) pp. 91-8 and R. FREMDLING, ' Railroads and German Economic Growth: A Leading Sector Analysis ', *Journal of Economic History*, XXXVII (1977), pp. 587-8.

backs to steel production stand out as significant for the expansion of capacity and the diffusion of technology in France, Germany, United States and Italy (in the late XIXth century).[46]

Of course the impact of backward linkages varied from country to country and their importance for industrial development depended primarily upon the extent to which demand for capital goods required to establish the main network and its rolling stock was directed towards imported inputs and equipment. At the outset almost every country except Britain and Belgium laid down imported rails and hauled freight with foreign locomotives. But in some countries the process of import substitution quickly redirected demand towards domestic industry. In others, the lags, for a variety of reasons, were long, and the establishment of the initial networks exercised almost no impact upon local metallurgy, coal and engineering but contributed to the continued development of British, French and Belgium export industries. For example Spain, Italy and Tsarist Russia are all examples of countries where until late in the XIXth century, foreign suppliers derived the most of the benefits from orders for their rails and rolling stock.[47] In France and Germany rapid and decisive moves towards import substitution — initially in the mill sector of the iron industry and in the construction of locomotives, but then followed by the shift into the manufacture of coke-smelted pig iron — imparted a significant

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[46] F. CARON, 'French Railroad Investment, 1850-1914', in R. CAMERON (ed), *Essays in French Economic History* (Homewood, 1970) pp. 315-40; R. FOGEL, 'Railroads as an Analogy to the Space Effort', in P. TEMIN (ed), *New Economic History* (London, 1973), pp. 238-42; FENOALTEA, 'Railroads and Italian Industrial Growth', p. 336; R. TILLY, 'Capital Formation in Germany in the Nineteenth Century', in P. MATHIAS and M. POSTAN (eds), *The Cambridge Economic History of Europe*, vol. VII (Cambridge, 1978) pp. 414-18.

[47] A. GOMEZ-MENDOZA, 'Los Ferrocarriles y la industria siderurgica (1855-1913)', *Moneda y Credito*, December 1980; V.K. YATSUNSKY, 'The Industrial Revolution in Russia', in W. BLACKWELL (ed), *Russian Economic Development* (New York, 1974), p. 127, and J. NADAL, 'Spain, 1830-1914', in C. CIPOLLA (ed), *The Fontana Economic History of Europe*, vol. 4 (2) (London, 1973) pp. 596-9.

stimulus to domestic metallurgy and to the transition from charcoal to coke smelted pig iron.[48]

Why did Tsarist Russia, Italy and Spain not take full advantage of potential linkages to industrialization, which had been demonstrated during the construction of railways in other countries? One possible explanation is that their Governments failed to impose tariffs on cheaper foreign rails and rolling stock, either because their statesmen were ideologically blinkered in favour of free trade or because the foreign capitalists and companies, who provided a large share of the finance required for the establishment of rail networks in Spain, Italy and Russia, insisted on directing the orders for rails and equipment overseas.[49] While such explanations are not without point, they seem to rest too heavily on the lack of foresight exhibited by statesmen and the bias of foreign investors towards their own national industries. At the time the decision presented itself as a problem of how quickly local capacity in metallurgy and engineering could be expanded to cope with a "bunched" and cyclical demand for rails, locomotives, rolling stock and other manufactured inputs required by the railways. In Germany, France and Belgium the metallurgical and engineering industries had attained levels of development and efficiency from which import substitution could proceed smoothly. In other words, the fairly rapid reallocation of demand towards local suppliers which occurred in these economies did not lead to bottlenecks, intolerable delays and prohibitive costs for the establishment of

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[48] See chapters by Fenoaltea, Caron and Fremdling in O'Brien, ed., *Railways and Economic Development* and F. Crouzet, 'Essor declin et renaissance de l'industrie Française des locomotives, 1838-1914', *Revue d'Histoire Economique et Sociale*, 55 (1977), pp. 121-52.

[49] Nadal, 'Spain', pp. 596-9 and 551-2; F.J. Coppa, 'The Italian Tariff and the Conflict Between Agriculture and Industry. The Commercial Policy of Liberal Italy, 1860-1922', *Journal of Economic History*, XXIV (1964), pp. 742-46; L. Cafagna, 'The Industrial Revolution in Italy, 1830-1914' in C. Cipolla, ed., *Fontana Economic History of Europe*, Vol. 4(1) (London, 1973), pp. 286-92; M. Falkus, *The Industrialization of Russia*, 1700-1914 (London, 1972), pp. 56-57.

railway networks.[50] Furthermore (in contrast to Spain, Italy and Russia) these economies seem far less dependent on foreign capital to provide the finance required for investment in social overhead capital. Spain, Italy and Russia were short of domestic venture capital. Their levels of production trade and income rendered that investment a more expensive and riskier proposition. Their relatively "difficult" terrains increased the ratio of capital to output in transportation. Their existing plant and manpower in metallurgical and engineering industries compared unfavourably with France, Germany and Belgium. Only a handful of engineers worked in Russia in the 1860s.[51] At the onset of railways construction in 1856 Spain possessed sufficient capacity to produce only 15,000 tons of iron compared with a demand for rails over the next five years of around 30,000 tons per annum. And Italy emerged from the Risorgimento with very limited capacity to produce pig and wrought iron.[52]

In short, the preconditions for the kind of successful import substitution which occurred in Germany, France and Belgium were not present everywhere even in Western Europe and in some states the imposition of tariffs on imported railway equipment would surely have led to costly delays in construction and the emergence of a railway network saddled with considerable capital charges and compelled to charge high prices for freight and passenger services. Thus by implication the criticism of Cavour, Kankrin, Bunge, Luxan and other European statesmen for their failure to utilise protective tariffs to take advantage of opportunities for backward linkages is an argument for a railway system heavily subsidised by Governments. The

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[50] CROUZET, 'Essor declin et renaissance', pp. 121-52; CARON, *Economic History of Modern France*, pp. 155-9 and see chapters by Caron, Fremdling and Laffut in O'BRIEN, ed., *Railways and Economic Development*.

[51] O. CRISP, 'Labour and Industrialization in Russia', in P. MATHIAS and M. POSTAN, ed., *Cambridge Economic History of Europe*, vol. VII (2) (Cambridge, 1978).

[52] B. MITCHELL, 'Statistical Appendix, T. 4' to C. CIPOLLA, ed., *Fontana Economic History of Europe*, vol. 4 (2) (London, 1973).

unexplored premise of that view is that the long-term social gains generated specifically by railway demand for the products of the metallurgical and engineering industries would more than compensate for the delays, higher costs and increased taxes necessitated by constructing and maintaining national railways networks with domestic rather than foreign rails, rolling stock and other equipment. At the same time, part of the costs of protection afforded to iron and steel would (as the Italian example shows) be borne by industries utilising metals, particularly engineering and shipbuilding.[53]

For Spain, Italy Russia and other parts of Eastern Europe the counterfactual scenario of tariffs, import substitution and railway construction combining to promote rates of industrial growth at far higher levels than those achieved with free trade seems altogether improbable, and the examples of France, Belgium and Germany are not relevant for countries with limited capacities in engineering and metallurgy at mid century.

Railways influenced the volume of capital formation as well as variations in rates of investment. For example, net investment in railways dominated investment in the Gewerbe, or modern sector of the German economy from 1851-79.[54] But to assess their influence on the long-term growth of particular economies historians need to specify a model which exposes interconnexions between railway investment and other variables in a closed and open economic system. Such models are, however, easier to adapt from economic theory than to use actually to quantify the influence of railway expenditure.[55] Several historians have, however, analysed the extent to which investment expenditures on railways operated to impart greater stability to economies afflicted by fluctuations in the level of economic ac-

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[53] See chapter by Fenoaltea in O'Brien, ed., *Railways and Economic Development.*

[54] See chapter by Fremdling in O'Brien, ed., *Railways and Economic Development.*

[55] Fenoaltea, 'Railroads and Italian Industrial Growth', and Williamson, *Late Nineteenth Century American Development*, ch. 9.

tivity. Apparently in Britain and America such expenditures helped to induce booms and to alleviate depressions.[56] But for Italy Fenoaltea's analysis suggests a 'mild boost to industry's cyclical instability' while French investment in railway companies also intensified the amplitude of cycles in the XIXth century.[57] But in Germany railway investment fluctuated in the approved contra-cyclical manner.[58] The sequence of expenditures on railway networks are likely to vary from country and from period to period. No definite conclusions could, however, be drawn from these correlations until the connexions between cycles of investment in railways and of economic activity are analysed and elucidated at the level of industries and even firms.

More important questions should be raised about connexions between opportunities to buy shares in railway companies and the total volume of investible funds made available to an economy. If we assume inflexible rates of domestic saving as well as the availability of other projects competing for funds with railways, their influence on the level of capital formation will be seen as negligible. But if expenditures on railways attracted foreign funds or new savings to finance the networks, then it becomes possible to argue that railways raised the overall rate of investment by some positive percentage. Railroads apparently attracted both foreign capital and immigrants into the United States.[59] Although sceptics maintain that capital migrates in search of profits not railways, there can be no doubt that European investors, banks and other financial institutions, weaned on the paper securities of British and French railways, were geared

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[56] FISHLOW, *American Railroads*, pp. 103-16 and HAWKE, *Railways and Economic Growth*, p. 376.

[57] See chapters by Caron and Fenoaltea in O'BRIEN, ed., *Railways and Economic Development* and FENOALTEA, 'Railroads and Italian Industrial Growth', pp. 338-9.

[58] See FREMDLING, *Eisenbahnen und Deutsches Wirtschafts Wachstum*, pp. 151-58.

[59] FISHLOW, *American Railroads*, pp. 117-18 and WILLIAMSON, 'Greasing the Wheels', pp. 203-9.

towards similar opportunities in Belgium, Italy, Spain and Russia.[60] The voracious demands for capital made by railway companies over short cycles of economic activity influenced institutional developments in the capital markets of Britain and France which not only mobilised funds but educated new social groups in impersonal investment and increased propensities to save.[61] Debate on the precise importance of effects of this kind is likely to remain inconclusive.

Finally, railways widened markets which promoted economies of scale, encouraged the relocation of economic activity, stimulated competition and increased trade and specialisation. Williamson's important analysis of these "forward linkages" from railways to the economy of the Midwestern United States demonstrates that they could be profound. Nothing like his general equilibrium model has been applied to the economic history of Western Europe.[62] Prima facie it seems that for most parts of Europe broad patterns of interregional and international trade established before the advent of railways continued and the iron road carried forward the process of integrating local economies into national and international markets. Trade in the XIXth century emanated basically from natural and traditional advantages of the kind stressed by Ricardo (and adumbrated by Heck-

[60] See chapters by Gomez-Mendoza, Laffut and Fenoaltea in O'BRIEN, *Railways and Economic Development* and J. MORILLA CRITZ, *Banca y Ferrocarriles en Malaga en el Siglo XIX* (Cordoba, 1978) and FENOALTEA, 'Railroads and Italian Industrial Growth' p. 327, and O. CRISP, *Studies in the Russian Economy Before 1914* (London 1976) chs. 7 and 8.

[61] M.C. REED, *Investment in Railways in Britain, 1820-40* (London, 1975) and G.R. HAWKE and M.C. REED, 'Railway Capital in the United Kingdom in the Nineteenth Century', *Economic History Review*, XXII (1969), pp. 269-86.

[62] Partial equilibrium methods have been used by R. DUMKE, 'The Political Economy of German Unification: Tariffs, Trade and Politics in the Zollverein Era (unpublished Ph. D. thesis, University of Wisconsin, 1956) and by P.K. O'BRIEN, 'Railways and Market Integration in Western Europe, 1840-1915' and J. METZER, 'Railroads and the Efficiency of Internal Markets'. Unpublished papers delivered to the Second Madrid Conference on the History of European Railways, December, 1980.

scher and Ohlin) were becoming more important and railways reinforced tendencies towards industrial specialisation based upon favourable endowments of skilled labour, accessible supplies of capital and those "temporary" gains which accrued to pioneers in new products and technology. Nevertheless the composition of commodities traded between the countries and regions of Europe did not alter profoundly between 1840 and 1914, when railways provided particular regions with greater opportunities to export products in which they enjoyed cost advantages.[63]

For several economies (including Britain and Holland) well served by waterborne and road transport relatively small gains flowed from the integration of national economies and from linking interior regions and natural resources to world markets. Even in Spain the location of vineyards and mineral ore deposits near to the sea, implied that railways were not a necessary condition for the rapid growth of wine and ore exports in the second half of the XIXth century. Although they did bring Spain's isolated agricultural regions into competition with each other.[64] In Italy, despite the high hopes of post-unification governments, the trunk lines built before the 1880s did not promote a rapid expansion of interregional trade. Many regions remained too poor to trade, their capacity to absorb exports from other parts of Italy remained low and complementarity in production among Italian regions was not marked. Integration exacerbated dualism between North and South and encouraged imports.[65] But rail links from

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[63] N. SANCHEZ ALBORNOZ, 'El Mercado de Productos Agrarios en España and V. ZAMAGNI, 'Railway Building and Market Integration in Post Unification Italy' (1861-1913) — unpublished papers delivered to the Second Madrid Conference on the History of European Railways, December 1980); BAIROCH, *Commerce exterieur*, pp. 81-7.

[64] See chapter by Gomez-Mendoza in O'BRIEN, ed., *Railways and Economic Development*.

[65] V. ZAMAGNI, 'Railways Building and Market Integration in Post Unification Italy', unpublished paper delivered to the Second Madrid Conference on the History of European Railways, December, 1980.

the Upper Po Valley to the sea permitted the industrial triangle (Turin, Milan and Genoa) to develop.[66]

For other economies the stimulus to production seems more marked. Thus Belgium's planners tried from the outset to build lines which would integrate the local economy into Western Europe.[67] In Russia railroads increased regional specialisation and " there was a major reorientation of resources towards those areas offering a higher level of productivity in the cultivation of rye and wheat ". Exports of Russian grain increased roughly four times between 1860-64 and 1875-79 and added about 4% to national income.[68] Furthermore, they linked Donbas coking coal with Krivoi Rog iron ore deposits and created a new heavy industry complex in the Ukraine.[69] Their forward linkage effects on the growth of Germany's coal and metallurgical industries were profound enough for Fremdling to label the railroad as " the hero of Germany's industrial revolution ".[70] In France their advent led (as Caron shows) to the spread of wine cultivation in Languedoc, and stock raising in the Charente.[71]

Railways carried forward the reduction in transportation costs initiated by waterborne carriers and thereby widened markets, stimulated competition and provided access to natural resources and more efficient locations for productive activity. Their capacity to bring about reductions in costs per ton kilometre were maximised in those parts of Europe where access to productive resources was prohibitively expensive by waterways and roads and where they successfully appropriated freight over me-

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[66] See chapter by Fenoaltea in O'Brien, ed., *Railways and Economic Development.*

[67] See chapter by Laffut in O'Brien, ed., *Railways and Economic Development.*

[68] J. Metzer, ' Railroad Development and Market Integration: The Case of Tsarist Russia ' in *Journal of Economic History*, XXXIV (1974), pp. 529-49 and W. Kelly, ' Railroad Development and Market Integration in Tsarist Russia: Evidence on Oil Products and Grain, *Journal of Economic History* XXXVI, (1976), pp. 908-16.

[69] C. White, ' The Concept of Social Savings in Theory and Practice ', *Economic History Review*, XXIX (1976), pp. 88-89.'

[70] See chapter by Fremdling in O'Brien, ed., *Railways and Economic Development.*

[71] See chapter by Caron in O'Brien, ed., *Railways and Economic Development.*

dium hauls from road transportation. Only in special cases, such as the trade in meat or perishable farm produce, were railways a necessary condition for the extension of the market. Access to markets was, for most products, available by road and in many places by water.

Clearly it will not be possible to quantify the manifold effects of railways on Europe's regional and international trade. And associated with the spread of railways, there also occurred geographical shifts by enterprises within well defined economic regions and such gains from the relocation of economic activity could, in aggregate, exceed the gains from longer distance trade. But they seem difficult to detect and impossible to measure, except as a by-product of business or industrial history. But railways invariably lowered freight costs per ton kilometre and the cuts in transport margins were passed on in the form of lower prices. Such reductions seem to have been particularly important for fuels, construction materials and agricultural surpluses meat and wine. Thus railways exercised their most profound effects on long-run growth by altering the structure of relative prices and the terms of trade between regions and sectors of the European economy. They appear to have had greater effects on primary production — agriculture and mining than upon manufacturing industry. But their dynamic effects on capital formation, technical progress and the reallocation of resources which flowed from the reduction in transport marups have not been measured. Nevertheless, Williamson's central question: what would have happened to economic development if price differentials had remained at their pre-railway levels, is the kind of counterfactual approach which will appeal to a traditional historiography which saw railways as a pervasive and extremely important element in the economic growth of Western Europe from 1840-1914.

Not all regions benefited equally from railways. As always the gains depended on the elasticities of demand and supply or

the capacity of a given economy to take advantage of the opportunities to trade afforded by railways. If consumers resident in a particular region responded to falling prices by importing heavily from another region, a substantial gain would occur in consumer surplus and their welfare. If a region's capacity to supply was elastic because resources were underemployed in the pre-rail situation or because inputs could be augmented at low cost, production could expand rapidly in response to the diffusion of cheaper transport. Unfortunately there were many parts of Europe (particularly in southern and eastern Europe) whose people remained too poor to take advantage of the opportunities for cheaper and more variegated consumption provided by railways. Their capacity to respond to the widening of markets continued to be restrained by unfavourable resource endowments and rising marginal costs of production.

For these regions the gains from railways before 1914 were positive but more limited than the gains which accrued to North Western Europe and the United States. For some parts of Europe (Southern Italy, Castille, Hungary and Rumania) the benefits from trade creation may have been offset by the losses from trade diversion to other regions. Their workers had no option but to migrate in search of higher incomes.[72]

Perhaps the contrasting economic histories of Germany and Spain from 1850-1914 will illustrate how railways could carry forward but not propel rapid industrialisation. In Germany the railroad linked backwards and forwards to agriculture and to a multiplicity of industries (already in the process of sustained economic growth), while Spain lacked several preconditions for an accelerated rate of economic change. Spanish agricultural productivity was lower; its industrial base (particularly its

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[72] ZAMAGNI, 'Railway Building and Market Integration' and I. BEREND, 'Railways and Economic Development in Eastern Europe' – unpublished papers delivered to the Second Madrid Conference on the History of European Railways; V. ZAMAGNI, *Industrializzazione e squilibri regionali in Italia* (1978), Chs. 2 and 5.

metallurgical and engineering sectors) were less developed; regional specialisation seems less marked; and the complementary networks of roads and waterways were not in place. Spanish railways did shift the Spanish economy closer to its production possibility boundary, but their effects were less profound than they were in Germany.[73] Thus in countries like Spain, Italy, the Austro-Hungarian Empire, Tsarist Russia and other parts of Eastern Europe railways accomplished a great deal by 1914. But despite all the euphoria which accompanied its introduction and the hopes placed on its supposed potential for both political and economic integration the iron road was never a sure road for development.

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[73] See chapter by Gomez-Mendoza in O'Brien, ed., *Railways and Economic Development*, and P. Tedde de Lorca, 'La Compañia de los Ferrocarriles Andalusas, 1878–1920', *Investigaciones Economicas*, August, 1980.