HARVARD UNIVERSITY

A. ALFRED TAUBMAN CENTER FOR STATE AND LOCAL GOVERNMENT

JOHN F. KENNEDY SCHOOL OF GOVERNMENT

Research Working Paper Series

Nature Or Nurture: Why Do Railroads Carry Greater Freight Share In The United States Than In Europe?

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December 20, 2005

WP05-15

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Abstract

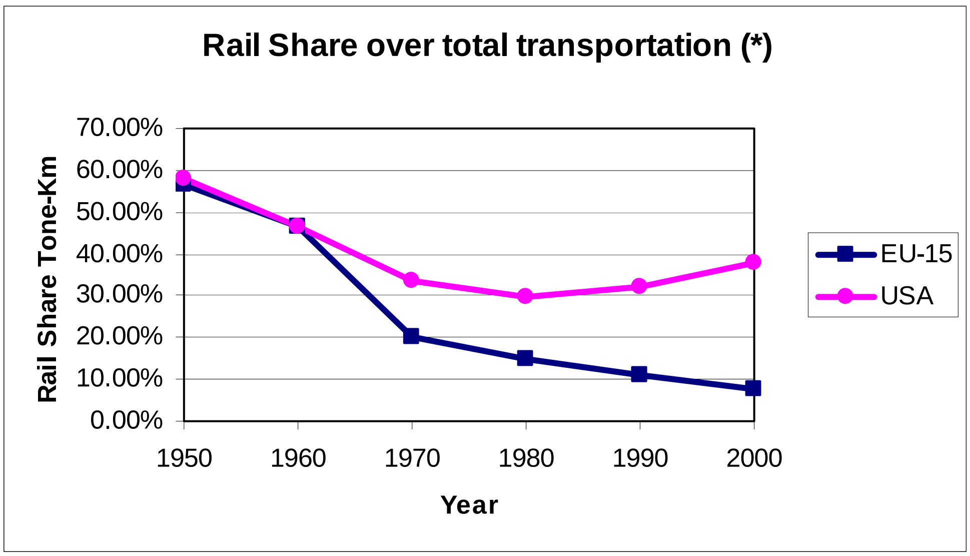
During the 1950s the share of freight carried by railroads was similar and declining in both the United States and Europe. By 2000 the railroads' share of freight (measured in ton-kilometers) had reached 38 percent in the United States while falling to 8 percent in Europe. This paper examines the reasons for the difference in rail's share of freight in Europe and the United States. We find that almost 80 percent of the gap in 2000 is probably due to natural or inherent differences, principally geography, shipment distance and commodity mix. A little more than a 20 percent of the gap cannot be explained by these inherent differences and is presumably due to public policies including priority of passenger service, lack of interoperability at borders, and incentives of the rail operators. We estimate that if that policy gap were closed railroads' share of freight in Europe would almost double, increasing to 15 percent.

Key Words: Railroad, freight transportation, Europe, United States, Competition.

I. Introduction

During the 1950s the share of freight carried by railroads was similar and declining in both the United States and Europe. Beginning in the 1960s, however, the trends diverged, as shown in Figure 1. In the United States the decline slowed during the 1960s and 1970s, and railroads' share of freight actually increased during the 1980s and 1990s. In contrast, European rail freight share steadily declined throughout this period. By 2000 the railroads' share of freight (measured in ton-kilometers) had increased to 38 percent in the United States while it fell to 8 percent in Europe.

Figure 1: Comparison of EU and US Rail Share Trends



(*) Pipeline and coastal transportation are not included in 1950 and 1960
Source: US data from Eno Transportation Foundation, Inc.
From 1970 to 2000 EU data from EUROSTAT
From 1959 to 1960 Europe Data from the Economic Division for Europe of United Nations

One possible explanation is that differences in geography and other natural or inherent characteristics make the United States more suitable for rail freight than Europe. The United States has three times the land area of the European Union (EU-15) which results in longer shipment distances that favor railroads over trucks. And the United States, despite its land mass, has only one-ninth the coastline of Europe which favors railroads over coastal shipping. The mix of commodities shipped differs between the United States and Europe as well, and often in ways that bolster United States railroad share. For example, a substantial portion of United States electricity is generated by burning coal which requires substantial movements of coal over long distances.

An alternative explanation is that public policies have been more supportive of rail freight in the United States than in Europe. At first glance this idea seems suspect: Europe has much higher taxes on motor vehicle fuels and a long history of subsidizing its railroads. And although both Europe and the United States have built extensive high-performance highway systems, in Europe these are often financed by tolls while in the United States many are not. However, countervailing factors could be at work. The United States has encouraged its freight railroads to be more efficient by leaving them in private hands instead of nationalizing them, as Europe did. Moreover, the United States released the private railroads from the obligation to provide urban commuter service in 1958 and intercity passenger service in 1970 and then substantially eliminated government controls over freight tariffs in 1980, three steps which allowed railroad managers the freedom and flexibility to focus on freight.

This paper adds to the literature an examination of the reasons for the difference in rail's share of freight in Europe and the United States. As the first comprehensive analytical comparison, the research provides an initial explanation of the rail share issue at the macro level. The methodology features a step-by-step calculation of European Union rail share under the assumption of United States conditions. We begin by calculating the European Union rail freight volume assuming that its rail share equals that of the Unites States. That theoretical volume is then reduced to reflect the role of water and pipeline, shipment distance, and commodity mix. The residual is thought to be a result of policy differences.

In brief, we find that a bit less than 80 percent of the gap in 2000 is probably due to natural or inherent differences, principally the shorter coastline and the longer shipment distances but also differences in commodities moved. A little bit more than 20 percent of the gap cannot be explained by these inherent differences and is presumably due to public policies. If that gap were closed, railroads' share of freight in Europe would approximately double, increasing from 8 to 15 percent. We believe this estimate is conservative because of the numerous European Union policies favoring railroads.

Section II of this paper provides background about the railroads in the United States and the European Union as well as the current concerns about rail share in the European Union. Section III describes the data sources used. Section IV explains the calculations used to estimate what portion of rail's lower European share is due to inherent differences between Europe and the United States. Section V considers the residual portion, which we attribute to policy differences between Europe and the United States. Section VI provides conclusions based on the research and suggests areas of further analysis.

In this paper the European Union refers to the EU-15: Austria, Belgium, Denmark, Germany, Greece, Finland, France, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom. The ten countries which joined the European Union in 2004 are not included both because their integration into the Union is just beginning and because consistent data for these new members is not readily available.

II. Background

The United States. The improvement in the performance of United States freight railroads in the late 20th century coincides with important changes in public policy toward railroads. Until 1970 virtually all intercity railroad services—passenger and freight—were provided by privately owned but government-regulated companies. The most important regulator was the Interstate Commerce Commission (ICC), which had been established by Congress in 1887 in part to prevent railroads from abusing the monopoly power they were thought to enjoy. Toward that end, the ICC eventually acquired powers to control entry and exit to the railroad industry, mergers, service offerings and tariffs (Kheeler 1983). By the 1950s, however, improvements in waterways, the construction of the Interstate and Defense Highway System and the growth of trucking had substantially weakened the railroads' natural monopoly in freight (Winston 1990 et al., Kheeler 1983). The development of the highway system and the improvement in aircraft technology greatly increased competition from buses, autos, and airlines and diverted almost all passengers from the railroads, with the exception of commuter services in the largest metropolitan areas and intercity services along the Northeast Corridor running from Washington through New York to Boston.

The railroads began to complain that the ICC, and its sister regulatory agencies at the state level, were making it difficult for them to adapt to the increased competition. Regulators often prevented the railroads from abandoning unprofitable passenger services or lightly used freight branch lines, for example, forcing the companies to try to make up the losses in the declining number of markets that were profitable. The railroads' complaints gained credibility in the 1960s as the financial situation of the industry deteriorated steadily (Winston 2004). By 1970 the railroad industry was in crisis, and between 1970 and 1975 several large carriers filed for bankruptcy.

Congress responded in part by passing two acts that relieved the railroads of the responsibility of providing passenger services. The first, passed in 1958, stripped state regulators of the power to prevent the railroads from abandoning unprofitable intrastate services. This act had the effect of forcing metropolitan areas that wanted to maintain urban commuter railroad services to either subsidize their operation by incumbent railroads or to take over the responsibility for commuter services themselves. The second act, passed in 1970, established a government-owned company, Amtrak, to provide intercity passenger services. Railroads were required to make a contribution (in cash or in rolling stock) proportional to their estimated financial losses from intercity passenger service and to grant Amtrak the right to operate over their lines at a reasonable cost and, in return, Amtrak would assume responsibility for their passenger services. A few years later Amtrak acquired its own right-of-way in the Northeast Corridor as the result of the bankruptcy of the largest railroad in the region.

When relief from passenger service proved insufficient to arrest the railroads' decline Congress responded in the 1970s by restricting the ICC's powers to regulate freight services and tariffs. These efforts culminated in the Staggers Act of 1980, which virtually eliminated ICC controls over freight tariffs and rescinded the long-standing prohibition against private long-term contracts between shippers and railroads. The act's intention was that shippers and railroads would negotiate long term contracts governing the services offered and the tariffs to be paid. Shippers would be protected from monopoly power because they could negotiate a long-term contract before they invested in facilities on a railroad's lines (Gomez-Ibanez 2003). Shippers could appeal to the ICC (and later to its successor, the Surface Transportation Board) in the event of an impasse, but only if the railroad was insisting on tariffs that were more than 180 percent of its variable costs and certain other tests were met.

The effect of the Staggers Act was to allow the competitive market, not regulation, to drive railroad decision-making. Private long-term contracts gave railroads and shippers the protection they needed to make specialized cost-saving investments tailored to particular freight movements. The use of dedicated unit trains to carry coal and other bulk commodities spread rapidly, for example, because of the ability to customize services and assure long-term shipper commitments. These and other innovations led to substantial productivity gains and cost reductions (Bitzan and Keeler 2003, Chapman and Martland 1997). Revenue ton-miles per employee-hour increased more than 320 percent from 1980 to 2002, for example, while gallons of fuel per revenue ton-mile dropped 41 percent during that same time period. As part of the effort to improve productivity, railroads shed excess and underutilized lines while improving core operations. Light density lines were often sold to specialized short-line operators, whose flexible work rules and low cost structures enabled them to compete with other modes for traffic.

Competition also brought new service offerings to customers. Many of the innovations addressed the need for the railroads to compete with trucks. Intermodal traffic (trailers and containers moving on railroad flatcars) became the fastest growing segment of railroad traffic as railroads found their niche in this very competitive sector by leveraging lower line-haul costs. Ironically, trucking companies–competitors with railroads–have become major railroad customers. Railroads have also entered the logistics services arena to increase their ability to compete with trucks. For example, railroads have been developing logistics parks that integrate rail, truck, and transload services with warehousing capabilities to serve major markets.

United States policies that enabled freight railroads to create new services and lower costs have resulted in the United States railroads dramatically improving their financial position. Net railway operating income grew from $485 million in 1970 to $3.9 billion in 2000. Return on net investment improved from 1.7 percent to 6.5 percent between 1970 and 2000, according to data from the Association of American Railroads. From a social welfare perspective annual gains have been measured in billions of dollars (Winston et al. 1990; Peltzman and Winston 2000).

The European Union. The European railroad system is profoundly influenced by the fact that it developed as a set of national networks focused primarily on domestic rather than international traffic (ECMT 2003; Meersman and Van de Voorde 2004). Thus, rail networks in countries such as France and Spain mainly have corridors radiating from their capitals. Not only were country-centric networks constructed, but little attention was paid to interoperability of equipment or crews. At borders, locomotives and crews often must be changed because of different signal and electrification systems and train crew licensing requirements as well as pressure from labor unions. Spain represents an extreme case where the track gauge is different than its neighboring countries making interoperability an overwhelming technical hurdle (Izquierdo and Vassallo 2004).

Most European railroads were nationalized after World War II, and their primary objective continued to be the domestic movement of people and goods (Lewis, Semeijn and Vellenga 2001). In most cases transporting people took priority over freight. This was seen in the allocation of track time and in the investment in passenger rolling stock and infrastructure (ECMT 1998). The absence of market incentives for innovation and rate freedom together with the continued improvements in truck, bus, auto and air service, contributed to worsening financial performance (Cantos and Maudos 2001).

The creation of the European Economic Community in 1957 called the nationally focused strategies into question since the benefits of a Common Market depended on cross-border trade. Road operators made the transition to an “EU transportation mode” fairly quickly while the railroads lagged (Commission of the European Communities 2001). But the resulting growth in highway traffic increased traffic congestion and air pollution. Average traffic speeds have declined, an increasing portion of fuel is consumed in traffic jams, and the cost of traffic delays has been estimated at two percent of GDP in Europe (Ribbink 2005).

During the 1990s European Union policy makers responded to the shift to highway modes with a series of directives designed to make rail more competitive. The key reform, set out in a 1991 EEC Directive (number 91/440) was to require the national railroads to separate their train operations from the management of track, stations and other infrastructure and to allow independent train operators to use the infrastructure. The idea behind this directive was that while infrastructure was a natural monopoly, train operations were not. Infrastructure would be managed as a regulated entity, providing equal access to all train operators. The hope was that open access to the tracks would encourage new service offerings, innovations and cost reductions (Rothengatter 1991). Separation of infrastructure from operations was thought particularly important to promote pan-European traffic since independent train operators could, at least in principle, provide seamless international through services.

The European Union allowed member countries wide latitude in deciding how to separate infrastructure from train operations and, provided a generous timetable for achieving separation, particularly for domestic services. However, certain obstacles, such as equipment compatibility and interoperability, have proven more difficult than originally expected. There is considerable variation among the member states in the progress they have made in separation and the means employed. Britain is arguably furthest along in that infrastructure and operations are fully unbundled and the train companies are all privately owned (Kain 1998; Dunn and Perl 2001; Helm 2001; Haubrich 2001). Germany is close behind Britain while other countries are still in the first stages of applying the European Union policy (Henry and Quinet 1999; Izquierdo and Vassallo 2004).

The European Union Ministers placed renewed emphasis on improving rail in their 2001 White Paper on Transport. The paper outlines rail’s problems–lack of suitable infrastructure, constrained interoperability, limited innovation, non-transparent costs and poor reliability. The document also reiterates that open access to infrastructure is the key reform and establishes the objective of increasing the rail’s share of the European freight market from 8 percent to 15 percent by the year 2020.

III. Data Sources

The primary source of data on rail shares in Europe is the Eurostat Transport Database. Eurostat is the Statistical Office of the European Community and its mission is to gather and adjust data from the different member statistics offices in order to provide consistent data to European institutions. European Union freight traffic can be divided into three categories: (1) intra-country traffic (that originates and terminates within a single EU country), (2) intra-EU traffic (that originates and terminates in different EU countries) and (3) extra-EU traffic (that originates or terminates within the EU but is destined for or originates outside the EU). The Eurostat database provides the most detailed data on intra-country traffic, including freight volumes broken down by mode, commodity type, and distance traveled. The database has less detailed information for intra-EU traffic; in particular, it gives rail and road tonnage by commodity type but it does not specify the distances traveled, only the countries of origin and destination. To estimate the intra-EU distances we used the average distance between the primary industrial centers of the origin and destination countries. Eurostat provides only aggregated data on extra-EU rail transportation, so this traffic segment, which is relatively small, is not included in the analysis.

The United States data on rail shares is drawn primarily from Rebbie Associates' (now Global Insight's) Transearch Database, but is adjusted with information from the US Census of Transportation. Transearch is widely used by carriers and governments for evaluating transportation issues because it provides much more detailed data than the US Census. The Transearch database consists of an enormous sample of individual shipments including mode, origin, destination, commodity, and tonnage. The origin-destination information is used to estimate the distance for each shipment. One problem with the Transearch data is that it is thought to oversample long distance truck shipments and undersample short distance truck shipments compared to figures from the Census. Consequently, we distributed the Transearch road tons by the Census mileage blocks to assure consistency with the official Census data.

A great deal of effort was required to ensure that the commodity classifications and distance categories in the European and US data were consistent. Commodities are classified into seven categories: agricultural products, coal/solid mineral fuels, petroleum products, iron ore/steel/metal products, building products, chemical/fertilizer, and machinery/manufactured articles. The detailed definitions of the categories are provided in Appendix A. Of note, the code 24 of NST/R "Miscellaneous articles", 46 of STTC "Miscellaneous mixed shipment", and 40 of SCTG "Miscellaneous" include manufactured articles that are shipped in containers.

The distance blocks adopted are conditioned by the information available. The Eurostat database provides aggregated information in only 7 blocks: 0 – 50 km, 50 – 150 km, 150 – 500 km, 500 – 1,000 km, 1,000 – 2,000 km, 2,000 – 6,000 km, and more than 6,000 km. In order to compare the information, the United States data are aggregated according to the European Union blocks.

IV. Inherent Differences and Their Effects on Rail Share

The starting point for assessing the rail share difference between the United States and the European Union is to estimate the impact of the key inherent differences—competitive position of water and pipeline modes, shipment distances, and commodity mix. The European freight volume across all modes totaled 3,068 billion ton-kilometers in 2000. The United States rail share in that year was 38 percent. If the European railroads had captured the same share of freight traffic as the United States railroads, they would have carried 1,165 billion ton-kilometers of freight, 974 billion ton-kilometers greater than the 201 billion ton-kilometers[1] the European railroads actually carried that year. The impact of each inherent difference is explained below.

Water and Pipeline. As Table 1 shows, coastal and inland waterways carry 45 percent of all freight in the European Union compared to 20 percent in the United States, a difference presumably due in large part to Europe's longer coastline. The importance of coastal and waterway shipping in Europe probably also contributes to the fact that pipelines carry only 3 percent of freight in Europe compared to 12 percent in the United States. Many of the commodities that move by pipeline in the United States, particularly petroleum and its byproducts, move by coastal and inland waterway shipping in Europe.

[1] The EU railroads actually carried 240 billion ton-kilometers. 38 billion ton-kilometers were extra-EU shipments, which were excluded because of the data limitation described above.

Table 1: Freight Mode Share (Ton-kilometers in millions)

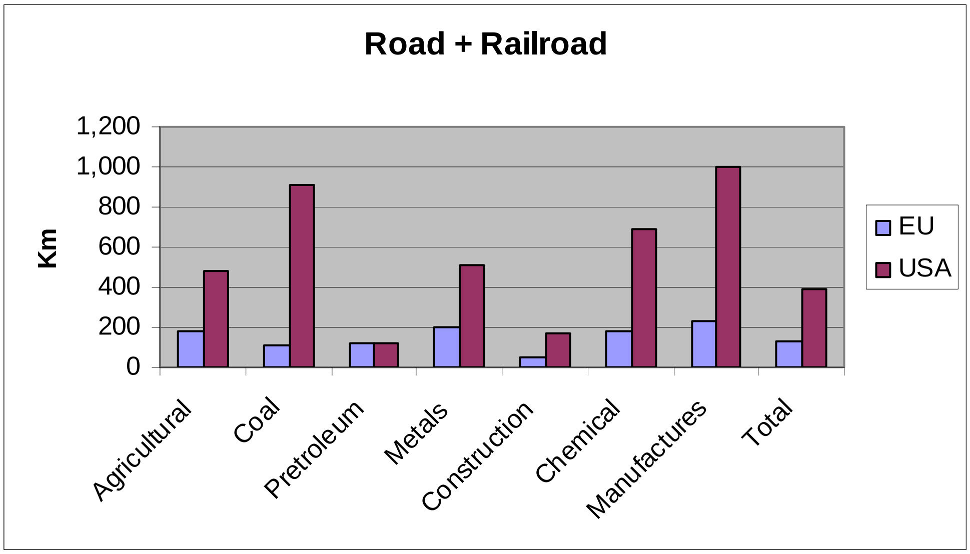
Year 2000	Ton*Km		All modes share		Rail + Road Share	
	US	EU-15	US	EU-15	US	EU-15
Railroad	2,468,206	240,000	38.00%	7.82%	58.82%	15.11%
Road	1,728,066	1,348,000	26.60%	43.94%	41.18%	84.89%
Rail + Road	4,196,272	1,588,000	64.60%	51.76%	100.00%	100.00%
Barge	814,154	125,000	12.53%	4.07%		
Pipeline	992,753	85,000	15.28%	2.77%		
Coastwise	492,354	1,270,000	7.58%	41.40%		
Other Modes	2,299,261	1,480,000	35.40%	48.24%		
Total	6,495,533	3,068,000	100.00%	100.00%		

To control for the impact of Europe's more extensive coastline and waterways, this analysis focuses on railroad versus road transportation and excludes water and pipeline shipping. Pipeline shipments are also excluded because the petroleum and other products typically carried by pipelines are generally not carried in large volumes by railroads. Finally, and as a practical matter, there is relatively little data on coastal shipping by commodity type and distance for either the United States or Europe.

If water and pipeline traffic is excluded, rail's share of freight increases from 38 percent to 58 percent in the United States and from 8 percent to 15 percent in Europe (see again Table 1). European railroads and trucks carried 1,588 billion ton-kilometers in 2000 and if the European railroads had captured the United States share of this traffic (58 percent) they would have carried 934 billion ton-kilometers. Thus, water and pipeline characteristics explain 232 billion ton-kilometers (1,165 billion – 934 billion) of the US-EU freight volume gap (see Table 3). A more detailed explanation of this calculation is provided in Appendix B. Since we have eliminated water and pipeline, the remainder of the analysis considers only road and rail.

Shipment Distance. As Figure 2 shows, average shipping distances are substantially greater in the United States than in Europe for every major commodity type except petroleum products. The average distance for all road and rail shipments was 132 kilometers in Europe versus 386 kilometers in the United States.

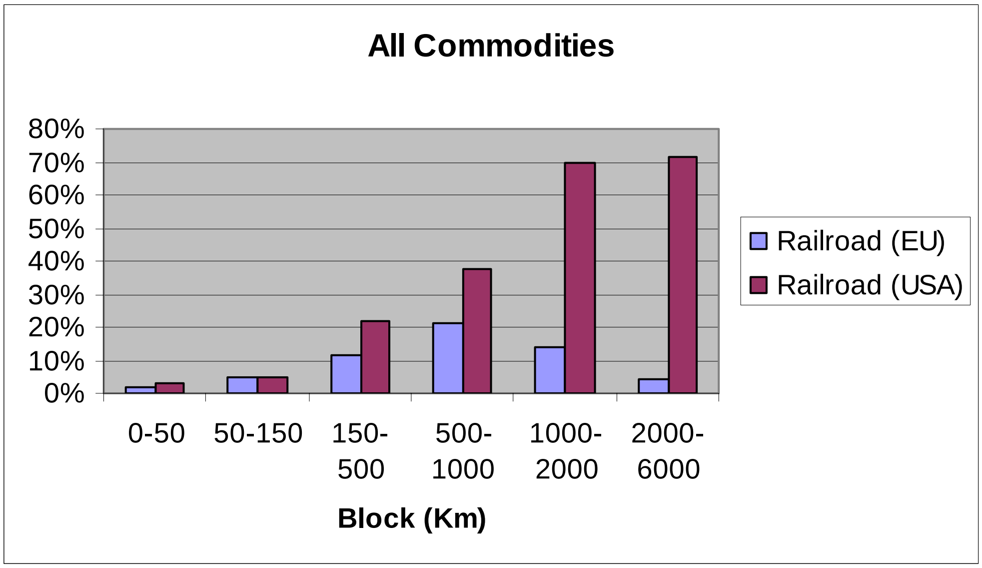
Figure 2: Comparison of Average Length of Haul in the US and EU



Rail becomes more competitive with truck as shipment distance increases because rail's lower line-haul cost becomes more important with longer distances. As Figure 3 shows, in the United States rail's share increases from only 3 percent in the 0-50 km block to 38 percent in the 500-1000 km block and even more in the 1000-2000 km block. Every commodity type has the same pattern. In Europe rail's share also increases with distance but more gradually and it falls off for distances exceeding 1000 kilometers. Rail's share of European road and rail traffic increases from 2 percent in the 0-50 km block to 21 percent in the 500-1000 km block, but then falls to 14 percent in the 1000-2000 kilometer block. The low share of rail in the longer-distance blocks is probably due in part to the difficulties with cross-border shipments in Europe, a problem analyzed in the next section.

Figure 3: Rail Share of Road and Rail Traffic

by Mileage Block for all Commodities

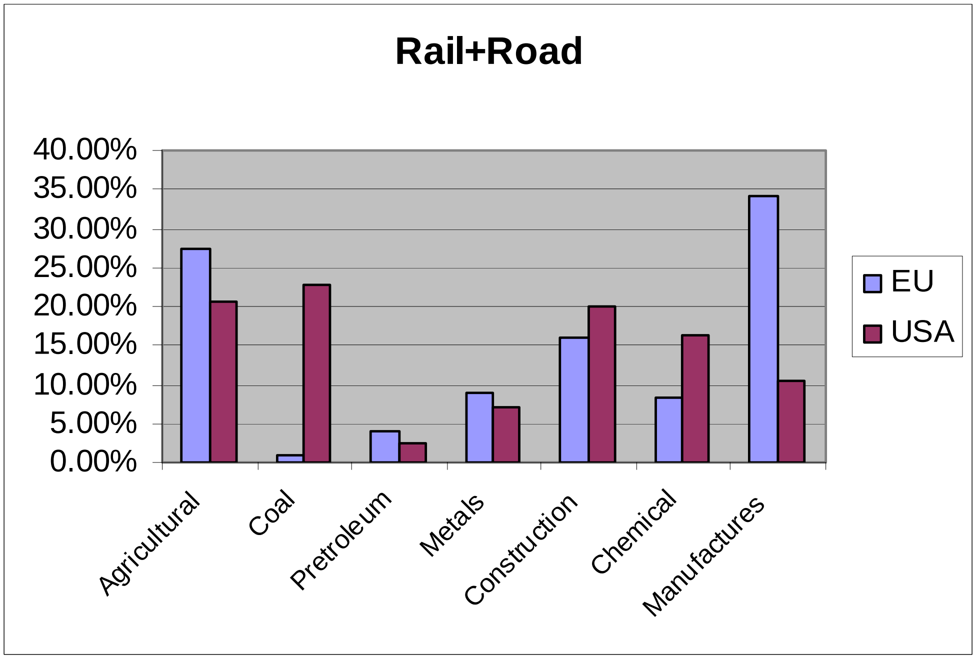


If the European railroads were able to capture the same share of truck and rail traffic by distance block as the United States railroads did, then European railroads would have carried 521 billion ton-kilometer. Shipment distance therefore explains 413 billion ton-kilometers of the gap (from 934 billion to 521 billion). It is notable that this adjustment for Europe's shorter shipment distances is more important than the previous adjustment for Europe's more extensive water transportation (see Table 3). The adjustment for distance is described in more detail in Appendix B.

Commodity Mix. A third intrinsic difference between Europe and the United States is commodity mix. As Figure 4 shows, the commodities carried are similar with two important exceptions: coal and manufactured goods. Coal accounts for almost 23 percent of rail and truck ton-kilometers in the United States but only 1 percent in Europe. Manufactured goods, by contrast, account for only 10.5 percent of rail and truck ton-kilometers in the United States but 34 percent in Europe. Since railroads are generally more competitive in carrying bulk lower-value commodities, these differences in commodity mix favor railroads in the United States and disadvantage railroads in Europe.

Figure 4: Comparison of EU and US Commodity Mix

(Percent of road and rail total volume in ton-kilometers)



If the European railroads had the same share of road and rail traffic by commodity type and distance block as the United States railroads did, then the European railroads would have carried 397 billion ton-kilometers in 2000. This final adjustment for commodity mix is the smaller than the previous adjustments for coastlines and distances, reducing the European railroads' expected traffic by only 124 billion ton-kilometers (from 521 billion to 397 billion). Table 2 shows the contribution of individual commodities to the 124 billion ton-kilometer differential. The main effect of the commodity adjustment is to reduce the expected coal traffic and increase the expected manufactured goods traffic on the European railroads.

Table 2: Detailed Impact of Commodity-Mix (Million of Ton-Kilometers)

Million of ton-km (Year 2000)	Agricultural Products	Coal and Solid Mineral Fuels	Petroleum and Products	Iron Ore, Steel and Metal Products	Cement, Building Products	Chemical and Fertilizers	Machinery and Manuf. Articles	Total
Commodity Mix Effect	28,880	-217,898	4,414	5,118	-6,100	-30,843	92,748	-123,680

Table 3 summarizes the adjustments made to the expected European rail traffic to account for intrinsic differences between Europe and the United States. If the United States rail share is multiplied by the freight volumes carried by all modes in Europe, European railroads should carry 1,166 billion ton-kilometers instead of 201 billion. But this simple calculation implicitly assumes that the European railroads enjoy the same weak water competition, long commodity distances, and heavy coal movements that United States railroads benefit from. If the effects of water competition, distance, and commodity mix are adjusted for, the expected European rail traffic would be 397 billion ton-kilometers, or a little less than twice as much as actually carried. Table 4 breaks the residual difference or shortfall of 196 billion ton-kilometers down by commodity type. The potential rail traffic gains are concentrated in agricultural products, coal, manufactured goods, and chemical and fertilizers. In metal products, however, the performance of the railroads in Europe appears stronger. The “negative” potential for iron, steel and metal products reflects the comparative success of European Union rail in capturing medium distance shipments that account for the bulk of this commodity’s volume. This could result from advantageous rail infrastructure, custom design services or subsidies.

Table 3: Summary of the Rail Share Differential Methodology and Results (Million of Ton-Kilometers)

Step	ASSUMPTIONS					RESULTS		
	Number of ton-km moved	Role of water and pipeline	Distribution of tones by distance block	Commodity-mix	Rail share / (rail + road) by commodity and block	Million of tone-kilometers	Increase or Decrease	Explanatory Effect
	EU	**US**	**US**	**US**	**US**	1,165,794		
1							231,748	Effect of water competition
	EU	EU	**US**	**US**	**US**	934,046		
2							413,104	Distance Effect
	EU	EU	EU	**US**	**US**	520,942		
3							123,680	Commodity Mix Effect
	EU	EU	EU	EU	**US**	397,262		
4							196,179	Residual
	EU	EU	EU	EU	EU	201,083		

Table 4: Breakdown of Shortfall by Commodity (Million of Ton-Kilometers)

Million of ton-km (Year 2000)	Agricultural Products	Coal and Solid Mineral Fuels	Petroleum and Products	Iron Ore, Steel and Metal Products	Cement, Building Products	Chemical and Fertilizers	Machinery and Manuf. Articles	Total
Current EU	25,491	9,770	12,451	46,725	18,120	18,739	69,822	201,118
Potential EU	124,836	26,175	13,753	26,701	28,183	37,444	140,170	397,262
Residual	99,345	16,405	1,302	-20,024	10,064	18,705	70,348	196,145
Increment	389.73%	167.90%	10.46%	-42.86%	55.54%	99.82%	100.75%	97.53%

We interpret this 196 billion ton-kilometer shortfall as the likely consequence of different public policies toward railroads and trucking in Europe and the United States. In other words, if Europe's relevant policies were the same as those in the United States', European railroads might have carried almost twice as much freight in 2000 as they actually did.

V. Possible Policy Explanations

This residual volume is assumed to reflect a combination of policies—some favor European Union rail share and others serve to disadvantage rail's competitive position. This section details the policy differences that may have contributed to the differences in rail share. The discussion is at a macro-level, more detailed analysis is required to understand the direct impact of each policy consideration. We note that this section is somewhat speculative; however our objective is to provide a discussion of relevant policies. One policy difference which is unlikely to impact the residual is the European Union's requirement to separate infrastructure from operations and require open access. Our data on rail shares are from 2000, when many European countries were just beginning to comply with the vertical unbundling regulations, therefore, given our data set, such an analysis would be premature.

European Policies Favoring Rail Freight. In two respects, European transport policy favors rail freight more than United States transport policy does, which makes the European rail traffic shortfall somewhat surprising. First, road fuel prices are higher and road tolls more prevalent in the European Union than in the United States. Diesel prices vary over time and by geography but generally fuel prices in Europe are about twice that of the United States. With respect to road tolls, Table 5 shows that for relevant European countries user fees are charged to use between 12 and 30 percent of their trunk network. In contrast, only 1.3 percent of the United States interstate trunk highways are toll roads. Table 5 illustrates that toll fees per kilometer were comparable in the United States and the European Union.

Table 5: Road charges applied in some European Countries and in the United States in 2000

Country	Charging mechanism	Truck Fees	Kilometers in which the charges are applied(*)	Percentage of the trunk network
Belgium	Vignette	8.000 €/day	1,702	13.6 %
France	Toll	0.196 €/km	7,840	27.9 %
Germany	Fee by Km	0.136 €/km	11,800	28.6 %
	Vignette	8.000 €/day		
Italy	Toll	0.100 €/km	5,563	12.1 %
Spain	Toll	0.154 €/km	2,783	13.8 %
United States	Toll	0.150 €/km	4,529	1.3 %

(*) US data in 2003

Second, Europe subsidizes its freight railroads more heavily than the United States although precise comparisons are difficult. The principal subsidies in the United States are restricted to passenger services[2]. United States freight railroads are not subsidized directly, and in fact pay substantial corporate income taxes ($538 million in 2001) and property taxes to federal, state and local governments. The European railroads receive substantial subsidies that support both passenger and freight operations. Table 6 shows that the vast majority of rail service subsidies support passenger services. However, more than half of total railroad subsidies support infrastructure facilities, which are shared by both passengers and freight.

[2] The federal government spends approximately $1 billion per year to cover the deficit of Amtrak, and state and local governments spend a significant amount supporting commuter rail services.

Table 6: Public Budget Contributions to European Railroads (year 2001)

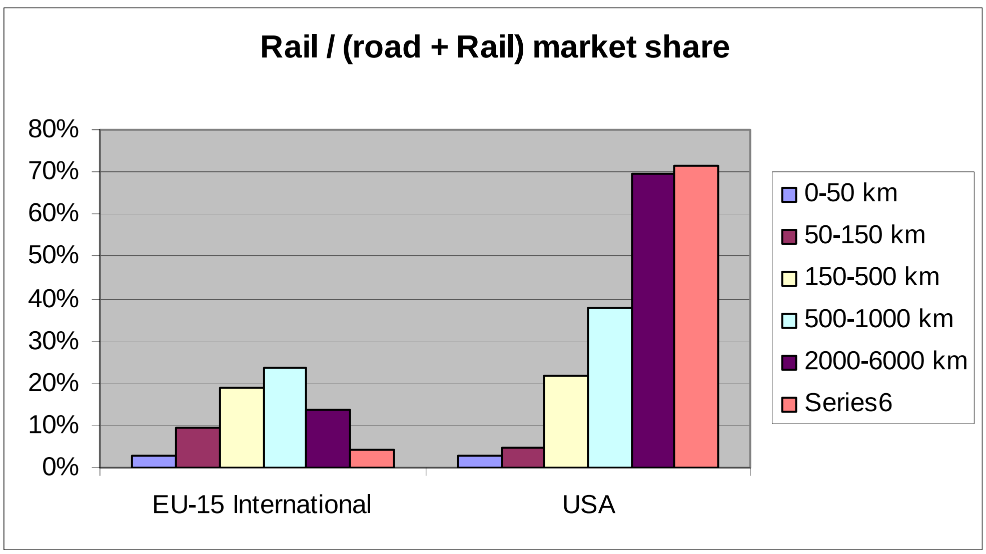
Form of payment	EU-15 (million Euros)
Passenger Services	11,541
Freight Services	275
Infrastructure and Capital Investment	18,364
Others	8,126
Total	38,306

Source: NERA

European Policies Disadvantaging Rail Freight. European transport policies seem to disadvantage rail freight in several ways, but probably the most important of these is the priority that is given to passenger service. Rail carries 6.25 percent of all intercity passenger traffic in Europe compared to 0.3 percent in the United States. (It is interesting to note that the improvement in rail position in the United States coincides with the shedding of passenger services.) Freight and passenger services share 70 percent of railroad infrastructure in Europe and only 12 percent is exclusively devoted to freight transportation. Track capacity is limited, thus, to the extent that it is used for passenger trains, it is unavailable for rail freight. However, passenger operations are generally concentrated in the morning and evening hours. There are thus many hours for freight operations; although, the scheduling task becomes more complex.

A second way in which rail freight is probably disadvantaged in Europe is the lack of interoperability at the borders and its consequent delays. The estimation of the policy impact includes the effect of the borders since we applied the market share of the United States whose network, although built by independent companies, was designed for interoperability; in strong contrast to the nationally focused European Union railroads. Figure 5 shows the comparison of European Union international rail shares along with United States rail share. As expected the United States share increased with distance. The same was true for European international rail freight when shipment distances are lower than 1,000 km. The evidence of a borders effect in Europe is that the international share declined in the distance blocks above 1,000 kilometers (see Figure 5). The international transportation share in Europe in the shorter mileage blocks does not seem to be much lower than in the United States. A possible explanation for this result is that most of the short haul international transport in Europe takes place in central Europe, where there are fewer interoperability problems.. Thus the borders effect may be higher in the more peripheral countries such as Spain. The results of this analysis should be approached with caution, since the international transportation by distance block was estimated on the basis of the origin-destination matrix among the European Union countries. Nevertheless, Europe's lower market share in long-distance blocks seems to imply that policies facilitating cross-border movements of rail freight are likely to increase rail share in Europe.

Figure 5: Impact of Borders on Rail Share



A third policy difference that may limit rail freight in Europe is the lack of productivity-enhancing infrastructure in Europe. Evidence of this gap includes the substantially longer freight trains that operate in the United States compared to the European Union. In the United States, unit trains are typically more than 1,500 meters which is more than two times longer than those in Europe. In addition, the United States has an extensive rail network operating double-stack container services. This technology doubles productivity in those trains.

A fourth policy area of concern is the incentives of the rail operators. It is notable that United States freight rail share accelerated in the 1980s following deregulation. Many European Union countries have seen similar results when competition has been introduced in other sectors such as electricity, telecommunications, and air transportation. Railroads in Europe are implementing an important reform in order to introduce competition: unbundling infrastructure from operation. In 2000, only some countries had seriously implemented this new approach, so it is too early to evaluate its effectiveness.

Potential policy actions to increase European rail freight share. Four policies appear to hold promise for increasing European rail freight share. First, increasing interoperability through technical means (e.g. unifying signal systems) and training (e.g. locomotive drivers that are qualified in multiple countries) would be expected to yield greater rail shares for longer-distance shipments. We consider increasing interoperability to have high impact based on our share analysis. Implementing this policy would be challenging from the prospective of both coordination and funding. However, these challenges can be overcome.

Second, and probably most challenging, is balancing the needs of both passenger and freight services. We recognize that passengers would remain the priority in Europe. Notwithstanding the need for passenger service, there are opportunities to focus on freight. For example, as new infrastructure for high speed services is built, existing lines can be refocused on freight. Optimizing freight and passenger schedules would likely increase freight carrying capacity without deteriorating passenger services. The high potential for rail growth that these measures can have makes the effort worthwhile.

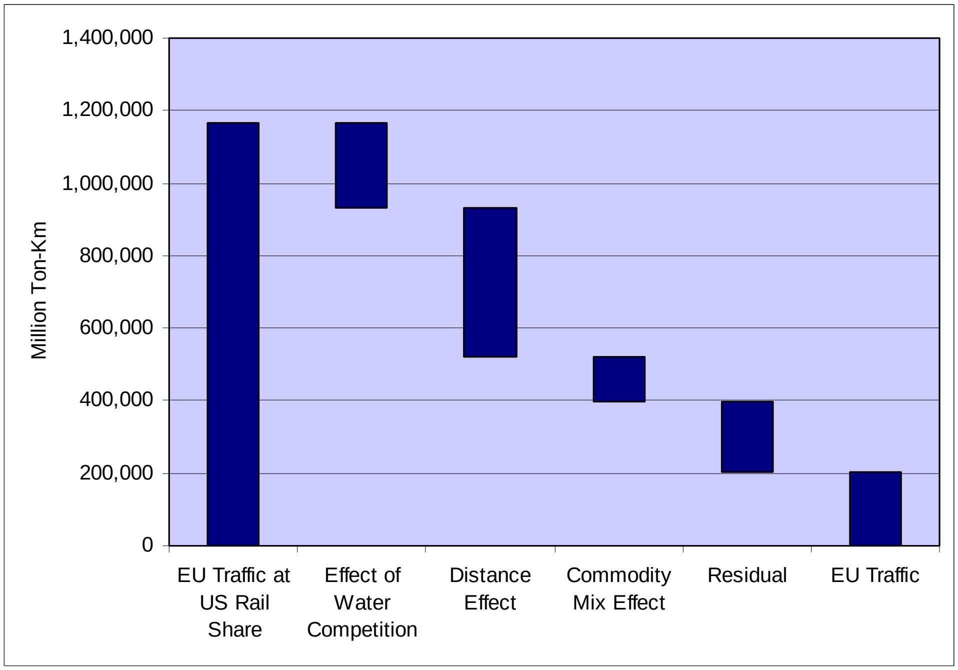
The third policy change is enhancing infrastructure. Adding track and improving signaling can permit both longer trains and higher speeds, thus increasing rail freight productivity. These approaches are capital intensive. Consequently, a financial assessment is required to confirm that the traffic growth would provide a solid return on investment.

The final policy area is promoting competition for rail freight. The experience in the United States demonstrates the value of competition. Several European countries (encouraged by the European Union) have already launched efforts to increase competition. As a result, several rail companies are forming with management teams exclusively focused on rail freight. These efforts should be evaluated as they establish a longer track record. We expect that these projects will yield benefits, and that competitive principles can be applied more broadly throughout the European Union. An additional benefit of fostering independent rail freight operators is the value of dedicated management. The single focus on freight enables the management team to better understand costumer needs and develop responsive service products. It also enables investment decisions to reflect the needs of the freight market. As noted above, passenger service is the priority in Europe. Thus, it is unlikely that freight can receive the sufficient attention in rail companies providing both freight and passenger services.

VI. Summary and Further Research

Three key conclusions emerge from the research. First, the shorter freight distances and more competitive coastal transportation in Europe are the main factors explaining the difference between European Union and United States rail share. Second, commodity mix is not materially different in the two geographies, and, even though this factor has some influence in the market share explanation, its influence is limited. Third, notwithstanding the structural factors noted above, there is substantial opportunity for European rail share gains through changes in policy. Estimated conservatively, the potential rail share gains resulting from policy actions could increase current European Union rail share 97 percent or 196 billion ton-kilometers (see Figure 6). The gains due to an increase of efficiency can be even larger since, unlike the United States, the European Railroads are subsidized and the fuel taxes in Europe are substantially higher than in the United States. Four policy areas warrant investigation: the impact of interoperability on the long distance rail market share, the opportunity to both segregate freight operations and more effectively operate joint freight and passenger services, the influence of better infrastructure to support freight operations, and the effect of fostering competition on efficiency gains.

Figure 6: Summary Explanation of EU and US Rail Share Differential



Overall, our findings support the feasibility of the European Union Commission's goal stated in the 2001 White Paper to increase European Union rail freight share from 8 to 15 percent. However, the structural differences between the European Union and the United States make it unlikely that the European Union would ever approach the United States 38 percent rail share benchmark.

Additional research will enable the refinement of this macro analysis. Specifically, further work may improve our estimates of the impact of intrinsic differences between the European Union and the United States. More in-depth study of the four policies highlighted above can confirm their relevance and size as well as identify additional high-impact policies.

Acknowledgements

We wish to thank Professor Jose Antonio Gómez-Ibañez of Harvard University for his inspiration, direction, and sustentative input.

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Appendix A
Groups of commodities according to the UE NST/R codes, the US STTC codes, and the US SCTG codes

	UE NST/R Codes (EUROSTAT)	US STTC Codes (TRANSEARCH)	US SCTG Codes (CENSUS)	
AGRICULTURAL PRODUCTS	01 Cereals		01 live animals and live fish	08 Alcoholic beverages
	02 Potatoes, other fresh or frozen fruits and vegetables	01 Farm products	02 Cereal grains	09 Tobacco products
	03 Live animals, sugar beet		03 Other agricultural products	25 Logs and other wood in the rough
	04 Wood and cork	08 Forest products	04 Animal feed	
	05 Textile materials		05 Meat, fish and seafood	
	06 Foodstuff and animal fodder	20 Food products	06 Milled grain and bakery	
	07 Oil seeds and oleaginous fats		07 Fats and oils	
COAL AND SOLID MINERAL FUELS	08 Solid minerals fuels	11 Coal	15 Coal	
PETROLEUM AND PRODUCTS	09 Crude petroleum	13 Crude oil	17 Gasoline and aviation fuel	
	10 Petroleum products	29 Petroleum products	18 Fuel oils	
IRON ORE, STEEL AND METAL PRODUCTS	11 Iron ore, iron and steel waste	10 Metal ores	14 Metallic ores	
	12 Non-ferrous ores and waste	33 Primary metals	32 Base metal	
	13 Metal products	34 Fabricated metals	33 Articles of based metal	
BUILDING PRODUCTS	14 Cement, lime, manufactured building materials	24 Lumber and wood products	10 Building stone	13 Nonmetallic minerals
		32 Clay, concrete, glass, stone	11 Natural sands	26 Wood products
	15 Crude and manufactured minerals	14 Non metallic minerals	12 Gravel and stone	31 Nonmetallic minerals products
CHEMICALS AND FERTILIZERS	16 Natural and chemical fertilizers		19 Coal and petroleum prod.	23 Chemical products
	17 Coal chemicals, tar	28 Chemical and allied products	20 Basic chemicals	24 Plastics and rubbers
	18 Other chemicals		21 Pharmaceutical products	27 Pulp and paper
	19 Paper pulp and waste paper	26 Pulp, paper and allied products	22 Fertilizers	
MACHINERY AND MANUFACTURED ARTICLES	20 Transport equipment	37 Transportation equipment	28 Paper articles	37 Transport equipment
		35 Machinery	29 Printed products	38 Precision instruments
	21 Manufactures of metal		30 Textiles	39 Furniture
	22 Glass, glassware, ceramic products		34 Machinery	40 Miscellaneous
	23 Textile	25 Textile mill products	35 Electronic equipment	
	24 Miscellaneous articles	46 Miscellaneous mixed shipment	36 Vehicles	

Appendix B:

Adjustments for Inherent Differences

Water and Pipeline. To account for the difference in water availability, the EU volume at US rail share was reduced by the ratio of US road plus rail share to EU road plus rail share as expressed in Formula 1 below. The resulting volume deduction is 232 billion ton-kilometers.

$$
\begin{aligned}
r_{om} &= T_{EU} \cdot \frac{R_{US}}{T_{US}} \cdot \left[1 - \frac{RR_{EU}/T_{EU}}{RR_{US}/T_{US}} \right] \\
R_{om} &= T_{EU} \cdot \frac{R_{US}}{T_{US}} - r_{om}
\end{aligned}
\tag{1}
$$

$r_{om} =$	Other mode effect on rail transportation (ton-kilometers)
$R_{om} =$	Rail transportation controlling by other modes effect (ton-kilometers)
$T_{EU} =$	Total transportation in the EU in ton-kilometers
$T_{US} =$	Total transportation in the US in ton-kilometers
$R_{US} =$	Rail transportation in the US in ton-kilometers
$RR_{US} =$	Rail plus Road transportation in the US in ton-kilometers
$RR_{EU} =$	Rail plus Road transportation in the EU in ton-kilometers

The reduction of rail plus road is calculated according to Formula 2.

$$
\begin{aligned}
rr_{om} &= T_{EU} \cdot \left[\frac{RR_{US}}{T_{US}} - \frac{RR_{EU}}{T_{EU}} \right] \\
RR_{om} &= T_{EU} \cdot \frac{RR_{US}}{T_{US}} - rr_{om}
\end{aligned}
\tag{2}
$$

$rr_{om} =$	Other mode effect on rail plus road transportation (ton-kilometers)
$RR_{om} =$	Rail plus Road transportation controlling by other modes effect

Shipment Distances. The impact of the shorter distances in the EU is estimated by comparing the effect on the railroad share when the US distance-block distribution is substituted for the EU distance-block distribution. As shipment distances are larger in the US than in Europe and railroads are more favorable for long distances than road, this calculation gives us the distance effect or, in other words, the part of the market-share difference between Europe and the United States that is explained by distance. The calculation is detailed below.

$$r_d = \sum_{i=1}^{i=n} \sum_{j=1}^{j=m} RR_{om} \cdot CM_{US}^{j} \cdot \left(DB_{US}^{ij} - DB_{EU}^{ij}\right) \cdot \left(\frac{R_{US}^{ij}}{RR_{US}^{ij}}\right) \tag{3}$$

$$R_{om/d} = R_{om} - r_d$$

$r_d =$	Distance effect on rail transportation (ton-kilometers)
$R_{om/d} =$	Rail transportation controlling by other modes effect and distance effect (ton-kilometers)
$m =$	Number of commodities
$n =$	Number of distance blocks
$CM_{US}^{j} =$	$RR_{US}^{j} \Big/ \sum_{j=1}^{j=m} RR_{US}^{j}$ (Commodity-mix distribution in the US)
$DB_{US}^{ij} =$	$RR_{US}^{ij} \Big/ \sum_{i=1}^{i=m} RR_{US}^{ij}$ (Distance-block distribution in the US)
$DB_{EU}^{ij} =$	$RR_{EU}^{ij} \Big/ \sum_{i=1}^{i=m} RR_{EU}^{ij}$ (Distance-block distribution in the EU)
$R_{US}^{ij} =$	Rail transportation in the US in ton-kilometers (distance block i and commodity j)
$RR_{US}^{ij} =$	Rail plus Road transportation in the US in ton-kilometers (distance block i and commodity j)

Commodity Mix. The commodity-mix effect is calculated as the difference between the ton-kilometers that the EU would move if the EU followed the pattern of the US in terms of commodity mix. The commodity mix effect is calculated according to equation 4.

$$r_{cm} = \sum_{i=1}^{i=n} \sum_{j=1}^{j=m} RR_{om} \cdot \left(CM_{US}^{j} - CM_{EU}^{j} \right) \cdot \left(DB_{EU}^{ij} \right) \cdot \left(\frac{R_{US}^{ij}}{RR_{US}^{ij}} \right) \tag{4}$$

$$R_{om/d/cm} = R_{om/d} - r_{cm}$$

$r_{cm} =$ Commodity-mix effect on rail transportation (ton-kilometers)

$R_{om/d/cm} =$ Rail transportation controlling by other modes effect, distance effect, and commodity-mix effect (ton-kilometers)

$CM_{EU}^{j} =$ $RR_{EU}^{j} \Big/ \sum_{j=1}^{j=m} RR_{EU}^{j}$ (Commodity-mix distribution in the EU)

The commodity-mix effect was 123 billion ton-kilometers. Table 2 displays the commodity-mix effect by commodity. Of note, coal explains most of the commodity difference between Europe and the US.