EMPTY RAILCAR BACKHAULS FROM MEXICO: OPPORTUNITIES FOR REFRIGERATED TRADE

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INTRODUCTION

When theory and observed fact are inconsistent, then either the theory needs to be changed, or an economic opportunity exists to close the contradiction. The fronthaul – backhaul problem provides examples where opportunities can be found. A fundamental understanding of transportation is that carriers are willing to accept less than their full costs on one leg of their journey, if the alternative is to return empty. This is referred to as the backhaul. Willingness to accept very low rates on the backhaul are greater if the carrier has already made a round trip profit on the fronthaul load. Consequently, in traffic lanes in which the backhaul trips are chronically empty, a trade opportunity exists.

An earlier study of transporting refrigerated food products from Canada to Mexico (Prentice and McLachlin, 2007) revealed that the majority of refrigerated rail cars return from Mexico to Canada without a load. A follow up study of this observation was undertaken in Aguascalientes, Mexico from January to March 2008. Structured interviews were undertaken with representatives of trucking companies, railways, warehouse operators, frozen food exporters and government officials[1]. In February 2009, a workshop was held in Aguascalientes that brought together participants in the cold chain to discuss the results of the research.

[1] The qualitative method used is explained in Prentice and McLachlin, (2008).

The purpose of this paper is to identify the economic problem that causes approximately three quarters of these refrigerated railcars to return empty. The paper begins with a conceptual framework that explains why empty railcars occur and can persist for long periods. A joint product model is presented to explain fronthaul/backhaul pricing and the determination of empty rail car numbers. Subsequently, five hypotheses are explored to identify the cause of empty northbound returns from Mexico.

JOINT PRODUCT PRICING MODEL

Joint products have a constant, well-defined functional output relationship. One product cannot be produced without creating a by-product in a fixed proportion. The fronthaul/backhaul trip in transportation is an example of a joint product. By definition the fronthaul is always loaded, but the backhaul may be an empty return. This complicates the efficient pricing of the traffic and their shares of the round-trip cost.

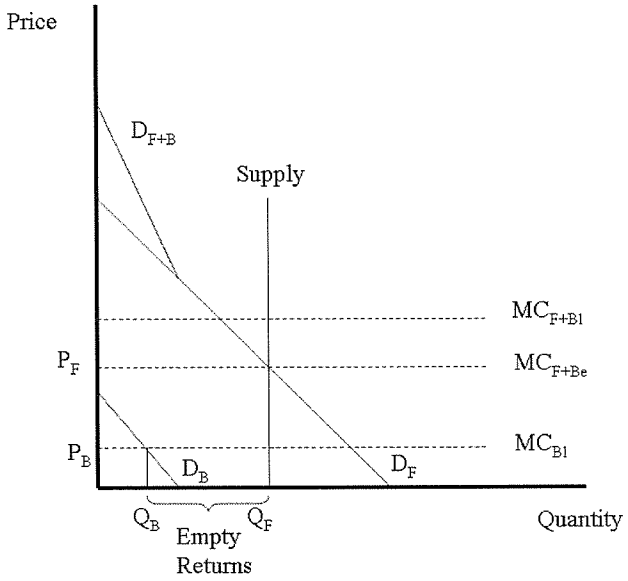
Economic freight rates cannot be set by a simple division of costs between the two halves of the round trip. The volume of backhaul traffic may not generate enough revenue to pay its half of the costs. The freight rates for the fronthaul and backhaul loads depends on the balance of the trade in the two directions. The number of round-trips is determined by the freight rates set for the fronthaul demand.

The frozen food trade between Canada and Mexico is illustrated by the diagram in Figure 1. Canada ships frozen French fries, pork, and beef to Mexico in refrigerated rail cars. The southbound shipments are the fronthaul demand (D_F) and the return loads from Mexico are the backhaul demand (D_B). The combined round-trip demand is simply the vertical addition of the fronthaul and the backhaul (D_{F+B}). The kink in the round-trip demand occurs where the backhaul price is zero. To the right of this point, the number of trips (Q_F) is determined solely by the fronthaul demand.

Southbound rates (to Mexico) are high because three-quarters of the railcars return empty. The average price of the fronthaul (P_F) is determined by the marginal costs of the round-trip assuming an

empty return (MC_{F+Be}). The supply of refrigerated railcars at this price is QF. The number of railcars that return with a load (Q_B) is determined by the marginal costs of the loaded backhaul (MC_{Bl}).

Figure 1



The marginal costs of the backhaul include more than just the out-of-pocket expenses associated with the shipment. The opportunity cost of a faster empty return to obtain a more lucrative fronthaul load is also considered. The number of empty returns is the difference between the quantity of cars demanded for the fronthaul and the quantity of loaded backhauls demanded (Q_F - Q_B) at the backhaul of P_B.

How would more backhaul shipments affect freight rates? If the volume of traffic could be doubled by new shipments of frozen vegetables from Mexico, the number of empty returns would fall. Figure 2 and Figure 3 illustrate the impact of increasing the volume of backhaul vegetable shipments.

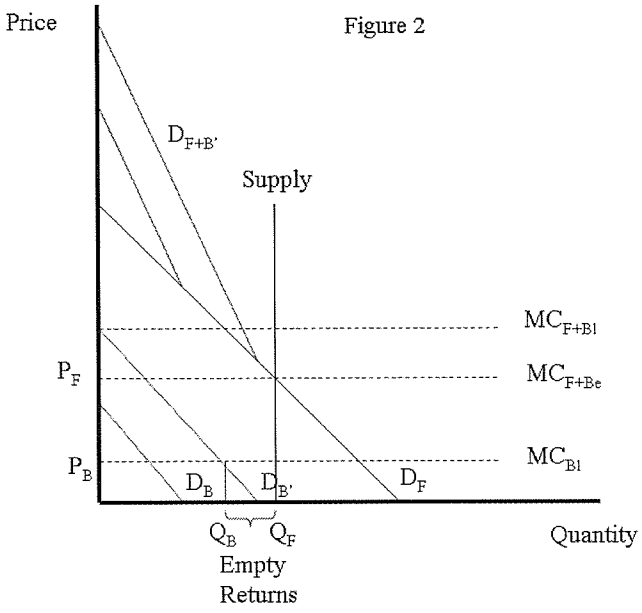


Figure 2

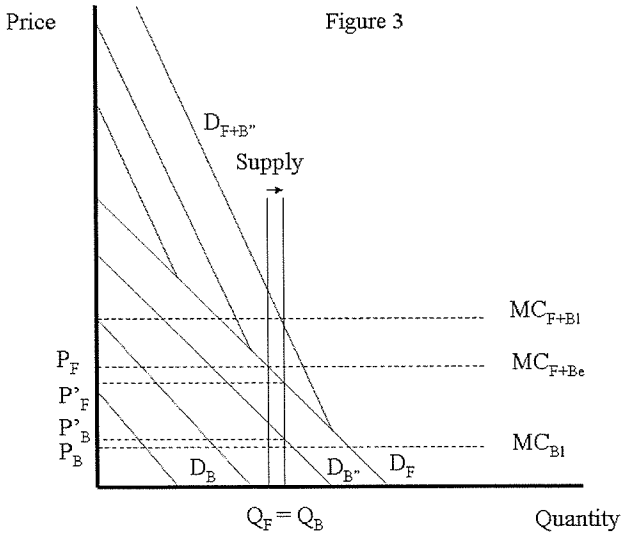


Figure 3

The expansion of backhaul demand from D_B to $D_{B'}$ in Figure 2 is sufficient to reduce the number of empty returns, but not sufficient to alter freight rates. The number of railcars would still be determined by solely the fronthaul demand[2].

Figure 3 illustrates the continued demand expansion for shipments of frozen vegetables from Mexico to $D_{B''}$. The joint demand increases to $D_{F+B''}$. Now the round-trip costs become relevant. The marginal cost of the loaded round-trip is (MC_{F+B1}). The division of costs lowers the fronthaul rates from Canada (P'_F) which increases the quantity demanded for the fronthaul. All the available supply is demanded by the backhaul at the slightly higher rate (P'_B).

The theoretical framework demonstrates that the increase of the demand for the backhaul is a win-win-win situation. The railways earn more revenue and gain equipment utilization. The backhaul shippers gain a low cost transport, and can increase their volumes significantly before raising freight rates. As the freight markets come into balance, the fronthaul shippers obtain lower freight rates. The obvious benefit of filling the railcars provides the incentive to ask why in reality so many return empty from Mexico.

EMPTY BACKHAUL HYPOTHESES

A map of the study area and the Class I railways is presented in Figure 4. The area enclosed by the circle is referred to as the Bajío, which is the fertile plateau north of Mexico City where most of the fruit and vegetable processors are located. Aguascalientes and Celaya are important interchange locations for the Ferromex and KCS de Mexico railways. The majority of the shipments from this area to the U.S. and Canada cross the U.S.-Mexico border at Laredo.

None of the railways have a direct line from Canada to Mexico. Shipments must be interlined from the Mexican railways (Ferromex,

[2] Note that when the backhaul demand increases, so does the total demand from D_{F+B} to $D_{F+B'}$. The increase is not enough to influence the round trip costs with full loads in each direction.

KCS de Mexico), to the US railways (BNSF, Union Pacific, Kansas City Southern) to the Canadian railways (CP Rail, CN Rail). As a result of the inter-switching, single car rail shipments can take from 22 to 30 days for transit north and south.

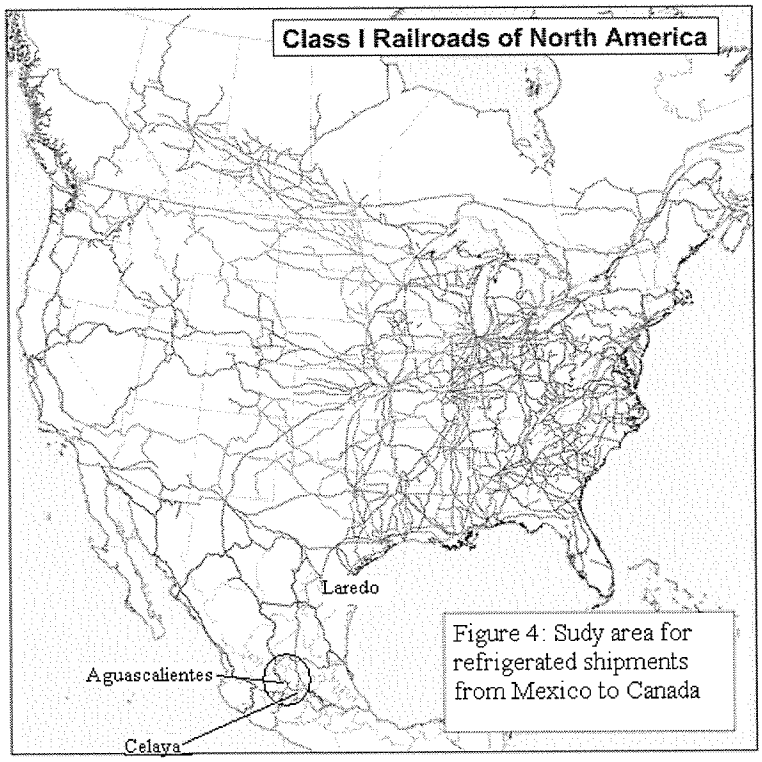


Figure 4: Sudy area for refrigerated shipments from Mexico to Canada

The exploration of the empty rail car backhauls from Mexico is undertaken with five hypotheses that are developed as a framework for the study. The individual hypotheses are seen neither as an exhaustive list, nor as isolated, to the extent that more than one reason could explain the lack of loaded backhauls.

Alternative Hypotheses:

1. The volume of frozen food exports from Mexico is insufficient to justify railcar movements.

2. The empty railcars are not returning to the right places / the railways are not interested in accommodating the business.
3. Railcar freight rates and service are not competitive with trucks for the movement of Mexican frozen food exports.
4. Infrastructure gaps in the refrigerated cold chain make railcars unattractive for shipping from Mexico.
5. Mexican shippers lack confidence in the railways to deliver loads reliably and in good condition.

Hypothesis One: The volume of frozen food exports from Mexico is insufficient to justify railcar movements.

A survey of frozen food exporters in the Mexican states of Aguascalientes and Guanajuato identified sophisticated and well established frozen food exporters. These included three large exporters[3] that make truckload shipments of frozen strawberries, spinach, cauliflower, and broccoli to the U.S. and Canada.

The major frozen food trade between Canada and Mexico is presented in Figure 5 for the period 2004 to 2008. Two-way trade is worth about $70 million annually. The data indicate that Canada has a favourable trade balance, but the volumes may not be that much different because meat exports are more valuable per kilogram than vegetables.

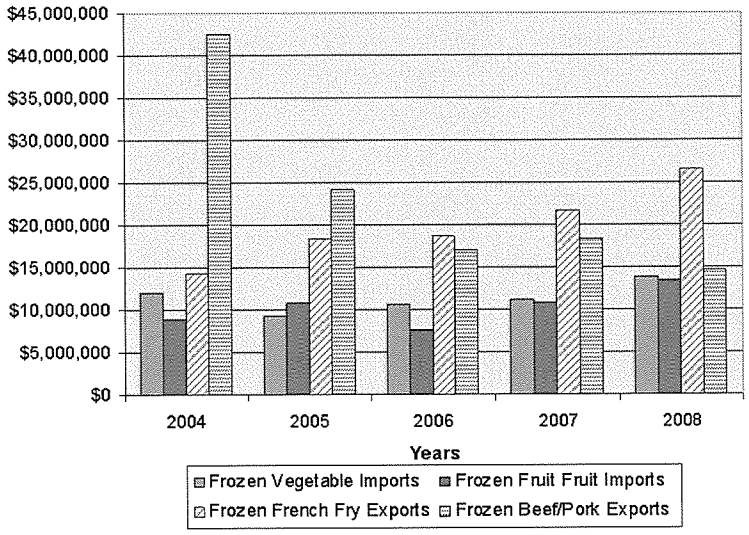
The Mexican imports are all moved by truck. Assuming a value of $4 per kilogram and 20,000 kilograms per truck, Mexican frozen food shipments to Canada would amount to approximately 375 truckloads. This volume suggests that there would be adequate cargoes to fill the empty railcars for northbound shipments. There is also reason to anticipate growth if rail shipment reduced costs. The market share of Mexican products averaged 10.7 percent of frozen fruit and vegetable imports to Canada from 2004 to 2008.The data and the interviews

[3] Three exporters that were interviewed are: La Hacienda Congelados, Frigorizados La Huerta and Friendly Nature de Mexico.

with current exporters confirm that adequate frozen food shipments are available to utilize refrigerated railcars.

Hypothesis one that there is insufficient volume is rejected.

Figure 5 Frozen Food Imports from Mexico to Canada, and Frozen Food Exports from Canada to Mexico: 2004-08



Hypothesis Two: The empty railcars are not returning to the right places / the railways are not interested in accommodating the business.

As a representative of a well-known frozen and refrigerated warehouse operation in Mexico explained:

> The train companies set two conditions. If you want to use rail, you have to send loads that travel a long distance and are very heavy. They are always interested in backhauls. So, it is difficult for one customer.

In response to a question about products going back from Mexico, another representative of the same company stated that:

> There are a lot of vegetable producers of broccoli, strawberries, etc. [We are] putting some effort into that, working with those producers in order to export from Mexico to the United States or Canada by train.

A representative of a North American railway company, with offices in Mexico, commented that:

> We know that there is a lot of backhaul business there [and] it makes a lot of sense for us to look at this business.

Another railway representative stated:

> . . . if we can get backhaul traffic, that would be the perfect move. So, [we are] now willing to look for options, negotiate, and get the cars to get the traffic, but we need to create a balanced business.

The Canadian railways make their position very clear. They have equipment and would like to carry return loads, but they have been unsuccessful in finding suitable shippers in Mexico. A railway's concern is cycle-time extension. Refrigerated railcars are valuable and they are managed intensively to obtain high utilization. A deviation from their routings to pick up or deliver backhaul loads needs to be efficient to make a meaningful contribution to the opportunity costs associated with an extension of the round-trip cycle-time for the railcars.

A representative of one of the Canadian railways explained the opportunity costs of east/west corridors versus north/south corridors:

> [We have] a lot of reefers in Canada, but that is just for domestic. . . . In 35 or 40 days, you complete a cycle, say from Winnipeg to Mexico and then back to Winnipeg . . . . in the same time [you can] probably have two or three round trips, without sharing the equipment or the business with anybody else. So, to have 60 railcars going down to Mexico for one

> particular customer, [we] can make much more money keeping the reefers in the network and multiply the business.

The Mexican railways are interested in accommodating refrigerated shipments and are working to build incremental traffic. Representatives of five Class 1 railways came to the Cadena de Frio Workshop which also indicated their interest[4]. The railways suggested that return routes of railcars from Mexico to western Canada would be considered favourably because that is where they are picking up frozen meat and potato products for southbound shipments. The railways want to retrace their routes and avoid empty miles and additional switching.

Hypothesis two that empty railcars are returning to the wrong places is rejected.

Hypothesis Three: Railcar freight rates and service are not competitive with trucks for the movement of Mexican frozen food exports.

In terms of refrigerated railcar/truck competition, total logistics costs must be considered. Railcars require loads that are three times the size of truckloads, which might exceed some consumers demand, but the costs are very much in the favour of the railways. As one rail representative stated:

> Reefer over the road is very expensive, . . . 30 to 40% more expensive [than rail]. It's also 30 to 40% faster. It may work for some [shippers] but not for all.

On a tonne-kilometer basis, the truck rates are higher than the rail freight rate, but some additional costs for rail shipments such as transshipping, storage and financing inventory in transit have to be considered. Data were provided by one Mexican shipper that included

[4] The Cadena de Frio Workshop was held on February 17, 2009 at the Universidad Politecnica de Aguascalientes. The following railways attended: CP Railway, CN Rail, Union Pacific Railroad, Burlington Northern-Santa Fe, and Kansas City Southern de Mexico.

charges for trucking from their plant to the US border at Laredo, storage and transshipping to railcars, and inventory.

- Trucking to the border $.0275/pound
- Storage and transshipping $.015/pound
- Inventory financing 60 days

On a shipment of 120,000 pounds to California, the savings over truck worked out to $.03/pound, or $3,600. Even under the least favourable shipping scenario refrigerated railcars offered an advantage over trucking, but this shipper did not think that the savings were great enough to accept the additional risk and financing costs.

A Mexican railway representative explained the problem they are facing when competing with trucks as follows:

> We have not been able to convince the producers to get to the railroad at the nearest place. What they are doing – in Guanajuato, where they produce carrots, cauliflower, broccoli, etc. – is going by truck to the border, to a warehouse, and then by truck. . . . . They all choose the same thing. Everything in Mexico is exported and imported via Jaurez and Laredo – and then from there, from the warehouse, going to California. Imagine from here, you are crossing half of the American territory.

Hypothesis three is rejected, with qualification. Rail can offer lower logistics costs but in the eyes of potential Mexican shippers carries more risk.

Hypothesis Four: Infrastructure gaps in the refrigerated cold chain make railcars unattractive for shipping from Mexico.

The development of frozen food industry in Mexico has occurred in the past 30 years. Until the last ten years, the Mexican railway system was operated as a government-owned monopoly. After decades of bad management and under-investment, the railways'

market share in Mexico was reduced to about 10 percent of the freight. As one respondent pointed out:

> I don't think there was a terminal in Mexico where they could unload the product and reefer it at a warehouse. So, Mexico was ready for the trucking industry, but not for the rail industry . . . it was equipment, the reefer containers and facilities at the destination [that held us back].

Consequently, most of the refrigerated vegetable processing plants are located without any consideration of rail service.

A sophisticated frozen food warehouse operator (Frialsa Frigorificos) has built three facilities with rail access, so frozen food exporters could load railcars at their locations. This means a short refrigerated truck haul and some handling/storage costs, but the infrastructure exists to handle railcar loading in the area of frozen food production.

The other infrastructure issue may be the availability of refrigerated railcars. As noted by a railway representative, some shippers may not want to share leased railcars with others, even if they otherwise return empty:

> If the company moving the product doesn't want any other company to touch the cars, . . . we cannot do anything about that. We [would] have to agree with the shipper and the consignee – with all the people involved – that the product and the quality of the cars will be the same. So, it's difficult to do that.

Some railways also have refrigerated railcars that they could direct to loading in Mexico. Whether shippers with leased cars would cooperate remains to be determined.

Frialsa Frigorificos is opening a refrigerated warehouse at the Colombia crossing near Laredo, Texas to undertake meat inspection for railcars. The facility that is expected to open by December 2009 will enable more refrigerated railcars to proceed to destination in Mexico rather than being transshipped to trucks at the US-Mexico border. Accordingly, more refrigerated railcars in total are expect to be available for source loading in Mexico.

Hypothesis four that infrastructure gaps make railcars unattractive is rejected.

Hypothesis Five: Mexican shippers lack confidence in the railways to deliver loads reliably and in good condition.

The improvement of the Mexican railways since privatization is apparent. The railways have invested millions of dollars in rolling stock, new locomotives, signals and track. Kaufman (2001) observes that the Mexican railways are now operating like the other Class I railways of North America. As a result they now carry 20 percent of the freight in Mexico. The railways have become particularly effective in moving shuttle trains of grain to receivers in Mexico.

The image of the Mexican railways with the frozen food industry is less favourable. A Mexican exporter summed up the general view exporters have of the Mexican railways, by pointing out several trustworthiness concerns: (1) Who will take care of the product during transport? (2) What will happen at the border? Who will be responsible for broken seals, etc.? and (3) Who is going to protect the product, given the large number of people riding the rails illegally?

He summarized by pointing out that in order to get his business, the railways would have to (1) guarantee the product will not be unfrozen, (2) allow him to check its location and temperature via the internet, (3) ensure security of the product, (4) ensure reliable border clearance, and (5) offer rates that more than compensate for the extra required inventory financing. Unless these things could be done, he saw no reason to change to rail.

In response to a question about what they were doing to try to change this culture, a Mexican railway representative said:

> [We try to] just convince them and talk to them and show them how it works. For instance, for the cars (General Motors, Nissan), you have to convince them to put [their] cars inside these big railroad cars and [promise to] put them at the border in 24 hours. And, they say, "Never in the life." The first time we made it in 24 hours, but the cars inside were without radios, etc. . . . They don't want to [leave] the cars with us. So, we

> talk again with them, lower our price, etc. to convince them, but, the railroad brand was burned. . . . We spoke with some of the big bosses of some companies and they said, "We don't even want to know anything about the railways.

The experience of theft and vandalism has not been eliminated. At the recent workshop, the railways noted that some interchange locations, of which Celaya, Mexico was singled out, remain chronic problems for the railways. One solution was to develop new interchange points, like Aguascalientes, where security could be improved.

Hypothesis five cannot be rejected. The views of the frozen food exporter above were repeated in various ways by several others. Until the railways can provide assurance that the loads will be secure and the service is reliable, the frozen food exporters are likely to continue relying on over-the-road movements...

DISCUSSION

The problem of empty rail backhauls from Mexico to Canada is a key challenge for frozen food shippers. The costs of round-trips have to be borne by the fronthaul shippers, which make Canadian exporters less competitive, and the lower revenues make north/south moves less attractive to the railways than their east/west corridors. The question posed by this research is why these refrigerated railcars are not being utilized by Mexican shippers.

Five hypotheses are explored. Three are easily rejected. The quantity of frozen food exports from Mexico is sufficient to provide backhauls. The railways are interested in the business and there does not appear to be any critical infrastructure gaps. The lack of competitiveness of rail versus truck is given a qualified rejection. Railways have an advantage in terms of cost, but carry risk, causing the Mexican shippers to discount the benefits. This leads to the last hypothesis that Mexican shippers lack confidence in the railways. This rationale for the shippers' actions could not be rejected.

It seems clear that the opportunity to utilize the empty railcar backhauls can be exploited, but the railways and other intermediaries need to work on developing the confidence of Mexican shippers. The railways were successful in convincing the automobile manufacturers that they can perform, and there is every reason to believe that the railways can provide a reliable cold chain for frozen vegetables and fruit from Mexico. There is a need to prove that they can perform with some trial shipments and to work with the shippers to overcome their preconceptions of security and risk factors.

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