Transportation - Rates

1981



# Ocean Freight Rate Variability as a Factor in International Agricultural Trade

by

James K. Binkley*

*Assistant Professor, Department of Agricultural Economics, Purdue University.

Presented at AAEA meetings, Clemson University, July 26-29, 1981.

Abstract

Due to inelastic shipping supply, ocean freight rates can fluctuate significantly over short periods. This variability can affect trade analysis. This paper presents evidence on rate variability and discusses possible implications for welfare gains from price stabilization and free trade, for comparative advantage, and for the effects of market power.

James K. Binkley is an assistant professor of Agricultural Economics at Purdue University, where he has been since 1977. He holds a B.A. in economics from Indiana University, an M.A. in Agricultural Economics from Washington State University, and a Ph.D. in Agricultural Economics from Virginia Tech. His major areas of interest are transportation and trade, econometrics, and resource economics.

A topic of considerable interest to agricultural trade analysts is the effects of variability in international grain prices. Since the escalation of grain trade in the seventies and the reduction in world stocks, price fluctuations have increased, primarily resulting from production shortfalls in various parts of the world. With world grain stocks at relatively low levels and trade projected to (if anything) increase, it is likely that world grain prices will continue to be somewhat unstable.

Generally, most research dealing with price variability has shown that it tends to inhibit trade and that it is detrimental from a global welfare standpoint. It creates incentives for individual traders to instigate policies to protect themselves from the ill effects of variables price, policies which tend to "export" these effects to the rest of the market and increase aggregate welfare losses. Thus, there is a tendency toward policy control and away from free trade, which in turn leads to more severe price responses on world markets. This has been amply illustrated by research that has been conducted, which has concentrated on interactions between price variability and policy and the role of supply and demand elasticities in determining the welfare impacts of price changes. Many analysts have concluded that the best way to deal with price variability is through elimination of trade barriers.

An aspect of price variability that has been completely ignored is the role played by international transportation. This is somewhat surprising in view of the intense interest in international price variation, for ocean freight rates are extremely variable. Indeed, the transport sector can be both a source of variability in delivered prices (irrespective of shifts in grain demand or supply) and can affect the way agricultural price changes in one region are translated into effects on others. It can also affect the relative benefits of free trade and trade under various policies.

The purpose of this paper is twofold: 1) to explain why international transport rates are variable and to present evidence that they in fact are, and 2) to link this knowledge to existing information concerning the effects of unstable price and other important trade issues. As such, the paper is primarily expository. The intent is to acquaint trade analysts with a factor the ignoring of which can affect the outcome of trade analysis in some cases.

## Variability in Ocean Grain Rates

Nearly all seaborne grain moves in vessels specializing in bulk cargoes in large lots, generally full shiploads. These transport markets are free of economic regulation and for all practical purposes are perfectly competitive (see Binkley and Harrer). Rates are set by bargaining between shippers and shipowners and reflect supply and demand conditions existing when charters are arranged. Demand for transportation of bulk commodities is relatively volatile, and short-run supply of shipping services is extremely inelastic over certain ranges. This leads to a situation where rates can change dramatically over short periods.

The supply of shipping is of particular interest here. When a given segment of the shipping market (say, that for grains) is at normal capacity, supply expansion can occur in three ways: deliveries of new vessels, more intensive use of existing vessels, and entry of capacity from other shipping markets. Concerning the first, this bears little relation to short-term events, since it takes at least two years to construct a ship. Thus, new deliveries are as likely to be made during periods of excess capacity as when they are needed, and will augment short-run supply only by chance. More intensive use of existing capacity is similarly not likely to make a significant contribution. This is due to the escalation in costs encountered: the major means of increased vessel utilization is increasing speeds, but

fuel consumption rises exponentially with speed. The attraction of vessels from other markets represents the only short-run supply response of any consequence. However, a response cannot be immediate, due to existing contractual arrangements, costs of converting from carriage of one commodity to another, and so on. Further, this source of supply expansion presupposes the existence of slack capacity in other markets (relative to the market in question). For the above reasons, the upper portion of the short-run supply function is very inelastic, suggesting that if the capacity in a given market is at or near full utilization, an abrupt demand increase is likely to only increase rates in the near term, with some supply response over time through attraction of capacity from other sources.

Along the lower portion of the supply function, the converse is the case. When rates are insufficient to cover variable costs, vessels are often "tied up" - idled in ports. This response is delayed, due to tie-up costs and expectations that rates might rise in the near future. But sustained periods of low rates result in extensive tie-ups. Since vessels have differing variable costs, this practice makes for nearly perfectly elastic supply at rates approximating the variable costs of less efficient ships.

Thus, the general shape of the short-run supply function is approximately that of a backwards "L". A demand shift confined to the elastic portion may bring about little if any change in rates; a shift from the elastic to the inelastic portion may cause a dramatic increase in rates, with little supply response. Hence, a major factor in rate volatility is the location of the point where supply changes from elastic to inelastic. Zannetos estimated an aggregate short-run supply function for the tanker market and found that this point occurs at about 95% of capacity, and estimated that beyond that point, a 1.66% increase in demand would increase rates by 83%. Since dry bulk shipping markets are qualitatively similar to those for oil, they have

similar potential volatility.

As an illustration of the short-term variability in ocean freight rates, consider the year 1973. For that year, the average percentage change in the monthly Norwegian Shipping News dry cargo trip charter rate index (the standard used in the industry) was 10.5%, with a range of 2.2 to 31.9%. Further, since this index applies to all bulk commodities on a world-wide basis, it tends to mask the variability that might be encountered for a given commodity, especially for specific route. This is evident from data in Table 1, which shows quarterly percentage charges for the NSN index and for grain rates on two routes, U.S. Gulf to Europe and U.S. East Coast to Europe for a period in the late seventies. The latter are much more variable, and the short-term behavior of rates on the two routes is not parallel. This suggests that, in the very short-run, demand fluctuations on a particular route may bring little if any supply response and only serve to change rates.

Monthly changes in ocean rates tend to be of a cumulative nature and generate wide swings over longer periods. Illustrative of this is the data in Table 2, which presents average annual rates for grain shipments for selected routes for 1972-75. For most of these routes, the highest rate for the period was at least three times the lowest rate. In light of the discussion above, it is of interest to view this data in the context of other information on world shipping. For example, between 1972 and 1973, world seaborne grain trade increased by 29%; the average increase for the rates in Table 2 was 143%. This suggests very inelastic grain shipping supply. However, during the same period, other bulk trading also increased, putting exogenous pressure on grain shipping rates. On the other hand, there was also an increase in the dry bulk fleet due to new deliveries and a marked reduction in idle vessels. Generally, 1974 grain rates were higher than those for 1973, even though grain trading declined. This was primarily due

Table 1. Quarterly Percentage Changes in Norwegian Shipping News Dry Cargo Freight Index and in Average Grain Rates from U.S. Gulf and U.S. East Coast to Europe

| Year | Quarter | Percent Change | | |
|---|---|---|---|---|
| | | NSN | U.S. Gulf-Europe | U.S. East Coast-Europe |
| 1977 | 1 | -3.3 | -5.4 | -9.5 |
| 1977 | 2 | 0.1 | -0.8 | -14.7 |
| 1977 | 3 | 3.1 | 28.8 | 28.4 |
| 1977 | 4 | -0.8 | -6.9 | 0.7 |
| 1978 | 1 | 5.0 | 24.8 | 6.0 |
| 1978 | 2 | -1.0 | -1.4 | 50.9 |
| 1978 | 3 | 5.7 | 31.1 | -8.1 |
| 1978 | 4 | 2.0 | 7.0 | 19.9 |
| 1979 | 1 | 11.9 | 50.7 | 35.3 |
| 1979 | 2 | 16.8 | 14.0 | -11.4 |

Source: Calculated from Norwegian Shipping News and FATUS.

Table 2. Average Ocean Rates for Grain, Various Routes, 1972-75 (Rates in Dollars Per Long Ton)

| Route | 1972 | 1973 | 1974 | 1975 |
|---|---|---|---|---|
| U.S. Gulf-Europe | 4.31 | 12.45 | 11.17 | 6.08 |
| Great Lakes-Europe | 8.98 | 21.18 | 23.12 | 14.67 |
| U.S. East Coast-Europe | 4.34 | 12.94 | 14.19 | 5.78 |
| U.S. North Pacific-Japan | 7.74 | 16.12 | 27.23 | 11.92 |
| U.S. Gulf-Japan | 5.94 | 15.34 | 23.95 | 11.41 |
| Brazil-Europe | 7.67 | 19.73 | 26.22 | 10.68 |
| Australia-Japan | 9.82 | 15.21 | 22.28 | 11.73 |

Source: Calculated from Maritime Research, Inc.

to an increase in trade of other commodities. Similarly, a reduction in the latter in 1975 permitted grain rates to fall (by about 50%) even though the volume of seaborne trade rose slightly.

In short, primarily due to transport supply inelasticities, international shipping rates for grains are subject to strong fluctuations, overall and on a given trading route. These arise due to events both endogenous and exogenous to world grain markets, and have potential implications for trade research and trade policy in certain situations. Some of these are now examined.

## Effects of Rate Variability

### Price Stabilization and Welfare

In conventional trade analysis, when transport costs are considered at all, they are viewed as causing vertical shifts in either the excess demand or supply function. If this is the case, transport costs affect the levels of export and/or import prices but have no effect on price variability. Thus, if interest lies in the effects of variable prices, transport can safely be ignored. However, transport costs bring about vertical shifts only if transport supply is perfectly elastic, which is true only of the lower portion of the curve. Given the inelasticity characteristic of shipping supply along its upper portion, transport markets can play a significiant role in determining how traders are affected by price fluctuations.

In Figure 1 are presented an excess demand and an excess supply curve. A transport supply function of the type described above has been superimposed on the latter. Price variation is introduced through shifts in the excess demand function, which is assumed to move between $ED_0$ and $ED_1$. Without transportation, price varies between $P_0$ and $P_0'$. With transport, the price to the importer varies between $P_I$ and $P_I'$, which is always greater than the no transport case; for the exporter, the variation is between $P_E$ and $P_E'$, which is always less.

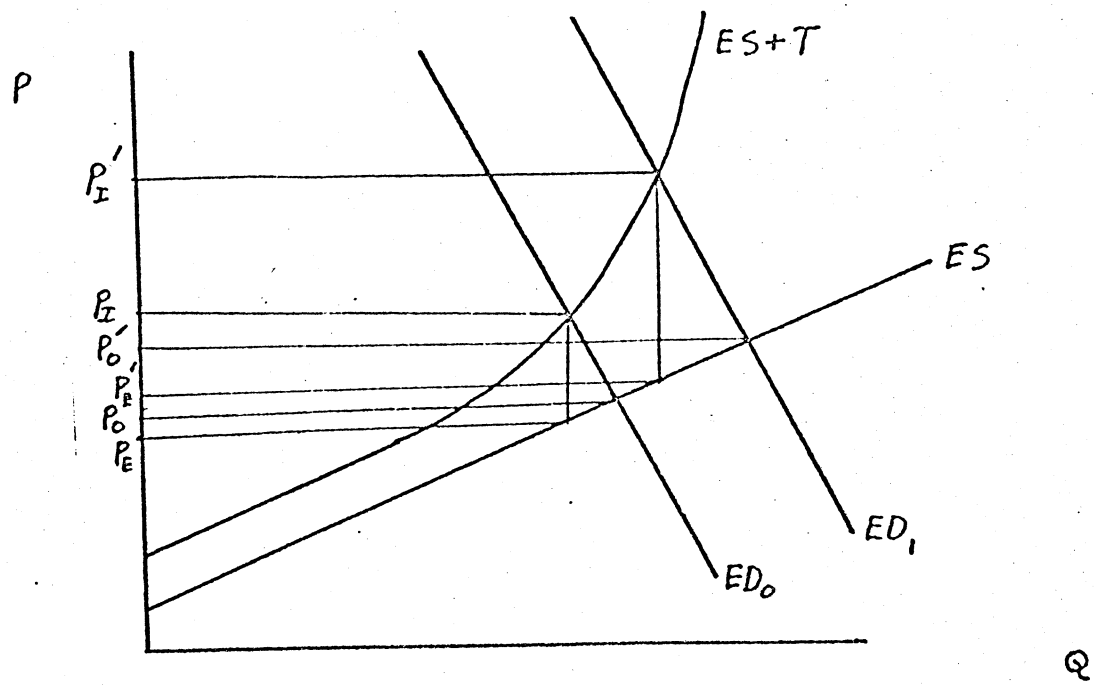


FIGURE 1: Effects of Transport on Rate Variability.

For the case depicted, where instability arises due to excess demand, Hueth and Schmitz have shown that, ignoring transport, producers, and consumers in the exporting country gain (in a welfare sense) from price instability, as do consumers in the importing country, while producers in the importing country lose. The world as a whole loses from instability. Since gains or losses vary directly with instability, inelastic shipping supply will increase social losses. This follows since exporter price variation is reduced (and hence so are welfare gains in the exporting country) and importer price variation is increased (thus increasing net welfare losses). Therefore, the nature of transport markets gives importers a greater stake in stabilization and exporters a smaller stake in destabilization. From a global perspective, the gains from stabilization are increased.

Following the arguments of Hueth and Schmitz, an analogous result applies when instability arises due to shifts in the excess supply function. Then the gainer from instability (the importer) gains less because import price variability is reduced, while the loser (the exporter) loses more because his price variability is increased.

In each of these cases, then, the nature of transport markets increases incentives for price stability. The practical relevance of this depends upon whether varying transport costs are translated into "sufficiently large" effects on delivered grain prices. Using the U.S. Gulf to Europe as an example, we might suppose the 1975 rate of $6.12/long ton as a reasonable estimate of the long-run equilibrium rate for then prevailing levels of cost. Given this supposition, the 1972 rate was about 5 cents per bushel lower than the norm while that in 1973-74 was about 15 cents above it. For Brazil, the corresponding procedure yields prices 11 cents below and 30 cents above the norm. These ranges do not appear to be so small as to justify their being completely ignored.

As noted above, it has been contended that the best way to alleviate problems associated with price variability, at least from a global standpoint, is to remove all policies discouraging free trade. Such arguments have considerable merit, but they ignore negative transport effects. Tariffs, trade agreements, levies, and other trade restrictions tend to stabilize quantities traded and hence world prices must absorb a disproportionate share of the shocks incurred on grain markets. Under free trade, quantity becomes more variable, since it plays a larger role in restoring equilibrium after a disturbance occurs. But with more variation in quantity traded comes more variation in transport costs and, consequently, in price (as compared to the case of constant transport costs). Thus, although free trade might tend to reduce variability in delivered prices, the reduction will be smaller than would be true if transport were not a factor.

There is another aspect to this issue. There are economies of scale in ocean shipping, and these have brought about significant increases in average vessel size. However, this has been less true of grain than other bulk trades. Use of large ships is economic only if trade flows are stable.

Due to volatility in the grain trade, their use has been restricted to a few major trading routes (Bulk Systems International). More stability in quantities of grain shipped would permit increased use of large vessels, which would tend to lower average rates as well as their variability. Thus, from the standpoint of transport, free trade may not be an unmitigated blessing.

Comparative Advantage and Transport Price Variability

That transport costs affect comparative advantage is undisputed. The data in Table 2 indicate that there currently exists rather large differences in average transport rates to, say, a given importer from alternative producers. An important question is the role these differences have played in determining existing trading patterns and the extent to which changes in the current existing matrix of rates would change these patterns. It seems likely that rate variability would reduce the effect of rate differences per se, for traders then become concerned not only with the effect of transport on the price paid or received but the variance of this effect.

Jabara and Thompson have recently argued that, under conditions of international price uncertainty, a risk averse importer will produce more of a good which it also imports that would be true without the uncertainty. As they state, this "may indeed be consistent with a broad concept of comparative advantage which recognizes that risk has a subjective cost" (p. 197). A logical extension of this argument is that, ceteris paribus, such an importer, when it does enter international markets, will choose that supplier whose exports are subject to the least price variations. Thus, ignoring any differences in f.o.b. price variation, an importer would prefer an exporter with relatively stable transport rates, a fact which might reduce the effect of different rate levels. On the other hand, rate variability can accentuate differences in average rates. Even if highly variable, rates are

unlikely to fall very much below costs, but they can deviate substantially above them. This gives fluctuations an upward bias.

Again referring to Table 2, it is apparent that rates on some routes are subject to larger fluctuations than are rates on others. Perhaps of more importance, when rates rise, they appear to rise by about the same percentage on all routes, causing larger fluctuations for high cost shippers and worsening their position during periods of active trade. For example, assuming equal f.o.b. prices, Brazil's position relative to the U.S. in terms of price c.i.f. Europe was worse in 1973 than in 1972. From the standpoint of comparative advantage, rate variability may be a more important factor than any differences in average rates that might exist in the absence of variability, both due to the "subjective cost" of variability itself and the tendency for fluctuations to at least temporarily magnify differences in rate levels. This might be an important consideration for spatial equilibrium models, which often appear to be overly-sensitive to small differences in average transport costs.

It can be argued that since large rate changes are usually associated with periods of intense trade activity, a sellers' market exists, and importers are not in a position to be very sensitive to either the level or variability of transport costs. This may have some validity. However, it can also be argued that importers seeking long term contracts with exporters (in order to insure stable supplies at reasonably stable prices) may be sensitive to such differences. Even though a contract may shield the buyer from f.o.b. price variation, it will generally not provide protection from changes in transport rates, unless providers of transportation are parties to such agreements.

Market Power in International Grain

Carter and Schmitz have advanced the hypothesis that major importers such as Europe and Japan yield monopsony power in world grain markets. To the

extent that this hypothesis has validity (and they provide some empirical support), the elasticity of the marginal cost of importing curve assumes greater importance. The significance of transport costs is magnified, for inelastic transport supply causes a disproportionate impact of rates on marginal cost of imports as trade expands. With full or near-full utilization of shipping capacity, an increase in trade raises rates on all shipments, not just on the marginal unit, and a buyer with monopsony power will be more hesitant to expand purchases than he would be if transport were not a factor. This is true a fortiori for expansion of purchases from a single supplier, since this is likely to increase demand for shipping on a particular trading route, and consequently also increase freight rates on that route.

Potential market power effects can be illustrated via some rough calculations. Suppose Japan, which accounts for about 15% of world seaborne grain and soybean imports, increased it purchases by 5%, leading to a .75% increase in world trade. If ocean freight rates were to respond as they did in 1972-73, when a 29% increase in trade induced a 143% increase in rates (as noted above), rates would rise by about 3.7%. Assuming Japan currently imports 25 million tons of grain and soybeans, and supposing an average freight rate for Japanese imports of $15 per ton, the import expansion would increase Japan's freight bill on existing imports by nearly $14 million. In effect, this would increase the price of the 1.25 million tons of new imports (5% of 25 million) by over $11 a ton (as compared to no freight rate increases), perhaps a sufficient rise to dampen the demand increase. While only an approximation, this example suggests that market power can endow transportation with more significance than it would otherwise have.

## Conclusions

This paper has provided evidence that international transport rates for grain are characterized by a large degree of variability, often evidenced by significant upward fluctuations. Yet nearly all theoretical and empirical trade analysis either ignores transport or views transport costs as a constant. While this may be of no consequence in many contexts, the misapprehension of the nature of transport markets may affect the outcome of some analyses and can lead to inappropriate policy prescriptions. For example, as indicated above, the benefits of free trade may be diminished by unstable transport markets. In any case, when conducting trade studies, researchers might be well-advised to consider whether the nature of these markets has any significant impacts with respect to a given problem.

## References

Binkley, James K. and Bruce Harrer, "Major Determinants of Ocean Freight Rates for Grains: "An Econometric Analysis." Am. Jou. Agr. Econ., February, 1981.

Carter, Colin and Andrew Schmitz, "Import Tariffs and Price Formation in the World Wheat Market." Am. Jou. Agr. Econ., August, 1979.

"Grain and Derivatives-Trade with Uncertain Constraints." Bulk Systems International, April, 1980.

Hueth, Darrell and Andrew Schmitz, "International Trade in Intermediate and Final Goods: Some Welfare Implications of Destabilized Prices." Q. Jou. of Econ., August, 1972.

Jabara, Cathy and Robert L. Thompson, "Comparative Advantage and Price Uncertainty." Am. Jou. Agr. Econ., May, 1980.

Maritime Research, Inc., Weekly Newsletter, various issues.

Norwegian Shipping News, various issues.

USDA, ESS, Foreign Agricultural Trade of the U.S., various issues.

Zannetos, Zenon S., The Theory of Tankship Rates. Cambridge: M.I.T. Press, 1966.