

## OIL PRICES, TRANSPORT COSTS AND GLOBALISATION

*Detailed data enables us to examine how the costs of transporting goods imported into the United States have changed over the last thirty years or so. Clear trends emerge, yet the link with the price of oil – a significant component of these costs – is not always obvious. It is only by conducting an econometric analysis that the real impact of the price of oil on the choice of mode of transport, imported product prices and the division of the market between supplier countries can be determined. The results obtained appear to indicate that, due to their impact on transport costs, rising oil prices actually undermine global integration by favouring countries located close to the world's major markets over those that are further away.*

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The pressures on supply capacities and speculation that led to soaring oil prices right up until the beginning of the summer of 2008 have disappeared with the deepening financial crisis and the sudden and brutal slowdown in global economic activity. The average price of crude oil, which stood at 133 dollars per barrel in July 2008, fell to 52 dollars in November. It is likely that oil prices will remain relatively low in the coming months, in spite of the fact that OPEC members are reducing production in an attempt to push prices up again. As a result, the focus is now shifting away from concerns about the impact of oil prices on world growth and the pursuit of globalisation towards the financial sphere and the risks of burgeoning protectionism. That is not to say that previous concerns have disappeared because quite the reverse is true. If we take oil, production capacity is inadequate, as are exploitable reserves. In the medium term, this situation is made even more worrying by the fact that current market prices are discouraging some of the investment required. Sooner or later, therefore, prices are likely to soar once again. We are going to focus here on the impact of the price of oil on transport costs and the effect of these costs on globalisation. In particular, we are asking whether increasing transport costs are likely to lead to a decline in global integration in favour of the regionalisation of trade.

### ■ Three substitution effects

Rising oil prices bring into play three types of substitution effects in transport and international trade. The first of these concerns substitution between modes of transport. Air transport for manufactured goods – be they intermediate or end-products – has played a significant role in globalisation due to speed of delivery. But as a mode of transport, it is highly oil-intensive. According to the International Air Transport Association, between 2000 and 2007 the proportion of annual operating costs of air transport represented by energy-related expenses rose from 14% to nearly 30%. It is estimated that, per tonne of transported goods and kilometre travelled, air transport consumes 30 to 50 times more energy than sea transport and almost 10 times more than road transport. Under such conditions, a rise in oil prices has a far more significant impact on air transport and is bound to lead to a substitution effect in favour of other modes of transport. The result would ultimately be a slowdown in the global mobility of goods.

The second substitution effect concerns products. The price of transporting goods to a given destination depends largely on their weight, although the transport quality requirements (insurance, handling *etc.*) for an expensive product are slightly higher than they are for a cheaper one.

Transport costs are thus higher, as a proportion of the cost of the delivered product, for a cheap product. Since any increase in the price of oil passed onto the cost of transport alters the relative prices of the goods transported in favour of those of superior quality, this penalises trade in cheap products more than trade in expensive products.

The third effect concerns a geographic shift in trade: rising oil prices and The third effect concerns a geographic shift in trade: rising oil prices and transport costs alter the relative prices of imported goods as a function of how far they have travelled and benefit those suppliers who happen to be closest to the target market.

Evidently, the price of oil is just one of the factors affecting transport costs and, consequently, the choice of mode of transport, supplier country and the quality of products transported<sup>1</sup>. As a result, the change in modes and costs of transport for goods imported into the United States over the last thirty years, presented below, does not necessarily show a clear link with oil price movements. The econometric analysis of the detailed data that then follows enables us to isolate the impact of oil prices and determine the extent to which this has altered trade dynamics<sup>2</sup>.

## Costs and modes of transport

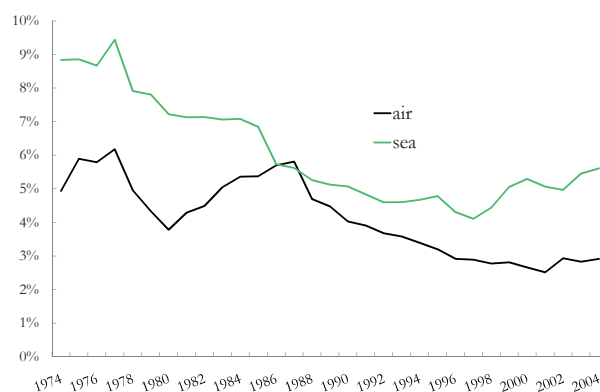
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The observations presented here are based on data supplied by the US Census Bureau<sup>3</sup>. This database contains the value, weight and cost of transporting goods imported by air or sea into the United States, from each of its partner countries. It identifies 1,800 products and covers the period 1974 to 2004. We have excluded trade in oil products from the analysis.

## Costs and values

Over the period 2000-2004, average freight rates to the United States (ratio between the cost of transport and the value of the good transported) were 2.8% for air transport (half of what it was in the period 1974-1978) and 5.3% for sea transport (40% less than in the period 1974-1978) - see graph 1. The air freight rate was less than that of sea freight: the cost per tonne of air transport was 33 times higher (average over the whole period), but the value per tonne of goods transported by air was 50 times higher.

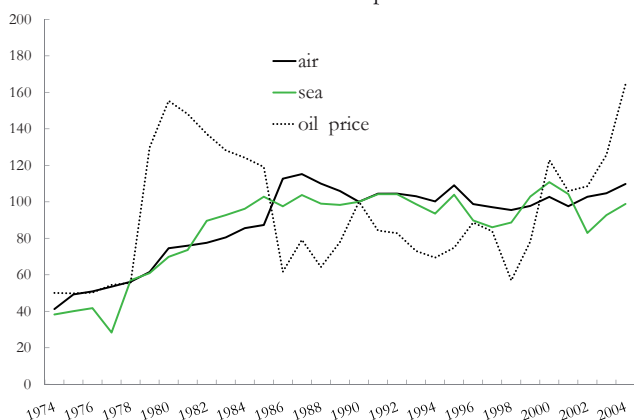
Graph 1 – Freight rates for goods (excluding oil) imported into the United States - 1974-2004



Source: US Census Bureau - D. Hummels, authors' calculations.

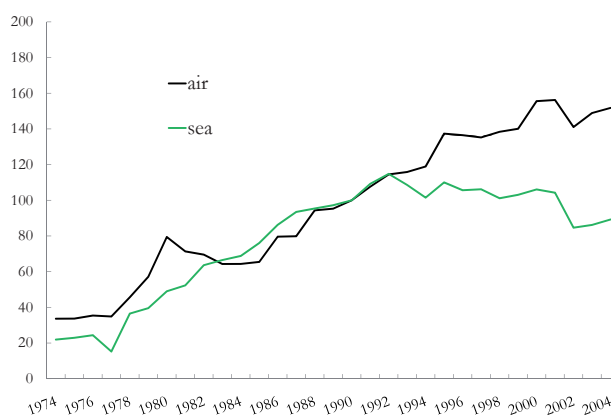
Transport costs per tonne increased up until the period 1985-86 (graph2a), and then remained relatively stable. At the beginning of the period, their increase was concurrent with that of the price of oil; however, the rising oil prices seen during the 2000s have not shown up in transport costs per tonne.

Graph 2a – Transport costs per tonne for goods imported into the United States and oil price - 1990 = 100



Source: US Census Bureau - D. Hummels, authors' calculations.

Graph 2b – Per tonne value of imported goods 1990 = 100



1. C. Gouel, N. Kousnetzoff & H. Salman (2008), "Commerce international et transports : tendances du passé et prospective 2020", *CEPII WorkingPaper*, No. 2008-28, December.  
 2. For more details, see D.Mirza & H.Zitouna (2009), "Oil prices, geography and endogenous regionalism", *CEPII WorkingPaper*, pending publication.  
 3. This database has been put online by David Hummels. See <http://www.mgmt.purdue.edu/faculty/hummelsd>.

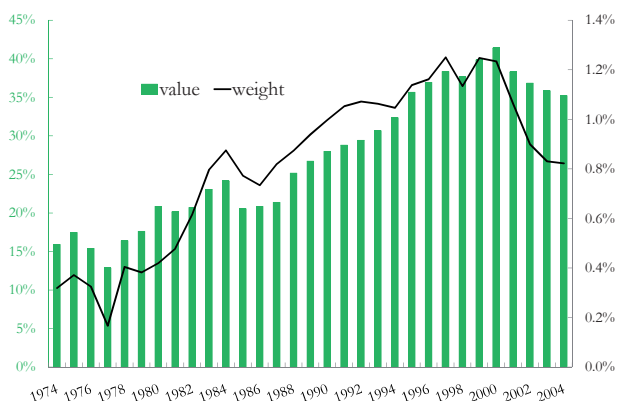
The *value per tonne* of goods transported increased, over the whole period, more than the transport costs per tonne (graph 2b): it is this difference that explains the fall in freight rates.

### Air or sea

As regards the division between sea transport and air transport, it should be remembered that the highest tonnage is transported by sea: all primary goods, heavy goods and low-value goods that can tolerate relatively long shipping times. As we have already pointed out, air transport is used for goods with a per tonne value that is far higher than those transported by sea: 62 times higher for the period 2000-2004. Hence, for this period, air transport accounts for barely 1% of the total tonnage imported into the United States by air or sea (excluding oil), but for 38% of the value of these imports.

Looking at the change over the thirty-year period (graph 3), it can be seen that the trend is for the share of air transport, in terms of both volumes and values transported, to increase. However, a significant reversal is observed from 2001, when oil prices were rising sharply and, of course, there was a fall in air traffic following the terrorist attacks of 11 September. At the time of this event, the decline in air transport in terms of the value of goods transported was less marked: the value per tonne of goods transported by air increased in comparison with that of goods transported by sea (see graph 2b).

Graph 3 – Proportion of US imports transported by air in terms of weight and value



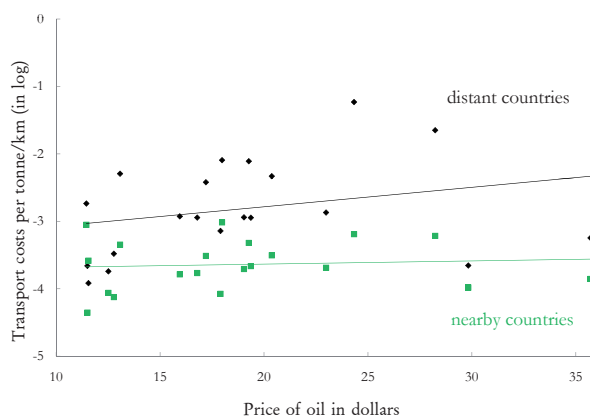
Source: US Census Bureau - D. Hummels, authors' calculations.

### Distance, fixed costs and variable costs

Transport costs can be broken down into fixed costs (warehousing, loading, etc.) and variable costs, which are a function of distance and transport time (fuel, personnel, etc.). All things being equal, the closer the trading country, the higher the proportion of fixed costs – unaffected by the price of oil – in overall transport costs will be. Hence, higher oil prices penalise countries that are further away disproportionately

to the distance covered. This is demonstrated in graph 4: the higher the price of oil, the greater, on average, the difference between per kilometre transport costs of distant countries and those closer by.

Graph 4 – Differences between transport costs of distant countries and nearby countries as a function of oil price



Notes: Nearby countries: less than 5,000 km from the United States; distant countries: more than 5,000 km away - Transport costs: averages of all trading partners, nearby (green square), distant (black circle).  
Source: US Census Bureau - R. Feenstra, authors' calculations.

### Measuring the three effects

In order to isolate the impact of the oil price on substitution between modes of transport, supplier countries and different qualities of imported products, we have to conduct an econometric analysis.

### Decline in air transport

First of all, we estimate the impact of an increase in the price of a barrel of oil on the costs of air freight relative to those of sea freight, for the same product, the same distance covered, and a similar unit value and weight. We then estimate the impact of this cost difference on the overall proportion in terms of the weight of goods transported by air.

The results we obtain indicate that the 7.5-fold increase in the price of oil that occurred between 1998 and 2008 led to an average increase of 6.1% in the relative cost of air transport compared to sea transport. In addition, econometric analysis gives us a figure of 2 for the elasticity of the share of air transport with respect to its relative cost. We thus find that for the period 1998 to 2008, the proportion of goods transported by air fell by 12.3% in favour of sea transport due to the greater increase in the former's cost. Hence, for the period 1998-2004, when we observe a decline in the share of air transport of nearly 27%, an almost three-fold increase in the price of oil led to a fall in the share of air transport of 5.4%; in other words, it accounted for more than one fifth of the decline observed.

## Increase in quality

As we mentioned earlier, any increase in the price of oil passed onto the cost of transport leads to a relatively higher increase in the price of low-quality imported goods than that of goods of superior quality. Confirming the theorem put forward by Alchian and Allen (which states that when the prices of two substitute products are increased by the same amount, demand will shift to the higher quality product), D. Hummels and A. Skiba<sup>4</sup> have provided empirical evidence to show that rising transport costs promote foreign demand for goods of superior quality. As a result, they trigger a change in the composition of international trade: on average, a 1% increase in per tonne transport costs leads to an increase in the per tonne value of exported goods of almost 1%. On the basis of their results and our own estimations of the impact of the price of a barrel of crude oil on transport costs, we can deduce that a 1% increase in the price of oil leads to 0.015% increase in the per tonne value of exported goods. Hence, the 7.5-fold increase in the price of oil has increased the average per tonne value of goods exported to the United States by almost 3.1% in the last ten years<sup>5</sup>.

## Nearby countries at an advantage

In order to examine the impact of transport costs on the geographic origin of US imports, we supplement our database with that supplied by the NBER<sup>6</sup>. This additional data only goes up to 2001, but it does allow us to take into account land imports from other countries on the American continent. We begin by estimating the impact of the price of oil on unit transport costs as a function of the distance from the US of the exporting country. We find that a 1% increase in oil prices leads to a 0.01% rise in transport costs for the countries furthest away from the US market (more than 10,000 km) relative to the average for

all exporters, and reduces the transport costs of the nearest countries (less than 3,000 km) by the same amount. We can then go on to estimate the resulting effect on the market shares of the two groups of countries. Following a 1% increase in the price of a barrel of oil, countries that are furthest away lose market share amounting to around 0.02% compared to the average, whereas the nearest countries gain 0.02%. Hence, all things being equal, a 7.5-fold increase in the price of oil over the last ten years will have increased the market shares of each of the countries close to the United States by 4.1%.

To sum up, due to its impact on transport costs, the 7.5-fold increase in the price of a barrel of crude oil seen between 1998 and 2008 has led to a 12.3% reduction in the proportion of goods transported by air and a 3.1% increase in the per tonne value of imported goods. It has also led to a 4.1% increase in the market shares of the countries that are closest to the United States. This slow-down in the mobility of goods, the regionalisation of trade and the higher proportion of more highly priced goods in imports suggest that, due to their impact on transport costs, rising oil prices undermine global integration; they serve to benefit countries located closest to the biggest markets (often rich countries) relative to the furthest away countries (often countries where salaries are low). However, these effects remain weak and only have a minor role to play compared with the forces that drive globalisation.

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4. D. Hummels & A. Skiba (2004), "Shipping the Good Apples Out? An Empirical Confirmation of the Alchian-Allen Conjecture", *Journal of Political Economy*, vol. 112, No 6, December.

5. The coefficient obtained by regressing the logarithm of a dependent variable on the logarithm of the oil price is only interpreted as an elasticity for a small variation of the latter. Conversely, for large variations in the price of oil, an adjustment coefficient must be calculated in order to more accurately predict the variable being studied. Cf. D. Mirza & H. Zitouna (2009), *op. cit.*

6. Assembled by R. Feenstra from US Census Bureau data that can be downloaded from <http://www.nber.org/data/>.

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