# Chapter 3

# QUANTIFYING THE IMPACTS OF STRUCTURAL REFORMS ON INTERNATIONAL TRANSPORT MARGINS

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- Transport costs using sea and air freight are assessed using data on the difference between cif and fob prices of imported goods in a number of economies where those data are available.
- The differences or 'margins' are explained by a variety of factors, including distance and the characteristics of the goods.
- Having removed the influence of those factors, the maritime and air transport policy environments are significant explanators of variations in margins – more open environments lead to lower margins.

## 3.1 INTRODUCTION

Transport costs are often viewed as technologically determined but in practice they vary considerably across different bilateral trade flows. Some of the variation is due to distance and other geographical constraints and some reflects commodity composition of trade. However, port infrastructure and corrupt customs officials are policy-related trade barriers, while other determinants of transport costs may be indirectly policy related. For example, a lack of competition among shippers may be due to low volumes or to the non-implementation of an anti-monopoly policy. Variations related to institutional settings such as poor law enforcement increase trade risks and hence affect insurance rates and inventory costs.

Understanding better what determines trade costs stems from their impact on international trade flows. Higher trade costs significantly impede trade for some, and since the major component of trade costs is undoubtedly the transport component, a better understanding of its determinants ensures policy makers are equipped with the best instruments with which to reduce them.

This paper attempts to identify the major determinants of air and maritime transport costs for exports from APEC members towards four major trading partners – Australia; Brazil; Chile; and the United States of America (USA) – using commodity level data at the 6-digit level of aggregation of the Harmonised System (HS).[2]

The paper is organised as follows: Section 3.1 presents the background, Section 3.2 describes the data and presents some summary findings and trends, Section 3.3 discusses the determinants of transport cost, Section 3.4 presents the econometric analysis and results and Section 3.5 presents some conclusions.

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## 3.2 DATA DESCRIPTION

The dataset used in all the analyses consists of import data collected by the customs agencies of four importing economies – Australia; Brazil; Chile; and the USA – at the 6-digit level of aggregation of the HS. The data contain detailed records of import value, weight, cost, insurance and freight (cif) values and free on board (fob) values and commodity codes for the years 1990–2008. In this section of the paper the trends in *ad valorem* transport costs over time are analysed as well as trends across exporting APEC members for 1990–2008. *Ad valorem* transport costs are calculated from the data as the difference between the cif and fob values divided by the fob value ((*cif-fob*)/*fob*) for each importer/exporter, year and 6-digit product combination.

Trends in transport costs over time are calculated and analysed in the following ways: aggregate, *ad valorem* and import-weighted transport costs calculated for each exporting APEC member for each year by mode of transport. In addition, and following Hummels (2007) and Moreira, Volpe and Blyde (2008), *ad valorem* transport costs are calculated and adjusted for commodity composition and changes in the value to weight ratio over time. This is achieved by regressing 6-digit *ad valorem* transport costs on the value to weight ratio and year dummies and economy-pair-product fixed effects. The exponentiated, predicted *ad valorem* transport costs by year are the adjusted values which control for changing commodity composition and trade partners over time.

Tables A1 to A3 (Annex 3) report the import-weighted *ad valorem* transport costs overall and by mode of transport for each APEC member to all four pooled importers. (The importers are pooled to alleviate the problem of a small number of transactions for some of the smaller APEC economies.) Table A1 highlights the fact that, in 2008, Mexico; Singapore; Malaysia; Canada; and Japan had the lowest value of *ad valorem* transport costs. Low values are also evident for Brunei and Papua New Guinea. However, the small number of trade flows from these two economies renders the values less statistically reliable. Overall, several APEC members had a reduction in transport costs of over 50% over the period under consideration. These include Chile; Mexico; New Zealand; Peru; the Russian Federation (where data is only available since 1992); Papua New Guinea; and Brunei. For ocean transport, the economies with a greater than 50% reduction in transport costs are Mexico; Chile; and Brunei, while for air transport they are Canada; China; Indonesia; Korea; and Chinese Taipei.

Analysing trends by importing economy, Figures A1–A4 (Annex 3) graph average, import-weighted *ad valorem* transport costs for each of the importing economies in the dataset. For the USA (Figure A1), the trend is downward for air transport costs, but otherwise there is not a great decline for sea transport or for APEC members in general. Australian imports, on the other hand, show a clear downward trend for all four series (Figure A2). Chilean and Brazilian imports (Figures A3 and A4) are more volatile but the trend is downward overall. Pooling the four importers in Figure A5 (Annex 3), shows a clear downward trend for air freight charges and significantly less so for sea freight, APEC freight costs and overall freight charges.

Once we adjust for commodity composition, the changing value to weight ratios and changes in trading partners over time, the average overall transport costs are higher and exhibit smaller percentage declines over time (Table A4, Annex 3). The individual APEC economies' adjusted transport costs are graphed in Figures A6a–A6c (Annex 3).

## 3.3 DETERMINANTS OF TRANSPORT COSTS

There is an extensive literature which has examined the determinants of transport costs. Several factors have been found to have robustly and significantly influenced transport costs.

Higher volumes of bilateral trade on routes allow shippers to take advantage of scale economies and thus lower freight charges. This is most likely to influence ocean shipped goods more than air shipped goods. Related to volume are trade imbalances, where high volumes of trade in one direction are not matched by the volumes of trade on the return leg. If vessels are forced to return empty, this will be reflected in the price charged for shipping. On some routes there are significant differences in the prices of hauling containers on eastbound and westbound directions of a unique route. When the trade imbalance is very high, such as the USA–Asia and Asia–USA routes, the price of transporting a container one way can be close to double the price of hauling it back (Containerisation International 2010).

An obvious determinant of transport costs is geography, especially distance. Transport costs are increasing in distance but there are clearly non-linearities in this relation due to high fixed costs. Distance is strongly positively correlated with time, and increasingly, time costs influence the ability for exporters to fit into global supply chains which crucially depends on timely delivery.

The presence of market power and lack of competition on routes will adversely affect freight charges. Similarly, restrictive regulatory policies related to transport services would significantly raise prices above marginal cost if they act to impede the competitive environment in which the transport sector operates. A measure of competition is the number of carriers servicing a particular economy as well as measures of restrictive regulatory environments. The number of carriers is obtained from UNCTAD's Liner Shipping Connectivity Index (LSCI) which lists the number of liner companies operating on a route. For the general regulatory environment in the air and ocean transport sectors, two constructed indices are used – one for air and one for sea. Table 3.1 shows the values for APEC for the year 2008. China; the USA; and Hong Kong, China are the economies which have the highest number of liner companies operating on the route, which is to be expected given the large volumes of containerised trade for these economies. Table 3.1 also reports the values of the restrictiveness indexes for air and sea transport. For the sea index, higher values are associated with fewer restrictions while for the air index, higher values are indicative of a greater degree of restrictiveness. These policy indices were prepared as part of this project, by Bertho (Chapters 13 and 14) for sea transport and Zhang and Findlay (Chapter 4) for air transport. Annex 3 provides more detail on all the data and Chapter 4 includes a more detailed discussion of the air policy index.

Higher quality infrastructure, higher quality of logistics services and improvements in and implementation of trade facilitation measures also play significant roles in lowering transport costs. Port and airport infrastructure affect transport costs in several ways. For example, technological advances mean that cargo can be loaded and unloaded more rapidly and thus create gains in efficiency. Infrastructure levels are highly correlated with economic development and GDP *per capita*. The World Economic Forum's *Global Competitiveness Report* surveys enterprises regarding port and airport infrastructure and efficiency in 135 economies (Porter & Schwab 2008). Among APEC members, Singapore and Hong Kong, China are ranked 1st and 2nd respectively with respect to port and airport infrastructure quality. Of the APEC members, only Australia; Canada; Hong Kong, China; and Singapore rank in the top 20 for airport infrastructure, while Canada; Hong Kong, China; Malaysia; Singapore; and Chinese Taipei rank in the top 20 for port infrastructure (Table 3.2). The GCR survey assigns economies a score on a scale of 1 to 7, with a score of 1 for underdeveloped infrastructure and 7 for infrastructure that is as developed as the world's best, and then ranks them according to the results.

**Table 3.1: Measures of restrictiveness and competition for APEC members, 2008.**

| APEC member | Liner companies | Air index | Sea index |
|---|---|---|---|
| China | 88 | 4.17 | 0.599 |
| USA | 84 | 0.75 | 0.45 |
| Singapore | 80 | 1.17 | n.a. |
| Hong Kong, China | 70 | 3.5 | n.a. |
| Korea | 69 | 3 | 0.611 |
| Malaysia | 68 | 1.67 | 0.614 |
| Japan | 65 | 2.75 | 0.611 |
| Chinese Taipei | 49 | 3.17 | n.a. |
| Thailand | 46 | 1.67 | 0.399 |
| Viet Nam | 41 | 4 | 0.25 |
| Indonesia | 38 | 3 | 0.649 |
| Australia | 37 | 1 | 0.75 |
| Russian Federation | 36 | 3.42 | 0.75 |
| Canada | 35 | 2.75 | 0.611 |
| Mexico | 30 | 2.5 | 0.667 |
| New Zealand | 27 | 2.17 | 0.813 |
| Philippines | 26 | 3.5 | 0.39 |
| Peru | 23 | 2 | 0.556 |
| Chile | 21 | 3 | 0.857 |
| Brunei | 6 | 4 | n.a. |
| Papua New Guinea | 6 | n.a. | n.a. |

Source: Number of liner companies: UNCTAD, Liner Shipping Connectivity Index – Index values based on Bertho (2010) and Zhang & Findlay (2010)
Notes: For air index, a higher number signifies a less restrictive environment.
For sea index, a higher value indicates more restrictive.

**Table 3.2: *Global Competitiveness Report* infrastructure rankings.**

| APEC member | Airport Rank | Port Rank |
|---|---|---|
| Australia | 20 | 42 |
| Brunei | 39 | 36 |
| Canada | 18 | 15 |
| Chile | 25 | 37 |
| China | 75 | 55 |
| Hong Kong, China | 2 | 2 |
| Indonesia | 76 | 105 |
| Japan | 50 | 26 |
| Korea | 27 | 30 |
| Mexico | 57 | 95 |
| Malaysia | 21 | 16 |
| New Zealand | 24 | 24 |
| Peru | 95 | 128 |
| Philippines | 90 | 101 |
| Papua New Guinea | n/a | n/a |
| Russian Federation | 89 | 77 |
| Singapore | 1 | 1 |
| Thailand | 29 | 49 |
| Chinese Taipei | 33 | 19 |
| Viet Nam | 93 | 113 |
| USA | 13 | 12 |

Source: Porter & Schwab 2008

General institutional quality and corruption is another potentially important determinant of transport costs. Where there is a known problem of bribe taking by customs officials at port or at airport level or where there may be uncertainty or risk to the merchandise being transported, transport firms will pass some of these costs on to exporters, so transport costs will be higher from those destinations. Sequiera and Djankov (2008) provide detailed evidence from two African ports. An indicator of corruption is the Corruption Perceptions Index (*cpi*) (Transparency International 2008). This is a general perceptions index of the level of public and political sector corruption and bribe taking which may impact on transport costs. The *cpi* relates perceptions of the degree of corruption and ranges between 10 (highly clean) and 0 (highly corrupt). APEC members range between 2 and 9.3 for 2008 (Table 3.3). For 2008 the *cpi* is highly correlated with air and port infrastructure (0.82 for port and 0.79 for air).

**Table 3.3: APEC rankings in the Corruption Perceptions Index, 2008.**

| | | | | | |
|---|---|---|---|---|---|
| New Zealand | 9.3 | Chile | 6.9 | Thailand | 3.5 |
| Singapore | 9.2 | Chinese Taipei | 5.7 | Viet Nam | 2.7 |
| Australia | 8.7 | Korea | 5.6 | Indonesia | 2.6 |
| Canada | 8.7 | Malaysia | 5.1 | Philippines | 2.3 |
| Hong Kong, China | 8.1 | China | 3.6 | Russian Federation | 2.1 |
| Japan | 7.3 | Mexico | 3.6 | Papua New Guinea | 2 |
| USA | 7.3 | Peru | 3.6 | Brunei | n/a |

Source: Transparency International 2008.

Transport costs are influenced by a good's value-to-weight ratio, since heavy, low value-added items are more expensive to transport than are light, high value-added ones. In part, this is due to higher insurance charges, which are included in the transport cost variable ((*cif-fob*)/*fob*) but are generally proportional to the value of the goods, since higher value-added goods may also attract higher quality freight services. There is a trend for goods to become lighter with technological advances, so that changes in the value-to-weight ratio (increasing) over time means that air transport becomes more attractive and less costly. Consequently, we expect the share of air shipped goods to be increasing over time. Figure 3.1 graphs the air share of imports for Australia; Brazil; Chile; and the USA between 1990 and 2008. The air share of imports from APEC economies by value and by reporter is not exhibiting any clear trend over the period 1990–2008. For Australia; Brazil; and Chile there was an increase in the share of imports in the mid to late 1990s, while for the USA the rise in the share commenced earlier. All four economies have experienced a reduction in the air share of their imports since around 2000.

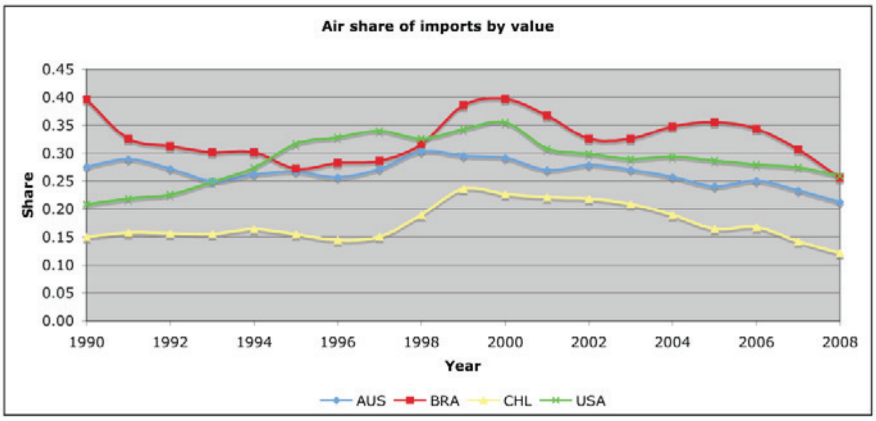


**Figure 3.1: Air share of imports by value for Australia; Brazil; Chile; and the USA, 1990–2008.**

## 3.4 ESTIMATING A MODEL OF TRANSPORT COSTS

### 3.4.1 Determination of freight costs

In this section, the determinants of air and sea transport costs for APEC member exports to four large economies – Australia; Brazil; Chile; and the USA – are analysed econometrically. The modelling approach incorporates as many of the factors identified above as possible.

As the previous discussion has highlighted, there are many factors contributing to the determination of freight costs. Our modelling strategy follows earlier studies (e.g., Micco & Serebrisky 2006, Clark, Dollar & Micco 2004, Fink, Mattoo & Neagu 2002, Wilmsmeier & Hoffmann 2008, Hummels 2007, Hummels, Lygovysky & Skiba (forthcoming), Micco & Perez 2002, Mirza & Habib 2009, Moreira, Volpe & Blyde 2008 and Wilmsmeier, Hoffmann & Sanchez 2006) where we incorporate as many of the determinants as possible. Since many of the variables are highly correlated, it is not possible to include them all in one model as this leads to unstable coefficients across specifications. The modelling strategy begins with a baseline specification in which the main determinants of transport costs are considered. Several additional models are estimated which specifically control for factors such as those affecting competition on a route, factors related to infrastructure and efficiency and those which capture the general quality of the exporting economy's institutions.

For each transport mode, the baseline specification models transport costs in the following way:

$$\ln\left(f_{ijkt}\right) = \beta_0 + \beta_1 \ln\left(dist\right)_{ij} + \beta_2 \ln\left(imports_{ijt}\right) + \beta_3 \ln\left(\frac{val}{wgt}\right)_{ijkt} + \alpha_k + \gamma_t + u_{ijkt} \qquad (1)$$

where $i$ indexes partner economies, $j$ indexes reporting economies, $k$ indexes commodities imported by economy $j$ disaggregated at the 6-digit level of the Harmonised System, and $t$ indexes time. The dependent variable, $\ln\left(f_{ijkt}\right)$, is the log of *ad valorem* freight charges. The baseline determinants of freight include $\ln\left(imports_{ijt}\right)$ which is the log of the value of total imports from economy $i$ to economy $j$ in period $t$ for each transport mode, $\ln\left(\frac{val}{wgt}\right)_{ijkt}$ is the log of the unit value of each good shipped and $\ln\left(dist\right)_{ij}$ is the log of distance between each economy pair. Distance is from Centre d'Etudes Prospectives et d'Information Internationales (CEPII) and is measured as the distance between two economies based on bilateral distances between the biggest cities of those two economies, those inter-city distances being weighted by the share of the city in the economy's overall population. In addition, a product specific fixed effect $\alpha_k$ is included and $u_{ijkt}$ is the idiosyncratic error. The product-fixed effects capture any commodity-specific features which influence freight costs but are difficult to quantify and not explicitly included in the models. For instance, these effects control for such things as the fact that bulky goods have higher transportation costs in every period than, say, shipping shoes. Freight costs are expected to be positively related to distance and negatively related to the value of imports since there exist economies of scale in transport, but this is perhaps more important for ocean freight. The value of imports may be endogenous in the model since imports also depend on transport costs. Ignoring this endogeneity may lead to biased estimates of the model parameters. When the models were estimated by two-stage least squares using GDP as an instrument, this resulted in implausible estimates with incorrect signs.

In the second specification, the focus is primarily on factors that affect the level of competition on shipping routes. For this, the baseline specification is augmented in turn with several variables which capture either a restrictive regulatory environment or the presence of market power. For these specifications, the baseline model for ocean freight is modified by the addition of sea index and airfreight for air freighted goods. These indexes capture the degree of restrictions in force on a route. Additional models for ocean-freighted imports are estimated, which include elements to capture the competitive features of the route (see Data sources in Annex 3). These second set of market power models include such things as number of carriers, number of ships or liner services operating on a route. These variables make up a composite index – the Liner Services Connectivity Index (LSCI) – compiled by UNCTAD – which is also included on its own.

The third focus is on institutional quality in the exporting economy. To capture this feature, we include the *cpi* for the exporting economy (Transparency International 2008). This index is a general 'catch-all' variable which is expected to be negatively related to freight charges – that is, the higher the index, the better the institutional quality and the lower the transport charge.

The final focus of this study accounts for the quality of infrastructure and trade facilitation measures. For these specifications, the baseline model is augmented by two measures to capture these features. The first infrastructure variable included is an index of port infrastructure quality (for ocean transport) in the exporting economy and a measure of air infrastructure quality (for air transport), both obtained from Porter and Schwab (2008). For trade facilitation quality, we include the Enabling Trade Index (*eti*) for the exporting economy also from Porter and Schwab. Table 3.4 summarises the expected direction of the relationships between the various determinants and transport costs.

**Table 3.4: Expected sign of determinants of transport costs.**

| Determinants | Expected sign |
|---|---|
| Value total imports | (–) |
| Value/weight | (+) |
| Distance | (+) |
| LSCI and components | (–) |
| Port/air infrastructure | (–) |
| Enabling trade index | (–) |
| Corruption perception index | (–) |

### 3.4.2 Results

The results from estimating transport cost models for ocean and air freight are presented in Tables 3.5 and 3.6. The positive relationship between distance and *ad valorem* transport costs is as expected, with robustly estimated elasticities ranging between 0.26 and 0.4.

The negative relationship expected between import volumes and transport costs is evident in the econometric results: depending on the model specification and other things being equal, the estimated elasticity is between -0.036 and as high as -0.07 for ocean freight (Table 3.5) and between -0.084 and -0.120 for air freight (Table 3.6). In comparing model results, this is partly due to greater economies of scale on routes. Note that the coefficient on imports loses all of its explanatory power and changes signs when estimated within models with the LSCI competition variables included (models 4 and 5), and so has been omitted.

**Table 3.5: Transport cost regressions for ocean shipped goods.**

| | (1) | (2) | (3) | (4) | (4a) | (4b) | (4c) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|---|---|---|
| **Years covered** | **1990-2008** | **2007-2008** | **1990-2008** | **2004-2008** | **2004-2008** | **2004-2008** | **2004-2008** | **2004-2008** | **2008** | **1998-2008** |
| Log(dist) | 0.268*** | 0.304*** | 0.280*** | 0.322*** | 0.323*** | 0.319*** | 0.328*** | 0.315*** | 0.305*** | 0.273*** |
| | (0.004) | (0.007) | (0.004) | (0.006) | (0.006) | (0.006) | (0.010) | (0.006) | (0.009) | (0.004) |
| Log(sea imports) | -0.068*** | -0.036*** | -0.071*** | | | | | | -0.041*** | -0.040*** |
| | (0.001) | (0.002) | (0.001) | | | | | | (0.002) | (0.001) |
| Log(value/wgt) | -0.390*** | -0.403*** | -0.386*** | -0.423*** | -0.429*** | -0.430*** | -0.418*** | -0.431*** | -0.410*** | -0.396*** |
| | (0.003) | (0.005) | (0.003) | (0.004) | (0.004) | (0.004) | (0.006) | (0.004) | (0.006) | (0.003) |
| eti | | -0.019*** | | | | | | | | |
| | | (0.004) | | | | | | | | |
| Sea index | | | -0.487*** | | | | | | | |
| | | | (0.013) | | | | | | | |
| Log(ships) | | | | -0.046*** | | | | | | |
| | | | | (0.003) | | | | | | |
| Log(liner services) | | | | | -0.024*** | | | | | |
| | | | | | (0.003) | | | | | |
| Log(liner companies) | | | | | | -0.033*** | | | | |
| | | | | | | (0.005) | | | | |
| Log(max ship size) | | | | | | | -0.027*** | | | |
| | | | | | | | (0.008) | | | |
| LSCI | | | | | | | | -0.000*** | | |
| | | | | | | | | (0.000) | | |
| Port infrastructure | | | | | | | | | -0.002 | |
| | | | | | | | | | (0.003) | |
| cpi | | | | | | | | | | -0.010*** |
| | | | | | | | | | | (0.001) |
| R-squared | 0.271 | 0.200 | 0.279 | 0.214 | 0.236 | 0.239 | 0.210 | 0.239 | 0.202 | 0.244 |
| N | 1156239 | 137035 | 942441 | 217018 | 275996 | 284779 | 63115 | 284779 | 69601 | 713108 |

* $p<0.1$, ** $p<0.05$, *** $p<0.01$. Year dummies included but output suppressed. All models estimated by fixed effects with product-fixed effects. Robust standard errors in parentheses. R-squared value is from the 'within transformation' of the data in the fixed effects regression. Models 4 and 5 are estimated for containerised shipments only as the LSCI relates to containerised traffic only.

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**Table 3.6: Transport cost regressions for air shipped goods**

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| **Years covered** | **1990-2008** | **2007-2008** | **2008** | **2008** | **1998-2008** |
| Log(distance) | 0.394*** | 0.257*** | 0.239*** | 0.250*** | 0.338*** |
| | (0.003) | (0.006) | (0.007) | (0.007) | (0.004) |
| Log(air imports) | -0.084*** | -0.108*** | -0.117*** | -0.120*** | -0.102*** |
| | (0.001) | (0.002) | (0.002) | (0.002) | (0.001) |
| Log(value/wgt) | -0.362*** | -0.304*** | -0.278*** | -0.271*** | -0.333*** |
| | (0.004) | (0.005) | (0.006) | (0.006) | (0.004) |
| eti | | -0.030*** | | | |
| | | (0.005) | | | |
| airindex | | | 0.055*** | | |
| | | | (0.004) | | |
| Air infrastructure | | | | -0.099*** | |
| | | | | (0.006) | |
| cpi | | | | | -0.036*** |
| | | | | | (0.001) |
| R-squared | 0.274 | 0.178 | 0.166 | 0.170 | 0.257 |
| N | 931667 | 113728 | 58054 | 47516 | 479416 |

* $p<0.1$, ** $p<0.05$, *** $p<0.01$. Year dummies included but output suppressed. All models estimated by fixed effects with product-fixed effects. Robust standard errors in parentheses. R-squared value is from the 'within transformation' of the data in the fixed effects regression.

Port infrastructure is found to have no significant effect on maritime transport costs. These results are somewhat surprising, since other studies have found this variable significant (e.g., Micco & Perez 2002 and Clark, Dollar & Micco 2004).

Using an alternative measure of port infrastructure (maximum ship size), we find the impact of the size of ships that ports can accommodate has a strong negative impact on shipping costs. The coefficient is not high but is statistically significant. This result has implications for economies of scale and potential cost savings for economies that can take advantage of technological improvements. Ship size and port infrastructure are highly correlated with the total level of imports: if imports are high then ship size is generally larger.

As expected, the components of the LSCI (models 4 and 4b) which capture the competitive environment in which the exporting economy is operating, all have a negative and statistically significant impact on shipping costs. Similarly, including the LSCI on its own also negatively impacts shipping charges but the effect is very small.

Turning to the restrictiveness index for ocean freight, the coefficient is negative and statistically significant. That is, a higher sea index is associated with a less restrictive environment and we would expect shipping costs to be lower. The estimated coefficient indicates that a one unit increase in the index would see *ad valorem* transport costs fall by approximately 48%, *ceteris paribus* (APEC index values are about 0.6 at present, on average). For air freight, the air index is found to have a statistically positive effect on *ad valorem* freight: higher values of the index indicate a greater degree of restrictiveness on a route and therefore higher *ad valorem* air transport costs.

Institutional quality, captured by the *cpi*, has more than three times the estimated impact on transport costs for air freight compared to ocean freight. This is plausible if higher value goods, which are generally shipped by air, attract more bribe-taking behaviour. The *eti* also has a greater negative impact on air freighted goods compared to ocean-freighted goods, suggesting that improvements in trade facilitation measures may be better directed at airport procedures, where the benefits would be greater.

## 3.5 CONCLUSION

Transport costs are important and amenable to reduction by technical progress and by policy measures. The richness of the customs data for Australia; Brazil; Chile; and the USA allows us to break down transport costs into the various determinants. However, transport costs remain a significant component of the wedge between the prices of domestic and imported goods.

Transport costs depend on more than distance or bulk or scale, and the role of the determinants vary by mode of transport. Transport costs are related to distance and to weight.

Sea freight is cheaper than air per kilogram but imports arriving by air have lower *ad valorem* trade costs because air freight is used for higher value goods. The choice of transport mode is, however, more complex than simply having more valuable and lighter goods shipped by air. Air transport will be favoured when speed is important, and for such goods in poor exporting-economy institutions this may be a particularly significant obstacle.

The econometric results reported in Tables 3.5 and 3.6 indicate that distance and bulk have the expected relationship to transport costs, and that transport costs fall with the volume of trade. The distance and weight variables are statistically significant for both modes, but the coefficients are larger and confidence intervals tighter for sea than for air. Good institutions, as measured by the *cpi* (Transparency International 2008), are associated with lower trade costs, but the impact is greater for air freight.

There are caveats to our conclusions. With just two modes there is an important feedback mechanism because the choice of mode is not simple and it is related to the impact of exporting-economy institutions. There is also an endogeneity concern related to the vicious cycle of high transport costs reducing trade flows and low trade volumes being a cause of high transport costs. Moreover, by focusing only on dollar values of transport costs we do not directly address the role of time, which some authors (Hummels 2001) identify as more important than financial costs, at least for some goods.

Using indicators of restrictiveness in transport services sectors, the econometric results highlight the importance of competitive environments for reducing transport costs for both air and sea transport.

The relevance of research on trade and transport costs is on how transport costs impact on trade flows. Future research should focus on the analysis of the effect of transport costs on exports of the APEC member economies to reporting economies such as USA; Australia; Chile; and Brazil. Since similar detailed customs level data exist for other economies, notably New Zealand and a selection of Latin American economies through Asociación Latinoamericana de Integración (ALADI), future research should focus on the analysis of APEC export flows to these economies.

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## ANNEX 3

### Data sources

**Figures A1–A6**

Figure A1: Imports to the USA.
Figure A2: Imports to Australia.
Figure A3: Imports to Chile.
Figure A4: Imports to Brazil.
Figure A5: Imports to the USA; Australia; Chile; and Brazil.
Figure A6a: Average adjusted *ad valorem* transport costs, selected APEC members.
Figure A6b: Average adjusted *ad valorem* transport costs, selected APEC members.
Figure A6c: Average adjusted *ad valorem* transport costs, selected APEC members.

**Tables A1–A5**

Table A1: Import weighted *ad valorem* transport costs, APEC members' exports to the USA; Australia; Brazil; and Chile.
Table A2: Import weighted *ad valorem* transport costs by sea, APEC members' exports by sea.
Table A3: Import weighted *ad valorem* transport costs by air, APEC members' exports by air.
Table A4: Average *ad valorem* transport costs adjusted for commodity composition.
Table A5: Weighted and adjusted *ad valorem* freight to the USA; Australia; Brazil; and Chile.

## DATA SOURCES

This study makes use of detailed customs data as available. These data record the export (*fob*) value of goods, the cost of freight and insurance and the corresponding import (*cif*) data for all imports from all destinations at the product level by mode of entry (ship, air or rail). In this way, the transport and insurance costs of only those imports that have arrived by ship can be analysed. The detailed customs data available are used to calculate *ad valorem* transport costs (USD paid in freight charges per $ of merchandise import value [*fob*]) at the product level.

The Enabling Trade Index (*eti*) from the World Economic Forum. The *eti* is designed to measure the 'institutions, policies, and services facilitating the free flow of goods over borders and to final destinations'. The index is composed of four sub indexes to capture the main enablers of trade: (1) market access, (2) border administration, (3) transport and communications infrastructure, and (4) the business environment. We use the 2009 index which is the latest available and relates to the year 2008. A higher value of the index indicates higher quality trade enabling measures in place.

The measure of overall infrastructure quality is taken from the World Economic Forum's *Global Competitiveness Report* (Porter & Schwab 2008). The port infrastructure index and the air infrastructure index are two of the components of the Global Competitiveness Index. A higher index is indicative of higher quality infrastructure.

The Corruptions Perceptions Index (*cpi*) is obtained from Transparency International (2008) and indicates the degree of public sector corruption as perceived by the business community and economy analysts. The *cpi* is measured on a scale of 0–10, with a higher number indicating less corruption.

UNCTAD's Liner Shipping Connectivity Index (LSCI) is a composite index composed of liner shipping connectivity between the importing economy and the exporting economy. In the empirical analysis of the paper, different aspects and components of the LSCI were used. The LSCI is derived from principal component analysis and includes the following elements of connectivity: number of carriers, TEU deployed, number of vessels, shipping opportunities and maximum size (TEU) of a ship on a specific route.

The abbreviated names of the APEC member economies are:

| | | | | | |
|---|---|---|---|---|---|
| Australia | AUS | Japan | JPN | The Republic of the Philippines | RP |
| Brunei Darussalam | BD | Republic of Korea | ROK | The Russian Federation | RUS |
| Canada | CDA | Malaysia | MAS | Singapore | SIN |
| Chile | CHL | Mexico | MEX | Chinese Taipei | CT |
| People's Republic of China | PRC | New Zealand | NZ | Thailand | THA |
| Hong Kong, China | HGC | Papua New Guinea | PNG | United States | USA |
| Indonesia | INA | Peru | PE | Viet Nam | VN |

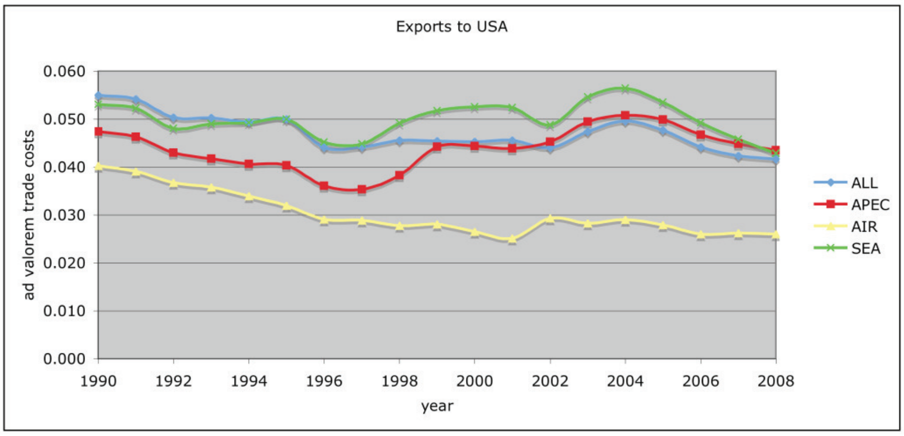


**Figure A1: Imports to the USA.**

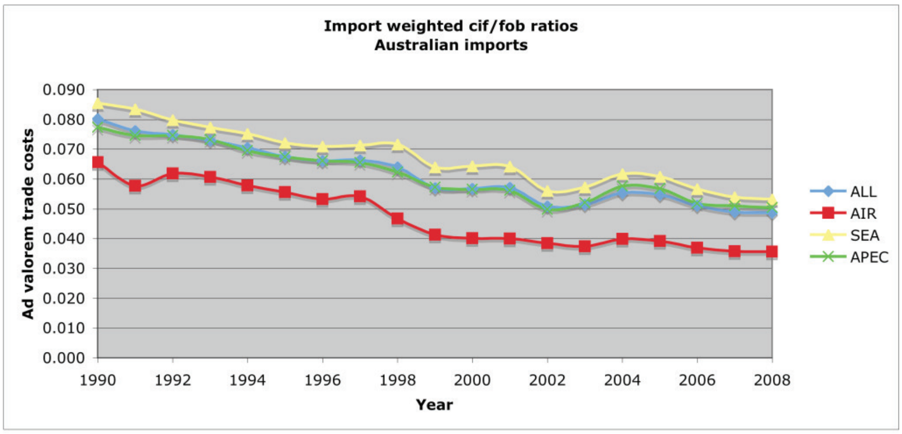


**Figure A2: Imports to Australia.**

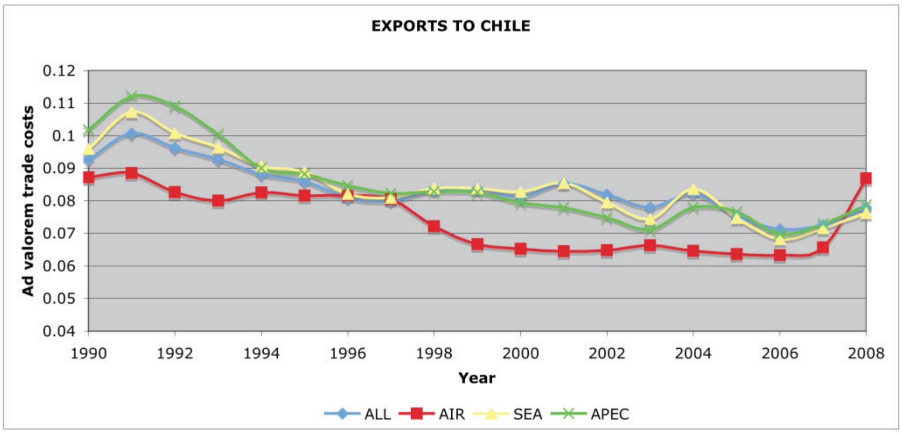


**Figure A3: Imports to Chile.**

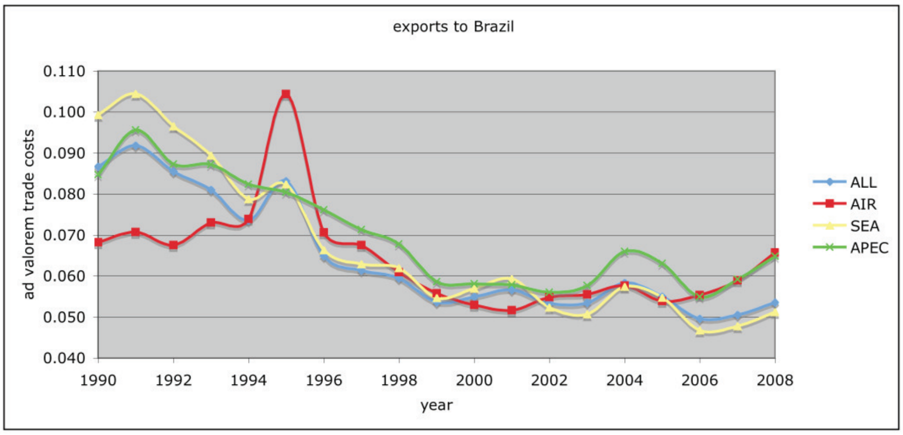


**Figure A4: Imports to Brazil.**

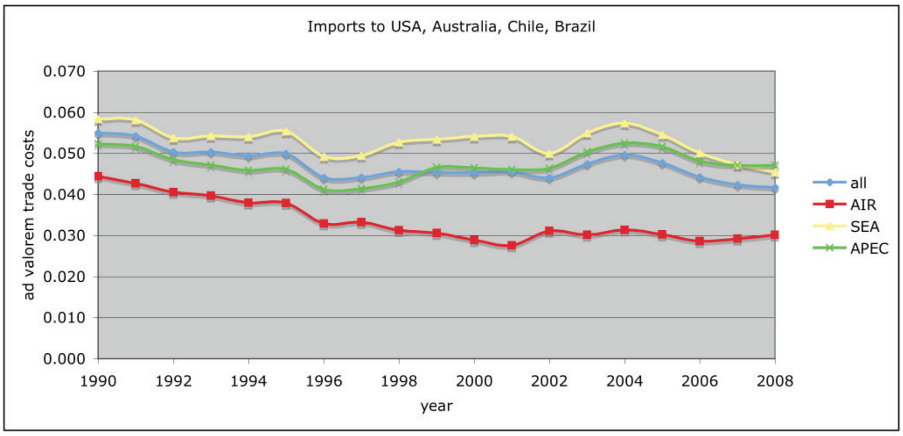


**Figure A5: Imports to the USA; Australia; Chile; and Brazil.**

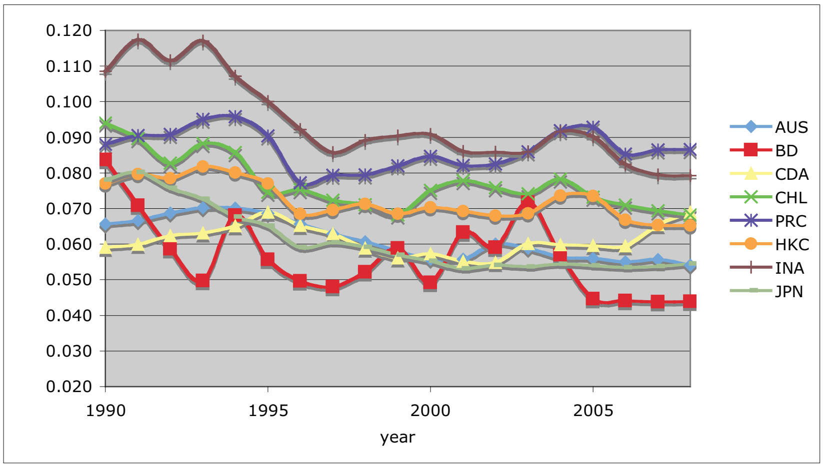


**Figure A6a: Average adjusted *ad valorem* transport costs, selected APEC members.**

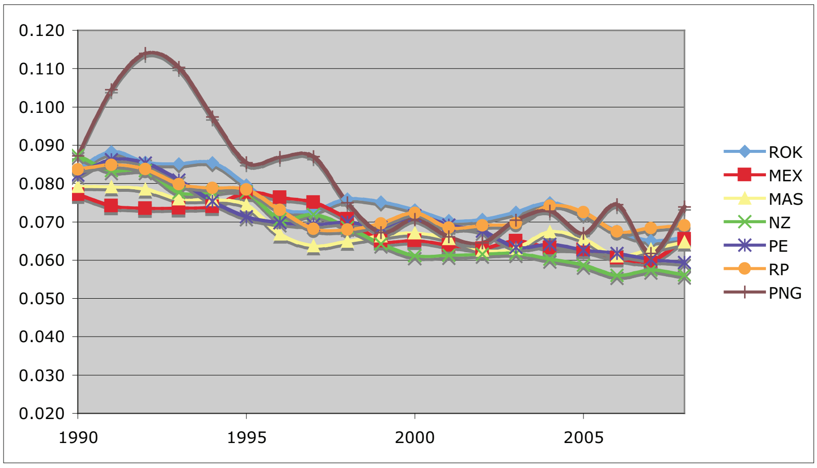


**Figure A6b: Average adjusted *ad valorem* transport costs, selected APEC members.**

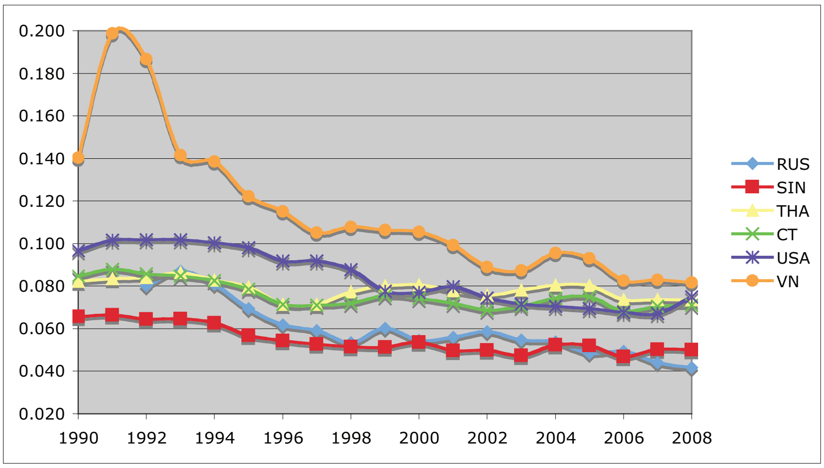


**Figure A6c: Average adjusted *ad valorem* transport costs, selected APEC members.**

| | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.085 | 0.072 | 0.048 | 0.160 | 0.074 | 0.051 | 0.102 | 0.042 | 0.045 | 0.050 | 0.049 | 0.096 | 0.017 | 0.061 | 0.074 | | 0.030 | 0.054 | 0.05 |
| 0.082 | 0.073 | 0.039 | 0.143 | 0.073 | 0.051 | 0.102 | 0.042 | 0.045 | 0.047 | 0.054 | 0.092 | 0.009 | 0.063 | 0.071 | | 0.028 | 0.054 | 0.05 |
| 0.086 | 0.056 | 0.036 | 0.143 | 0.070 | 0.050 | 0.085 | 0.036 | 0.043 | 0.041 | 0.055 | 0.091 | 0.013 | 0.062 | 0.063 | 0.086 | 0.025 | 0.051 | 0.05 |
| 0.086 | 0.056 | 0.035 | 0.144 | 0.071 | 0.049 | 0.083 | 0.034 | 0.043 | 0.038 | 0.056 | 0.090 | 0.027 | 0.067 | 0.059 | 0.066 | 0.023 | 0.050 | 0.05 |
| 0.088 | 0.036 | 0.040 | 0.122 | 0.069 | 0.050 | 0.079 | 0.032 | 0.041 | 0.035 | 0.050 | 0.086 | 0.033 | 0.067 | 0.055 | 0.067 | 0.023 | 0.048 | 0.05 |
| 0.088 | 0.045 | 0.053 | 0.112 | 0.067 | 0.050 | 0.073 | 0.033 | 0.035 | 0.032 | 0.053 | 0.085 | 0.032 | 0.058 | 0.052 | 0.064 | 0.021 | 0.044 | 0.04 |
| 0.082 | 0.042 | 0.046 | 0.128 | 0.059 | 0.044 | 0.067 | 0.027 | 0.034 | 0.031 | 0.043 | 0.084 | 0.033 | 0.063 | 0.042 | 0.057 | 0.017 | 0.040 | 0.04 |
| 0.077 | 0.040 | 0.046 | 0.126 | 0.055 | 0.042 | 0.066 | 0.028 | 0.035 | 0.031 | 0.046 | 0.078 | 0.035 | 0.053 | 0.036 | 0.060 | 0.018 | 0.037 | 0.03 |
| 0.071 | 0.063 | 0.044 | 0.134 | 0.058 | 0.042 | 0.070 | 0.030 | 0.042 | 0.031 | 0.049 | 0.078 | 0.041 | 0.052 | 0.033 | 0.051 | 0.019 | 0.040 | 0.04 |
| 0.067 | 0.069 | 0.039 | 0.113 | 0.074 | 0.047 | 0.081 | 0.030 | 0.043 | 0.033 | 0.041 | 0.074 | 0.036 | 0.056 | 0.038 | 0.040 | 0.022 | 0.047 | 0.05 |
| 0.065 | 0.062 | 0.031 | 0.120 | 0.076 | 0.048 | 0.082 | 0.031 | 0.039 | 0.035 | 0.032 | 0.069 | 0.025 | 0.060 | 0.039 | 0.034 | 0.022 | 0.045 | 0.06 |
| 0.059 | 0.072 | 0.033 | 0.133 | 0.071 | 0.046 | 0.080 | 0.028 | 0.041 | 0.036 | 0.028 | 0.069 | 0.034 | 0.073 | 0.040 | 0.046 | 0.023 | 0.044 | 0.05 |
| 0.059 | 0.058 | 0.036 | 0.140 | 0.067 | 0.049 | 0.074 | 0.029 | 0.040 | 0.032 | 0.028 | 0.069 | 0.022 | 0.073 | 0.041 | 0.050 | 0.024 | 0.042 | 0.06 |
| 0.059 | 0.061 | 0.039 | 0.149 | 0.072 | 0.051 | 0.074 | 0.030 | 0.040 | 0.032 | 0.033 | 0.067 | 0.019 | 0.066 | 0.043 | 0.059 | 0.027 | 0.046 | 0.06 |
| 0.064 | 0.070 | 0.040 | 0.124 | 0.072 | 0.053 | 0.081 | 0.032 | 0.039 | 0.035 | 0.033 | 0.063 | 0.018 | 0.054 | 0.049 | 0.066 | 0.027 | 0.048 | 0.06 |
| 0.061 | 0.047 | 0.036 | 0.103 | 0.069 | 0.049 | 0.079 | 0.031 | 0.043 | 0.032 | 0.032 | 0.063 | 0.018 | 0.048 | 0.050 | 0.061 | 0.028 | 0.047 | 0.05 |
| 0.054 | 0.043 | 0.033 | 0.066 | 0.064 | 0.045 | 0.069 | 0.031 | 0.043 | 0.030 | 0.021 | 0.061 | 0.020 | 0.041 | 0.047 | 0.051 | 0.026 | 0.044 | 0.05 |
| 0.056 | 0.035 | 0.035 | 0.071 | 0.061 | 0.046 | 0.064 | 0.031 | 0.042 | 0.031 | 0.020 | 0.056 | 0.015 | 0.044 | 0.045 | 0.048 | 0.026 | 0.043 | 0.04 |
| 0.053 | 0.036 | 0.033 | 0.075 | 0.058 | 0.044 | 0.059 | 0.034 | 0.043 | 0.032 | 0.021 | 0.049 | 0.013 | 0.041 | 0.047 | 0.046 | 0.028 | 0.043 | 0.04 |
| **-36.94** | **-50.11** | **-31.16** | **-53.07** | **-21.38** | **-14.45** | **-41.82** | **-19.07** | **-5.44** | **-36.42** | **-56.75** | **-48.80** | **-26.24** | **-32.28** | **-35.97** | **-46.04** | **-5.76** | **-20.69** | **-19.3** |

**Table A2: Import weighted *ad valorem* transport costs by sea, APEC members' exports by sea.**

| AUS | BD | CDA | CHL | PRC | HGC | INA | JPN | ROK | MAS | MEX | NZ | PNG | PE | RP | RUS | SIN | CT | THA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.092 | 0.080 | 0.059 | 0.166 | 0.068 | 0.042 | 0.097 | 0.040 | 0.043 | 0.064 | 0.051 | 0.101 | 0.071 | 0.073 | 0.084 | | 0.040 | 0.048 | 0.06 |
| 0.090 | 0.073 | 0.048 | 0.152 | 0.066 | 0.040 | 0.097 | 0.039 | 0.043 | 0.056 | 0.057 | 0.097 | 0.071 | 0.078 | 0.078 | | 0.036 | 0.048 | 0.06 |
| 0.095 | 0.057 | 0.044 | 0.159 | 0.064 | 0.040 | 0.079 | 0.034 | 0.044 | 0.049 | 0.059 | 0.099 | 0.046 | 0.070 | 0.070 | 0.113 | 0.037 | 0.047 | 0.05 |
| 0.096 | 0.053 | 0.043 | 0.158 | 0.065 | 0.041 | 0.078 | 0.032 | 0.045 | 0.044 | 0.060 | 0.098 | 0.046 | 0.074 | 0.068 | 0.081 | 0.035 | 0.048 | 0.05 |
| 0.099 | 0.042 | 0.058 | 0.133 | 0.064 | 0.042 | 0.074 | 0.031 | 0.048 | 0.041 | 0.054 | 0.097 | 0.046 | 0.075 | 0.065 | 0.077 | 0.039 | 0.047 | 0.05 |
| 0.096 | 0.042 | 0.091 | 0.116 | 0.063 | 0.046 | 0.069 | 0.033 | 0.049 | 0.041 | 0.056 | 0.096 | 0.040 | 0.063 | 0.066 | 0.074 | 0.033 | 0.045 | 0.05 |
| 0.091 | 0.034 | 0.081 | 0.135 | 0.055 | 0.038 | 0.062 | 0.025 | 0.045 | 0.039 | 0.045 | 0.091 | 0.043 | 0.071 | 0.056 | 0.070 | 0.027 | 0.041 | 0.04 |
| 0.086 | 0.032 | 0.085 | 0.130 | 0.050 | 0.037 | 0.061 | 0.027 | 0.046 | 0.041 | 0.050 | 0.086 | 0.045 | 0.059 | 0.051 | 0.070 | 0.030 | 0.038 | 0.04 |
| 0.090 | 0.075 | 0.090 | 0.134 | 0.054 | 0.038 | 0.072 | 0.030 | 0.057 | 0.046 | 0.054 | 0.084 | 0.058 | 0.069 | 0.053 | 0.064 | 0.036 | 0.043 | 0.04 |
| 0.079 | 0.067 | 0.082 | 0.110 | 0.072 | 0.044 | 0.080 | 0.030 | 0.059 | 0.054 | 0.045 | 0.078 | 0.046 | 0.059 | 0.065 | 0.055 | 0.040 | 0.056 | 0.06 |
| 0.074 | 0.055 | 0.063 | 0.117 | 0.075 | 0.047 | 0.081 | 0.032 | 0.055 | 0.058 | 0.035 | 0.074 | 0.033 | 0.050 | 0.073 | 0.048 | 0.041 | 0.056 | 0.07 |
| 0.068 | 0.070 | 0.063 | 0.125 | 0.070 | 0.044 | 0.080 | 0.028 | 0.051 | 0.056 | 0.031 | 0.072 | 0.048 | 0.063 | 0.067 | 0.062 | 0.041 | 0.051 | 0.06 |
| 0.064 | 0.052 | 0.062 | 0.130 | 0.065 | 0.042 | 0.073 | 0.027 | 0.049 | 0.050 | 0.028 | 0.071 | 0.039 | 0.062 | 0.064 | 0.055 | 0.040 | 0.048 | 0.06 |
| 0.066 | 0.059 | 0.060 | 0.138 | 0.074 | 0.050 | 0.077 | 0.030 | 0.052 | 0.056 | 0.033 | 0.069 | 0.042 | 0.059 | 0.069 | 0.063 | 0.043 | 0.054 | 0.07 |
| 0.071 | 0.067 | 0.059 | 0.116 | 0.077 | 0.051 | 0.082 | 0.031 | 0.050 | 0.065 | 0.034 | 0.063 | 0.040 | 0.058 | 0.072 | 0.070 | 0.046 | 0.058 | 0.07 |
| 0.068 | 0.045 | 0.048 | 0.096 | 0.075 | 0.048 | 0.079 | 0.031 | 0.052 | 0.066 | 0.032 | 0.064 | 0.029 | 0.052 | 0.071 | 0.065 | 0.049 | 0.055 | 0.07 |
| 0.062 | 0.043 | 0.043 | 0.060 | 0.071 | 0.046 | 0.069 | 0.032 | 0.051 | 0.062 | 0.020 | 0.062 | 0.033 | 0.038 | 0.063 | 0.053 | 0.048 | 0.052 | 0.06 |
| 0.065 | 0.034 | 0.042 | 0.063 | 0.066 | 0.046 | 0.064 | 0.032 | 0.050 | 0.054 | 0.019 | 0.056 | 0.024 | 0.037 | 0.059 | 0.051 | 0.044 | 0.052 | 0.05 |
| 0.060 | 0.036 | 0.037 | 0.070 | 0.062 | 0.047 | 0.059 | 0.035 | 0.053 | 0.048 | 0.020 | 0.049 | 0.025 | 0.037 | 0.062 | 0.049 | 0.036 | 0.049 | 0.05 |
| **-34.61** | **-55.33** | **-37.20** | **-57.75** | **-9.98** | **10.51** | **-39.53** | **-10.41** | **22.74** | **-24.62** | **-61.34** | **-51.69** | **-64.18** | **-49.16** | **-25.72** | **-56.70** | **-10.12** | **2.40** | **-14.6** |

| | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.012 | 0.014 | 0.145 | 0.130 | 0.065 | 0.172 | 0.055 | 0.054 | 0.028 | 0.030 | 0.074 | 0.001 | 0.033 | 0.052 | | 0.023 | 0.089 | 0.041 |
| 0.091 | 0.014 | 0.109 | 0.137 | 0.068 | 0.160 | 0.053 | 0.052 | 0.030 | 0.028 | 0.071 | 0.001 | 0.035 | 0.054 | | 0.022 | 0.087 | 0.043 |
| 0.025 | 0.012 | 0.092 | 0.123 | 0.065 | 0.171 | 0.044 | 0.043 | 0.027 | 0.027 | 0.063 | 0.000 | 0.042 | 0.050 | 0.012 | 0.019 | 0.071 | 0.042 |
| 0.075 | 0.013 | 0.101 | 0.121 | 0.060 | 0.156 | 0.040 | 0.037 | 0.028 | 0.030 | 0.060 | 0.001 | 0.049 | 0.043 | 0.013 | 0.018 | 0.059 | 0.039 |
| 0.029 | 0.012 | 0.088 | 0.115 | 0.061 | 0.148 | 0.035 | 0.028 | 0.025 | 0.029 | 0.054 | 0.001 | 0.051 | 0.038 | 0.013 | 0.018 | 0.053 | 0.039 |
| 0.079 | 0.016 | 0.102 | 0.102 | 0.056 | 0.123 | 0.034 | 0.018 | 0.022 | 0.035 | 0.053 | 0.002 | 0.050 | 0.034 | 0.014 | 0.017 | 0.041 | 0.035 |
| 0.087 | 0.012 | 0.118 | 0.091 | 0.052 | 0.108 | 0.031 | 0.018 | 0.022 | 0.031 | 0.055 | 0.003 | 0.043 | 0.027 | 0.011 | 0.014 | 0.038 | 0.034 |
| 0.095 | 0.015 | 0.135 | 0.091 | 0.048 | 0.103 | 0.031 | 0.019 | 0.023 | 0.029 | 0.050 | 0.004 | 0.038 | 0.024 | 0.012 | 0.014 | 0.035 | 0.035 |
| 0.023 | 0.014 | 0.158 | 0.086 | 0.048 | 0.060 | 0.030 | 0.020 | 0.018 | 0.029 | 0.057 | 0.008 | 0.025 | 0.020 | 0.008 | 0.015 | 0.035 | 0.031 |
| 0.118 | 0.013 | 0.137 | 0.090 | 0.051 | 0.084 | 0.029 | 0.022 | 0.019 | 0.028 | 0.057 | 0.005 | 0.048 | 0.021 | 0.007 | 0.018 | 0.034 | 0.041 |
| 0.176 | 0.012 | 0.158 | 0.083 | 0.049 | 0.083 | 0.027 | 0.019 | 0.019 | 0.022 | 0.050 | 0.003 | 0.095 | 0.020 | 0.006 | 0.017 | 0.033 | 0.039 |
| 0.123 | 0.011 | 0.209 | 0.074 | 0.051 | 0.075 | 0.025 | 0.023 | 0.020 | 0.019 | 0.054 | 0.003 | 0.117 | 0.021 | 0.006 | 0.017 | 0.034 | 0.038 |
| 0.158 | 0.012 | 0.229 | 0.079 | 0.060 | 0.079 | 0.033 | 0.025 | 0.020 | 0.027 | 0.056 | 0.003 | 0.109 | 0.027 | 0.016 | 0.019 | 0.035 | 0.054 |
| 0.159 | 0.014 | 0.253 | 0.062 | 0.053 | 0.057 | 0.032 | 0.021 | 0.017 | 0.031 | 0.060 | 0.003 | 0.089 | 0.024 | 0.016 | 0.020 | 0.035 | 0.039 |
| 0.158 | 0.015 | 0.245 | 0.055 | 0.055 | 0.072 | 0.035 | 0.021 | 0.015 | 0.030 | 0.061 | 0.003 | 0.053 | 0.027 | 0.011 | 0.018 | 0.033 | 0.037 |
| 0.150 | 0.015 | 0.206 | 0.050 | 0.050 | 0.077 | 0.032 | 0.025 | 0.015 | 0.028 | 0.060 | 0.004 | 0.043 | 0.026 | 0.008 | 0.016 | 0.032 | 0.030 |
| 0.082 | 0.016 | 0.137 | 0.045 | 0.044 | 0.068 | 0.030 | 0.024 | 0.014 | 0.027 | 0.055 | 0.003 | 0.049 | 0.029 | 0.010 | 0.015 | 0.030 | 0.032 |
| 0.119 | 0.022 | 0.160 | 0.045 | 0.046 | 0.072 | 0.027 | 0.023 | 0.017 | 0.029 | 0.056 | 0.002 | 0.084 | 0.027 | 0.010 | 0.015 | 0.029 | 0.029 |
| 0.090 | 0.023 | 0.133 | 0.047 | 0.040 | 0.064 | 0.030 | 0.022 | 0.019 | 0.031 | 0.051 | 0.002 | 0.067 | 0.027 | 0.008 | 0.018 | 0.030 | 0.031 |
| **647.87** | **58.73** | **-8.03** | **-63.90** | **-39.33** | **-62.69** | **-45.36** | **-59.80** | **-32.43** | **5.60** | **-31.72** | **42.92** | **103.58** | **-47.63** | **-37.69** | **-21.42** | **-66.05** | **-24.23** |

**Table A4: Average *ad valorem* transport costs adjusted for commodity composition.**

| BD | CDA | CHL | PRC | HGC | INA | JPN | ROK | MAS | MEX | NZ | PNG | PE | RP | RUS | SIN | CT | THA |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.084 | 0.059 | 0.094 | 0.088 | 0.077 | 0.109 | 0.078 | 0.084 | 0.079 | 0.077 | 0.087 | 0.087 | 0.082 | 0.084 | | 0.066 | 0.085 | 0.082 |
| 0.071 | 0.06 | 0.09 | 0.091 | 0.08 | 0.117 | 0.08 | 0.088 | 0.079 | 0.074 | 0.083 | 0.104 | 0.086 | 0.085 | | 0.066 | 0.088 | 0.083 |
| 0.059 | 0.062 | 0.083 | 0.091 | 0.078 | 0.112 | 0.076 | 0.086 | 0.079 | 0.074 | 0.083 | 0.114 | 0.085 | 0.084 | 0.08 | 0.064 | 0.086 | 0.084 |
| 0.05 | 0.063 | 0.088 | 0.095 | 0.082 | 0.117 | 0.073 | 0.085 | 0.076 | 0.074 | 0.078 | 0.11 | 0.081 | 0.08 | 0.087 | 0.065 | 0.085 | 0.086 |
| 0.068 | 0.065 | 0.086 | 0.096 | 0.08 | 0.107 | 0.068 | 0.085 | 0.076 | 0.074 | 0.078 | 0.097 | 0.075 | 0.079 | 0.081 | 0.063 | 0.082 | 0.083 |
| 0.056 | 0.069 | 0.075 | 0.09 | 0.077 | 0.1 | 0.065 | 0.08 | 0.074 | 0.078 | 0.078 | 0.085 | 0.071 | 0.078 | 0.069 | 0.057 | 0.078 | 0.08 |
| 0.05 | 0.065 | 0.075 | 0.077 | 0.069 | 0.092 | 0.059 | 0.073 | 0.067 | 0.076 | 0.071 | 0.087 | 0.07 | 0.073 | 0.062 | 0.054 | 0.071 | 0.071 |
| 0.048 | 0.063 | 0.072 | 0.079 | 0.07 | 0.086 | 0.06 | 0.073 | 0.064 | 0.075 | 0.072 | 0.087 | 0.069 | 0.068 | 0.059 | 0.053 | 0.071 | 0.071 |
| 0.052 | 0.059 | 0.071 | 0.079 | 0.071 | 0.089 | 0.059 | 0.076 | 0.065 | 0.071 | 0.069 | 0.075 | 0.07 | 0.068 | 0.053 | 0.052 | 0.072 | 0.077 |
| 0.059 | 0.056 | 0.068 | 0.082 | 0.068 | 0.09 | 0.057 | 0.075 | 0.066 | 0.065 | 0.064 | 0.067 | 0.069 | 0.07 | 0.06 | 0.051 | 0.075 | 0.08 |
| 0.049 | 0.057 | 0.075 | 0.085 | 0.07 | 0.091 | 0.055 | 0.073 | 0.067 | 0.065 | 0.061 | 0.071 | 0.072 | 0.072 | 0.054 | 0.054 | 0.074 | 0.081 |
| 0.063 | 0.055 | 0.078 | 0.082 | 0.069 | 0.086 | 0.053 | 0.07 | 0.066 | 0.064 | 0.061 | 0.066 | 0.069 | 0.069 | 0.056 | 0.05 | 0.072 | 0.078 |
| 0.059 | 0.055 | 0.076 | 0.083 | 0.068 | 0.086 | 0.054 | 0.071 | 0.063 | 0.063 | 0.062 | 0.065 | 0.068 | 0.069 | 0.059 | 0.05 | 0.069 | 0.076 |
| 0.072 | 0.06 | 0.074 | 0.086 | 0.069 | 0.086 | 0.054 | 0.072 | 0.063 | 0.065 | 0.062 | 0.07 | 0.063 | 0.07 | 0.055 | 0.047 | 0.071 | 0.078 |
| 0.057 | 0.06 | 0.078 | 0.092 | 0.074 | 0.092 | 0.054 | 0.075 | 0.067 | 0.063 | 0.06 | 0.073 | 0.064 | 0.074 | 0.054 | 0.052 | 0.074 | 0.08 |
| 0.045 | 0.06 | 0.073 | 0.093 | 0.073 | 0.09 | 0.054 | 0.072 | 0.066 | 0.063 | 0.059 | 0.067 | 0.063 | 0.073 | 0.048 | 0.052 | 0.075 | 0.08 |
| 0.044 | 0.059 | 0.071 | 0.085 | 0.067 | 0.082 | 0.053 | 0.068 | 0.061 | 0.061 | 0.056 | 0.074 | 0.062 | 0.067 | 0.049 | 0.047 | 0.068 | 0.074 |
| 0.044 | 0.065 | 0.069 | 0.086 | 0.065 | 0.079 | 0.054 | 0.065 | 0.063 | 0.06 | 0.057 | 0.062 | 0.06 | 0.068 | 0.044 | 0.05 | 0.071 | 0.074 |
| 0.044 | 0.069 | 0.068 | 0.087 | 0.065 | 0.079 | 0.054 | 0.066 | 0.065 | 0.066 | 0.056 | 0.074 | 0.059 | 0.069 | 0.042 | 0.05 | 0.071 | 0.074 |
| **-47.62** | **16.95** | **-27.66** | **-1.14** | **-15.58** | **-27.52** | **-30.77** | **-21.43** | **-17.72** | **-14.29** | **-35.63** | **-14.94** | **-28.05** | **-17.86** | **-47.50** | **-24.24** | **-16.47** | **-9.76** |

**Table A5: Weighted and adjusted *ad valorem* freight to the USA; Australia; Brazil; and Chile.**

| | | | | | APEC | | | |
|---|---|---|---|---|---|---|---|---|
| **Year** | **Adjusted air freight#** | **Adjusted sea freight#** | **Import-weighted air freight*** | **Import-weighted sea freight*** | **Adjusted air freight** | **Import-weighted air freight** | **Adjusted sea freight** | **Import-weighted sea freight** |
| 1990 | 0.141 | 0.084 | 0.043 | 0.055 | 0.18 | 0.05 | 0.088 | 0.05 |
| 1991 | 0.144 | 0.084 | 0.041 | 0.055 | 0.19 | 0.049 | 0.09 | 0.049 |
| 1992 | 0.148 | 0.082 | 0.039 | 0.051 | 0.193 | 0.044 | 0.09 | 0.047 |
| 1993 | 0.15 | 0.082 | 0.038 | 0.052 | 0.201 | 0.042 | 0.091 | 0.046 |
| 1994 | 0.149 | 0.079 | 0.037 | 0.051 | 0.195 | 0.038 | 0.086 | 0.046 |
| 1995 | 0.156 | 0.076 | 0.037 | 0.053 | 0.193 | 0.035 | 0.084 | 0.048 |
| 1996 | 0.143 | 0.072 | 0.032 | 0.047 | 0.183 | 0.032 | 0.08 | 0.043 |
| 1997 | 0.145 | 0.069 | 0.032 | 0.047 | 0.186 | 0.033 | 0.077 | 0.043 |
| 1998 | 0.144 | 0.068 | 0.03 | 0.05 | 0.18 | 0.031 | 0.078 | 0.046 |
| 1999 | 0.135 | 0.066 | 0.03 | 0.051 | 0.169 | 0.031 | 0.079 | 0.051 |
| 2000 | 0.131 | 0.068 | 0.028 | 0.051 | 0.163 | 0.03 | 0.078 | 0.052 |
| 2001 | 0.13 | 0.067 | 0.027 | 0.051 | 0.161 | 0.03 | 0.076 | 0.05 |
| 2002 | 0.135 | 0.063 | 0.03 | 0.048 | 0.168 | 0.036 | 0.069 | 0.048 |
| 2003 | 0.139 | 0.061 | 0.029 | 0.052 | 0.167 | 0.034 | 0.069 | 0.054 |
| 2004 | 0.137 | 0.062 | 0.03 | 0.054 | 0.168 | 0.035 | 0.073 | 0.056 |
| 2005 | 0.136 | 0.062 | 0.029 | 0.052 | 0.166 | 0.034 | 0.073 | 0.055 |
| 2006 | 0.132 | 0.058 | 0.028 | 0.048 | 0.164 | 0.032 | 0.067 | 0.051 |
| 2007 | 0.141 | 0.054 | 0.028 | 0.045 | 0.177 | 0.033 | 0.065 | 0.05 |
| 2008 | 0.154 | 0.053 | 0.029 | 0.043 | 0.197 | 0.035 | 0.064 | 0.048 |

Notes: # *Ad valorem* freight rate adjusted for commodity composition and value to weight. Includes economy-pair-product effects.
**Ad valorem* freight weighted by imports. Pooled data from the USA; Australia; Chile; and Brazil.