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7 October 2009

SciencesPo. GEM Groupe d'Économie Mondiale

Working Paper
October 2009

LIBERALISING AIR CARGO SERVICES IN APEC

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ABSTRACT

This study aims at assessing the link between a more liberal air cargo regime and increased bilateral merchandise trade in the Asia Pacific region, under the auspices of APEC. Using the gravity model and employing the Air Liberalisation Index (ALI) developed by the WTO Secretariat, this paper finds strong support for two hypotheses. First, more liberal air services policies are positively, significantly and robustly associated with higher bilateral trade in merchandise. The results also show that air transport policy matters more for some sectors than for others. A particularly strong relationship is found between bilateral liberalisation and trade in manufactured goods, time sensitive products, and parts and components. Considering the sector found to be most sensitive to the degree of aviation liberalisation, the estimates imply that a one point increase in the ALI is associated with an increase of 4% in bilateral parts and components trade, prior to taking account of general equilibrium effects. These findings have important policy implications. In particular, economies actively seeking greater integration in international production networks could greatly benefit from a more liberal aviation policy regime.

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I. Introduction

Air freight transportation plays an increasingly important role in the ongoing integration of APEC economies, boosted by the rapid growth of exports from the Asia Pacific region. In particular, the emergence of China as a major economic power house has spurred international trade dramatically over the last decade or so. Similarly, a number of developing countries in the region have become exporters of time sensitive products, such as electronic equipment and garment. These commodities are highly dependent on accurately timed imports of inputs and exports of semi-finished or finished products, as part of global production networks and just-in-time supply chain management. Air cargo often represents the only way to access distant markets in a timely fashion.

Air cargo is governed by the regulations established in the Chicago Conference of 1994, since the grant of traffic rights in bilateral air service agreements (ASAs) relates to "passengers, cargoes and mail". The system, created at a time when almost all airlines were national flag carriers and the air cargo industry was still in its infancy, typically determines through bilateral ASAs the traffic rights of airlines, the tariffs and the number and frequency of flights. Other important features of these agreements relate to airline designation and limitations on foreign ownership. There are also a range of domestic rules affecting carriers' operations, such as restrictions on the provision of ground-handling services and to diversify into ancillary air cargo functions (e.g. ground transportation). These restrictions prevent free route development and network optimisation, constraining flexibility in the provision of air cargo services, which is increasingly necessary for modern manufacturing.

Under growing pressure to keep pace with global trade and economic expansion, the national and international regulatory framework for air cargo has become more liberal over the last 30 years or so. The US air cargo deregulation of 1977, which served as a model for passenger deregulation in the US, liberalised licensing of air cargo carriers and opened domestic routes to full competition. The European common aviation area, finalised in 1997, allowed any EU carrier to operate in any routes in the EU (including domestic routes of any other Member State), granted them operational flexibility and ended regulatory discrimination between scheduled and non-scheduled services. These events have contributed to the broader liberalisation brought about by open skies agreements and by regional initiatives, including in APEC. Open skies typically provide additional access and trading opportunities for cargo services.

These reforms had a considerable impact on the air cargo industry. In the US, new carriers and forwarders entered the industry, a large number of new routes were opened and, most notably, the reform led to the emergence of integrated express carriers. In the EU, although direct effects were less significant

since air cargo in the internal market plays a limited role compared to other transport modes such as rail and road, the reforms set the stage for broader air transport liberalisation. Open skies agreements fostered air cargo services in bilateral routes and facilitated international hub-and-spoke operations (OECD, 2002).

Air cargo liberalisation efforts have so far been undertaken largely outside multilateral bodies such as the WTO; yet, there seems to be growing consensus among air transport stakeholders that, in light of its nature, air cargo liberalisation could be separated from reforms in passenger transport and occur more rapidly. The challenges posed by the regulatory system (and by the increasing competitive threat of integrated express operators) have also prompted business-led responses, particularly through the development of global airline alliances among carriers of different countries. As for passenger services, air cargo carriers have started to cooperate, through e.g. common service options, in an attempt to build global networks. A number of cargo carriers from APEC economies are members to these alliances.

The objective of this study is to examine the link between a more liberal air cargo regime and increased bilateral trade in the Asia Pacific region, under the auspices of APEC. The next section provides some background on liberalisation initiatives by Asia Pacific economies and at the multilateral level. Section III reviews developments that are affecting the nature and performance of the air cargo industry, as well as recent global and APEC industry trends. Section IV then analyses the regulation of air cargo services in APEC economies, and Section V provides estimates of the sensitivity of different types of merchandise trade in APEC to the liberalisation of air cargo services. The last section concludes.

II. Background on APEC and global air cargo liberalisation developments

Air cargo liberalisation in APEC

Air cargo has been part of broader discussions on air transport liberalisation in APEC since the establishment of the Air Services Group (ASG) in 1995. A reform programme was adopted by APEC leaders in 1999 known as the Eight Options for More Competitive Air Services with Fair and Equitable Opportunity (hereafter the Eight Options). One of the options refers to air freight and stipulates "that APEC economies progressively remove restrictions in the operation of air freight services while ensuring that fair and equitable opportunity for the economies involved." The Eight Options do not lock APEC economies into a particular method of achieving air transport liberalisation. Each option is to be adopted at a pace consistent with each economy's national interest and progress made unilaterally, plurilaterally or multilaterally through fora like the GATS is equally acceptable.

Several APEC economies have agreed to open skies agreements plurilaterally or bilaterally, with specific air cargo liberalisation provisions. The Multilateral Agreement on the Liberalisation of International Air transport (MALIAT), signed by Brunei Darussalam, Chile, New Zealand, Singapore and the US in 2001, provides for 5th and 7th freedom access for all-cargo flights and has liberal provisions on intermodal rights. The participants of MALIAT have agreed to amend the Agreement to allow for new Members to accede on a cargo-only basis, so as to allow interested countries to take advantage of the air cargo network of participant economies, independently of decisions to liberalise air passenger services. The Andean Pact, to which Chile and Peru are parties, also provides full freedom for all-cargo non-scheduled flights of Member countries' airlines and between Member countries and third countries.

Bilateral open skies negotiated by the US, several of which signed with APEC economies, always provide for cargo related elements. These include 5th and at times 7th freedom rights for cargo operators, competitive ground support (such as self-handling and intermodal rights) and liberal treatment of non-scheduled cargo services. Notably, these agreements have granted access to major US carriers (e.g. United Airlines) and integrated express carriers (e.g. Fed-Ex) the freedom to fly between different countries in Asia. Unrestricted all-cargo services for specified routes are also in place between a number of other APEC economies, including Australia and New Zealand, which provide for 7th freedom rights. Important developments have also taken place in China, which has been moving towards a more liberal policy for cargo, including by permitting joint ventures for cargo carriers. China has further allowed the use of Hainan Island for 5th freedom cargo flights by foreign carriers.

Air cargo liberalising initiatives within ASEAN

In South East Asia, liberalisation of air transport is proceeding at a slower pace, although air cargo is leading the way. In 2002, ASEAN air transport authorities signed a Memorandum of Understanding on Air Freight Services (hereafter MOU), as an important element of the implementation of the open skies policy that they initially agreed to pursue in 1995 at their first summit in Bangkok. The MOU allows 3rd and 4th freedom traffic rights for designated airlines of Member countries to operate all-cargo services of up to 100 tons weekly based on point-to-point route, with no limitations on frequency and aircraft type. In 2007, the Agreement was amended to increase the permitted capacity to 250 tons per week. The MOU is viewed as a milestone in ASEAN since it is the first agreement on air services adopted by all ASEAN Members.

Liberalising agreements have also been signed by a sub-set of ASEAN Member countries. Brunei Darussalam, Cambodia, Singapore and Thailand concluded the Multilateral Agreement on the Full Liberalisation of all Air Cargo Services in 2003. The Agreement allows carriers from the four economies to operate unlimited air cargo services between them and provides for other ASEAN nations to sign on when they are ready. Other similar agreements allowing for unlimited cargo operations have been concluded by some ASEAN Members with third parties, including Malaysia and Thailand.

Multilateral developments

The WTO has so far succeeded in applying multilateral trade rules to three limited aspects of air transport, in the form of a separate Annex on Air Transport Services under the GATS. In particular, the Agreement addresses three ancillary services: (1) aircraft repair and maintenance; (2) the selling and marketing of air transport services; and (3) computer reservation system services. The GATS specifically excludes traffic rights and the services directly related to the exercise of these rights. Several proposals relevant to cargo have been submitted during the first review of the Annex; these ranged from the addition of ground-handling services and services auxiliary to all modes of transport, to the more ambitious inclusion of air freight services (WTO 2000a; and WTO 2000b).

At the same time, as part of the general services negotiations in the Doha Round, interested Members have focused on several issues relevant to air cargo. A proposal, co-sponsored by a number of developed and developing countries in 2004, called for the liberalisation of logistics services, including air freight transport and services auxiliary to all modes of transport (e.g. cargo handling, and storage and warehousing services). The proposal also suggests additional commitments aimed at reducing administrative burdens of goods at customs, which are being taken up in the broader WTO discussions on trade facilitation. These include in relation to more efficient procedures and formalities, customs clearance and electronic processing (WTO, 2004).

The International Civil Aviation Organisation (ICAO), the other prominent multilateral body with jurisdiction on air transport, has also recently stressed the importance of easing restrictions to air cargo transport. During the Fifth Worldwide Air Transport Conference held in Montreal in 2003, ICAO's Secretariat pointed out that in light of its different characteristics from passenger transport, air freight could be the subject of a special regulatory treatment. It suggested various proposals to liberalise air cargo, ranging from more liberal traffic rights to liberalisation of ownership rules and other aspects specific to all-cargo operations, such as more liberal arrangements for intermodal transport and ground handling and

warehousing. ICAO is of the view that these proposals could be formalised by incorporating an "Annex on air cargo services" in bilateral ASAs.

At the Conference, participants from various organisations involved in air transport as well as ICAO's Contracting States put forth proposals that acknowledged the special nature of air cargo and called for its separated and more rapid liberalisation. The discussions led to the adoption by all ICAO's Member States of a "Declaration of Global Principles for the Liberalisation of International Air Transport." With respect to air cargo, the Declaration stipulates that: "States should give consideration to liberalising the regulatory treatment of international air cargo services on an accelerated basis, provided that clear responsibility and control of regulatory, safety and security oversight is maintained."

III. The evolving characteristics of air cargo transport

Since the 1980s, with the reduction of tariffs and other trade barriers, there has been a marked trend towards international integration of economic activity. This has resulted in large volumes of products, raw materials and components flowing across international borders as part of global supply chains. Advanced manufacturing requires a complex international network of assembly and production sites, shipping parts from one location to the other, and often back to its origin following processing and assembling of products.[1] Emerging economies in Asia-Pacific, in particular, have been at the centre of location strategies by multinational firms in sectors such as electronics and clothing to take advantage of lower labour and material costs. For example, through the 1990s Philips Semiconductor and Dell Computer benefited significantly in terms of cost and shipping time reduction by locating sourcing operations respectively in Thailand and Malaysia (Kasarda *et al*., 2004).

Underlying these developments is also the emergence of a new commercial environment in which time is playing an increasingly important role for competitive success. A prominent advance in production, distribution and inventory control methods is commonly known as "just-in-time", under which all elements in the value chain are synchronised to decrease production and delivery cycles and reduce inventories. The logic behind just-in-time operations is that inventory costs have become prohibitively

[1] It should be noted that manufactured exports, particularly in industries characterised by international production sharing, contain a considerable amount of imports. In 2001, for example, the import content represented 32% of export value in the electronics sector in China, 65% in Thailand and 72% in the Philippines (Nordås *et al.*, 2006).

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high in the production and distribution of many manufacturing products in the new global economy. Early delivery can increase warehousing and inventory expenses, while late delivery can result in costly interruptions of production and foregone sales. Product life spans are also shortening in several industries, such as electronics, pharmaceuticals and designer clothes (Nordås *et al.*, 2006).

The speed and enhanced reliability of air cargo play an essential role in the implementation of international production networks and just-in-time supply chain management. According to IATA, air cargo currently accounts for 35% of the value of world trade (IATA, 2006) and the share is considered to be higher in the Asia-Pacific region. Advanced manufacturing firms are also increasingly locating at sites near air cargo hubs to optimise their location strategies. In many Asian economies, these developments have contributed to foster investment in aviation infrastructure. Airports from Kuala Lumpur, Singapore and Thailand's new Bangkok International Airport are setting world standards for security and efficiency, operating round the clock. China has made remarkable infrastructure investments in its busiest airports, with major expansions in Beijing, Guangzhou and Shanghai (Senguttuvan, 2006).

Air cargo shipping is a complex endeavour that involves a wide range of firms and requires on-going coordination between them, both with respect to the physical movement of products and the management and exchange of information. The industry has typically distinguished providers in three core functions, physical carriage, forwarding and integration:

- **Air carriers:** predominantly move cargo from airport to airport and largely rely on freight forwarders to deal directly with customers. So-called *combination* carriers either use only the belly holds of their passenger aircraft and consider cargo as a marginal source of income (e.g. United Airlines); or both dedicated freighter aircraft and the belly holds in passenger aircraft (e.g. Korean Airlines). All cargo airlines operate only freighters on scheduled and non-scheduled operations (e.g. Nippon Cargo Airlines in Japan). In light of the seasonal nature of part of air cargo, charters play a non-negligible role. The bulk of the world's air cargo is carried by combination carriers in scheduled and non-scheduled operations.

- **Freight forwarders:** act as intermediaries between airlines and the end customer (e.g. U-Freight and Nippon Express). They contract with airlines for the carriage of goods and buy block space on their flights, consolidate shipments for carriers, and deliver the goods to consignees through contracting with ground transportation services. In addition, by leasing and sometimes operating aircraft, forwarders are also acting as virtual air carriers.

- **Integrated express carriers:** constitute a particularly dynamic segment, which first developed in the US facilitated by the 1977 Air Cargo Deregulation Act. Express carriers (e.g. FedEx and UPS) provide as one entity the different components of door-to-door services. To achieve higher speed and reliability, they use dedicated multimodal transport networks, owning and operating their own aircraft of different sizes, surface transportation equipment such as trucks, and automated handling and storage facilities. At times, integrators operate similarly to forwarders, relying on charters and other third party capacity to provide the actual transport services.

In recent years, the traditionally fragmented nature of air cargo firms has undergone profound change. Just-in-time manufacturing and decreasing product life spans, coupled with technology advances (e.g. real-time booking and tracking), have led to a reorganisation of the industry towards more integrated, ground-linked structures. The most prominent challenge to the traditional air cargo system has resulted from the rapid expansion of integrated service providers. Until recently, a single shipment was handled by several airlines, multiple forwarders, as well as customs brokers, warehouse operators, and trucking firms. Express companies have thrived by reducing some of this complexity through the integration of air and ground functions performed by airlines, forwarders, and ancillary service providers (Bowen and Leinbach, 2002). As a result, integrated express operators such as FedEx and UPS now rank among the largest cargo airlines in the world (see below).

Meanwhile, some large international freight forwarders are operating their own trucking fleet to handle goods on the way to and from the airports and are expanding into value-added services for comprehensive supply chain management. So-called third-party logistics (e.g. US-based Geologistics) handle warehousing, order fulfilment, inventory analysis and other logistics functions for multinational clients (Schwarz, 2005). Similarly, airlines are giving a higher profile to their cargo divisions, sometimes making them separate entities. For example, Cathay Pacific has expanded into the express industry with its Wholesale Courier and Cargo Express services (Dodwell and Zhang, 2000). These companies increasingly provide express services similar to those of the express operators. Airlines have also attempted to compete with integrators by forming partnerships with freighter and shipping companies.

Another important development in the airline industry has been the creation of cargo alliances, partly intended to meet the challenges posed by regulation in the sector and by the growth of integrators. Like for passenger services, air cargo carriers have started to cooperate through common service options, sales and compatible information systems in order to build global networks. Air cargo alliances first emerged in 2000 with the establishment of the WOW Alliance (initially named New Global Cargo) and of Sky Team Cargo. Several cargo carriers from APEC economies are members to these alliances.

Singapore Airlines Cargo and as of 2004 Japan Airlines are part of the WOW Alliance, while Sky Team Cargo includes Delta Airlines, Korean Airlines and Aeroméxico Cargo.

Traditionally, air cargo specialised in high value-to-weight products, perishable goods or urgent items (e.g. medicines). In the late 1990s, the range of air transported products has widened, reflecting an increasingly liberal and dynamic trading environment. The industry has grown with rising value-per-weight of many goods but has also been able to move down the value-to-weight ladder. Electronics and garment account for a significant share of international air cargo flows. As noted, these industries have combined low-cost labour (particularly in Asia) with air transport in complex, labour-intensive production processes and international supply chains. Other important commodities carried by air include food (e.g. live animals), pharmaceuticals and machine parts (Kasarda *et al*., 2006). Most cargo airlines are also involved in the transportation of mail.[2]

While for obvious reasons air passenger and cargo transport share many features, there are a number of characteristics which are specific to air freight. For starters, air cargo flows are "unidirectional" since, unlike passengers, goods move in one direction. This imbalance is apparent in the cargo flows between Asia and North America. Secondly, the routing of goods (e.g. whether they fly direct to destinations) is not very important as long as time requirements for delivery are met. Air cargo firms, particularly integrated express operators, also rely considerably on overnight transport in order to make best use of the time between close of business, when a company hands over its shipment, to delivery early the following day (reducing the lead-time of cargo on the ground). Furthermore, air freight is often combined with other modes of transport, which allows the use of more remote and less congested airports (Zhang and Zhang, 2002).

Recent global and APEC regional industry trends

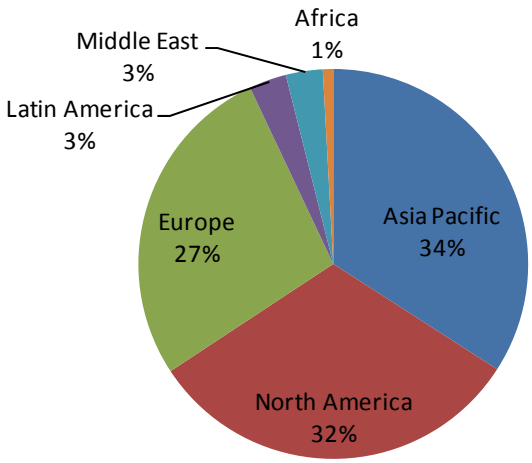
The air cargo industry has grown at a rapid pace over the past several decades. World air cargo volumes grew at 7.7% per year between 1980 and 2000, more than twice as fast as the growth of GDP ICAO, 2001). Air cargo growth has subsequently slowed in light of major external events. Work by the WTO Secretariat shows an average growth rate of around 6% between 2000 and 2005; growth was uneven during the period ranging from double-digit growth to actual declines (WTO, 2007). More recently, with the slowdown in world trade caused by the global financial crisis, international air cargo traffic fell

[2] Although for simplicity this paper uses cargo and freight interchangeably, technically cargo is the sum of freight and mail.

considerably (IATA, 2009). Industry specialists also suggest that even though the air cargo industry has often achieved high rates of traffic growth, air cargo revenues have been declining in recent years (Grünschloß, 2005). IATA estimates that around 50% of air freight is carried in the belly holds of passenger aircraft (quoted in Aviation Week and Space Technology, 7 May 2007), although all cargo airlines and particularly integrated express operators are growing rapidly.

The air cargo traffic pattern in different regions of the world is varied (see e.g. Boeing, 2007; and WTO, 2007). The Asia Pacific region has experienced dynamic growth and currently accounts for almost 40% of world traffic, while growth has been modest in North America and Europe, the other two largest air cargo markets (see Figures 1-2 below). According to Boeing, the Asia Pacific region will continue to lead the world air cargo industry in average annual growth rates in the next 15 years. All Asia-related traffic is expected to expand, with the fastest-growth rates forecasted for the intra-Asia market at 8.6% growth per year. China will be the fastest-growing market in the world with an estimated average 10.8% growth per year (Boeing, 2007).

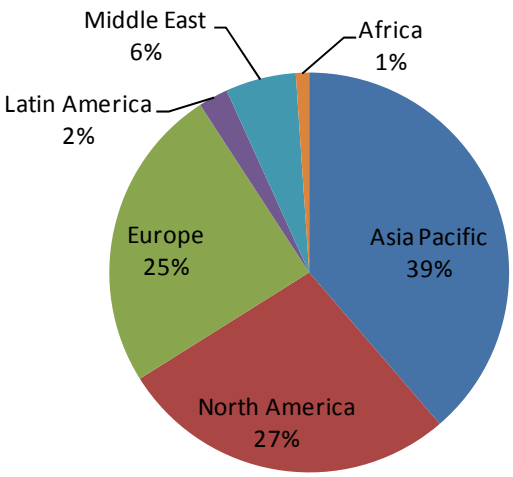
Figure 1. Percent of cargo traffic by region, 2000



Note: Million of ton-kilometres performed.

Source: Airline Business.

Figure 2. Percent of cargo traffic by region, 2005



Note: Million of ton-kilometres performed.

Source: Airline Business.

Among the top 25 airlines in the world in terms of cargo traffic, 11 are from Asia and a total of 19 are from APEC economies (see Table 1). The pattern of air cargo development is different between Asia and the US. Although several Asian airlines have dedicated cargo fleets, air cargo remains for the most part carried in the belly compartments of passenger aircraft, which are typically wide-bodied. As such, passenger airlines compete head-on for the general air cargo business. In the US, most passenger carriers use narrow-bodied aircraft, which significantly limits their capacity to carry cargo. This is one of the factors contributing to the rise in the share of US cargo carried by integrated expressed operators by around 60% in the last 30 years (Zhang and Zhang, 2002). As indicated in Figure 1, Fed-Ex is now the largest cargo airline in the world and UPS ranks third.

Table 1. World leading cargo airlines, 2005

Airline	Rank	Country	Type	Traffic	Revenue
FedEx	1	United States	I	14,641	21,446
Air France-KLM	2	France	C	10,830	3,498
UPS	3	United States	I	8,460	3,920
Korean Air	4	Korea	C	8,139	2,273
Singapore Airlines Cargo	5	Singapore	C	7,874	1,953
Lufthansa Cargo	6	Germany	C	7,829	3,209
Cathay Pacific	7	China	C	6,618	1,653
China Airlines	8	Chinese Taipei	C	6,078	1,409
Cargolux	9	Luxembourg	F	5,292	1,446
EVA Air	10	Chinese Taipei	C	5,285	1,242
Japan Airlines	11	Japan	C	5,177	2,017
Air China Cargo	12	China	C	5,060	n/a
British Airways	13	UK	C	4,933	884
Emirates	14	UAE	C	4,451	1,214
Martinair	15	Netherlands	C	3,518	874
Northwest Airlines	16	United States	C	3,335	947
American Airlines	17	United States	C	3,226	622
United Airlines	18	United States	C	2,949	729
Asiana Airlines	19	Korea	C	2,857	836
Air China	20	China	C	2,763	454
Polar Air Cargo	21	United States	C	2,599	556
Nippon Cargo Airlines	22	Japan	F	2,598	911
Malaysia Airlines	23	Malaysia	C	2,534	574
LAN Airlines	24	Chile	C	2,392	910
Qantas	25	Australia	C	2,329	572

Note: C: Combination carriers; F: Dedicated freight operators; and I: Integrated express operators. Traffic is in million of ton-kilometres performed and revenue in USD millions.

Source: Airline Business.

Similarly to passenger services, air cargo industry trends are closely related to broader economic performance. The Asia-Pacific region has experienced the highest GDP growth rates during the last decade or so (CAPA, 2007). In particular, the expansion of Asian air freight markets has been led by the booming Chinese economy and by shifts in production and manufacturing of consumer goods from North America and Europe towards Asia, where as noted low-cost labour is more readily available. Furthermore, the relatively long distances in Asia-Pacific and the fact that major countries in the region do not share land borders, increase the importance of air cargo as land transport is often not feasible. Another characteristic of the geographic structure of Asian markets (and of the industry in general) is the concentration of its leading airports (e.g. Hong Kong and Singapore) in so-called freight corridors, which convey long distance freight for further hub-and-spoke distribution in local markets (Senguttuvan, 2006).

The growth of air cargo in the APEC region has taken place notwithstanding the intervention of major external events that have occurred over the last decade. These include the Asian financial crisis, the collapse of the technology bubble, the September 11 attacks in the US, SARS and recent global crisis. Increasing jet fuel prices have posed a further challenge to the industry. These shocks had a significant impact on some APEC economies. For example, fleet sizes were reduced in Japan, Chinese Taipei and Korea, which are important producers of information technology products particularly hit by the crises. Yet, apart from the recent financial crisis, cargo volumes were consistently less affected than passenger volumes and, even during the crises, major Asian carriers went on with investments to expand their cargo divisions. SARS even had a paradoxically positive effect on all cargo traffic, since freight that could no longer be transported in belly holds of passenger aircraft was shifted to all cargo flights (WTO, 2007).

IV. Regulation of air cargo services

As noted, like passenger services, air cargo is governed by the regulations set forth in the Chicago Conference of 1944, although it would seem that in general the regime accorded to cargo flights is more liberal than for passenger flights. In addition, different categories of air cargo providers are not subject to the same regulatory mechanisms. Traditional air carriers (combination and all-cargo airlines) that carry the highest share of cargo on a scheduled basis are subject to the highest level of regulation. Non-scheduled charter operators and integrated express carriers are generally subject to less extensive regulation. Integrated express operators are also often able to circumvent regulatory constraints by subcontracting their operations to local providers. Pure freight forwarders are the least restricted providers because they do not typically entail any air carriage themselves, but purchase the needed services from authorised operators (OECD, 2002).

Air cargo carriers are also constrained by a range of other regulations affecting their operations. Foreign ownership restrictions are typically in place preventing foreign carriers from gaining a controlling interest in domestic airlines (to be distinguished from ownership and control criteria in bilateral ASAs). Air carriers may not be permitted to diversify into complementary air cargo functions such as ground transportation and warehousing. Laws in some countries restrict ground handling to particular firms or the airport authority or prevent airlines from offering such services. For example, in Hong Kong air cargo carriers must use one of three franchise companies for cargo loading. In other countries such as Australia, China and Indonesia airlines are prohibited from providing their own ground handling services. The time required for customs to clear air cargo in airports represents another prominent hindrance to service providers (US ITC, 2005).

The existing regulatory framework that governs the air cargo industry is under increasing pressure to keep pace with worldwide trade and economic expansion. The international regulatory system prevents free route development, network optimisation and flexible service design by different categories of providers. As seen in Section III, air cargo carriers have different needs than passenger carriers. The unbalanced nature of cargo flows often requires a second or third stop in order to make routes profitable. Flexibility in the provision of air cargo services has become increasingly necessary in today's internationally fragmented supply chains and just-in-time manufacturing practices. Other restrictions affecting carriers' operations, such as diversification into ancillary services, constrain the provision of integrated air cargo services. Similarly, products must be able to move through customs in a timely and cost-efficient manner (Kasarda *et al*., 2004).

The bilateral air transport regime

The bilateral ASAs regime in the APEC context was discussed in detail for passenger services in Geloso Grosso (2008). The system specifies services (passenger and cargo) and routes that can operate between two countries, designates airlines, and stipulates capacity and fares. Two other important features of ASAs relate to rules on ownership and in particular to restrictions on foreign participation and on the ability to operate charter services. This paper focuses on the particular characteristics of air cargo services against the backdrop of traditional regulatory elements:

- **Traffic rights:** To meet the needs of their manufacturing customers and operate efficiently in hub-and-spoke systems, modern air cargo services increasingly require ability to route cargo and operate capacity as trade volumes dictate, picking up and dropping off cargo at any point along that route. As such, to provide flexibility for planning air cargo services, the capacity to exercise 5th and 7th freedom traffic rights is considered particularly important. (Carry freight between two countries on a route with origin/destination in its home country; and carry freight between two countries by an airline of a third country on a route with no connection with its home country.) These rights by allowing for triangular operations and improved return traffic possibilities would also take better into account the fact that air cargo flows are often unbalanced. In addition, industry specialists view authorising cabotage operations (carry freight within a country by an airline of another country on a route with origin/destination in its home country) as a way to enhance network building (OECD, 2002).

- **Designation:** In order to provide services a carrier must be designated under the bilateral ASAs. Broadly speaking, there are two possibilities: single designation where each party may designate one airline and multiple designation where each party has the right to designate one or more airlines. Single designation or limited multiple designation can pose particular difficulties for all-cargo and express companies, since it is often the national flag or major passenger carriers that are granted the right to offer services.

- **Capacity and pricing regulation:** The frequency, type of aircraft and capacity to be used in conducting transportation services remain restricted in bilateral agreements. These restrictions, coupled with the limited number of route designations in certain agreements, have remained a significant operational limitation. Nevertheless, in recent years several ASAs have incorporated more flexible capacity regimes for cargo services, for example through negotiated incremental capacity increases. Most current bilateral ASAs also retain pricing provisions, although they affect different categories of air cargo providers to varying degrees. On certain routes, for instance, integrated express providers are free to set their own rates with limited if any government intervention. An important aspect of pricing regulation are mandatory filing requirements. Although often put in place to protect against preferential or discriminatory pricing, these measures may lead to competition policy concerns (WTO, 2001).

- **Ownership rules:** Traditional bilateral ASAs typically provide for the most restrictive provision in this area, requiring that the air carriers designated by a contracting party be "substantially owned and effectively controlled" by nationals of that contracting party. Governments have adopted such an approach for several policy reasons, including safeguarding essential safety requirements in order to avoid the emergence of substandard air carriers. Ownership provisions have also been seen as a way to ensure national participation in international air transport (OECD, 2000). However, since there is often no need to protect the national flag, ownership and control regulation is more flexible in the case of cargo services (WTO, 2007).

- **Charters:** The operation of international charter services may not be allowed in bilateral ASAs, since as for passenger services, charter operators may be perceived to divert traffic of scheduled services. Charters and leasing of aircraft[3] (see below) represent a significant source of flexibility

[3] Technically, the operational control of leasing differs from charter arrangements where control of the aircraft and crew remains with the owner of the aircraft.

for the air cargo industry, in responding to seasonal peak loads and in developing cargo operations with limited capital.

Other impediments to air cargo firms' operations

Prominent restrictions affecting the operations of air cargo firms beyond traffic rights and other elements of the bilateral regulatory system include the following:

- **Foreign ownership restrictions:** Governments typically limit the majority of ownership or equity in air transport carriers to nationals. Such restrictions reinforce the provisions on ownership in bilateral ASAs (see above). Ownership rules often extend beyond companies to ownership and control of the aircraft they operate and at times to the nationality of their flying personnel. In such cases, leasing and particularly "wet leasing" (hiring with flying personnel) of foreign freight aircraft may be restricted (OECD, 1999). Joint ventures with local carriers may also be limited, although these restrictions are being increasingly relaxed, for example in China (WTO, 2007).

- **Airport utilisation:** Airport congestion and slot scarcity can inhibit air cargo services, particularly combination carriers carrying passengers and cargo, since these carriers tend to operate during the day at peak hours. All-cargo carriers and integrated express operators are less affected by slot scarcity as they work principally at night. The latter operators are more constrained by so-called airport curfews, whereby airports stop their services during night time, in light of noise-related environmental concerns. However, although some airports in APEC are congested (e.g. Japan), as seen in Section II, many Asian economies are significantly investing in airport infrastructure and only few maintain restrictions on night flights (Senguttuvan, 2006).

- **Ancillary services:** Air cargo carriers may be hampered by the regulatory regime applied to ancillary services, such as ground handling and multimodal transport, which play an important role in the provision of door-to-door integrated services. Ground handling services include ramp-handling, parcel dispatching and storage. Restrictions are often in place (including as part of provisions in bilateral ASAs) limiting air cargo carriers to choose freely between selecting among competing ground handling suppliers, providing their own ground handling services or performing such services for other carriers. The provision of integrated air cargo services also depends significantly on other transport modes, particularly surface transport, to reach the final destination. However, transport licenses are for the most part sector specific, which compartmentalise

operations and constrain the ability particularly of express operators to control every stage of the freight journey. Finally, restrictions are also often imposed on air carriers to diversify into other cargo services, such as freight forwarding (OECD, 2002).

- **Customs procedures:** Although beyond the scope of this study, industry experts have noted that customs can have a considerable impact on time-sensitive global supply chains. For example, Ruo (2002) finds that the time spent on crossing customs in China accounts for over 40% of the total international cargo transport time. Customs clearance is an integral part of governments' responsibility to enforce tariffs, safeguard public health and interdict illicit drugs. Nevertheless, delays at customs can seriously undermine the operation of air cargo companies and increase delivery times. Bottlenecks can arise from inadequate resourcing of customs facilities, both in terms of human resources and modern technology (e.g. electronic data interchange, or EDI), inconsistent and unpredictable valuation criteria and inspection procedures or restrictions on the value and weight of shipments. Lack of risk-based techniques to designate shipments for intensive physical examination represents a further concern. In several countries, inefficiencies are compounded by varying standards of professional integrity (Oxford Economic Forecasting, 2005).

Regulation of air cargo in APEC

As noted earlier, the bilateral air transport system applies to cargo as well. In particular, cargo carried in the belly holds of passenger airlines is by definition governed by the same regime. A detailed analysis of the bilateral regime in the context of APEC economies was conducted by Geloso Grosso (2008). However, bilateral ASAs often include specific provisions for all-cargo flights, including integrated express operators, which are generally more open than for passenger carriers. In addition, air cargo carriers are also affected by a range of other impediments affecting their operations. Although there exists no single comprehensive source of information on the range of regulations affecting air cargo, a picture of the regulatory landscape in APEC economies can be drawn from combining different sources.

CAPA

CAPA (2007) represents the most comprehensive set of data on the main cargo-specific features of bilateral ASAs in the APEC context. The report, prepared as part of the implementation of the APEC Eight Options, draws on the most recent surveys undertaken in the context of the ASG, complemented by other sources. These include the 2004 ICAO's Register of Air Services Agreements, CAPA's own

material and governments' websites. The analysis covers around 300 bilateral agreements concluded by APEC economies and includes route schedules, traffic rights and tariff regulation specific to cargo, in addition to clauses in ASAs relating to the provision of ground handling services.

Table 2 below presents the main findings of the analysis. It indicates that although restrictions to air cargo services remain in place in many bilateral agreements, there has been some progress in easing them by APEC economies. 56 ASAs have incorporated open route schedules for cargo, representing about 20% of the agreements for which data on this component are available. Open 3rd and 4th freedom rights are in general as common as 5th freedom, even though restrictions to the latter remain widespread (106 ASAs, over 50% of the total). Notably, 25 bilateral ASAs grant 7th freedom rights for cargo services.

Tariff restrictions for freight transport have been liberalised in almost 50 bilateral agreements, although some restrictions in this area are still very common (111 ASAs, about 60% of the total). Also significant is the headway achieved in introducing domestic competition in the provision of ground handling services (over 60% of ASAs) and on self-handling, allowed by as many as 73 agreements. In addition, as seen in Section II, encouraging signs pointing towards liberalisation of cargo provisions are provided by plurilateral and regional agreements such as the MALIAT and the Andean Pact.

Table 2. Analysis of APEC bilateral ASAs

Type		No ASAs	% of ASAs
Routes	Open schedules	56	20.4
	Restricted schedules	115	41.8
Freedoms	Open 3rd & 4th	74	27
	Open 5th	66	26
	Restricted 5th	106	53.8
	7th	25	11.3
Tariffs	Open	48	23.9
	Some restrictions	111	60.7
Ground handling	Single domestic provider	27	16.5
	Competing domestic providers	145	62.8
	Self-handling	73	36.3
	Foreign designated third party handling	32	19.6

Source: CAPA, 2007.

Achard

Building on the WTO QUASAR developed by the WTO Secretariat, Achard (2009) has created a database with information on cargo-specific provisions in ASAs. The information is based on the actual texts of the agreements and on memorandums of understanding amending them. The analysis covers a sample of 120 routes and 111 ASAs regulating the traffic on these routes, and the provisions of ASAs coded are almost the same as those used in QUASAR to calculate the Air Liberalisation Index (ALI). The different measures have then been aggregated in alternative ways to calculate a composite indicator, the Cargo Air Liberalisation Index (CALI, see Section V below).

A total of 102 APEC routes are included in the analysis, 44 among APEC Members and 58 between Members and non-Members. As shown in Table 3, while ASAs concluded among APEC economies are somewhat more liberal, the pattern of regulatory provisions is similar for the two samples. 5th freedom rights are granted in the majority of cases (around 75% in both APEC-APEC and APEC-non APEC routes), whereas 7th freedom and cabotage are very rarely accorded. A similar percentage of ASAs among APEC Members permit multiple designation with a fewer number (over 60%) according it between APEC and non-APEC airlines.

Tariff and ownership rules remain restrictive in the majority of ASAs. Over 70% of APEC-non APEC ASAs require double approval of tariffs, with about 50% of agreements imposing it on routes within APEC (in line with what is found in the broader sample analysed by CAPA). A similar number of ASAs maintains the more restrictive substantial ownership and effective control requirement in the two samples. Restrictions on capacity are also in place in a large number of ASAs in the form of pre-determination or Bermuda I although, particularly in the APEC-APEC sample, a relatively large number of agreements (almost 30%) grant free determination. Some headway has also been achieved with respect to cooperative arrangements and change of gauge (allowing to change aircraft during a journey).

Table 3. Features of APEC bilateral routes

	APEC-non APEC	APEC-APEC		APEC-non APEC	APEC-APEC
5th freedom	43	32	**Pre-determination**	19	10
7th freedom	1	2	**Bermuda I**	14	11
Cabotage	0	1	**Free determination**	7	12
Single designation	8	6	**SOEC**	41	25
Multiple designation	37	28	**COI**	0	1
Dual approval	42	22	**PPoB**	4	8
Country of origin	0	0	**Cooperative agreements**	11	13
Dual disapproval	1	1	**Wet leasing**	2	5
Zone pricing	0	0	**Change of gauge**	14	11
Free Pricing	11	11	**Intermodal rights**	7	9

Source: Achard, 2009.

GEA

While information on impediments affecting the operations of cargo carriers in general is not available, the Global Express Association (GEA), the international body representing business interests of integrated express operators, has collected data on restrictions affecting the sector. GEA has made available on-line a fairly comprehensive inventory of measures in over 150 countries compiled using information from official government responses to a questionnaire. The WTO Secretariat has summarised from the inventory those operational restrictions that may affect the air services component of express operators (WTO, 2007).

Restrictions to integrated express delivery operations in selected APEC economies are presented in Table 4 below. Limitations on foreign investment in the sector remain in place in several countries, in the form of foreign ownership limits, exclusion of foreign service providers from certain activities and local partnership requirements. Some countries restrict the ability of foreign operators to expand into complementary air cargo functions such as warehousing and there are also restrictions on ground handling services. Several APEC economies further maintain limitations on the value and weight of shipments, as part of broader constraints relating to customs procedures.

Table 4. Restrictions to express delivery operations in selected APEC economies

Country	Entry restrictions in the express delivery sector	Restrictions on foreign investment that relate to express delivery services	Requirements for or restrictions on the use of local services	Restrictions on the weight, price, etc. of express shipments	Discriminatory restrictions on slots and ground handling	Restrictions on transport and delivery operations
Brunei Darussalam			All cargo required to be transferred to the Brunei International Air Cargo Warehouse prior to release			
Canada		All courier/LVS programme participants must be Canadian-based companies in order to obtain the appropriate licences and certificates		Shipments valued in excess of C$ 1,600 are not eligible for treatment as express shipments		
Chinese Taipei	Multiple licensing requirements; USD1,200 air freight forwarder service permit	Domestic express services prohibited to foreign-owned companies		Less than 70 kg		
Hong Kong, China				Ban on transporting letters weighing less than 2 kg		
Indonesia	Restrictive licensing	Foreign ownership limited to 49%	Customs brokerage and warehousing required to be locally owned	Less than 110 kg, 274 cm length and less than USD 500 in value		
Japan						Express delivery operators are required to have a licence from the Ministry of Infrastructure and Transport; postal vehicles are exempt from this requirement
Korea	Applicants for air express delivery licences must have a worldwide network covering over 50 countries					

Country	Entry restrictions in the express delivery sector	Restrictions on foreign investment that relate to express delivery services	Requirements for or restrictions on the use of local services	Restrictions on the weight, price, etc. of express shipments	Discriminatory restrictions on slots and ground handling	Restrictions on transport and delivery operations
Malaysia	Restrictive licensing and special fees USD 4,000 per year	Foreign ownership limited to 49%			Ground handling must be performed by a specific local company	
Mexico		Only domestic applicants may obtain the requisite licences to allow trucks to operate on highways	Required to use external broker for shipments above USD 5,000			
New Zealand			The data must be sent to the New Zealand customs through a third party, ECN			
Peru				Less than USD 2,000 and 50 kg		
Philippines	Two licences required from one ministry	Foreign ownership limited to a maximum of 40%	Moratorium on new bonded warehouses forces use of existing, locally-owned warehouses			Movement restrictions
Singapore					Ground handling limited to two local companies	
Thailand	Restrictive licensing	Local partner requirement	Requirement to use locally-owned warehouses	Deliveries of a value of less than B 40,000	Ground handling must be performed by TAGS	
United States		Foreign-owned companies may not engage in domestic transport operations				

Source: Global Express Association, 2007.

V. Sensitivity of merchandise trade to the liberalisation of air cargo in APEC

Literature review

Despite the growing importance of the air cargo sector as a facilitator of international trade, little formal research has analysed the impact of liberalisation (or lack thereof) on trade flows. A number of empirical studies have analysed the effects of transport costs on trade flows, at times specifically incorporating air shipping costs. A widely used framework for the analysis is the gravity model, which describes bilateral trade as a function of GDP, distance and other geographical and institutional variables. Limão and Venables (2001) employ a gravity model that explicitly includes transport costs, in addition to distance, to analyse bilateral trade flows. The study finds that a 10% increase in transport costs reduces trade volumes by 20%.

Hummels (2001) explicitly takes account of the effects of transport time in a detailed study of US imports. He finds that an increase of shipping time of one day reduces the probability of exports to the US by 1% (for all goods) and 1.5% (for manufactured goods). The study includes direct estimates of the tariff equivalents of time and finds that air shipping costs declines are equivalent to reducing tariffs on manufactured goods from 32% to 9% ad-valorem. Nordås *et al.* (2006) extend Hummels' analysis and estimate the impact of time on the probability to export and on trade volumes to Australia, Japan and the UK. The authors find that time has a large and robust impact on the probability to export, and the impact is strongest in the electronics sector. Time also has a large impact on trade volumes, and again the effect is greater for electronics.

The US International Trade Commission undertook a broad investigation of logistics services covering a wide range of restrictions affecting different segments of the industry, including air cargo (US ITC, 2005). The study found that both US merchandise exports and foreign merchandise exports shipped through the US are sensitive to the availability and quality of logistic services in the importing country. Lower levels of trade impediments related to logistics services, especially with respect to airport, seaport, and customs procedures, in the importing country are associated with higher US merchandise exports. The effects on international trade are most robust for US airborne exports, since they tend to be made up of time-sensitive products. In another study, Wilson *et al.* (2005) use a gravity model to show that trade facilitation, including the efficiency of air transport markets, can play a major role in promoting trade.

Work on the potential impact of reforming specifically the air transport industry has so far focused on passenger services, with very few studies examining the air cargo component. Using simple correlation analysis, Kasarda et *al.* (2004) report a statistically significant relationship between aviation liberalisation (defined as the number of existing bilateral agreements) in 63 nations and the volume of air cargo. Micco and Serebrisky (2004), analyse the effects of open skies agreements signed by the US with its aviation partners on air transport costs. The study finds that the long-term effect of signing these agreements can reduce air freight costs by around 8%.

More recently, Achard (2009) used a gravity model to estimate the impact of regulation on air cargo flows, using data collected by IATA on the top 100 routes worldwide between 2002 and 2007. The analysis employs the CALI as a cargo-based variant of the WTO ALI (see Section IV), which is built by using both expert judgment and statistical techniques. In particular, it uses principal component analysis as pioneered by Gonenc and Nicoletti (2000) and more recently applied again to air passenger services by Piermartini and Rousova (2008). The study provides evidence that air transport liberalisation is associated with larger bilateral cargo flows.

Methodology

This paper extends previous empirical work in two directions. First, it uses the WTO ALI to investigate the impact of aviation policy on bilateral trade in APEC. The ALI has previously been used to analyse the determinants of bilateral air traffic (Geloso Grosso, 2008; and Piermartini and Rousova, 2008), with Achard (2008) being the only study so far applying (a variant of) it to air cargo. The approach here differs from Achard's in that the analysis focuses on a single region (APEC) in which air transport is particularly important, and it uses bilateral trade data rather than cargo flows as the dependent variable. Even though the ALI has in principle been developed for passenger traffic, as seen in Section IV most segments of air cargo are also governed by the bilateral air transport system and a significant amount of merchandise travels as belly cargo on passenger services.[4]

[4] The CALI developed by Achard (2009) could not be employed in the analysis since it is not available for enough routes in the sample used here. Achard (2009) also reports that simple correlation coefficients between the ALI and the CALI for selected routes range from 0.6 to 0.9 depending on the weighting schemes used. Thus, the ALI can be considered as an acceptable proxy for policy restrictions affecting cargo. In any case, the gravity model employed in this study will give consistent estimates of the impact of aviation policy on trade provided that the measurement error associated with the ALI is not systematically related to noise in the trade data, which is unlikely.

Furthermore, the use of bilateral trade data as the dependent variable makes it possible to examine the potential for air liberalisation to affect some sectors more strongly than others. Due to data limitations, previous work has not been able to do that. In particular, this paper uses previous results from the international trade literature to separate time sensitive and time insensitive goods, and parts and components from final goods trade. Particularly in the Asia Pacific region, there is good reason to expect that access to affordably priced and reliable air transport services is most important for manufacturers of time sensitive goods, and parts and components (see Section III).

Against this background, the standard gravity model of bilateral goods trade is employed in this study to test two hypotheses:

1. Greater bilateral air transport liberalisation, as measured by the ALI, is associated with larger bilateral trade flows.

2. Air transport liberalisation has a stronger effect on trade in sectors such as time sensitive goods and parts and components, than on others such as time insensitive goods and final products.

The gravity model

The empirical analysis here uses a version of the Anderson and Van Wincoop (2003) gravity model. The gravity model is the workhorse of the applied international trade literature. It is well suited to this analysis because it allows for bilateral trade costs to play an important role in determining the observed pattern of international trade flows. It is consistent with the model's theoretical underpinnings to introduce data on the degree of aviation liberalisation on each bilateral route as one determinant of bilateral trade costs. The two hypotheses set out above follow directly from the intuition that air transport liberalisation can be expected to reduce trade costs, and to do so more significantly for time sensitive sectors.

First, a gravity model is estimated for APEC economies using data on total imports (i.e. summing over sectors) as the dependent variable. The model takes the following form:

$$\log(X_{ij}) = \log(E_j) + \log(Y_i) - \log(Y) + (1-\sigma)\log(t_{ij}) - (1-\sigma)\log(P_j) - (1-\sigma)\log(\Pi_i) + \varepsilon_{ij} \qquad (1)$$

where: X_{ij} is exports from country i to country j, proxied here by better-quality import data; E_j and Y_i are respectively country j's expenditure and country i's production; Y is worldwide output; σ is the intra-sectoral elasticity of substitution (i.e. the elasticity of substitution among product varieties); t_{ij} is the bilateral trade costs function; and ε_{ij} is a residual satisfying standard assumptions. The two terms $\left(P_j\right)^{1-\sigma} = \sum_{i=1}^{N} \Pi_i^{\sigma-1} \omega_i \left(t_{ij}\right)^{1-\sigma}$ and $\left(\Pi_i\right)^{1-\sigma} = \sum_{j=1}^{N} P_j^{\sigma-1} \omega_j \left(t_{ij}\right)^{1-\sigma}$, with ω_i being the country's share in global output or expenditure, represent respectively inward and outward multilateral resistance. The first of these terms captures the dependence of j's imports on trade costs across all suppliers, while the second captures the dependence of i's exports on trade costs across all destination markets.

Anderson and Van Wincoop (2003) show that inclusion of the multilateral resistance terms in the model is vital in order to ensure unbiased parameter estimates, and to take account of general equilibrium effects in counterfactual simulations. However, it is not necessary to estimate these complex, nonlinear functions of trade costs and prices directly. Consistent estimates of the parameters of the trade cost function, which are what we are interested in, can be obtained by including appropriate dimensions of fixed effects. In the simple case of a single sector (e.g. total imports), fixed effects by exporter and by importer control for the size of each economy, as well as inward and outward multilateral resistance. The gravity model becomes:

$$\log\left(X_{ij}\right) = c + \sum_{i=1}^{N} d_i + \sum_{j=1}^{N} f_j + \left(1-\sigma\right)\log\left(t_{ij}\right) + \varepsilon_{ij} \qquad (2)$$

where the d and f terms are, respectively, exporter and importer fixed effects.

All that remains is to specify the trade costs function t. To do this, the analysis uses the ALI and a set of control variables that are standard in the gravity modelling literature: distance as a proxy for transport costs; a geographical contiguity (common border) dummy; a common language dummy; a common coloniser dummy; a dummy for the existence of a colonial relationship between two countries; and bilateral tariffs. Thus:

$$\log\left(t_{ij}\right) = b_1 ALI_{ij} + b_2 \log\left(1 + tariff_{ij}\right) + b_3 \log\left(dist_{ij}\right) + b_4 border_{ij} + b_5 language_{ij} + b_6 comcol_{ij} + b_7 colony_{ij} \qquad (3)$$

Since the interest here is in identifying sector-specific impacts of air transport liberalisation, in addition a version of the gravity model is needed that can be used with sectoral data. Such a model is given by a simple rearrangement of (1), in which k indexes sectors, and the model parameters are allowed to vary across sectors.

$$\log\left(X_{ij}^{k}\right)=\log\left(E_{j}^{k}\right)+\log\left(Y_{i}^{k}\right)-\log\left(Y^{k}\right)+\left(1-\sigma_{k}\right)\log\left(t_{ij}^{k}\right)-\left(1-\sigma_{k}\right)\log\left(P_{j}^{k}\right)-\left(1-\sigma_{k}\right)\log\left(\Pi_{i}^{k}\right)+\varepsilon_{ij}^{k} \quad (4)$$

Estimation issues

Traditionally, gravity models such as the one set out here have been estimated by ordinary least squares (OLS). However, recent work by Santos Silva and Tenreyro (2006) shows that OLS estimates can be highly unreliable in this type of log-linearised model when the error term in the original non-linear model is heteroskedastic. Unlike standard heteroskedasticity, which can lead to bias in the estimated variance-covariance matrix only, the type of heteroskedasticity identified by Santos Silva and Tenreyro (2006) can produce serious bias in the coefficient estimates as well. To deal with this problem, the authors suggest using the Poisson pseudo-maximum likelihood (PPML) estimator. Poisson produces consistent parameter estimates under relatively weak assumptions (the data need not follow a Poisson distribution) and is robust to the multiplicative heteroskedasticity investigated by Santos Silva and Tenreyro (2006).[5]

The question of whether a particular dataset is subject to the type of heteroskedasticity that can be dealt with by Poisson estimation is, of course, an empirical one. This study therefore estimates all models by OLS and Poisson. To test whether the OLS log-linearised model is appropriate, the fitted values are used to perform a Park test (Santos Silva and Tenreyro, 2006, equation 11). The null hypothesis for that test is that the OLS model is adequate. Next, the Poisson fitted values are used to test the null hypothesis that the PPML model is adequate (Santos Silva and Tenreyro, 2006, equation 13).

In all but one case, strong evidence is found that OLS is an inappropriate estimator: the null hypothesis is rejected at conventional levels of significance, most commonly at the 1% level. By contrast, the second test statistic rejects the null hypothesis of Poisson in one baseline regression (10%), and three

[5] Another advantage of the PPML estimator is that observations for which trade is zero can be included in the estimation sample. In the present case, however, very few observations fall into this category; Poisson is used primarily as a means of dealing with heteroskedasticity. The criticisms that have been leveled at the PPML estimator as a means of dealing with zeros — e.g. Helpman *et al.* (2008); Martin and Pham (2009); Martinez Zarzoso *et al.* (2006) — are therefore much less relevant here.

robustness regressions (10% or 5%). In those four cases, the Park test rejects OLS at the 1% level. Following the logic of Santos Silva and Tenreyro (2006), these results suggest that Poisson should clearly be the workhorse estimator for this dataset. Even in the four outlier cases mentioned, the PPML estimator will still provide consistent parameter estimates, even though they could conceivably be made more efficient by adopting a different heteroskedasticity assumption. In what follows, the analysis therefore reports Poisson results only, and includes the probability values associated with both sets of test statistics.

The dataset

As noted above, the policy variable for the empirical analysis is the ALI developed by the WTO Secretariat as part of its work on the QUASAR database. QUASAR represents the most comprehensive and informative source currently available on bilateral aviation policies, covering over 2000 agreements. The effective date for the database is 2005. That is also the base year for the regressions here, which are necessarily cross-sectional.

The ALI is calculated by selecting the provisions of bilateral ASAs deemed to be particularly important for market access and assigning a score between zero and 8 to each restriction. Zero indicates the most restrictive measure and eight the least restrictive. These scores are then averaged in consultation with a group of experts using weights intended to reflect the relative importance of each restriction. The ALI is the sum of the weighted scores obtained by a given ASA, and ranges between zero for very restrictive agreements and 50 for very liberal ones. The scores attributed can also be altered to take into account the specific situation of a country pair, in particular by giving more weight to: 1) fifth freedom traffic rights (e.g. for geographically remote countries such as Australia and New Zealand); 2) withholding, in particular community of interest and principal place of business; and 3) multiple designation.

The dependent variable is bilateral trade between APEC economies. These data are sourced from the United Nations COMTRADE database, accessed via the World Bank's WITS interface. Import data are supplemented by mirror (export) data in the case of missing values. The small number of observations (approximately 2%) for which neither import nor export data are available are coded as zero. Great circle distance and the other geographical and institutional variables are from the CEPII distance dataset.[6] Bilateral effectively applied tariffs are sourced from UNCTAD's TRAINS database via WITS.

[6] These data are freely available at http://www.cepii.fr/anglaisgraph/bdd/distances.htm.

Regression results

Table 5 below presents the baseline estimation results. Column 1 uses total imports (equations 1-2) above. The model performs strongly, accounting for 97% of the variation in bilateral trade.[7] The coefficient on aviation liberalisation as measured by the ALI is positive, which is in line with expectations. It is only marginally significant at the 10% level (prob. = 0.103). Its magnitude suggests that, as an impact measure, a one point increase in the ALI score of a given ASA is associated with a 1.3% increase in bilateral trade; however, this assessment does not account for general equilibrium effects.

The signs and magnitudes of the control variables are largely in line with expectations as well: distance and tariffs have negative and 1% significant coefficients, while geographical contiguity has a positive and 5% significant coefficient. The only exception is the colonisation dummy, which is negative and statistically significant. However, this variable is only equal to unity in six observations (2.5% of the sample). This is unlikely to constitute a sufficient amount of variation to support valid inference; indeed, the colony dummy is statistically insignificant in nearly all other regressions reported here. Its unexpected sign is therefore not a major issue in interpreting the results.

Results using total imports may mask important cross-sectoral differences. For instance, Hummels (2001) shows that some goods are more time sensitive than others, either due to their physical characteristics, or possibly the way in which their production process is managed. To examine these possibilities further, a number of sectoral splits are exploited in the data by estimating separate models for different classes of goods (see equation 3 above). Treating the data in this way allows accounting for possible cross-sectional heterogeneity that might affect results using total imports, due to the fact that multilateral resistance varies across sectors, as does the intra-sectoral elasticity of substitution. At the same time, this approach makes it possible to exploit differences in product characteristics, including time sensitivity, to ensure the robustness of the first hypothesis and to test the second one.

Results from the first sectoral split, manufacturing (HS chapters 25-97) versus agricultural products (HS chapters 1-24), are in columns 2-3 of Table 5. Notably, the ALI is positively and significantly (10%) associated with bilateral trade flows in manufactured goods. In the case of agricultural products, though the association is still positive, it is considerably smaller in magnitude and statistically insignificant. Since the semi-elasticity for manufactures is nearly identical in magnitude to the coefficient

[7] The R^2 is calculated as the square of the correlation between actual and fitted values from the Poisson regression.

on the ALI in the total imports regression, it can be concluded that the bulk of the trade effects of air liberalisation in APEC passes through industrial products rather than agriculture. This finding seems intuitive given the importance of trade in manufactured goods within the region, as well as the relatively high levels of agricultural protection in many APEC countries.

Next, the analysis follows Djankov *et al.* (forthcoming) and trade in manufactured goods is unpacked into two sub-sectors: time sensitive and time insensitive products. To do so, the results from Hummels (2001) are used, coupled with the product lists contained in Table 7 of the working paper version of Djankov *et al.* (forthcoming). Under this approach, time sensitive and insensitive products are defined using the three two-digit SITC categories that exhibit the highest and lowest degrees of time sensitivity according to Hummels (2001).[8] Again, the regression results tend to support the second hypothesis: the coefficient on the ALI is positive and 10% significant in the case of time sensitive goods, but it is statistically insignificant for time insensitive products. Nevertheless, the difference between the two coefficients is not large and the ALI coefficient in the time insensitive goods equation is significant at the 15% level. Thus, results from this sectoral split are not as strong as anticipated.

As a final sectoral separation, trade in parts and components are considered versus trade in final goods. Ando and Kimura (2003) show that the rise of production networking, with its reliance on moving parts and components across borders quickly and reliably, has been a remarkable characteristic of trade relations in East Asia over recent years. As seen in Section III, given the importance of low inventory carrying costs and just-in-time management techniques in creating and sustaining networked production, the speed at which trade takes place can be critical. It therefore seems plausible that parts and components might be more sensitive to aviation policy liberalisation than final goods, since air transport is a ready means of moving parts and components quickly within a production network.

To define parts and components versus final goods, the product lists compiled by Ando and Kimura (2003) are used here. Results are presented in columns 6-7 of Table 5. In this case, the data strongly support the second hypothesis. The ALI coefficient is positive and 1% significant for parts and components trade. Its magnitude is at least double that of the coefficients in the previous columns of Table 5: a one point increase in the ALI is associated with an increase of 4% in bilateral parts and components trade, prior to taking account of general equilibrium effects. By contrast, the ALI coefficient for final

[8] Thus, time sensitive products are defined as: office machines (SITC code 75), electrical machinery (77), and photographic apparatus (88). Time insensitive products are: textile yarns and fabrics (65), non-metallic minerals (66), and furniture (82).

goods trade is statistically insignificant. Moreover, the difference between the estimated ALI coefficients in the two equations is statistically significant at the 5% level, suggesting that the impact of air liberalisation on parts and components trade is more important than for trade in final goods.

The previous regressions provide evidence that there is an economically and statistically significant association between aviation liberalisation and goods trade, but they do not allow identification of the effects of particular measures. To examine this question in more detail, a final regression is run using the parts and components data, in which the different policy components of the ALI are entered separately. The ALI is replaced with a series of dummies equal to unity if particular policies are included in an ASA. There is sufficient variation in the data to allow separate identification of the impacts of: fifth freedom rights; seventh freedom rights; multiple airline designation; free determination of capacity; free pricing; allowing cooperative agreements among airlines; and provision for principal place of business.

Results from this exercise are shown in column 8 of Table 5. With only two exceptions, the individual policies carry positive and statistically significant (1%) coefficients with sensible magnitudes. Thus, liberalisation along each of these dimensions is associated with more bilateral trade. The effect is especially strong for free pricing, which indicates that this is a particularly important policy from a trade point of view. However, the grant of fifth and seventh freedom rights, as well as multiple designation and allowing cooperative agreements among airlines, also have economically significant impacts.

The only exceptions in column 8 of Table 5 are free determination of capacity and the provision for principal place of business. In the former case, the coefficient is statistically insignificant. In the latter case, however, the coefficient is negative and significant at 1% level. The negative sign may be due to fact that, unlike the other regulatory components which are full liberalisation measures, principal place of business is still a restriction (although less burdensome than other withholding measures). This result however will require further investigation.

Table 5. Baseline regression results — PPML, reporter and partner fixed effects (2005)

	1	2	3	4	5	6	7	8
	Aggregate	Manufacturing	Agriculture	Time Sensitive	Time Insensitive	Parts & Components	Final Goods	Parts & Components
ALI	0.013	0.014*	0.004	0.017*	0.020	0.040***	-0.001	
	[0.008]	[0.008]	[0.017]	[0.010]	[0.013]	[0.009]	[0.009]	
Ln(1+tariff)	-5.387***	-5.172***	-4.907**	-2.585	-7.720***			
	[1.706]	[1.515]	[2.260]	[2.428]	[2.315]			
Ln(distance)	-0.548***	-0.599***	-0.717***	-0.537***	-0.722***	-0.802***	-0.634***	-0.803***
	[0.045]	[0.046]	[0.081]	[0.078]	[0.090]	[0.076]	[0.060]	[0.076]
Common Border	0.379**	0.085	0.783***	-0.147	0.135	-0.577**	0.026	-0.739***
	[0.165]	[0.153]	[0.256]	[0.251]	[0.249]	[0.251]	[0.202]	[0.258]
Common Language	0.041	0.055	-0.103	0.017	-0.139	0.258**	0.106	0.340***
	[0.097]	[0.095]	[0.180]	[0.109]	[0.190]	[0.114]	[0.101]	[0.128]
Common Coloniser	0.316	0.354	0.104	0.151	0.580*	0.226	0.179	0.333
	[0.300]	[0.268]	[0.499]	[0.279]	[0.345]	[0.298]	[0.344]	[0.275]
Colony	-0.295**	-0.134	-0.150	0.062	0.151	-0.095	-0.361*	-0.001
	[0.121]	[0.106]	[0.248]	[0.111]	[0.211]	[0.183]	[0.193]	[0.179]
5th Freedom								0.416***
								[0.123]
7th Freedom								0.533***
								[0.200]
Multiple Designation								0.419***
								[0.152]
Free Determination								-0.095
								[0.118]
Free Pricing								1.642***
								[0.228]
Cooperative Agrt.								0.361***
								[0.132]
PPOB								-1.348***
								[0.420]
Observations	240	240	240	239	237	248	248	248
R2	0.969	0.967	0.985	0.953	0.991	0.985	0.981	0.987
Prob.(H0: OLS)	0.003***	0.001***	0.054*	0.005***	0.012**	0.001***	0.003***	0.022**
Prob. (H0: Poisson)	0.471	0.234	0.498	0.054*	0.579	0.877	0.198	0.960

Note: Robust standard errors corrected for clustering by country pair are reported in brackets. Statistical significance as follows: *** (1%), ** (5%), and * (10%).

Robustness checks

The regressions presented above are estimated using all APEC country pairs for which the ALI has been calculated. However, not all of these countries in fact have an existing bilateral air link. In some cases, passengers and cargo must transit through a regional hub, such as Singapore, before reaching their final destination. As a result, a bilateral measure like the ALI might be a more meaningful indicator of trade costs for country pairs that have a direct air link. If the first hypothesis above is correct, one would expect to see stronger evidence of a link between the ALI and bilateral trade when the sample is limited to country pairs with a direct air link only.

To investigate this possibility further, the regressions in the first seven columns of Table 5 are re-estimated limiting the sample to only those country pairs with an existing bilateral air service (see Table 6). As expected, the ALI coefficient is greater in all seven regressions than in the corresponding regressions from Table 5. Statistical significance has also increased in most cases. Once again, the effect of aviation liberalisation on trade is particularly strong for manufactured goods, especially parts and components. These additional results provide strong support for both hypotheses outlined above.

Table 6. Robustness checks using country-pairs with a direct air link only — PPML, reporter and partner fixed effects (2005)

	1	2	3	4	5	6	7
	Aggregate	Manufacturing	Agriculture	Time Sensitive	Time Insensitive	Parts & Components	Final Goods
ALI	0.024***	0.019**	0.022	0.022**	0.027*	0.045***	0.000
	[0.008]	[0.008]	[0.019]	[0.010]	[0.014]	[0.009]	[0.009]
Ln(1+tariff)	-7.134***	-6.669***	-3.922	-5.007**	-6.355**		
	[2.254]	[1.859]	[2.833]	[2.377]	[3.164]		
Ln(distance)	-0.559***	-0.605***	-0.726***	-0.511***	-0.732***	-0.780***	-0.629***
	[0.040]	[0.043]	[0.079]	[0.071]	[0.094]	[0.065]	[0.060]
Common Border	0.218	-0.033	0.639**	-0.236	0.083	-0.606***	-0.022
	[0.159]	[0.149]	[0.274]	[0.227]	[0.260]	[0.214]	[0.202]
Common Language	0.005	0.037	-0.193	-0.053	-0.185	0.170*	0.065
	[0.094]	[0.095]	[0.212]	[0.112]	[0.200]	[0.102]	[0.104]
Common Coloniser	0.526*	0.479*	0.273	0.297	0.605*	0.362	0.221
	[0.291]	[0.257]	[0.535]	[0.259]	[0.358]	[0.282]	[0.341]
Colony	-0.324***	-0.151	-0.190	0.043	0.149	-0.117	-0.361*
	[0.112]	[0.108]	[0.211]	[0.112]	[0.218]	[0.161]	[0.198]
Observations	198	198	198	198	196	206	206
R2	0.971	0.967	0.974	0.910	0.982	0.974	0.963
Prob.(H0: OLS)	12.820***	0.027**	0.008***	0.012**	0.234	0.000***	0.007***
Prob. (H0: Poisson)	0.534	0.276	0.193	0.108	0.692	0.735	0.283

Note: Robust standard errors corrected for clustering by country pair are reported in brackets. Statistical significance as follows: *** (1%), ** (5%), and * (10%).

Another dimension in which robustness checks are important is the measurement of policy restrictiveness. The ALI has much to commend it as an indicator of liberalisation in aviation markets. It is based on professional judgment as to the relative restrictiveness of different measures, and has also been shown to correspond closely with alternative weighting methodologies such as factor analysis (Piermartini and Rousova, 2008). The possibility remains, however, that the relative economic impacts of different policies might be better captured with an alternative set of weights. As the results in this study using disaggregated policy measures suggest, there may be considerable variance across restrictions.

To examine whether the findings are robust to these further considerations, the model is re-estimated using the three variants of the ALI discussed above. Results are presented in Tables 7-8 below, using total imports, and data for the sectors found to be most sensitive to the degree of liberalisation in aviation markets. In terms of sign, magnitude and significance, the performance of these alternative liberalisation measures is very similar to that of the standard ALI. In three cases, the robustness measures are not statistically significant at the 10% level; however, each of these coefficients has a significance level of 12% or higher, which suggests that it would be inappropriate to draw conclusions from these isolated results. Taken together, the results are robust to the use of these other measures of liberalisation.[9]

[9] Additional results (available on request) show that these findings are also robust to the possible endogeneity of the ALI to bilateral trade. The age of each ASA is a strong instrument for the degree of bilateral liberalisation (first stage F = 12.40***): older ASAs tend to be less liberal, as indicated by a negative and 1% significant coefficient in the first stage regression. Moreover, ASA age cannot conceivably affect bilateral trade except through the degree of aviation market liberalisation, so it therefore satisfies the excludability restriction on instrument validity as well. Running two stage least squares on the parts and components data gives an ALI coefficient that is positive but statistically insignificant. However, a Hausman test fails to reject the null hypothesis that the ALI is in fact exogenous ($\chi^2(1) = 0.136$; prob. = 0.712). It is preferable, therefore, to rely on the results presented here rather than on instrumental variables results.

Table 7. Robustness checks using variants of the ALI with aggregate trade and manufacturing — PPML, reporter and partner fixed effects (2005)

	1	2	3	4	5	6
	Aggregate	**Aggregate**	**Aggregate**	**Manufacturing**	**Manufacturing**	**Manufacturing**
ALI 5th	0.018**			0.018***		
	[0.007]			[0.007]		
ALI Designation		0.013*			0.014*	
		[0.008]			[0.007]	
ALI Ownership			0.015			0.016*
			[0.009]			[0.009]
Ln(1+tariff)	-5.229***	-5.456***	-5.379***	-4.957***	-5.238***	-5.155***
	[1.705]	[1.702]	[1.706]	[1.428]	[1.519]	[1.514]
Ln(distance)	-0.565***	-0.545***	-0.548***	-0.621***	-0.595***	-0.599***
	[0.046]	[0.045]	[0.045]	[0.048]	[0.046]	[0.046]
Common Border	0.327**	0.368**	0.381**	0.016	0.076	0.089
	[0.164]	[0.168]	[0.165]	[0.159]	[0.156]	[0.153]
Common Language	0.057	0.051	0.040	0.078	0.066	0.054
	[0.098]	[0.098]	[0.097]	[0.097]	[0.099]	[0.096]
Common Coloniser	0.336	0.322	0.311	0.371	0.355	0.347
	[0.301]	[0.299]	[0.300]	[0.269]	[0.268]	[0.268]
Colony	-0.339***	-0.292**	-0.293**	-0.183*	-0.131	-0.131
	[0.123]	[0.118]	[0.121]	[0.103]	[0.107]	[0.106]
Observations	240	240	240	240	240	240
R2	0.972	0.969	0.969	0.969	0.967	0.967
Prob.(H0: OLS)	0.002***	0.003***	0.003***	0.002***	0.000***	0.001***
Prob. (H0: Poisson)	0.526	0.476	0.468	0.269	0.234	0.229

Note: Robust standard errors corrected for clustering by country pair are reported in brackets. Statistical significance as follows: *** (1%), ** (5%), and * (10%).

Table 8. Robustness checks using variants of the ALI with time sensitive goods, parts and components — PPML, reporter and partner fixed effects (2005)

	1	2	3	4	5	6
	Time Sensitive	Time Sensitive	Time Sensitive	Parts & Components	Parts & Components	Parts & Components
ALI 5th	0.016*			0.037***		
	[0.009]			[0.008]		
ALI Designation		0.016			0.038***	
		[0.010]			[0.009]	
ALI Ownership			0.019			0.045***
			[0.012]			[0.011]
Ln(1+tariff)	-2.349	-2.734	-2.569			
	[2.425]	[2.447]	[2.426]			
Ln(distance)	-0.557***	-0.530***	-0.536***	-0.843***	-0.794***	-0.802***
	[0.081]	[0.078]	[0.078]	[0.082]	[0.074]	[0.076]
Common Border	-0.227	-0.150	-0.145	-0.776***	-0.596**	-0.575**
	[0.265]	[0.252]	[0.251]	[0.268]	[0.250]	[0.249]
Common Language	0.037	0.027	0.016	0.304**	0.282**	0.256**
	[0.120]	[0.115]	[0.110]	[0.120]	[0.113]	[0.115]
Common Coloniser	0.145	0.147	0.146	0.220	0.209	0.216
	[0.278]	[0.280]	[0.279]	[0.302]	[0.295]	[0.299]
Colony	0.048	0.067	0.065	-0.133	-0.090	-0.093
	[0.115]	[0.112]	[0.112]	[0.200]	[0.168]	[0.182]
Observations	239	239	239	248	248	248
R2	0.911	0.909	0.909	0.972	0.971	0.970
Prob.(H0: OLS)	0.005***	0.002***	0.003***	0.009***	0.003***	0.002***
Prob. (H0: Poisson)	0.042**	0.046**	0.052*	0.378	0.771	0.898

Note: Robust standard errors corrected for clustering by country pair are reported in brackets. Statistical significance as follows: *** (1%), ** (5%), and * (10%).

VI. Conclusions

This paper has shown the importance of air transport and the policy regime that governs it for merchandise trade within APEC. As has been frequently pointed out in the literature, the Asia-Pacific region has experienced rapid trade growth over recent decades, leading to a high degree of international integration in some areas. Simultaneously, the region has seen remarkable growth in the importance of transnational production networks characterised by vertical disintegration, small inventories and just-in-time management. Networked production requires an environment allowing for rapid, affordable and reliable international transportation links, particularly with respect to air transport.

The bilateral air transport regime also applies to air cargo. In particular, cargo carried in the belly holds of passenger aircraft is by definition covered by the same system. In addition, bilateral ASAs often

include specific provisions for all-cargo flights which are generally more open than for passenger carriers. Some progress has been achieved in easing restrictions by APEC economies through bilateral open skies and encouraging signs pointing towards liberalisation are provided by plurilateral and regional agreements such as the MALIAT. Yet, restrictions remain in place in relation to traffic rights, tariffs, capacity and ownership rules. Other domestic operational restrictions such as limitations on foreign investment or on expansion into complementary cargo functions are further maintained by several APEC countries.

Using the gravity model, this paper finds strong support for two hypotheses with important policy implications. First, more liberal air services policies are positively, significantly and robustly associated with higher bilateral merchandise trade. This impact is greater for country-pairs that have a direct air transport link, but is also significant for country-pairs that rely on transit through third countries. These findings highlight the importance of moving forward on air transport liberalisation both bilaterally and through regional or multilateral fora like APEC and the WTO. The positive spillovers from more liberal aviation regimes can be significant.

In addition, the results in this study show that air transport policy matters more for some sectors. A particularly strong relationship is found between bilateral liberalisation and trade in manufactured goods, time sensitive products, and parts and components. Prior to taking account of general equilibrium effects, the estimates imply that a one point increase in the ALI is associated with an increase of 4% in bilateral parts and components trade, the sector found to be most sensitive to the degree of aviation liberalisation. These findings are intuitively appealing, since one of the main advantages of air transport over other transportation modes is speed. From a policy perspective, the results suggest that APEC economies actively seeking greater integration in international networks of production would do well to look at the potential for moving towards a more liberal aviation policy regime.

REFERENCES

Achard, P. (2009), "The Regulation of International Air Cargo Services", Master Thesis, Groupe d'Economie Mondiale, Sciences Po.

Anderson, J.E. and E. Van Wincoop (2003), "Gravity with Gravitas: A Solution to the Border Puzzle", The American Economic Review, Vol 93 No. 1**,** 170-192.

Ando, M., and F. Kimura (2003), "The Formation of International Production and Distribution Networks in East Asia", Working Paper No. 10167, National Bureau of Economic Research.

Boeing (2007), "World Air Cargo Forecast 2006-2007", Seattle, USA.

Bowen J. T. Jr. and T. R. Leinbach (2002), "Air Cargo Services in Asian Industrialising Economies: Electronics Manufacturers and the Strategic Use of Advanced Producer Services", Papers Regional Science, 82, 309–332 (2003).

Centre for Asia Pacific Aviation (CAPA) (2007), "Liberalisation of Air Services in the APEC Region, 1995-2005", APEC Transportation Working Group and the Australian Department of Transport and Regional Services.

Djankov, S., C. Freund, and C. Pham (forthcoming), "Trading on Time", *Review of Economics and Statistics*.

Dodwell, D., Zhang, A. (2000), "Air Cargo at Hong Kong's Service: an Analysis of Current and Future Roles, and Policy Priorities", Manuscript, Department of Economics and Finance, City University of Hong Kong.

Geloso Grosso, M. (2008), "Liberalising Air Passenger Services in APEC", Working Paper, Groupe d'Économie Mondiale, University of Sciences Politiques, November 2008.

Gonenc, R., and Nicoletti, G. (2000), "Regulation, Market Structure and Performance in Air Passenger Transport", OECD, Paris.

Grünschloß C. (2005), "The Development of International Airports into Air Cargo Hubs and its Economic Impact on Local Industrial Structures", Faculty of Business Administration and Management, Heinrich-Heine University Düsseldorf.

Helpman, E., M. Melitz, and Y. Rubinstein (2008), "Estimating Trade Flows: Trading Partners and Trading Volumes", *Quarterly Journal of Economics*, 123(2), 441-487.

Hummels, D. (2001), "Time as a Trade Barrier", Mimeo, Purdue University.

IATA (2006), "Air Freight 2006: Brighter Skies Ahead", *Economic Briefings*, February 2006.

IATA (2009), "Cargo Plummets 22.6% in December", *Press Release*, 29 January 2009, available at: http://www.iata.org/pressroom/pr/2009-01-29-01.htm.

Kasarda, J. D., J. Green and D. Sullivan (2004), "Air Cargo: Engine of Economic Development", study commissioned by the International Air Cargo Association (TIACA).

Kasarda, J. D., S. J. Appold and M. Makoto (2006), "The Impact of the Air Cargo Industry on the Global Economy", study commissioned TIACA and presented at the TIACA Air Cargo Forum, Calgary, Canada, September 13, 2006.

Limao, L. and Venables, A.J. (2001), "Infrastructure, Geographical Disadvantage, Transport Costs and Trade", World Bank Economic Review, 15, 451-479.

Martin, W., and C. Pham (2009), "Estimating the Gravity Model when Zero Trade Flows are Frequent", Working Paper, available at: http://www.deakin.edu.au/buslaw/aef/workingpapers/papers/2008_03eco.pdf.

Martinez-Zarzoso, I., F. Nowak-Lehmann, and S. Vollmer (2006), "The Log of Gravity Revisited", CeGE Discussion Paper 64, University of Goettingen, available at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=999908.

Micco, A. and T. Serebrisky (2004), "Infrastructure, Competition Regimes, and Air Transport Costs: Cross-Country Evidence", World Bank Policy Research Working Paper no. 3355, available at SSRN: http://ssrn.com/abstract=610399.

Nordås, H.K., E. Pinali, and M. Geloso Grosso (2006), "Time and Logistics as a Trade Barrier", OECD Trade Policy Working Paper No 35.

OECD (1999), "Regulatory Reform in International Air Cargo", document DSTI/DOT(99)1, Paris.

OECD (2002), "Liberalisation of Air Cargo Transport", document DSTI/DOT(2002)1/REV1, Paris.

Oxford Economic Forecasting (2005), "The Impact of the Express Delivery Industry on the Global Economy", Oxford.

Piermartini, R., and L. Rousova (2008), "Liberalisation of Air Transport Services and Passenger Traffic", Staff Working Paper ERSD-2008-06, World Trade Organisation.

Ruo, G. H. (2002), "Shanghai Customs Clearance Procedures and Logistics Information Services," Presentation to the Forum on "WTO Implications on Air Cargo Logistics in China", December 2002, Hong Kong.

Santos, S. and S. Tenreyro (2006), "The Log of Gravity", Review of Economics and Statistics, November 2006, 88(4): 641-658.

Senguttuvan, P. S. (2006), "Air Cargo: Engine for Economic Growth and Development — A Case Study of Asian Region", paper presented at the National Urban Freight Conference, 1-3 February 2006, METRANS Transportation Centre, School of Policy, Planning and Development University of Southern California, Los Angeles, USA.

Schwarz G. (2005), "Enabling Global Trade Above the Clouds: Restructuring Processes and Information Technology in the Transatlantic Air Cargo Industry", Graduate School of Geography, Clark University, Worcester, USA.

US International Trade Commission (ITC) (2005), "Logistics Services: an Overview of the Global Market and Potential Effects of Removing Trade Impediments", Investigation No 332-463, USITC Publication 3770.

Wilson J. S., C. L. Mann and T. Otsuki (2005), "Assessing the Benefits of Trade Facilitation: A Global Perspective", The World Economy, Blackwell Publishing, vol. 28(6), pages 841-871, 06.

WTO (2000a), "Communication from the European Communities and their Member States: the Review of the GATS Annex on Air Transport Services" document S/C/W/168.

WTO (2000b), "Communication from Australia: the Mandated Review of the GATS Annex on Air Transport Services" document S/C/W/167.

WTO (2001), "Developments in the Air Transport Sector since the Conclusion of the Uruguay Round, Part Seven: Background Note by the Secretariat", document S/C/W/163/Add.6.

WTO (2004), "Logistics Services", Communication from Australia, Hong Kong China, Liechtenstein, Mauritius, New Zealand, Nicaragua, Switzerland, the Separate Customs Territory of Taiwan, Penghu, Kinmen and Matsu, document TN/S/W/20.

WTO (2006), "Second Review of the Air Transport Annex: Developments in the Air Transport Sector (Part II). Quantitative Air Service Agreements Review (QUASAR) (Volumes I and II): Note by the Secretariat", document S/C/W/270.

WTO (2007), "Second Review of the Air Transport Annex: Developments in the Air Transport Sector (Part III): Note by the Secretariat", Part E: Air Cargo Services, document S/C/W/270/Add.2.

Zhang, A. and Y. Zhang (2002), "A Model of Air Cargo Liberalisation: Passengers vs. All-Cargo Carriers", Transport Research Part E 38 (2002) 175-191.