TRANSPORTATION COSTS OF FRESH FLOWERS: A COMPARISON ACROSS MAJOR EXPORTING COUNTRIES [*]

by
Henry Vega, Ph.D. Candidate
Center for Transportation Policy, Operations, and Logistics,
School of Public Policy, George Mason University [†]

SUMMARY

Exporting fresh flowers is one of very few successful efforts by producers in low-income countries to compete in international markets of high-value agricultural goods. While this success results from producers' ability to take advantage of their geographic location and access to low labor costs, it may not be sustainable in the long run due to unreliable supply chains and high transportation costs. In this regard, it is important to note that to date, there have not been many studies on the subject.

Using a case study approach of Ecuador's supply chain, complemented by an empirical analysis of microdata on exports from major fresh flower exporting countries to the United States, this study confirms producers' claims that time and transportation costs vary widely across countries. The findings of this study indicate that in the Ecuadorian case, time reliability of the supply chain is not the norm. For instance, a shipment of fresh flowers, from the time of harvest on a farm located near Quito until the moment it arrives to a U.S. retailer, can take from 44 ½ hours to almost 13 days. Furthermore, the results of the study also show that depending on the time of the year, transportation costs can be 10 - 20 percent higher for Ecuador as compared to those of Colombia, or on average, about $0.43 higher per kilogram.

While the sources of variations in transportation and time costs are beyond the scope of this study, infrastructure and institutional constraints are widely recognized as having a significant impact on the efficiency with which transportation systems operate. These constraints are present in the case of Ecuador and include inadequacies in current airport operations such as insufficient cargo facilities, runways that are too short to allow large aircraft to take off with full loads, complex governance issues of economic rights in air transportation, high costs of air navigation services, and the prevalence of unbalanced trade flows with the United States.

KEY WORDS: Ecuador, air cargo, transportation costs, supply chain, floriculture

---

[*] Study funded by the Inter-American Development Bank's research initiative, "The Clogged Veins of Latin American and the Caribbean: Assessing the Impact of Transport Costs on the Growth and Diversification of the Region's Exports." The author would like to thank Professor Kenneth Button and Professor David Hummels for the detailed and useful comments that they provided. He is also indebted to Professor Naoru Koizumi and Dr. Ting Zhang for their advice on several aspects of the statistical analysis. Finally, he gratefully acknowledges all the information provided by Ecuador's fresh flower industry experts, Alfonso Maldonado and Juan Abel Echeverría.

[†] Mailing address: 4400 University Drive MS 3C6, Fairfax, VA 22030 U.S.A. E-mail: hvega@gmu.edu

INTRODUCTION

This study examines the legal commercial growth of flowers, an activity that has evolved into a global industry since the turn of the last century.[1] Advances in genetics, transportation, logistics, refrigeration, and telecommunications technologies have resulted in the successful business of flower-growing in countries such as Colombia or Kenya and their subsequent distribution and commercialization in distant markets such as the United States and Russia. In this regard, innovations in the industry have translated into quality predictability of some producers, which is no easy task to accomplish when doing business with perishable goods.[2]

Firms producing cut flowers range from very small to very large, vertically-integrated operations. In addition, the flower industry's value chain includes freight forwarders, export and import agents, wholesalers or brokers, supermarkets, auction houses in the case of the European market, and numerous retailers and providers of airfreight and trucking transportation services. From a development perspective, the complexity of interactions across value chain members and the lack of adequate transportation infrastructure are often barriers to the entry of firms located in low-income countries. In Ecuador, for example, it took about 20 years for new firms to learn from previous failed attempts.

Using Ecuador as a case study, this paper provides a qualitative description of the value chain in the fresh-flower industry and a quantitative assessment of the magnitude of transportation costs across a sample of major exporting countries. In the case of Ecuador, time reliability of the supply chain is not the norm. For example, a shipment of fresh flowers, from the time of harvest on a farm located near Quito until the moment it arrives to a U.S. retailer, can take from 44 ½ hours to almost 13 days. In terms of cost, the results of this study confirm what is commonly believed in the industry about the wide variation in international transportation costs, even between neighboring countries. For example, depending on the time of the year, they can be 10 - 20 percent higher for Ecuador as compared to those of Colombia, or on average, about $0.43 higher per kilogram (kg).[3] It is also worth mentioning an unexpected result of the analysis, which is that transportation costs are the lowest in February even though this is the busiest month of the year as demand for transportation services significantly rises due to the Valentine's Day holiday**.**

The paper covers a range of issues from the size and significance of the industry to the regulatory framework surrounding the provision of air transportation services and is organized as follows. The first section illustrates the importance of the industry using Ecuador's fresh-flower industry as a case study. The second section describes the main characteristics of the value chain, and the third section identifies variations in airfreight costs among major exporting countries. Finally, the study discusses institutional and regulatory issues. Throughout the study, Colombia's industry is used as a benchmark.

[1] Cut flowers are blossoms from flowering plants sold as stems, bunches, or arrangements (fresh, dried, or preserved). The main types of cut flowers include carnations, roses, chrysanthemums, gladioli, tulips, orchids, lilies, alstroemeria, delphinium and larkspur, gerbera daisies, iris, lisianthus, and snapdragons.

[2] Good quality of fresh flowers is not only defined by type, size, color, absence of pests and diseases, and condition upon arrival, but also by performance, or so-called vase or shelf life.

[3] All denominations are in U.S. dollars unless otherwise stated.

FLORICULTURE: A GLOBAL INDUSTRY

Estimates of the annual consumption of commercially grown flowers worldwide vary by source and range from $40 - $60 billion. On the demand side, 80 percent of consumption is accounted for by six countries, including Germany, the United States, the United Kingdom, France, the Netherlands, and Switzerland.[4] While worldwide consumption has been on the rise, at the same time, consumers have also become more sophisticated in demanding new products. For example, the Russian market is well known for its preference for very large flower buds. In addition, niche markets in former Soviet republics are becoming prime growth prospects. To meet this growing and changing demand, production has continued to move from countries that have traditionally been consumers and growers, such as The Netherlands, to other relatively new producing countries. Data for 2004 data rank the Netherlands as the leader with 62 percent of all value traded, followed by Colombia with 14 percent and Ecuador with 7 percent (Hernandez et al, 2007).[5]

The shift in production locations has mainly been driven by the existence of more abundant labor and land elsewhere, and has been made possible by developments in air transportation and refrigeration.[6] Thus, in the United States the business of growing flowers, which began on the east coast and moved to western and southern states in the 1950s, has since expanded to several low-income and least developed countries (LDCs).[7] The impact of increased competition on prices has varied by region. While producers in South America have benefited from flat prices in the U.S. market, by contrast, in Europe the impact of new African suppliers has been reflected in a downward movement of prices. As a result, at the Dutch Cooperative Auctions (VBN), while the import price of roses was $0.16 per stem in 1997, it fell to $0.15 in 1998, $0.13 in 1999, and as low as $0.03 per unit in 2006. Differences among regions are also apparent in labor productivity. Labor utilization varies from about six workers per hectare in the Netherlands to 15 - 20 workers in South Africa, 25 - 30 in Kenya (Whitaker and Kolavalli, 2006), and 10 - 13 in Ecuador (Expoflores, 2004).

In recent years, two developments have had a significant effect on the global market. The first is increased competition in production and distribution. In this regard, established producers such as Ecuador, Kenya, Malaysia, and Thailand have expressed concern about the growth of the industry in China and India as China in particular is reportedly planning to quadruple annual exports to $200 million or to more than a billion

[4] The market share of world imports is as follows: Germany, 22 percent; United States, 15 percent; United Kingdom, 10 percent; France, 10 percent; the Netherlands, 9 percent; and Switzerland, 5 percent.

[5] The total area dedicated to flower production worldwide has increased on a global basis. In 2001 it was estimated at 200,000 hectares (UNITC, 2001). In this regard, developing countries' share of world exports increased from 21 percent in 1991 to 29 percent in 1998.

[6] Air transportation made it possible in the United States to shift cut-flower production from the eastern states to the western and southern states. Regularly scheduled commercial air flights eliminated eastern state growers' ability to charge a premium for freshness during the 1950s (Méndez, 1991).

[7] Developing countries with well-established industries include Colombia, Kenya, Zimbabwe, Cote d'Ivoire, Cameroon, the Dominican Republic, Jamaica, and Ecuador. Exports of cut flowers from LDCs increased from $18 million in 1995 to $45 million in 1999. LDC exporters include Zambia, Tanzania, Uganda, Malawi, Ethiopia, and Rwanda. Exporters of foliage include Haiti, Madagascar ,and Malawi. Currently, LDC exporters have a larger market share in the European Union than they do in the United States. For a study on the importance of LDCs to the industry, see UNITC (2001).

stems by 2010 (Bradsher, 2006).[8] On the distribution side, new flower centers have emerged in locations such as Dubai, Tel Aviv, and Kunming, China. These centers are likely to affect overall efficiency and lower transactions costs for distant producers, resulting in increased pressure on prices (as much as 80 percent of stems sold in the Dutch auctions are exported).[9]

The second important development, to a large extent linked to increased competition, is the considerable progress that has been made in consolidation and vertical integration. For instance, in October 2006 the two largest Dutch cooperative auctions (FloraHolland and Bloemenveiling Aalsmeer) announced their intention to merge. If the merger is authorized by the Netherlands Competition Authority, the new entity would become the world's largest flower marketplace with combined sales of about $4.68 billion. Furthermore, in the United States, large retailers such as Wal-Mart have increased the amount of purchases acquired directly from growers under long-term contracts. A related development is that producers have also integrated. Dole Fresh Flowers, for example, has its own chartered daily deliveries.[10]

The U.S. Market

Consumption of fresh flowers per U.S. household amounted to $9.87 on average in 2006, with two-thirds supplied by imports, up from 50 percent in 1994. This growth rate exceeds the demographic increase and consumption of other agricultural products (Malaga, 2005). Moreover, the effect of growth in consumption on prices has varied across flower varieties. As seen in Table 1, in the case of roses, for instance, prices have remained steady with a slight increase in 2004, up to about 40 cents per stem.

Table 1 – Average Unit Wholesale Prices by Flower Type (2000 – 2005)

Type	2000	2001	2002	2003	2004	2005
Chrysanthemums	0.31	1.30	1.31	1.30	1.33	1.40
Roses	0.37	0.37	0.37	0.38	0.40	0.39
Gerbera	0.31	0.31	0.30	0.30	0.31	0.31
Delphinium, larkspur	0.25	0.24	0.23	0.24	0.25	0.24
Carnations	0.16	0.16	0.16	0.18	0.18	0.20

Source: Jerardo, (2006b).

In 2005 approximately 82 percent of imported fresh flowers came from countries in the Western Hemisphere, with Colombia contributing 59 percent of the total, followed by Ecuador with 18 percent**.** Roses from Central and South American countries made up about half of all U.S. imports, which in 2005 totaled 1.35 billion stems (Jerardo, 2006a). Table 2 further illustrates the importance of the U.S. market for exports of flowers from the Western Hemisphere.

[8] China's advantage may further increase due to abundant low-cost laborers who can clean the thorns of the roses manually.

[9] Chrysanthemums grown in Thailand, for instance, may travel to the Netherlands on their way to the Japanese market. This uncovers what Jacques Teelen, FloraHolland CEO, calls a "disconnecting of the commerce and the logistics" (Economist, 2007).

[10] Dole's farms produce over 250 million stems and increasingly assemble value-added products such as ready-to-sell bouquets. Its Miami operation is a 328,000-square-foot building located on 17 acres, which features research labs and merchandise rooms to showcase about 820 flower varieties.

Ecuador's Fresh Cut Flowers

Ecuadorian flowers, particularly roses, have been recognized as among the finest in the world. The quality of Ecuadorian flowers is the result of a combination of production factors including ideal ecological zones (geographic advantage: altitude higher than 2,000 meters above sea level in the equatorial zone), relative proximity to the United States, availability of rich volcanic soils, abundant labor, and inventive entrepreneurs who seek to match flower, field, and market to maximize profits (Sawers, 2005). Notwithstanding its success, the development of Ecuador's floriculture industry has been a lengthy process characterized by early failures and later successes. Ecuador first attempted to export fresh flowers between 1963 and 1977, but export growth was limited by poor air transportation links to the U.S. market, a lack of technical know-how, and an absence of related industries.

Table 2 – Value of U.S. Imports of Cut Flowers by Country in $Million (2000 – 2005)

Country	2000	2001	2002	2003	2004	2005
Colombia	347.20	302.40	289.50	343.60	415.00	418.30
Ecuador	89.20	99.70	87.30	105.80	134.30	129.40
Netherlands	71.60	67.10	71.30	67.60	65.90	64.70
Costa Rica	19.40	14.70	15.20	17.10	18.80	23.50
New Zealand	2.40	3.20	3.30	4.00	4.30	4.60
Guatemala	5.50	3.40	3.00	3.90	4.10	3.90
Brazil	0.10	0.10	0.70	2.00	2.30	2.90
Chile	2.90	3.40	2.90	2.30	2.00	2.60
Kenya	0.00	0.00	0.50	0.90	1.10	1.20
China	1.40	1.40	1.00	1.50	1.00	1.00
World	610.50	565.50	541.70	610.90	705.90	709.10

Source: U.S. Census Bureau Foreign Trade Division Foreign Trade Statistics Database

The industry was revitalized in 1983,[11] and in the two decades that followed, the area of cultivated flowers grew to approximately 5,000 hectares according to Ecuador's Association of Producers and Exporters of Fresh-Cut Flowers (Expoflores).[12] Of this total, 60 percent were roses. The industry is still relatively young, and as it has matured, only some degree of consolidation has taken place. As shown in Table 3, between 1997 and 2003, the average farm size increased from 10.27 to 12.90 hectares. Given economies of scale, further consolidation of the industry is expected in the future. In this regard, as average growers expand their operations, they will likely be increasingly in a position to take advantage of cost efficiencies. Another important development concerns the fact that producers have become more automated and have developed a cost advantage relative to smaller producers. For example, in Colombia 40 firms with a size larger than 50 hectares account for 50 percent of exports.[13] Furthermore, in the United States, large

[11] Before Ecuatoriana de Aviacion, Ecuador's national carrier, scheduled a weekly flight in 1990, producers had to wait for unoccupied cargo space on passenger planes to transport their products (Arbeláez et al, 2007).
[12] Expoflores represents about 70 percent of producers.
[13] According to Colombia's Association of Flower Producers (Asocolflores), there are 60 medium firms with a size of 20-50 hectares representing 25 percent of exports and 200 small producers whose area is smaller than 20 hectares representing an additional 25 percent of exports.

greenhouse growers can produce ornamental crops at a per-square-foot cost that is 18 percent lower than growers half their size (Schumacher and Marsh, 2003).

From an economic development standpoint and as shown in Table 3, the industry has, in some cases, improved the socio-economic condition of impoverished rural Ecuadorian communities by adding an average of more than 5,500 jobs a year over the last decade. In total, it has generated more than 70,000 direct jobs to date.[14]

Table 3 – Ecuador's Floriculture Industry Statistics

Year	Area (hectares)	Number of Farms	Average Farm Size	Direct Jobs
1997	2,250	219	10.27	25,320
1998	2,700	241	11.20	35,348
1999	2,803	271	10.34	35,715
2000	2,977	277	10.75	36,097
2001	3,208	282	11.38	36,457
2002	3,262	284	11.48	37,130
2003	3,263	253	12.90	39,153
2004	3,396	295	11.51	44,214
2005	3,417	305	11.20	58,259
2006	3,441	350	9.83	76,758

Source: Expoflores

Furthermore, because of spatial concentration, in some counties, the industry is the single largest employer (see Table 4). In this regard, about 66 percent of the cultivated area is located in a single province, Pichincha, and about 22 percent in two adjacent provinces, Cotopaxi and Imbabura.[15]

Table 4 – Concentration of Flower Farms, Ecuador (2005)

Province	Number of ha	%
Pichincha	2,256	66
Cotopaxi	581	17
Imbabura	171	5
Guayas	164	5
Azuay	161	5
Other	83	2

Source: Expoflores

As for its significance in the larger economy, between 1997 and 2006 exports grew by almost 26 percent a year from $131 million to $436 million. Fresh flower exports are now the country's third largest non-oil source of foreign currency. Only export revenue

[14] Expoflores has estimated that 700,000 people are employed in floriculture-related industries, including agrochemicals, irrigation systems, air cargo transportation and logistics, packaging materials, and food services.
[15] Similarly, in Colombia, 85 percent of firms are located in the Sabana de Bogotá.

from bananas and shrimp exceeds that of the fresh flower industry.[16] Figure 1 shows the growth of the industry in volume and value.

As shown in Table 5, in 2006 by far the number one destination of Ecuador's fresh flower exports was the United States. Approximately 58 percent of value of exports, or 63 percent of volume, was destined for this country. Russia occupied the number two position with a considerable smaller market share of 14 percent of value, or 12 percent of volume.

Table 5 – Destination of Ecuador's Exports of Fresh Flowers (2006)

Destination	Kg	$ F.O.B.[1]	$ F.O.B.[1] per kg	% kg	% F.O.B.[1]
United States	65,606	254,041	3.87	63	58
Russia	12,535	59,094	4.71	12	14
Netherlands	11,014	48,115	4.37	11	11
Spain	1,863	10,940	5.87	2	3
Canada	2,483	10,803	4.35	2	2
Germany	1,752	9,021	5.15	2	2
Italia	1,537	7,960	5.18	1	2
Switzerland	1,267	6,188	4.88	1	1
Japan	517	5,283	10.23	0	1
Chile	808	3,215	3.98	1	1
Argentina	269	972	3.61	0	0
Other	4,513	20,211	4.48	4	5
Total	104,164	435,843	4.18	100	100

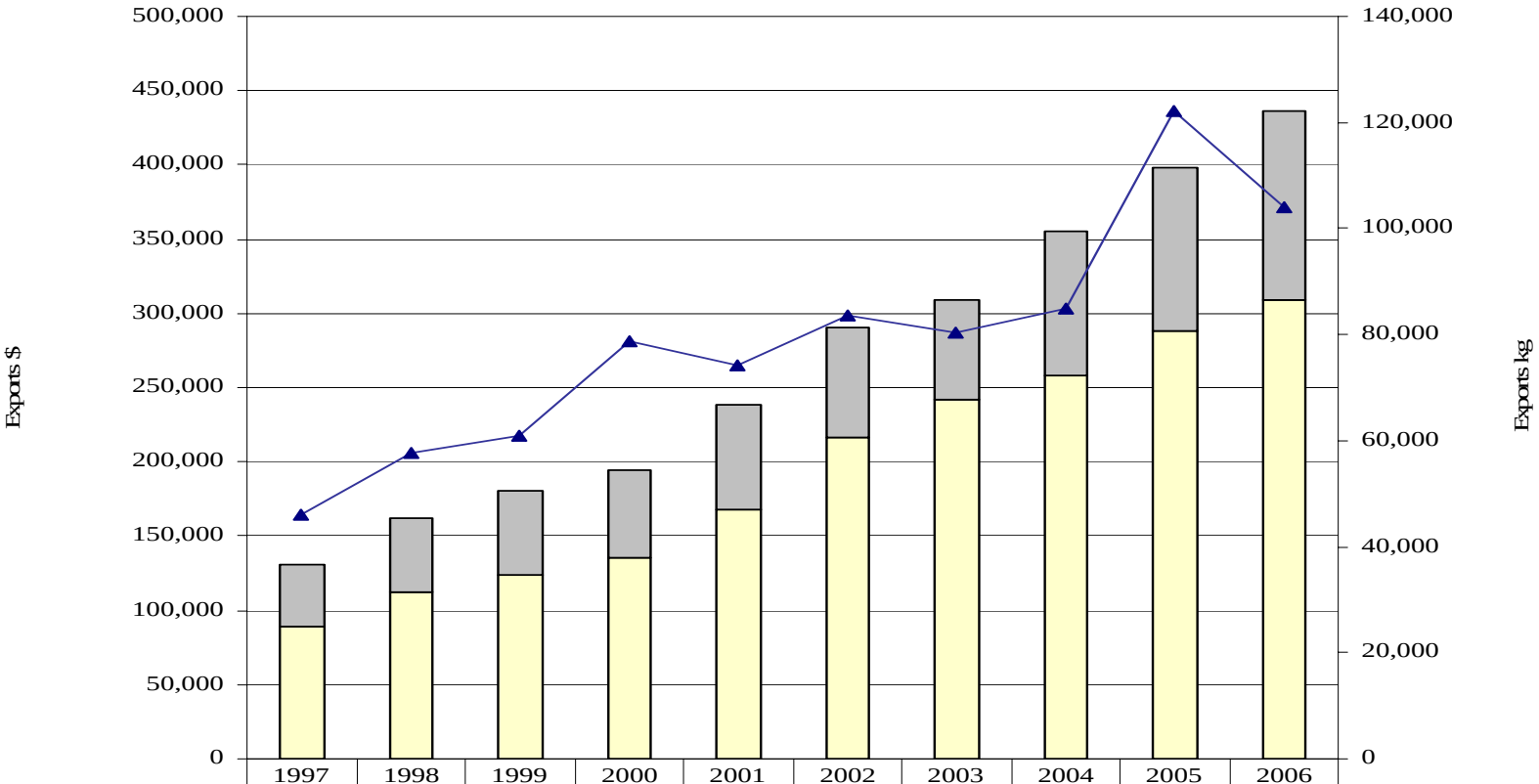
[1] Free on board prices.

Source: Ecuador's Central Bank

Production costs can be roughly broken down as follows: labor, around 60 percent; packing material, 10 percent; chemical products, 9 percent; construction maintenance, 5 percent; consumption materials, 3 percent; energy and fuel, 1 percent; and cuttings, 12 percent. These costs are doubled when adding expenses for marketing, finance, transportation, import duties and overhead (Arbeláez et al, 2007). According to Asocolflores, one dollar's worth of exported flowers increases tenfold once it reaches the end consumer in the United States.

[16] According to Ecuador's Export and Investment Promotion Corporation statistics, non-oil exports represented $5.18 billion in 2006.

Figure 1 – Ecuador's Export of Fresh Flowers (1997 – 2006)



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
$ Other	41,369	50,009	56,376	59,246	69,660	74,440	66,751	97,167	109,674	126,691
$ Roses	89,641	111,953	124,023	135,405	168,391	215,886	241,987	257,651	288,233	309,151
Volume Kg	45,948	57,770	60,935	78,825	74,230	83,631	80,363	84,853	122,185	104,164

Year

Source: Ecuador's Central Bank

VALUE CHAIN AND TRANSPORTATION COSTS IN THE INDUSTRY

As approximately 15 percent of worldwide air cargo is made up of perishables,[17] the importance of transporting perishable goods is growing. And as computers and other goods typically moved by air are increasingly being transported by ship, perishables have experienced an annual growth in volume over 7 percent. Measured as a share of new freight tonne kilometer (FTK),[18] perishables are growing at 12 percent annually, a rate exceeded only by that of capital equipment and intermediate materials and ahead of computers and apparel (von Heereman, 2006). In some South American and African countries, air transportation of perishables represents 80 - 90 percent of total exported airfreight. Notwithstanding these facts, however, air transportation networks connecting countries in these regions are not well developed. Countries lack either the infrastructure or the amenities, or both, to optimize time and cost of the value chain. In fact, industry estimates suggest that up to 35 percent of total production is lost after harvest due to mishandling and loss of quality in the form of vase life.[19] In addition, in many instances due to seasonality and inaccuracy in harvest forecasting, scheduling air services in advance can also be costly as producers contracting chartered services have to bear the cost of both outbound and inbound flights.

From an efficiency point of view, an examination of the aspects of reducing transportation costs and the loss of product quality is particularly relevant since producers appear to be in the weakest position to profit. As Table 6 illustrates, while profit margins differ by region, the producer's share can be as low as 4 percent in the Netherlands, in the United Kingdom, or in Germany, while the margin for the retailer can be as high as 42 percent in the United Kingdom, or 36 percent in the United States.

Table 6 – Profit Margins on Sales of Perishables

Point of Sale	Producer	Forwarder	Airline	Wholesaler	Retailer
United States	6%	25%	16%	17%	36%
Netherlands	4%	32%	14%	39%	11%
United Kingdom	4%	30%	15%	19%	42%
Germany	4%	35%	13%	25%	23%
Switzerland	5%	34%	14%	23%	24%

Source: Von Heereman (2006)

From the producers' perspective, factors with the potential to reduce transportation and logistics costs include:

- increased competition among airlines resulting in reasonable airfreight rates
- stable rates
- overall increased reliability and minimizing transit time variability
- guaranteed customer service from air cargo agencies (freight forwarders)

[17] High value-to-weight perishables include fresh flowers, seasonal fruits and vegetables, exotic fruits and vegetables, and fresh fish and seafood.

[18] One FTK is one metric tonne of revenue load carried one kilometer.

[19] The post-harvest treatment of flowers involves a value chain in which the processes carried out by chain members influences quality. After harvesting, in order to guarantee a vase life of about 7 days, all processes must occur in the shortest possible time under controlled temperature and humidity until final purchase

- suitable equipment and facilities for handling perishables
- appropriate storage capacity at different times
- adequate interface across transportation modes
- transparent and low administrative costs: easy booking, billing, claims

Ecuador's Value Chain Analysis

Value chains, also referred to as supply chains, are defined as institutional arrangements linking producers, processors, marketers, and distributors – often separated by time and space – that progressively add value to products as they go through the chain (see Button, 2001; Nabi and Luthria, 2002). In complex supply chains, the competitiveness of a sector depends on the existence of firms in related industries to provide support services, capital goods, inputs, and information. Firms in the production stage are in charge of processes usually involving research and development, technical know-how, infrastructure, planting and growing, materials procurement, harvest and on-farm post-harvest treatment, and packaging. On the logistics side, public entities and private firms often interact in the provision of public infrastructure such as roads, telecommunications, electricity, airport facilities, scheduled air services, freight forwarding and handling systems, cold storage, refrigerated trucking, quality control, and customs clearance. Finally, firms on the marketing side provide services involving information about supply and demand, advertising, compliance with quality and environmental standards, and customer service.

A general overview of Ecuador's fresh flower industry distribution supply chain is presented here. One of the challenges of supply chain analysis is the difficulty in defining a structure that is applicable to all firms. Thus, due to the heterogeneity of Ecuadorian producers, some have relatively short distribution supply chains consisting of two or three, while others have supply chain lengths that may include more than eight members. The purpose here is therefore to identify members and to assess variations in time from the moment flowers are harvested until they arrive in Miami. Figure 2 shows a short supply chain that represents an ideal scenario, while Figure 3 illustrates a scenario closer to current circumstances. A description of supply chain members follows.

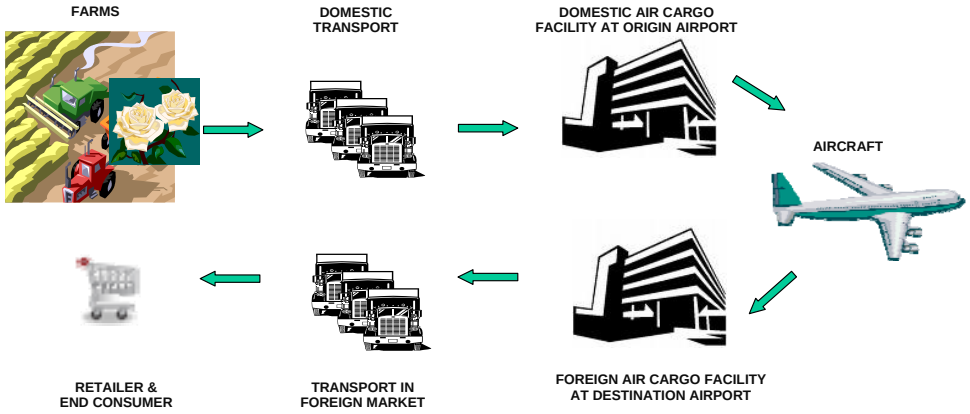
Road Transportation Infrastructure

Ecuador's public transportation infrastructure includes 43,197 km of roads, of which 6,467 km are paved (Ecuador, 2007). Since most farms are located within a few hours of two major cities, the roads that connect farms to cargo agencies' facilities are usually in good condition.

Cargo Agencies

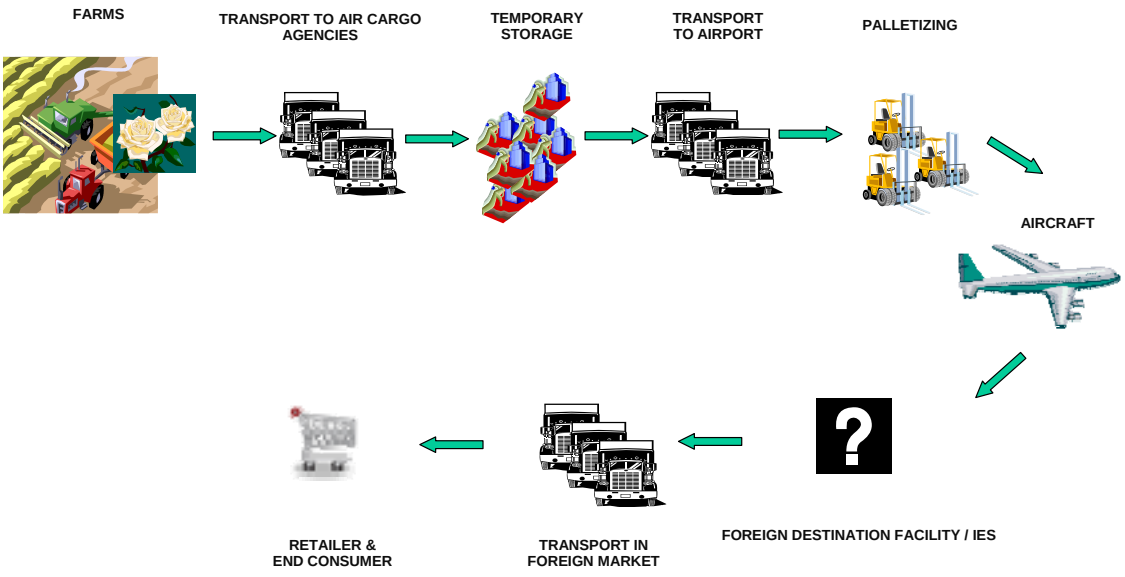
Neither Quito's International Airport (UIO) nor Guayaquil's International Airport (GYE) has sophisticated refrigeration facilities for the storage of perishables. However, this need has been met by numerous freight forwarders, also known as cargo agencies. There are about 80 agencies that have refrigerated rooms and the capability of dispatching fleets of trucks to transport semi-consolidated shipments to the airport.

Figure 2 – Supply Chain of the Fresh Flower Industry with Reduced Number of Participants



Source: Adapted from Expoflores (2007a)

Figure 3 – Current Participants in Supply Chain of Ecuador's Fresh Flower Industry



Source: Adapted from Expoflores (2007a)

Cargo agents provide two main services: guaranteeing cargo space with airlines and temporary storage. They may also act as an export agent in Ecuador and an import agent at the destination port.[20] Regarding the handling of freight from Ecuador to the U.S., larger agencies, such as Garcés & Garcés, offer their services for $25 per box, while smaller competitors charge fees on average up to $60 per box. Table 7 below further highlights the important factor of economies of scale as it relates to the fee structure.

Table 7
Selected Cargo Agencies' Average Handling Fees per Box of Fresh Flowers, Quito (2007)

Cargo Agency	Number of Employees	Weekly Boxes to the United States	Handling Fees per Box
Garcés & Garcés Cargo Services	57	15,000	$25-$35
Fresh Logistics Carga	45	7,500	$30
Royal Cargo	60	3,500	$35
Panamerican Cargo	3	1,000	$40
Sierra Cargo	12	500	$50
Corporación Logística Integral	30	30	$60

Source: Expoflores Logistics Census

Palletization

As with most cargo, perishable products transported by air need to be placed on top of pallets. This task is usually performed by the airline or by a contractor with the airline. Fees vary depending on whether the customer is an airline or a cargo agent. According to Expoflores (2007b), palletization fees range from $0.04 to $0.32 per box. As for the palletization process, although efforts are made to keep the flowers refrigerated, it is not uncommon to observe airlines palletizing cargo under open environment conditions due to infrastructure constraints. In the context of this discussion, it is important to mention that ideally, fresh flowers should be kept at temperatures below 3 degrees Celsius at all times. Temperatures in Quito range between 9 and 20 Celsius. In Guayaquil, temperatures are on average 10 degrees Celsius higher.

Airport Infrastructure

UIO, Quito's international airport, is located inside the city limits at about 2,814 meters above sea level and is open between 5:45 a.m. and 1:00 a.m. everyday. However, during the high season for perishables, in coordination with Ecuador's General Civil Aviation Directorate (DGAC), it operates 24 hours a day. The airport has a single runway, which is 3,120 meters long. A new Quito airport is scheduled to open in 2009 and is being built in a valley 24 kilometers west of the city at 2,400 meters above sea level.

There are three major constraints affecting exports of perishables from Ecuador. First, because of altitude constraints, only short-to-medium-range aircraft can land including A-340s, MD-11s, B-737s, B-757s, A-310s, and A-320s. For the same reasons, aircraft

[20] Some also offer transportation services to move the product from farms to their facilities, but most medium and large operations rely on their own trucks for this task.

cannot take off fully loaded.[21] Second, there is only a limited size area for refrigerated storage, about 7,000 square meters. During high season, the area fills very rapidly, and it is not uncommon to see boxes of flowers stored on the airport's tarmac. Third, the fee structure at Ecuadorian airports has a major impact on the cost of transporting perishable exports. As Table 8 illustrates, at $2,221, UIO landing and other fees for an aircraft weighing 150 metric tons, are the highest in Latin America. Airlines have objected to these fees because: (1) they are being used to finance the construction of the new airport, and (2) air navigation fees collected by the DGAC at major airports are used to cross-subsidize the provision of air navigation services at small and rural airports. From an economic efficiency point of view, the rationale behind the first criticism may not make much sense as the same airlines will likely benefit from improved air navigation services and increased number of slots in the new airport; however, efforts to cross-subsidize other airport operations with little or no regularly scheduled service is viewed by critics as regressive. In any event, the airlines' objections have had little or no impact on how the DGAC sets its fees.

Table 8 – Estimated Landing and Other Fees at Selected Airports (March 2007)

Country	Airport Code	Landing Fees	Other Fees	Total
Ecuador	UIO	1,661	560	2,221
Ecuador	GYE	952	305	1,257
Colombia	BOG	1,075	84	1,159
Costa Rica	SJO	60	427	487
Guatemala	GUA	40	112	152

Source: International Air Transport Association (IATA), Ecuador.

Airlines

From the start of the growth of the industry, guaranteeing cargo space on passenger flights has been a major problem. It was not until 1990 that the now defunct state-owned carrier Ecuatoriana de Aviación dedicated aircraft exclusively for cargo. Today, only a handful of carriers offer routes from Ecuador to the United States and Europe. Table 9 lists currently scheduled passenger and cargo services. In recent years integrated cargo carriers have become more important in Ecuador. An industry survey of airlines reveals that in 2005, cargo-only carriers such as Lan Cargo, Martin Air, Arrow Air, Cargolux, Tampa Cargo, and UPS together transported almost 79 percent of cargo out of Ecuador. In addition, the use of chartered cargo aircraft has remained an option that is mainly taken advantage of during the peak season.

U.S. International Airports

Miami International Airport (MIA) is the center of the U.S. flower distribution system. Two thirds of the flowers consumed in the United States are received by MIA, followed by New York International Airport (JFK), Los Angeles (LAX), and Dallas (DFW). In 2003 imports of flowers through MIA were valued at $967 million. Approximately 130

[21] A Boeing 757 jumbo-jet, although suitable for operating out of UIO, is capable of transporting only up to 6,000 boxes when taking off at an altitude of 600 meters or less.

importers manage offices and cooling facilities of more than 130,000 square meters and employ about 6,100 workers. Between 35,000 and 70,000 boxes arrive at MIA everyday depending on the time of the year (AFIF, 2007).

At MIA, flowers are kept in cooling facilities at all times. Inspection by the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS), which checks flowers for pests and diseases that may threaten U.S. agriculture, can take up to four hours. Often the flowers are checked in electronically by U.S. Customs before landing, and APHIS officers perform inspections 24 hours a day, seven days a week. Only 500 boxes per day or 2 percent of shipments are found to be non-compliant under APHIS regulations.[22]

Congestion delays at U.S. airports are a major concern as they are not uncommon nowadays. In the context of this discussion, the time an aircraft spends taxiing on the runway is very critical in affecting quality if the cargo hold is not air conditioned. For instance, it is common practice for pilots of passenger planes to switch off an engine after landing with the aim of saving fuel, thus leaving the cargo hold exposed to the outside temperature.

Table 9 – Scheduled Outbound Service, Quito International Airport (August 2007)

Airline	Number of Flights	Days / week	Route	Aircraft Type	
Aircomet	1	1	UIO-GYE-MAD	A-343	Passenger
Aircomet	1	2	UIO-GYE-MAD	A-332	Passenger
American	2	7	UIO-MIA	B-752	Passenger
Continental	1	7	UIO-IAH	B-738	Passenger
Delta	1	7	UIO-ATL	B-752	Passenger
Iberia	1	7	UIO-GYE-MAD	A-343	Passenger
KLM	1	6	UIO-BON-AMS	MD-11	Passenger
Lan Ecuador	1	7	UIO-JFK-MAD	B-763	Passenger
Lan Ecuador	1	7	UIO-MIA	B-763	Passenger
Lan Cargo	1	5	UIO-MIA	B-767 / DC-10	Freighter
Arrow Air	1	1	UIO-GYE	DC-10	Freighter
Martinair	1	2	UIO-GYE-MIA-AMS	MD-11	Freighter
Martinair	1	1	UIO-GYE-SJU-AMS	MD-11	Freighter
UPS	1	1	UIO-GYE-MIA	B-757	Freighter
UPS	1	1	UIO-GYE-MIA	B-757	Freighter

Source: Quito International Airport.

Foreign Destination Activities: Marketing and Distribution

There are different channels through which flowers are marketed and distributed in the United States. Once the flowers clear U.S. Customs and APHIS, there are two possible marketing scenarios: (1) a traditional channel involving importer, wholesaler, retailer; or (2) a channel characterized by vertical integration with several wholesalers associated with large retailers such as Wal-Mart.[23] About 90 percent of flowers imported from Colombia are marketed through alliances with vertically integrated import companies in

[22] If this occurs, the importer has three options: (1) return the shipment to the country of origin, (2) fumigate it, or (3) destroy it. The first option is the most expensive; fumigating is the favored option depending on the price of the shipment. Destroying the product is done when the costs of fumigation are too high with respect to the price of the shipment (Malaga, 2005).

[23] Other retailers, such as Equiflor, one of the five largest flower importers, either own or lease hundreds of hectares in several countries, the purpose being to guarantee production and quality predictability throughout the year (Malaga, 2005).

the U.S. (Hernandez et al, 2007). By contrast, only 30 percent of Ecuadorian exports are marketed this way.[24]

Under the first scenario, estimates for 2002 reveal that in addition to at least 130 importing firms in Miami, distribution channels for imported fresh flowers are made up of about 1,000 wholesalers countrywide, 57,000 specialized retailers (florists), and 60,000 retail chain stores. About 90 percent of flowers imported through Miami are sold outside the state of Florida (Arbeláez et al, 2007). From Miami, shipments can reach any city in the continental United States by truck in less than 5 days.

Retailers

Retailers are the final stop for the imported flowers before the product reaches the end consumer. Retailers include traditional florist shops, online stores, supermarket chains, roadside vendors, gas stations, drugstores, etc. Supermarkets account for almost 40 percent of U.S. flower sales (Sawers, 2005), and their importance is continuously increasing as the industry aims to spread sales evenly throughout the year. According to Miami (2004), five holidays account for 95 percent of all purchases of fresh flowers as a percentage of retail dollars. These holidays are: Valentine's Day, 36 percent; Mother's Day, 27.4 percent; Christmas/Hanukkah, 15.1 percent; Easter/Passover (8.9 percent); and Thanksgiving Day, 7.4 percent.

Assessing the "Hidden Cost" of Time in the Value Chain

Given the lack of data on incremental value contributed by each member of the flower supply chain, here an effort is made to complement the analysis by offering insight into the variability in the length of time flowers remain with each member of the supply chain. With the goal of obtaining as much consistency as possible in the data, a questionnaire was sent to the individuals responsible for operations at major cargo agencies in Quito, and their responses were used to fill in some of the blanks that emerged in the information found in published sources.

Table 10 provides a summary of the amount of time that a shipment of flowers spends under the control of different supply chain members. In terms of the variation in the time used for each process, it is apparent that producers' demand for reliability and adequate interface with other modes has clearly not been met. From the moment of harvest until the time the product arrives to the U.S. retailer, the trip can take anywhere from 44 ½ hours to almost 13 days. Assuming that roses can last up to 14 days in good condition if handled properly after harvesting and a modest retail shelf life expectancy of seven days, it is reasonable to state that from the seventh day in transit onwards, the cost of time increases as each additional travel day lowers the quality and consequently the price of the product.

[24] Small firms in particular usually opt for alternative ways to distribute flowers in the United States, which involves the use of a broker such as Armellini, a transportation company that acts as an intermediary between the producer and the retailer, without ever taking possession of the cargo.

Table 10 – Potential to Affect Quality throughout the Supply Chain

Process	Time	Potential to affect quality
Post-harvest on farm, Ecuador	4 - 8 hours	Medium
Storage on farm	12 - 72 hours	Low - Medium
Transportation to cargo agencies	1 - 6 hours	Medium
Storage at cargo agency	4 hours	Low
Palletizing, Quito	6 hours	Medium - High
Customs clearance, Quito	0.5 hours	Low
Loading to aircraft, Quito	1 - 2 hours	Medium - High
Flight UIO-MIA nonstop	4 hours	High
Customs clearance, Miami	4 - 12 hours	Low
Depalletizing, Miami	2 - 4 hours	High
Storage at cargo agency, Miami	4 - 72 hours	Low - Medium
Transportation to U.S. retailer	2 hours - 5 days	Medium

INTERNATIONAL TRANSPORTATION COSTS

A frequent claim of Ecuadorian fresh flower producers is that transportation costs are higher in Ecuador than in other countries, which significantly reduces competitiveness. In this regard, arguments supporting this contention are often anecdotal based on the "asking price" rate a freight forwarder is most likely to quote. Compared with their Colombian counterparts, producers assert that the freight rate from Ecuador is $1.60 per kg, while in Colombia it is $0.96. By contrast, IATA statistics indicate a freight rate somewhere in the middle between $1.31 and $1.38 per kg. Additional estimates suggest that transportation costs of Ecuadorian flower exports account for as much as 25 percent of the wholesale unit price of a stem in the United States and 33 percent in Europe. It is important to note that there is an important caveat regarding these estimates as they do not take into account the evolution of the freight rate through time or the effect of seasonality.

Using import data from the U.S. Bureau of Census, Foreign Trade Statistics, this section discusses variations among airfreight rates of fresh flowers, specifically of roses, across a sample of major exporting countries. This single product has been chosen to facilitate comparisons. Moreover, roses are very representative because of their large share in the market for imported fresh flowers.

Methodology and Data

When assessing transportation costs, due to the heterogeneity of supply chain lengths, a common measurement approach is to estimate average freight rates at the country level. However, when one of the trading partners is the United States, an indirect method, which estimates average freight rates using data obtained from the free-alongside-shipping (FAS) value and cost-insurance-freight (CIF) value of imports, can be used (Yeats, 1989; Cai et al, 2007).

Airfreight costs are defined by the U.S. Bureau of Census as "the aggregate cost of all freight, insurance, and other charges, excluding U.S. import duties." Yeats (1989) reports that insurance is approximately equal to 10 percent of total import charges. Thus, airfreight costs may be expressed as follows:[25]

$$\textit{Airfreight costs} = (\text{CIF value} - \text{FAS value}) \times 0.90 \quad (1)$$

FAS and CIF microdata are made available by the U.S. Census Bureau Foreign Trade Division through monthly statistics published as U.S. Imports of Merchandise. Following Cai et al (2007), the following two measures of freight rates are calculated: i) freight costs per kg of cargo, and ii) freight costs per dollar of cargo's FAS value.

$$\textit{Freight costs per kg} = \text{Freight costs} \times \text{Shipping weight}^{-1} \quad (2)$$

$$\textit{Freight costs per dollar} = \text{Freight costs} \times \text{Export value}^{-1} \quad (3)$$

[25] The FAS value – also called the customs value – reflects the costs of obtaining merchandise and placing those products alongside the vessel at the export port, while the CIF value represents the landed value of the merchandise at the first port of arrival. The difference between the CIF and FAS values represents import charges, which include both freight costs and insurance. A 2006 study by Micco and Serebresky finds that insurance fees make up about 15 percent of total air charges.

This calculation takes into account differences in quality and other aspects between units of cargo under the same Harmonized System category within and across countries. The empirical analysis is complemented by regression analysis of a fixed effects model using cross-sectional panel data on freight costs, FAS value, and the shipping weight of rose exports to the United States.

The purpose is twofold. First, a model is used to determine whether or not there are significant differences between the shipping rates of the countries in the sample. This is done using dummy variables to isolate for country-specific and time-specific effects. Shipping rates are estimated in dollars per kilogram (*FKG*) using the values calculated with equation (2) and as a percentage of dollar exported (*FVAL*) using the values calculated with equation (3). The country of Colombia, the month of February, and the year 2000 are used as benchmarks.

$$FKG = \beta_i COUNTRY_i + \ldots + \beta_i COUNTRY_j + \beta_k MONTH_1 + \ldots + \beta_l MONTH_{12} + \\ + \beta_m YEAR_1 + \ldots + \beta_n YEAR_7 + \varepsilon \quad (4)$$

$$FVAL = \beta_i COUNTRY_i + \ldots + \beta_i COUNTRY_j + \beta_k MONTH_1 + \ldots + \beta_l MONTH_{12} + \\ + \beta_m YEAR_1 + \ldots + \beta_n YEAR_7 + \varepsilon \quad (5)$$

Second, a model is used to measure how freight costs (*F*), measured in logarithms, relate to the country of origin, month, and year intercepts, after controlling for shipping weight and FAS value. The country of origin dummy is intended to capture all fixed conditions of a country such as distance and infrastructure.[26] Again, the country of Colombia, the month of February, and the year 2000 are used as benchmarks. The estimations of the model allow for synthesizing and averaging variations in freight rates, across countries and through time. They also allow for interpreting them as percentages**.**

$$\ln F_i = \beta_i COUNTRY_i + \ldots + \beta_i COUNTRY_j + \beta_k MONTH_1 + \ldots + \beta_l MONTH_{12} + \\ + \beta_m YEAR_1 + \ldots + \beta_n YEAR_7 + \beta_o \ln WEIGHT_{ij} + \beta_p \ln FAS_j + \varepsilon \quad (6)$$

The designated category among trade classifications for flowers in the U.S. Harmonized System is 0603110060: "roses, fresh, suitable for bouquets or for ornamental purposes, not elsewhere specified or included (NESOI)." This category includes all roses except for those with small blooms and spray roses. Roses from Central and South American countries make up about half of all U.S. fresh flower imports. In 2005 approximately 82 percent of imported fresh flowers came from these countries, with Colombia making up 59 percent of the total, followed by Ecuador with 18 percent.

The sample of countries includes only those with regular monthly shipments to the United States for at least five years during the seven year period from 2000 – 2006. The data used correspond to imports into all ports.[27] As the two largest suppliers of imported roses to the United States are Colombia and Ecuador, much of the analysis concentrates on comparisons between these two countries.

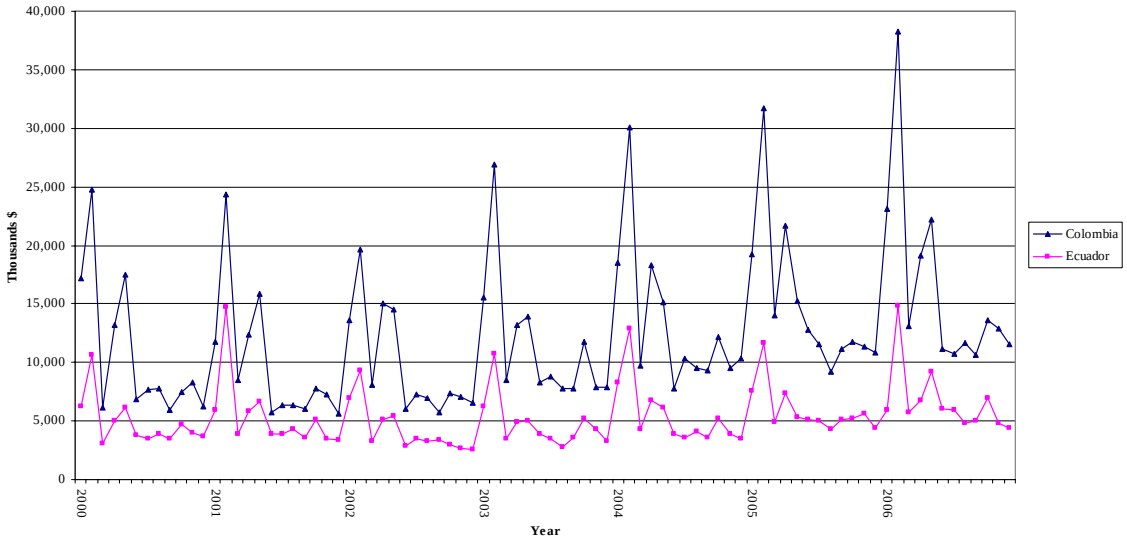
[26] This approach is adapted from Hummels (2001) whereby the total freight bill to the importer and commodity intercepts are related to the weight and value of the shipment and the distance it travels. In this modified approach, distance is dropped as its effect is constant and is already captured in the country dummy variable.

[27] Using more disaggregated data, freight rates can be estimated for each landing port; however, because the purpose here is to identify the average freight rate, the U.S. aggregated data used will suffice.

Results

From 2000 to 2006, the results show that the value of rose exports has continued to increase in a typically seasonal fashion, as is often observed in perishables markets. In Figure 4, it is observed that in the month of February, when supply and demand for roses experience a considerable expansion, Colombian exports increased from $24.8 million in 2000 to $38.3 million in 2006. Similarly, Ecuadorian exports rose from $10.6 million in 2000 to $14.9 million in 2006. In the seven-year period, roses exported from Colombia represented about $1.042 billion, or about $149 million per year, while roses exported from Ecuador during the same period accounted for about $450 million or $64 million per year.

Figure 4 – Monthly Export of Roses from Selected Countries, $Thousands (2000-2006)



Source: U.S. Census Bureau Foreign Trade Division Monthly Statistics

Measured in metric tons, volumes also vary throughout the year. Again, February was the busiest month. Table 11 shows that in February 2006 Colombia exported 8,483 metric tons but only 2,570 metric tons in June; it also indicates that Ecuador exported 3,519 metric tons in February but only 1,249 metric tons in November.

Table 11 – Export of Roses in Metric Tons from Selected Countries, Monthly Record Lows and Highs (2000-2006)

Country	Low/High[1]	2000	2001	2002	2003	2004	2005	2006
Colombia	Low	1,641	1,631	1,689	2,067	2,026	2,567	2,570
	High	5,831	5,790	4,914	6,357	6,577	7,117	8,483
Ecuador	Low	971	1,000	778	847	1,044	1,161	1,249
	High	2,982	3,867	2,789	2,888	3,335	2,908	3,519
Guatemala	Low	57	28	30	37	29	23	32
	High	208	171	207	211	166	175	204

[1] For all three countries, February is the month with the highest shipping weight. March, June, August, November, and December are the months with the lowest shipping weight.

Source: U.S. Census Bureau Foreign Trade Division Monthly Statistics and author's calculations.

In both cases, the exported weight in February is three to four times as much as the amount exported in the month with the record low. In the case of Guatemala, as can be observed in 2005, it is about eight times as much. Accordingly, providing appropriate storage capacity at different times can be very costly.

Considering the effects of distance, it is logical that Ecuador's transportation costs are slightly higher than those of Colombia, but still not as high as those of the Netherlands. As shown in Table 12, Ecuador's rates in February 2007, expressed as a percentage of cargo value, were much higher (12 percent) than those of Colombia and, unexpectedly, higher (10 percent) than those of the Netherlands. Only Kenyan and Israeli exports were subject to higher freight rates.

In 2006, which was the year with the highest rates, at $1.35 per kg, Ecuador's average freight rate for February was 50 percent higher than that of Colombia and 37 percent higher six months later in August. However, February rates are still lower than the figure for August. In previous years (not shown here) the effect of the Valentine's season ("Valentine's effect") on February's freight rates was more obvious.

Table 12 – Transportation Costs of Roses from Selected Countries to the United States

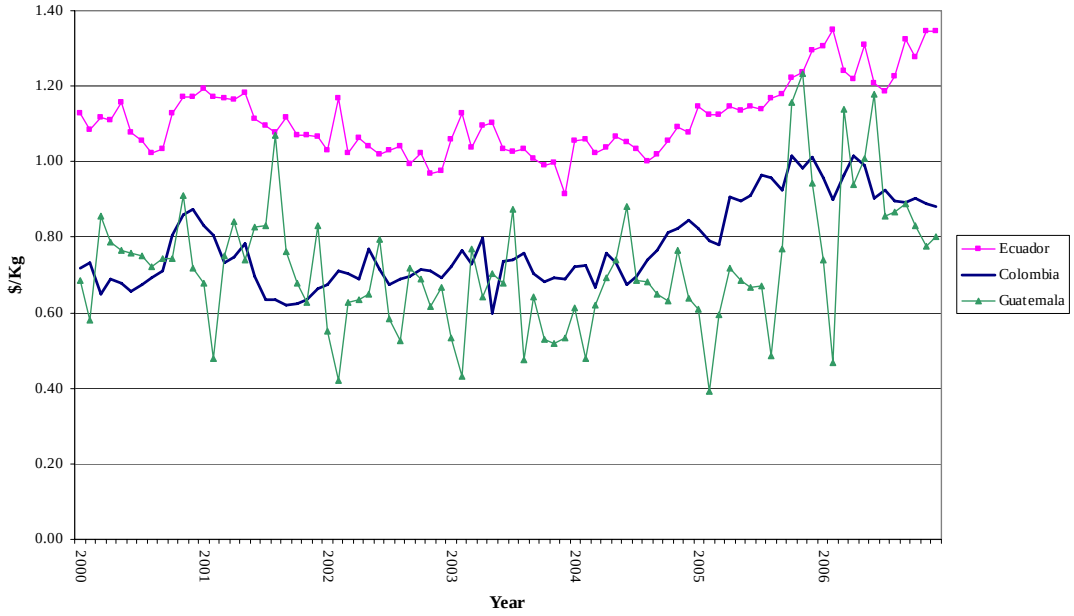
Country	Distance to Main entry	February 2006				August 2006			
		Shipments		Freight		Shipments		Freight	
	U.S. airport (statute miles)	Quantity (000 kg)	Price[1] ($/kg)	$/kg[2]	percent cargo Value[3]	Quantity (000 kg)	Price[1] ($/kg)	$/kg[2]	percent cargo value[3]
Colombia	1,506	8,483	4.51	0.898	20	2,836	4.10	0.895	22
Ecuador	1,787	3,519	4.23	1.350	32	1,278	3.74	1.227	33
Guatemala	1,017	204	4.19	0.468	11	40	4.51	0.866	19
Netherlands	4,120	63	4.49	0.984	22	n/a	n/a	n/a	n/a
Kenya	7,947	33	3.46	2.746	79	3	3.53	3.030	86
Costa Rica	1,117	2	5.51	1.093	20	3	6.53	1.707	26
Israel	5,677	1	3.41	2.294	67	n/a	n/a	n/a	n/a

[1] Shipment prices equal to cargo FAS value divided by quantity. Data obtained from the U.S. Foreign Trade Statistics [2] Freight rates calculated based on the formula as shown in (1). [3] Calculated based on the previous two columns.

Source: U.S. Census Bureau Foreign Trade Division Monthly Statistics and Author's Calculations.

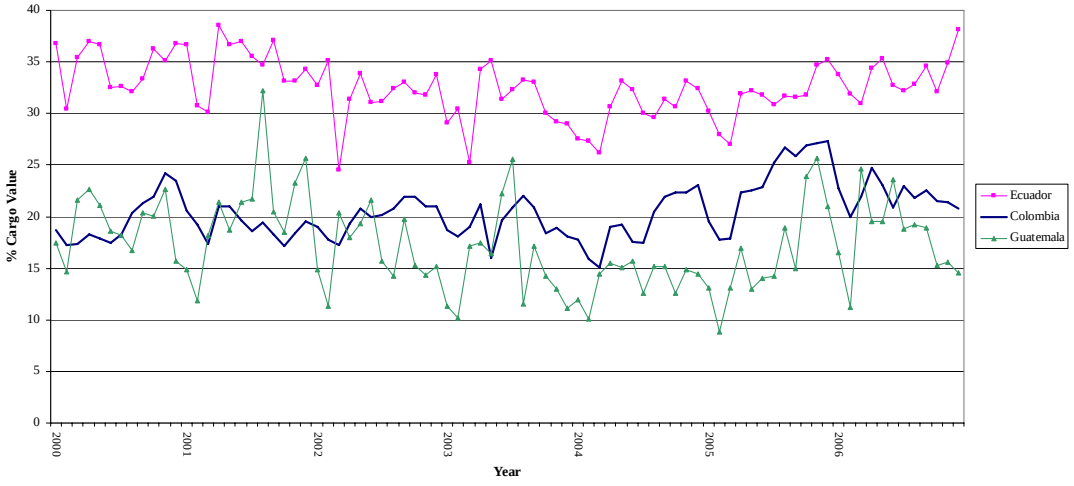
Overall, throughout the entire period covered in this study, Ecuador's transportation costs were higher than Colombia's, both in terms of dollars per kg (Figure 5) and as a percentage of shipment value (Figure 6). While it appears that these costs began to converge towards the end of the year 2005, in 2006 the trend stopped when some of the highest transportation costs were recorded.

Figure 5
Average Monthly Transportation Costs of Roses in $/kg, Selected Countries (2000 – 2006)



Source: U.S. Census Bureau Foreign Trade Division Monthly Statistics and Author's Calculations.

Figure 6
Average Monthly Transportation Costs of Roses Measured as a Percentage of Shipment Value, Selected Countries (2000 – 2006)



Source: U.S. Census Bureau Foreign Trade Division Monthly Statistics and Author's Calculations.

Sorting Out Freight Rates Using Regression Analysis

The results of the estimation of variations in freight costs are presented here. Table 13 contains the coefficients related to different specifications of equations (4), (5), and (6). Coefficients are within the expected values from the descriptive analysis performed earlier. To control for serial autocorrelation, dummy variables for month and year were added. In equation (6), the transformation of the variables to logarithms reduced multicollinearity problems. In general and on average during the whole period studied, when compared to Colombia's transportation costs, it can be stated that airfreight rates for Ecuador were 43 cents higher (Model I) per kg, and 15 points higher as a percentage of shipment value (Model II). After controlling for shipping weight and value (Model III), the coefficient associated with the dummy variable for Ecuador accounted for a 15 percent increase in airfreight transportation costs. This result is in line with the descriptive statistics presented earlier.

Table 13 – Regression Results of the Estimation of Variation in Freight Costs

	Dependent Variable: $ per kg	**Dependent Variable: percent of Shipment Value**	**Dependent Variable: Log Freight Costs**		
Independent Variable	**Model I**	**Model II**	**Model III**	**95% Conf. Interval**	
Colombia	(dropped)	(dropped)	(dropped)		
Costa Rica	0.05	1.60	-0.27***	-0.34	-0.20
Ecuador	0.43***	15.23***	0.15***	0.10	0.20
Guatemala	0.04	-0.12	-0.16***	-0.22	-0.11
Israel	1.11***	18.85***	0.07*	-0.01	0.14
Kenya	1.67***	44.35***	0.31***	0.25	0.38
Netherlands	0.82***	11.65***	0.07**	0.00	0.14
South Africa	2.24***	47.59***	0.24***	0.16	0.32
Year 2000	(dropped)	(dropped)	(dropped)		
Year 2001	0.25**	7.90***	0.03	-0.02	0.08
Year 2002	0.15	6.09**	-0.04	-0.09	0.01
Year 2003	0.19*	4.42*	-0.04	-0.09	0.01
Year 2004	0.07	2.31	-0.07**	-0.12	-0.02
Year 2005	0.29**	3.53	-0.01	-0.07	0.04
Year 2006	0.52***	12.34***	0.04	-0.01	0.10
February	(dropped)	(dropped)	(dropped)		
January	0.34**	9.81***	0.03	-0.04	0.09
March	0.57***	12.27***	0.06	-0.01	0.12
April	0.55***	16.90***	0.09***	0.03	0.16
May	0.47***	12.39***	0.07**	0.00	0.13
June	0.75***	16.14***	0.10***	0.04	0.17
July	0.49***	11.97***	0.06*	-0.01	0.12
August	0.51***	13.33***	0.07**	0.00	0.13
September	0.54***	13.94***	0.07**	0.00	0.14
October	0.51***	16.64***	0.07**	0.00	0.14
November	0.59***	13.82***	0.08**	0.01	0.14
December	0.29**	8.24**	-0.06*	-0.13	0.01
Weight, log			0.50***	0.33	0.67
Value, log			0.45***	0.28	0.61
Adjusted R^2	0.815	0.814	0.998		

Note: $N = 527$ for all regressions.

*** Significant at the 0.01 level. ** Significant at the 0.05 level. * Significant at the 0.10 level.

Although Ecuadorian exports faced lower freight rates of about 30 cents per kg (Model I) compared to those of the Netherlands, when the freight rate is calculated as a percentage of the shipment value (Model II), transportation costs of Dutch roses are lower by about 3.6 percent. Moreover, imports from other countries outside the Western Hemisphere were subject to higher transportation costs, and as expected, due to their proximity to the United States, imports from Guatemala and Costa Rica had lower trnsportation costs.

The coefficient associated with the dummy variable for the year 2006 was higher than the coefficients associated with dummies for previous years in all model specifications. Of all months, April and June were the two months associated with the largest increase of freight rates when compared to the rates applied in February.

The "Valentine's Effect"

The results of the analysis suggest, unexpectedly, that transportation costs are the lowest in February. In theory, low transportation costs in February may be the result of various factors. In this regard, exactly how relevant these factors are is an empirical question that goes beyond the scope of this study. Nevertheless, from an empirical standpoint, the following five factors merit special attention (Button, 2007):

(1) economies of scale and density as more flowers are moved during February;
(2) spare capacity in the air transportation fleet because of lower demand elsewhere in the system or for additional empty capacity on particular aircraft;
(3) lower demand for transportation of flowers, driving the price of competitive transport down;
(4) more predictable demand in a particular time period resulting in low-cost forward contracts for transportation services; i.e. less of a risk premium; and
(5) higher demand for transportation services into the flower areas thus reducing the overall cots of in-bound and out-bound movements of goods (flowers being the outbound part).

Clearly, neither lower demand in February nor higher demand for inbound transportation services are the case. Therefore, any one of the other three factors, or the interaction of two or more of them, would likely be the driving force behind lower transportation costs in February.

Alternatively, as pointed out by Hummels (2007), at least in the case of Ecuador which presents only a low "Valentine's effect" (Figure 5) on transportation costs measured in terms of dollars per kilogram, but a very high effect when measured as a percentage of shipment value (Figure 6), the source of the "Valentine's effect" could be the peak in the price of roses in February. That is, if the transportation cost per kilogram is constant, then a rise in the price of roses due to the Valentine's Day holiday is what causes the share of the transportation costs in shipping value to fall. Therefore, it may be an increase in the price of roses, and not a fall in the price of transportation costs, that causes the seasonal effect of February.

CHALLENGES TO REDUCING AIR TRANSPORTATION COSTS

Despite successful efforts to remove the most severe constraints on trade, such as tariffs, recently it has become clear that there are other limitations to the free movement of goods and factors of production, most notably, sub-optimally high transportation costs. Indeed, for a variety of technical reasons and especially due to the development of containerized freight systems and supply-side logistics, the global costs of moving many types of cargo have fallen. However, both internal and external transportation costs have generally remained high for low-income countries (Button, 2006). From an economic growth perspective, the importance of reducing air transportation costs derives mainly from its increasing role in the movement of perishable products and "exotics." Up to 80 percent of air cargo exports from South America (i.e., 340,000 tons to the United States and 150,000 tons to Europe in 2006) and Africa (i.e., 310,000 tons to Europe) are perishables with extremely short shelf lives.

In light of these developments and the fiscal constraints of lower income countries, decisions on infrastructure investments need to be carefully assessed from a public policy perspective. By simply looking at the heterogeneity of airfreight rates for a single commodity, roses grown in Central and South America, it is very difficult to explain what the sources of inconsistency among airfreight rates are. Even though providing an explanation goes far beyond the scope of this study, this section provides a contextual framework for a discussion of air transportation costs in the fresh flower industry. Table 14 lists the elements of this framework.

Table 14 – Microeconomic and Macroeconomic Conditions Influencing Airfreight Rates

Microeconomic Conditions	Macroeconomic Conditions
• Economies of scale	• Multilateral settings
• Economies of speed	• National aviation policy
• Economies of density	• Lack of airport competition
• Economies of diversity	• Increased safety and security standards
• Economies of experience	
• The peak load problem	• Bilateral trade relations

Microeconomic Conditions Affecting Transportation Costs

Due to a variety of economic factors, the direct impact of distance on the cost of travel is often offset in transportation networks. For example, the importance of distance often diminishes when airlines adopt a hub-and-spoke structure. Higher load factors, the use of larger planes that cost less per-traveled-mile than smaller planes, and more frequent flights that allow for increased aircraft utilization further reduce costs. A discussion of several microeconomic factors affecting transportation costs follows.

Economies of Scale and Density

Air transportation is a network industry, and as such, is subject to network effects. The presence of economies of scale on the supply side implies that an airline's marginal costs are increasingly lower as it fills to full capacity for a given origin-destination airport pair (i.e., the larger the quantities transported, the lower the unit cost). The presence of economies of density on the demand-side also leads to lower marginal costs. Consequently, an airline's total costs associated with servicing an extra origin-destination

airport pair will decrease with each additional service. In developed markets, with a view to achieving economies of density in air transportation, specialized air cargo carriers such as FedEx and UPS have adopted complex hub and spoke networks. By contrast, due to geographic and infrastructure constraints and the relatively small size of the market, air transportation networks have remained underdeveloped in South America.[28]

Economies of Speed and Increased Diversity

In contrast to other modes of transportation, economies of speed in aviation allow for aircraft to potentially be repositioned to almost anywhere in the world within hours. In an industry with overcapacity and increased price competition, the diversity of aircraft that can be chartered allows for the supply of air cargo services to be augmented almost instantly, once a critical mass of cargo exists. Consequently, as the amount of cargo ready to fill a plane increases, the types of aircraft that can be used also expands, and freight rates decrease due to the spread of the aircraft's fixed costs over a larger shipment.

Economies of Experience

Although in a high-information and low-transaction cost world, it is logical to expect that all providers of transportation services would optimally have access to the same technology and equal opportunity to bid for inputs, in reality, in the highly complex field of international commerce and logistics, experience contributes to lower transaction costs. Experience, for example, allows firms to more effectively organize work teams, establish higher effort standards, and recruit, train, and retain more productive employees (Idson and Oi, 1999). Specialized air cargo carriers are more likely to realize these economies through investing in research, training of personnel in the handling of perishables, and developing relationships with other agents such as freight forwarders and wholesalers. In this regard, integrated cargo airlines, such as UPS or FedEx have the advantage of dedicated facilities and personnel to address the complexities of dealing with perishable products.[29]

The Peak Load Problem

While passenger business is generally bidirectional, cargo is not. Rather, freighter routes are often imbalanced. This implies that when transporting goods from point *A* to point *B,* the freight rate charged must also cover the return trip from *B* to *A*. While this issue may be seen by the producer as discriminatory pricing, the transportation economics literature has long reflected that price differences in the presence of peak loads do not imply discrimination (Hirshleifer, 1958). When the demand for transportation services is unidirectional, freight rates are simply higher as the shipper pays for foregone capacity on either the inbound or outbound flight. When the trade imbalance is strongly positive (more exports than imports), transportation costs for exports tend to be higher than for imports. As reflected in Table 15, compared to other countries exporting roses to the United States, Ecuador has the most marked trade imbalance with the United States. Not surprisingly, Ecuador's freight rates are also higher.

[28] For a comprehensive review of issues surrounding air transportation networks see Ricover and Negre (2004).
[29] With the exception of UPS, major cargo carriers do not serve the Ecuadorian market.

Table 15 – Trade with the United States in Metric Tons (2006)

Trading Partner	Exports	Imports	Flow Unbalance
Ecuador	54,017	10,972	0.66
Kenya	3,708	1,361	0.46
Colombia	131,231	58,288	0.38
Costa Rica	28,909	13,694	0.36
Guatemala	14,685	8,795	0.25
Israel	51,018	35,148	0.18
Netherlands	76,477	112,170	-0.19
South Africa	8,234	21,957	-0.45

Source: U.S. Census Bureau Foreign Trade Division Monthly Statistics and Author's Calculations.

Macroeconomic Conditions Increasing Transportation Costs

The macroeconomic conditions affecting the flower industry's transportation costs relate to the institutions governing and regulating air transportation. Institutions are important as they can be instrumental in either facilitating or hindering the efficient allocation of resources (Coase, 1937), and their influence – in some cases – can even be superior to market forces, at least in the short-run. The main governance and regulatory issues surrounding the provision of air cargo services are described next.

Multilateral Settings

In 1944 the United Nations' Convention on International Civil Aviation established the International Civil Aviation Organization (ICAO) in an effort to reach a comprehensive multilateral agreement on the exchange of economic rights and aviation safety. Due to a lack of multilateral support at the time, today markets for air services are dependent on a series of complex bilateral air service agreements. For instance, a commercial aircraft's right to fly over South America is potentially subject to compliance with 65 bilateral agreements and the payment of "overfly" bills, as most countries charge fees for using their airspace.

In contrast to what has occurred in other regions of the world since 1978, only in recent years has there been some movement towards the liberalization of aviation in South America. In the Andean Community, in 1991 progress was made towards the establishment of a common aviation policy for its four country members when an integration initiative was launched. Based on the "open skies" principle, within the sub-region, airlines of the member states are given free access. However, member states have not granted cabotage rights to a third-country airline.[30] In another region of South America, progress towards extending liberalization to the Southern Common Market (MERCOSUR) countries has been strongly resisted by labor unions. Therefore, the restrictive policies of South American countries contrasts with those of other developing countries such as India, which have unilaterally declared open skies for all cargo and allow foreign airlines to serve domestic routes.

[30] Cabotage is defined as transportation services provided between two airports located in the same country irrespective of the country in which the aircraft is registered.

Ecuador's Aviation Policy

The General Civil Aviation Directorate (DGAC), part of the armed forces until 2002, is responsible for providing air navigation, aircraft safety and security, and management services for all Ecuador's airports. The only exceptions are Quito and Guayaquil where a concessionaire is in charge of management. In the context of this discussion, it is also worth mentioning that Quito's air navigation fees are the highest in the region, which creates an additional disincentive for airlines to serve this market. In addition and as mentioned earlier in this paper, DGAC uses surplus revenues collected at self-sustaining airports to cross-subsidize the construction and provision of air navigation services at smaller airports.

Overseeing the DGAC is the National Civil Aviation Council (CNAC), the regulatory body in charge of defining policy for airport infrastructure and air navigation services. Among its other responsibilities, CNAC authorizes new routes, negotiates international services agreements, and determines fares. Generally, with respect to determining fares, in Ecuador and in other Latin American countries there seems to be a strong interest in protecting domestic carriers from increased competition based on the argument that it would lead to "airline consolidation leaving small airlines having to face the reality of economies of scale" (Drosdoff, 2001).

Lack of Airport Competition

Ecuador's airports enjoy monopoly power as there is no competition between airports for international traffic. Moreover, until 2002, airport facilities did not operate with commercial criteria, but rather with the objective of providing the DGAC with a valuable source of foreign revenue. And while some degree of competition could be achieved if traveling time between the two major airports of Quito and Guayaquil were shortened, the reality is that regional disagreements over a hundred years old have halted the construction of a high-speed highway that could connect the two points in less than four hours.

Increased International Safety and Security Standards

In addition to the regulation of fares and competition, security and safety impose additional transport costs on aviation. Safety standards of Latin America's airlines lag behind those of Europe and the United States with a significantly higher accident rate on a percentage basis (based on the number of flight departures). Following the events of September 11, 2001, increases in investments and costs associated with security have mounted. However, on a positive note, in 2006 the U.S. Federal Aviation Administration (FAA) raised the safety rating of Ecuador to Category 1 following a reassessment of the DGAC. A Category 1 rating means that DGAC is able to license and oversee air carriers in accordance with ICAO aviation safety standards. For the ten years prior to 2006, the DGAC had a Category 2 rating, which meant that all of Ecuador's registered aircraft were banned from competing in the U.S. market.

Bilateral Trade Barriers

As reported by Sawers (2005), growth in the flower industry has been greatly favored by low policy-related trade costs. A preferential trade agreement between Ecuador and its largest trade partner, the United States, the Andean Trade Preferences Act (ATPA)

was signed in 1989 and ratified by the U.S. Congress in 1991.[31] Since then, Andean countries have faced almost no tariff barriers to entering the U.S. market. Before 1991, exports of flowers were penalized with tariffs ranging from 6.4 to 6.8 percent. The current regime of trade preferences is set to expire at the beginning of 2008. While Sawers has argued that Ecuador has historically shown a firm commitment to an open-trade regime and collaboration with the United States, this may be changing. Since his election in November 2006, Ecuador's President, Rafael Correa, has consistently stated that his administration would not seek another extension of the trade preferences and would instead prefer to compensate affected producers.

The current bilateral trade policy environment is therefore uncertain. In May 2006 political pressures in both Ecuador and the United States ended negotiations of a free-trade agreement between the two countries. In this regard, major investors have perceived a climate of uncertainty concerning Ecuador's foreign trade policy. In October 2006, for example, Dole Fresh Flowers Ecuador closed its farms leaving more than 900 workers unemployed. By contrast, Colombia finalized the negotiation of a free-trade agreement with the United States in February 2006, which is now awaiting ratification by the U.S. Congress. In addition to an improved business climate in Ecuador, an intensified trade relationship with the United States could potentially contribute to balancing inbound freight flows and also result in lower outbound airfreight rates.

Why Ecuador is More Expensive: The Perspective of Producers

Associations of producers can be successful in influencing the policymaking process (Kingdon, 1997). In the fresh flower industry in Colombia for example, Asocolflores has been instrumental in influencing policy decisions through long-term plans and investments.[32] By contrast in Ecuador, Expoflores, despite its efforts over many years to advocate a more sound approach to business-friendly policymaking, has been less successful. For instance, according to Expoflores' leadership (Expoflores, 2007), some national policies that could be easily implemented, have not been carried out. These policies include lowering tariffs on imports of raw materials and other production inputs, updating the drawback process, and reducing the complexity of import and export procedures. In addition, policies that are not easily implemented, but are crucial in terms of enhancing trade relations, include the pursuit of tax treaties with major trading partners and sound long-term trade agreements. Such initiatives would aim to expand market share in foreign countries and to make inroads in countries where high tariff barriers are still the norm, such as the former Soviet republics. With regard to trade relations with the United States, Expoflores has suggested that in the absence of a free-trade agreement, some alternative type of long-lasting agreement be pursued.

Regarding the air transportation sector, Expoflores' leadership has also expressed that the problems affecting the sector are, in its view, just another reflection of the overall regulatory and institutional environment that affects all sectors of the Ecuadorian economy. In this regard, there is a general perception in the airline sector that policies are simply crafted to benefit only some firms, especially foreign airlines, and that instead

[31] ATPA's successor, the Andean Trade Preferences and Drug Eradication Act (ATPDEA), expired in July 2007, and on June 26, 2007 the U.S. Congress gave the law only an eight-month extension.

[32] Much of its success can perhaps be attributed to the large size of the floriculture sector and to the relative political stability of the country, as compared to that of Ecuador's smaller flower industry and political instability since 1996.

of enhancing competition, these policies actually have the opposite effect (ENADE, 2007). For example, now that the U.S. FAA has upgraded Ecuador's DGAC to category 1, local carriers have the opportunity to compete in routes to U.S. markets. However, significant policy barriers to effective competition remain, such as high tariffs on imports of aircraft and spare parts and bilateral and multilateral air services agreements that are either outdated or nonexistent. Expoflores has also suggested that because of increased competition among airports and regions on a global basis, there may be a role, either for the national government or the local authorities, aimed at promoting Ecuador's new airports internationally as prime destinations in South America for scheduled and non-scheduled services of passengers and also cargo, in a similar fashion as other countries and cities do.

CONCLUSION

The relative success of growing fresh flowers in countries such as Ecuador, Colombia, and Kenya, and its distribution and commercialization in distant markets such as the United States and Russia, has been made possible due to advances in transportation and refrigeration technologies. Yet the transportation systems of perishables are far from perfect. Transportation and logistics costs are high both monetarily and in terms of loss of quality during handling.

The results of the study show that critical supply chain characteristics such as time reliability, adequate interface with other transportation modes, and appropriate storage capacity at different times, are not the norm across supply chain members in the fresh flower industry. For instance, a shipment of fresh flowers, from the time of harvesting on a farm located near Quito until the moment it arrives to a U.S. retailer, can take from 44 ½ hours to almost 13 days. Regarding airfreight rates, the results of the study show that Ecuador's costs are higher among a sample of flower exporting countries, including neighboring Colombia. Depending on the time of the year, it is estimated that transportation costs can be 10 - 20 percent higher for Ecuador as compared to those of Colombia, or on average, about $0.43 higher per kilogram (kg). While assessing the individual importance of a large number of possible sources of time and cost variations goes beyond the scope of this study, it is worth mentioning that infrastructure and institutional shortcomings impact the efficiency with which transportation systems operate. These limitations are present in the case of Ecuador and include restrictions on current airport operations such as insufficient cargo facilities, runways that are too short to allow large airplanes to take off with full loads, complex governance issues of economic rights in air transportation, high cost of air navigation services, the prevalence of unbalanced trade flows with the United States, and overall unfavorable macroeconomic policies toward the private sector.

Because little formal analysis of the changing value chain structures of industries in low-income countries exists (let alone substantive work assessing the impact on the region's economy of these changes), it is difficult to generalize and to draw any firm conclusions. Nevertheless, despite the complexity and high transportation costs of the fresh flower industry's value chain, on average, Colombian exports have faced relatively low transportation costs. Therefore, an assessment of the micro and macro economic conditions favoring Colombian producers may provide valuable lessons for other countries in the Western Hemisphere. For example, lessons could be derived by looking at the particular conditions influencing changes in the structure of the supply chain using input-output tables. In addition, due to its magnitude, empirically testing the causes of the "Valentine's effect" on freight rates would also be relevant. Finally, and as has been demonstrated from the gains made by consumers in other parts of the world where the aviation sector has been liberalized, full deregulation of the aviation sector, including declaring open skies for all cargo unilaterally, remains a viable option that policymakers in South American countries could seriously consider.

REFERENCES

AFIF (2007), 'South Florida Industry Statistics,' http://www.afifnet.org/sflstats.htm Miami: Association of Floral Importers of Florida, website accessed August 1, 2007.

Arbeláez, M. Meléndez, M. and N. León (2007) 'The Emergence of New Successful Export Activities in Colombia,' Bogota: FEDESARROLLO.

Asopa, V.N. (2006), 'Creating Competitiveness in Indian Floriculture,' Buenos Aires: International Food and Agribusiness Management Association's 16th Annual World Forum and Symposium, June 10-13.

Bradsher, K. (2006) 'Bouquet of Roses May Have Note: 'Made in China' The New York Times: September 25, 2006.

Button, K. (2001) *Handbook of Logistics and Supply-Chain Management* (edited with A. Brewer and D. Hensher) New York: Elsevier.

Button, K., (2006) 'Air Transportation Infrastructure in Developing Countries: Privatization and Deregulation,' Paper presented at the Fundación Rafael del Pino Conference on Comparative Political Economy and Infrastructure Performance: the Case of Airports, Madrid: September 18-19, 2006.

Button, K. (2007), Interview: June 28.

Cai, J. Leung, P. and M. Loke (2007) 'Do Hawai'i Producers Pay Higher Freight Costs for Agricultural Shipments to the U.S. Mainland Market Than Their Foreign Competitors?,' Honolulu: University of Hawai'i at Mänoa College of Tropical Agriculture and Human Resources.

Coase, R.H. (1937), 'The Nature of the Firm.' *Economica*, New Series, 4 (16): 386-405.

Drosdoff, D. (2001) 'Latin America's Airlines Face Strong Headwinds,' Washington, D.C.: Inter-American Development Bank. BIDAmérica Magazine, July.

Economist (2007), 'Petal power' May 12, p. 73.

Ecuador (2007), In CIA world fact book. Retrieved August 10, 2007, from https://www.cia.gov/library/publications/the-world-factbook/geos/ec.html

ENADE (2007), 'Primer Encuentro Nacional de la Empresa Privada,' Guayaquil: Comité Empresarial Ecuatoriano.

Expoflores (2004), 'Estadisticas de Mano de Obra Utilizada en el Sector,' Quito: National Association of Producers and Exporters of Flowers.

Expoflores (2007a), 'Exportación y Transporte,' Quito: Presentation of the Association of Producers and Exporters of Flowers of Ecuador to the Municipality of Quito, June 1, 2007.

Expoflores (2007b), 'First Survey of Logistics,' Quito: National Association of Producers and Exporters of Flowers.

Expoflores (2007c), Electronic Communication, Fairfax: September 21.

Hernandez, I., Cely, N., Gonzalez, F., Munoz, E. and I. Prieto (2007) 'The Discovery of New Export Products in Ecuador,' Quito: STRATEGA Business Development Services.

Hirshleifer, J. (1958), 'Peak Loads and Efficient Pricing: Comment,' *Quarterly Journal of Economics* 72 (3): 451-462.

Hummels, D. (2001), 'Time as a Trade Barrier,' West Lafayette: Purdue University

Hummels, D. (2007), Electronic Communication, September 24.

Idson, T.L. and W.Y. Oi (1999) 'Workers Are More Productive in Large Firms.' *The American Economic Review* 89 (2): 104-108.

Jerardo, A. (2006a) 'Floriculture and Nursery Crops Yearbook,' Washington, DC: U.S. Department of Agriculture Outlook Report from the Economic Research Service.

Jerardo, A. (2006b) 'Floriculture and Nursery Crops Outlook,' Washington, DC: U.S. Department of Agriculture Electronic Outlook Report from the Economic Research Service.

Kingdon, J. (1997) *Agendas, Alternatives, and Public Policies*, New York: HarperCollins.

Lapham and Keyser (2005). 'Zambia Flower Export Industry: Analysis of Limitations and Options for Growth, Gaborone, Botswana: U.S. Agency for International Development's Regional Center for Southern Africa.

Malaga, J. (2005) 'La Cadena de Comercialización de Flores Frescas en los Estados Unidos del Importador al Consumidor: Desarrollos Recientes,' Lubbock, Texas: Universidad de Texas Tech.

Méndez, J.A. (1991) 'The Development of the Colombia Cut Flower Industry,' Washington, DC: The World Bank Working Paper 1991.

Miami (2004) 'Miami International Airport Leads Nation in Flower Imports,' Miami: International Airport Press Release from May 7, 2004.

Micco, A. and T. Serebrisky (2006) 'Competition Regimes and Air Transport Costs: The Effects of Open Skies Agreements' *Journal of International Economics* 70: 25-51.

Nabi, I. and M. Luthria (2002) 'Building Competitive Firms: Incentives and Capabilities,' Washington, D.C.: World Bank Publications.

Oi, W.Y. (1999) 'The Hearty and Cheery State,' *Contemporary Economic Policy* 17 (1): 138-146.

Ricover, A. and E. Negre (2004) 'Estudio de Integración del Transporte Aéreo en Sudamérica,' Washington, DC: Inter-American Development Bank.

Sawers, L. (2005) 'Nontraditional or New Traditional Exports: Ecuador's Flower Boom,' *Latin American Research Review* 40 (3): 40–67.

Schumacher, S.K. and T.L. Marsch (2003) 'Economies of Scale in the Floriculture Industry,' *Journal of Agricultural and Applied Economics* 35 (3): 497-507.

UNITC (2001) 'Product Profile: Cut Flowers & Foliage,' Brussels: Third United Nations Conference on The Least Developed Countries Discussion Document.

von Heereman (2006), 'Air Transport of Perishables – Economic Challenges in a Highly Competitive Market,' Montreal: ICAO/ATAG/WB Development Forum Maximizing Civil Aviation's Economic Contribution.

Whitaker, M. and S. Kolavalli (2006). 'Floriculture in Kenya,' in Chandra, V. (ed.). *Technology, Adaptation and Exports. How some Developing Countries Got it Right*, Washington, DC: World Bank.

World Bank, (2004) 'Opportunities and Challenges for Developing High-Value Agricultural Exports in Ethiopia,' Ethiopia: The World Bank.

Yeats, A.J. (1989) 'Do Caribbean Exporters Pay Higher Freight Rates?,' Washington, D.C.: The World Bank Policy Research Working Paper 244.