ESTIMATING AN ORIGIN-DESTINATION TABLE FOR U.S. IMPORTS OF
WATERBORNE CONTAINERIZED FREIGHT

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Brian Seth Levine

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ABSTRACT

U.S. imports of containerized freight have been growing at about 10% per year over the past decade and now exceed 18.5 million TEUs (twenty-foot equivalent units) per year. Container traffic is highly concentrated at a small number of ports, with approximately 88% of total containerized imports (measured in TEUs) entering through the 10 largest ports. Clearly, waterborne containerized imports are of vital economic concern to the United States. Given the growth rate of imports experienced at U.S. container ports, the concentration of traffic at a small number of sea ports, and the vulnerability of some of these seaports to natural hazards, it is important to have an accurate understanding of the flow of containers from their origin country through U.S. seaports to their final destination in the United States, so that investments in port capacity and other transportation infrastructure can be made consistent with the needs generated by this traffic. This paper develops an optimization model to synthesize the PIERs international trade data, the Carload Waybill data available from the Surface Transportation Board, and economic data into an estimate of an origin-destination table for the number of containers (measured in TEUs) that are shipped from foreign countries to aggregations of Bureau of Economic Analysis (BEA) economic areas in the United States.

BIOGRAPHICAL SKETCH

Brian Levine was born and raised in Brooklyn, NY. He attended Stuyvesant High School in New York City and then enrolled in Cornell University for his undergraduate studies. In 2005, he received his bachelor's degree in Civil & Environmental Engineering and graduated magna cum laude with honors. His research interests include using mathematical models to understand the behavior of transportation systems, specifically related to airlines. Currently, he is supported by a Department of Energy Computational Science Graduate Fellowship and plans to continue at Cornell University for his Ph.D. and pursue further research in this field.

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LIST OF ABBREVIATIONS

BEA: Bureau of Economic Analysis

GDP: Gross Domestic Product

PIERS: Port Import Export Reporting Service

STB: Surface Transportation Board

TAZ: Transportation Analysis Zone

TEU: Twenty-foot equivalent containers

CHAPTER 1

INTRODUCTION

In 2006, almost 18.5 million twenty-foot equivalent units (TEUs) of goods entered the United States through U.S. container ports (U.S. Maritime Administration, 2007). On average, containerized import volumes have been growing at about 10% per year over the last decade. Figure 1 gives the total number of containers (in TEUs) imported, as well as the number that entered through the 4 largest container ports from 1997 to 2006. In 2006, approximately 23% of containers entered through the port of Los Angeles, which has experienced a growth rate of about 14% per year over the last decade. The second largest container port is Long Beach, which handled about 20% of imported containers in 2006 and has been experiencing a growth rate of about 20% per year over the last decade. It is clear from the figure that container traffic is highly concentrated at a small number of ports. Almost 88% of total containerized imports (measured in TEUs) enter through the 10 largest ports. These ports are Los Angeles, Long Beach, New York, Charleston, Savannah, Norfolk, Oakland, Seattle, Tacoma, and Houston.

Figure 2 gives the number of containers imported into the U.S. in 1997, 2000, 2003 and 2006 from the 10 largest importing countries (U.S. Maritime Administration, 2007). China is the largest, representing over 45% of containers imported in 2006 and experiencing more than a 20% annual growth rate over the last decade.

Figure 1. Containers (measured in TEUs) Imported from 1997 to 2006
(U.S. Maritime Administration, 2007)

Figure 2. Waterborne Containerized Imports from Select Countries
(U.S. Maritime Administration, 2007)

These waterborne containerized imports are worth over 30 trillion dollars in value and represent commodities such as furniture, electronics, machinery, toys and games, and beverages (Waterborne Databank, 2004). Clearly, these imports are of vital economic concern to the United States. Also, several container ports are in areas threatened by natural disasters. During the 1989 Loma Prieta earthquake in the San Francisco Bay Area, the Port of Oakland sustained significant damage from earthquake induced settlement and liquefaction resulting in damage to rail lines, cranes, and cracked wharf piles. Given the growth rate of imports experienced at U.S. container ports, the concentration of traffic at a small number of sea ports, and the vulnerability of some of these seaports to natural hazards, it is important to have an accurate understanding of the flow of containers from their origin country through U.S. seaports to their final destination in the United States, so that investments in port capacity and other transportation infrastructure can be made consistent with the needs generated by this traffic.

This paper focuses on the estimation of the number of containers (measured in TEUs) that are shipped from foreign countries through international and U.S. ports to aggregations of Bureau of Economic Analysis (BEA) economic areas in the United States. BEA areas are geographic regions, denoted by a collection of counties, which represent centers of regional economic activity. There are 177 of these regions in the United States. While there is considerable data related to containerized shipments, no origin-destination table of this nature currently exists. To estimate the origin-destination table, we have developed an optimization model that synthesizes data on international trade available from PIERS Global Intelligence Solutions and the Carload Waybill Sample of domestic railcar movements available from the Surface

Transportation Board (STB) with a gravity model of the demand for the transportation of international sea containers.

The next chapter focuses on the development of an optimization model to estimate an origin-destination model for containerized traffic. The third chapter describes the insights gained from the application of that model to U.S. waterborne containerized imports for 2004. The fourth chapter discusses conclusions and opportunities for future research.

CHAPTER 2

MODEL FORMULATION

We formulate the origin-destination table estimation problem as a linear program where the origins are one of 67 foreign countries and the destinations are aggregations of BEA economic areas which form 84 regions. As mentioned previously, we integrate two types of data into the optimization: the PIER dataset on international trade from 2004 and the Carload Waybill sample of domestic railcar movements from 2003. We also integrate a gravity model into the mathematical formulation. The goal is to synthesize an origin-destination table that matches the datasets and the gravity model as closely as possible.

Figure 3 presents a map of the 67 countries that are considered container origins and a graphical representation of the number of containers they export to the U.S. These 67 countries represent about 98% of the containers that entered the U.S. in 2004. In Figure 3, the container volumes for China and Hong Kong have been grouped together (though not in the model) and represent more than 39% and 7% of containers imported (as measured in TEU sea containers) in 2004, respectively. From this map, it is clear that the largest export countries can be grouped into three distinct regions: Asia, Europe, and Central & South America. Asia represents 72% of the exports with almost 11 million TEUs, Europe represents 16.9% with approximately 2.5 million TEUs, while Central & South America only represent 11.1% with 1.67 million TEUs.

Figure 3. Origin Countries

The 84 regions we refer to as Transportation Analysis Zones (TAZs) are illustrated in Figure 4 and cover the entire continental U.S. Each TAZ is composed of one or more BEA economic areas. The BEA economic areas are indicated by the dashed lines in the figure. For example, TAZ 152 is composed of BEA Economic areas 110 through 113. Since the countries are considered the origins and the TAZs are the destinations, the number of loaded containers to be moved (over some defined period of time) can be summarized by a 67 x 84 table. For this analysis, we use the 2004 PIERS international trade-data, the 2003 STB Waybill, and economic data from 2004; hence, the estimated origin-destination table is for 2004.

Figure 4. Transportation Analysis Zones.

The model estimates the OD table by determining route flows, denoted by f_r . This flow is the number of containers that travel on a route from a specific origin country to a specific TAZ. In this model, a route r consists of an origin country o , foreign departure port p' , U.S. port p , and destination TAZ d . Figure 6 below illustrates two sample routes from the country of Germany to the TAZ that includes Houston, TX. The first route goes through the Port of Lisbon in Portugal and then the Port of New York, whereas the second route goes through the port of Bremerhaven in Germany and then the Port of New York. Note there is a distinction between origin country o and what we call departure country o' , the country where the cargo is loaded onto a ship destined for the U.S. Therefore, each departure country o' has a collection of ports p' associated with it. As seen in Figure 5 below, the departure country o' may or may not be the same as the origin country o . There are thus four types of nodes in this model: nodes that represent the foreign countries (of which there are 67), nodes that represent the foreign ports (of which there are 455), nodes that represent the U.S. ports

Figure 5. Sample Routes in the Network

(of which there are 32) and nodes that represent each traffic analysis zone (of which there are 84).

The network described above also consists of a set of links (i,j) that connect nodes in the network. Thus, there are three types of links for which we have observations: (1) links starting at an origin country o and ending at departure port p' ; (2) links starting at departure port p' and ending at U.S. port p ; and (3) links starting at U.S. port p and at a TAZ d . We also have observations for groups of links of type 3 for which all links in a particular group start at the same port p but end at different TAZs d .

Observations of flows on links of type (1), $t_{op'}$, and (2), $l_{p'p}$, come directly from the 2004 PIERS dataset. Both types of link flows are hoped to be known with certainty, but deviations are allowed when either conflicts arise with the gravity model or are implied by differences with observations on other links.

Observations of flows on links of type (3), $n_{p\tilde{d}}$, where $\tilde{d}$ is a group of TAZs, come from the 2003 Carload Waybill Sample. The STB Waybill is approximately a 3% sample of rail traffic and therefore provides a detailed picture of rail movements over the rail network each year. Wolfe and Linde (1997) provide a useful description of the Waybill Sample and explain how it can be effectively used. However, the transportation of containers from a U.S. port p to a TAZ d can be either by truck or by rail, with rail substantially more likely as the distance from the port increases. Therefore, the Carload Waybill Sample provides a lower bound on the flow for these links. Again, we allow deviations in these flows where inconsistencies arise. It is also important to note that the STB Waybill does not explicitly identify the number of international containers transported. Rather, the STB Waybill identifies the number of carloads for STCC 46 transported from one county to another. This designation corresponds to mixed freight, which is used for intermodal shipments. Based on the origination county of these flows, we can attempt to infer which of these flows actually originated at a seaport.

In 2003, approximately 6 million TEU containers were imported through the Ports of Los Angeles and Long Beach. Leechman (2005) estimates, based on 2004 data, that rail traffic has about a 40% share from the Ports of Los Angeles and Long Beach. They also estimate that another 5% of containers from these two ports are trans-loaded near the port into 53 foot containers for rail shipment. Therefore, we can infer that about 2.7 million TEU containers move by rail from the Ports of Los Angeles and Long Beach. Since the ports of Los Angeles and Long Beach are both in Los Angeles County, for the purposes of extracting flows of rail cars from the 2003 STB Waybill, these ports are considered together. According to the 2003 STB Waybill, 1,886,000 rail carloads of STCC 46 originated in Los Angeles County. Thus, if we assume that

there are about 1.7 containers per railcar (Intermodal Association of North America, 2007), and that there are about 1.79 TEUs per container handled at these two ports (Pacific Maritime Association, 2007), we can infer that the total number of containers that originate in Los Angeles county is about 5.7 million TEU containers, of which about 2.7 million TEU containers originate at the ports.

Table 1 gives estimates of the number of containers (measured in TEUs and rounded to the nearest thousand) moved by rail from 12 of the largest ports. Miami is not included because the 2003 STB Waybill reports no rail carloads of STCC 46 originating in Miami-Dade County. It is not clear why this is the case, although the 2005 STB Waybill does have originations from Miami-Dade County. Leechman (2005) also provides estimates for the rail share from the Ports of Oakland, Seattle, and Tacoma. These have also been incorporated into the estimates of the number of containers moved by rail from each of these ports given below. For the remainder of the ports, we have no data to indicate what the share of rail might be. However, the number of TEU container originations implied by the rail carload originations in these counties is less than the number of containers handled at the ports, so it is reasonable to assume that all of the rail carloads originate at the ports themselves.

Table 1. Estimated Container Originations by Port

Port	Counties	TEU Containers Moved by Rail
LA/Long Beach	Los Angeles	2,700,000
Oakland	Alameda/Contra Costa/ San Joaquin	365,000
Seattle/Tacoma	King/Peirce	864,000
New York	Hudson, Union, Bergen, Essex	843,000
Baltimore	Baltimore	101,000
Norfolk	Norfolk, Portsmouth	296,000
Charleston	Charleston	160,000
Savannah	Savannah	140,000
Port Everglades	Broward	66,000
Houston	Harris	450,000

Using this information, we can estimate the spatial distribution of trips originating at each port. The fraction of the total number of TEU containers traveling by rail estimated to originate at that port can be applied to each observation in the STB Waybill that is assumed to originate in the associated county or counties. This gives an estimate of how many TEU containers travel between this port and each TAZ. Figure 6 gives these estimates for the Port of Los Angeles and Long Beach and the Port of New York. For example, this process implies that 370,000 containers (in TEUs) are bound for the Dallas area from the Ports of Los Angeles and Long Beach. It is useful to notice the large number of containers that are bound for Chicago, and to a lesser extent, Memphis. These are likely a result of the practice of “rebilling” on transcontinental rail movements, as discussed by Wolfe and Linde (2007). This occurs when carloads are interchanged between two railroads and therefore two separate waybills are generated, one for each segment of the movement. Since there is no mechanism to identify the follow-on movement, rebilling leads to over estimates of the traffic that terminates at interchange points such as Chicago and Memphis. To account for the practice of rebilling in the model, we assume that for ports on the east coast, observations of TEU containers into the TAZs that include Chicago and Memphis really reflect the flow of TEU containers bound for those TAZs as well as TAZs to the west. Similarly, for ports on the west coast, observations of TEU container flows for the TAZs that include Chicago and Memphis are assumed to be bound for those TAZs as well the TAZs to the east. These assumptions are reasonable given both the practice of rebilling and the fact that shippers tend to minimize their shipping distance; therefore, the follow-on movement is likely in the same general direction.

Figure 6. Flows from the Port of LA/Long Beach and the Port of New York to each TAZ based on the 2003 STB Waybill

Before describing the model in more detail, we present the following sets and parameters. Let (i,j) be the set of all links where i is the origin node of the link and j is the destination node of the link. As mentioned, each node is a foreign country, a foreign port, a U.S. port, or a TAZ. Let r be an index over the set of all routes. Let p be an index over the set of all U.S. ports. Let p' be an index over the set of all foreign ports. Let $p'(r)$ be the set of all routes that use foreign port p' . Let r_{ij} be the set of all routes that include link (i,j) . Let $p(r)$ be the set of all routes that include U.S. port p . Let R_{od} be the set of all routes connecting origin o with destination d .

The key decision variables in this model are the number of containers on route r , f_r , where each route is a path from an origin country o , through a foreign port p' , to a U.S. port p , to a TAZ d . These route flows can then be translated into an origin destination table by summing the route flows which have the same origin country and destination TAZ. These variables are constrained to be non-negative.

The PIERS international trade dataset gives the number of containers (in TEUs) that travel along each link from origin o to foreign port p' , $t_{op'}$. The first term on the left hand side of equation (1) is the sum of the route flows that use both origin o and foreign port p' . The next two terms are variables that represent the amount by which the route flows are lower or greater than that implied by the PIERS data $t_{op'}$. $u_{op'}^+$ is constrained to be non-negative and $u_{op'}^-$ is constrained to be non-positive. Therefore constraint (1) attempts to identify route flows that are as consistent as possible with the number of containers (in TEUs) shipped from each origin country to each foreign port of export.

$$\sum_{r \in r_{ij} | i=o, j=p'} f_r + u_{op'}^+ + u_{op'}^- = t_{op'} \quad \forall o, p' \quad (1)$$

The PIERS dataset also gives the total number of containers (in TEUs) that are shipped from each foreign port p' to each U.S. port p , $l_{p'p}$. The first term on the left hand side of equation (2) is the sum of the route flows that use both foreign port p' and domestic port p . The next two terms are variables that represent the amount by which the route flows are lower or greater than that implied by the PIERS data $l_{p'p}$. $g_{p'p}^+$ is constrained to be non-negative and $g_{p'p}^-$ is constrained to be non-positive. Therefore constraint (2) attempts to identify route flows that are as consistent as possible with the number of containers (in TEUs) shipped from each foreign port to each U.S. port.

$$\sum_{r \in r_{ij} | i=p', j=p} f_r + g_{p'p}^+ + g_{p'p}^- = l_{p'p} \quad \forall p', p \quad (2)$$

Given the link flow observations $l_{p'p}$ from the PIERS data, it is possible to compute the total number of containers (in TEUs) that depart each foreign port p' , $b_{p'}$. Constraint (3) attempts to identify values for the route flows, f_r , that match the PIERS

data for the number of containers that pass through each foreign port. However, deviations are allowed. $e_{p'}^+$ is a variable that represents the amount by which the flows, f_r , are smaller than that expected based on the PIERS data and $e_{p'}^-$ is a variable that represents the amount by which the flows, f_r , are larger than expected. $e_{p'}^+$ is constrained to be non-negative and $e_{p'}^-$ is constrained to be non-positive.

$$\sum_{r \in p'(r)} f_r + e_{p'}^+ + e_{p'}^- = b_{p'} \quad \forall p' \quad (3)$$

Additionally, given the same link flow observations $l_{p,p}$ from the PIERS data, it is also possible to compute the total number of containers (in TEUs) that enter each U.S. port, m_p , and then penalize deviations from these values. Constraint (4) encourages solutions that match the container volumes entering each U.S. port, but deviations are allowed. h_p^+ is a variable represents the amount by which the flows, f_r , are smaller than that expected based on the PIERS data and h_p^- is a variable that represents the amount by which the flows, f_r , are larger than expected. h_p^+ is constrained to be non-negative and h_p^- is constrained to be non-positive.

$$\sum_{r \in p(r)} f_r + h_p^+ + h_p^- = m_p \quad \forall p \quad (4)$$

Constraint (5) incorporates observations of container flows from the 2003 STB Waybill data. Each observation in the waybill applies to a group of links (i,j) starting from a U.S. port and ending at a TAZ or group of TAZs. The total freight shipped across those links must be at least as large as that implied by the 2003 STB Waybill data, $n_{p\tilde{d}}$, where p is the port and $\tilde{d}$ is the set of TAZ destinations that the observation pertains to. The set $\tilde{d}$ may be composed of a single destination TAZ or a collection of destination TAZs. The observations in the STB Waybill are lower limits

on the link flows for two reasons. First, the observations only include rail movements from the ports, and therefore exclude those shipped by truck. Second, we are using the 2003 STB Waybill rather than the 2004 dataset, and since containerized traffic has been growing at about 8% per year, we can expect that the 2004 values for the flows from the Waybill are generally greater than those in the 2003 (Intermodal Association of North America, 2007). The first term on the left hand side of Equation (5) is the sum of the route flows that use U.S. port p and terminate at a TAZ in the set $\tilde{d}$. The right hand side is the total number of TEU containers indicated by the 2003 STB Waybill that enter a port p and terminate at one of the TAZs in the set $\tilde{d}$. k_{pd}^+ is a variable that represents the amount by which the flows, f_r , are smaller than suggested by the STB Waybill. k_{pd}^+ is constrained to be non-negative.

$$\sum_{r \in r_{ij} | i=p, j \in \tilde{d}} f_r + k_{pd}^+ \geq n_{p\tilde{d}} \quad \forall p, \tilde{d} \quad (5)$$

For all TAZs, except the ones that include Chicago and Memphis, the observations in the STB Waybill pertain to a single destination TAZ. We do not write a lower limit for the TAZ that includes Chicago or the TAZ that includes Memphis separately from each port. Rather, if the port is on the west coast, we write a lower limit constraint that pertains to all TAZs to the east of the Mississippi River. If the port is on the east coast, we write a lower limit that pertains to all TAZs west of the Mississippi River plus the TAZs that include Chicago and Memphis. We compute this lower limit by summing the flows given in the Waybill from that particular port to each of the TAZs that the constraint pertains to. This allows the model to re-distribute the containers that the Waybill associates with Memphis and Chicago to other TAZs in the appropriate group from each port.

We can also create upper bounds on the flows from the ports to some of the TAZs from the 2003 STB Waybill. It is reasonable to assume that containers entering the U.S. through west coast ports would primarily move by rail if the destination TAZ is in the east. Similarly, it is reasonable to assume that containers entering the U.S. through east coast ports move primarily by rail if the destination is a TAZ is in the west. We use the Mississippi River as the geographic boundary of the East with the caveat that the TAZs that include Chicago and Memphis are assumed to be on the “rail only” side. For West Coast ports, this is consistent with the geographic boundary of the Mississippi. For East Coast ports, this assumes that the TAZs that include Chicago and Memphis are grouped with the TAZs to the West of the Mississippi River.

Let δ_p be the set of all TAZs d that are considered to be serviced only by rail from U.S. port p . Let x_p be the number of TEU containers that originate at port p and terminate at TAZs that are exclusively served by rail as given in the 2003 STB Waybill. y_p^- is a variable that indicates the amount by which the flows are larger than that suggested by the upper limits derived from the STB Waybill. y_p^- is constrained to be non-positive.

$$\sum_{r \in r_{ij} | i=p, j \in \delta_p} f_r + y_p^- \leq \gamma_p x_p \quad \forall p \quad (6)$$

where γ_p is an inflation factor. The inflation factor can be used to represent the amount above the values in the STB Waybill for which deviations are considered acceptable. It can also be used to compensate for the growth that has occurred between the time period of the PIERS international trade data and the STB Waybill. We use the growth that occurred between 2003 and 2004 at each of the ports as estimated by the U.S. Maritime Administration (U.S. Maritime Administration, 2007).

Thus, constraint (6) states that for each U.S. port p , the sum of the route flows to all destinations serviced only by rail must be at most the observation value in the STB waybill, increased by some inflation factor.

In order to give the model additional guidance as to how to determine the route flows and therefore the origin-destination table, we can incorporate a gravity model into the mathematical formulation. Constraint (7) is a gravity model for the movement of seaborne containerized freight imports from origin country o to TAZ d .

$$B_{od} = K_o G_o G_d d_{od}^{-\lambda} \quad \forall o, d \quad (7)$$

where B_{od} is the number of containers (in TEUs) shipped from origin country o to TAZ d , G_o is the GDP of origin country o (World Bank, 2007), G_d is the earnings in TAZ d (U.S. Commerce, 2007), d_{od} is the distance o to d and K_o is a country specific variable (what is commonly referred to as a K -factor in the freight demand modeling literature). Equation (7) can be simplified because K_o and G_o can be grouped together, since they are constant for a particular origin. If we then assume that d_{od} is the shortest route from o to d measured in travel time, and that λ is a constant, then $d_{od}^{-\lambda}$ is a constant for each origin-destination pair. The simplification is then given as equation (8) below, where $\hat{K}_o$ and B_{od} are the two decision variables, both of which are constrained to be non-negative.

$$B_{od} = \hat{K}_o G_d d_{od}^{-\lambda} \quad \forall o, d \quad (8)$$

This equation implies that the number of containers that flow from origin country o to destination TAZ d is proportional to both the GDP of the destination TAZ d and the

distance from country o to TAZ d . These are reasonable assumptions for two reasons. First, much of what is transported in waterborne containers are retail goods and the consumption of these goods is reasonably assumed to be proportional to economic activity. Second, distance has a negative impact on the demand for transportation. It is also important to realize that the PIERS international trade data provides substantial information on the total number of TEUs imported from each country. Hence, there is substantial information on the sum of the B_{od} variables for a given o . This information is integrated into the model through equation (1).

Ashtakala and Murthy (1988 and 1993) use a similar gravity model for land-based freight transportation and find that value of λ varies from 0.25 to 1.0 depending on the commodity. Ashtakala and Murthy (1988) also observe that higher exponent values are associated with the transportation of lower value goods. They reference two other studies that draw the same conclusion (Chisholm and O’Sullivan (1973) and Black (1971)). Since this model focuses on international waterborne shipments and the associated domestic land movement, it is unclear what an effective value of the exponent will be. One strategy to address this is to use different values for the exponent and select the one that appears to fit the data best; that is, generates the least amount of discrepancies with the data in the PIERS international trade dataset, the STB Waybill, and the resultant gravity model.

Constraint (9) allows the model to select route flows that deviate from the gravity model given in equation (8). This is done by attempting to match the route flows from a given country o to a TAZ d to the gravity model estimate for the sum of those route flows, B_{od} . Again, we include error terms to allow for deviations. q_{od}^+ is a variable represents the amount by which the flows, f_r , are smaller than that expected based on

the gravity model and q_{od}^- is a variable that represents the amount by which the flows, f_r , are larger than expected. q_{od}^+ is constrained to be non-negative and q_{od}^- is constrained to be non-positive.

$$\sum_{r \in R_{od}} f_r + q_{od}^+ + q_{od}^- = B_{od} \quad \forall o, d \quad (9)$$

The goal of this formulation is to identify route flows for containerized international freight traffic that enters the U.S. through seaports which is as consistent as possible with: (1) observations of flows from each foreign origin country to each foreign port of export; (2) observations of flows from each foreign port to each US port; (3) the total freight leaving each foreign seaport that is destined for the U.S.; (4) the total freight entering each US port; (5) the number of containers shipped by rail from the largest U.S. seaports to each TAZ or group of TAZs; (6) for each port, the number of TEU containers destined for the TAZs that are served by rail only; (7) a gravity model between origin country o and TAZ d based on GDP for each foreign country, earnings for each TAZ and the distance between them. (1)-(4) is obtained from the 2004 PIERS international trade dataset and (5)-(6) is obtained from the 2003 STB Waybill.

The objective is given in equation (10) below. The first term in the objective penalizes deviations from estimates of the number of containers that are exported from each foreign country through each foreign port. The second term penalizes deviations from the flows of containers from each foreign port to each U.S. port. The third term in the objective penalizes deviations from estimates of the number of containers that are exported from each foreign port to the U.S. The fourth term penalizes deviations from estimates of the number of containers that are imported through each U.S. port. The fifth term penalizes flows that are lower than that implied by the 2003 STB

Waybill from each U.S. port to each TAZ or group of TAZs. The sixth term penalizes flows that are higher than that implied by the 2003 STB Waybill for the largest U.S. ports to each group of TAZs that are served by rail only. The seventh term penalizes deviations from the gravity model. The final term in the objective minimizes the total distance represented by all of the route flows where D_r is the distance of the r^{th} route. We include this term to encourage the use of shorter routes, when possible, because this will produce a more reasonable solution. We use the rail distance to compute the land portion of the route distance, because if substantial travel is required on land, it is more likely to be done by rail than by truck.

$$\begin{aligned} & \sum_{(p',p)} \alpha_0 (u_{op'}^+ - u_{op'}^-) + \sum_{(p',p)} \alpha_1 (g_{p'p}^+ - g_{p'p}^-) + \sum_{p'} \alpha_2 (e_{p'}^+ - e_{p'}^-) + \\ & \sum_p \alpha_3 (h_p^+ - h_p^-) + \alpha_4 \sum_{pd} k_{pd}^+ - \alpha_5 \sum_p y_p^- + \sum_{(o,d)} \alpha_6 (q_{od}^+ - q_{od}^-) + \beta \sum_r f_r D_r \end{aligned} \quad (10)$$

α_0 , α_1 , α_2 , α_3 , α_4 , α_5 and α_6 are coefficients that reflect the relative importance of deviations from each set of constraints, and β is a per container mile penalty for travel distance. We penalize separately (1) deviations from expected total port container volumes at foreign ports and U.S. ports; (2) deviations from the observations of flows from individual foreign countries to individual foreign ports; and (3) deviations from the observations of flows from individual foreign ports to individual U.S. ports, because generally it is more important to match the total volumes at each port than it is to match the flows of containers between specific ports. It is also likely that the observations of total volumes at ports are more reliable than those on individual foreign port to U.S. port movements. By setting the coefficients α_3 and α_4 higher than α_0 and α_1 , this can be achieved. Since the data that supports the first four terms is derived from the PIERs international trade data, and that data is internally consistent, the trade-off in the objective is really between the first four terms, the fifth and sixth

which come from the 2003 STB Waybill, and the distance term. The distance term has the lowest penalty because it is simply used to choose between alternative optimal solutions.

CHAPTER 3

INSIGHTS FROM THE MODEL

This section focuses on the model results and insights that can be gained from the route flows and estimated origin-destination table. This origin-destination table is included in the appendix. When the exponent on the distance term in the gravity model (equation 8) is 1.2, the origin-destination table is consistent with both the 2004 PIERs international trade data for containerized imports and the gravity model. However, there is one inconsistency with the observations in the 2003 STB Waybill that were used to generate lower bound constraints (equation 5), and one inconsistency with the observations in the 2003 STB Waybill that were used to generate upper bound constraints (equation 6). These discrepancies are given in Table 2. The only discrepancy of significant magnitude is that from the Port of Houston to Los Angeles. The estimated route flows from the model imply that about 190,000 TEU containers enter at the Port of Houston and are bound for the Los Angeles area. The 2003 STB Waybill implies there are about 347,000 TEU containers that are shipped from the Port of Houston to the Los Angeles area by rail. Hence, there is a discrepancy of about 157,000 TEU containers. The 347,000 TEU containers reported in the Waybill represents about 77% of all rail movements from the Port of Houston estimated from the 2003 STB Waybill. While there is no evidence to discount this observation in the Waybill, the magnitude of the observation is somewhat inconsistent with the

Table 2. Discrepancies with the 2003 STB Waybill

	Constraint	Error
Houston - Los Angeles TAZ	Lower Bound, Eqn (5)	157,000
Ports of LA & Long Beach to TAZs East of Mississippi	Upper Bound, Eqn (6)	- 62,000

remainder of the traffic at the Port of Houston (which is more local in nature). The other discrepancy arises from a violation of the upper bound constraint. The 2003 STB Waybill and the growth rate at the ports of Los Angeles and Long Beach from 2003 to 2004 implies that about 1.8 million TEU containers travel from the ports of Los Angeles and Long Beach to all TAZ east of the Mississippi River, whereas the model estimates that this number is low by about 62,000 TEU containers. However, this represents an error of only about 3.5%.

From the route flows and the estimated origin-destination table, the flow of TEU containers can be tracked through the network. If we consider the traffic originating abroad in China, about 95% of TEU containers exported from Mainland China are shipped through eight Mainland Chinese ports, the Port of Hong Kong, the Port in Busan, South Korea and through the Port of Kaohsiung, Taiwan. These ports and the TEU containers imported are illustrated in Figure 7. It is useful to notice the concentration of activity at the Shanghai and Hong Kong port areas. The region from Shanghai to Hong Kong is a special economic zone with substantial financial incentives spurring tremendous growth. Historically, Hong Kong has been the dominant port, second only to Singapore. However, with the rapid growth in this special economic zone in China, the ports of Yantian and Shanghai have attracted substantial traffic. Today Shanghai is the second largest port in the world next to Singapore (Asian Economic News, 2007), with Hong Kong third.

Once TEU containers, originating in China, are exported through the collection of Asian ports mentioned above, the TEUs arrive at U.S. ports. Figure 8 gives the number of TEU containers imported from China through the six U.S. Ports with the highest volume. Together, these six ports represent about 94% of the total number of

Figure 7. Export Port Volumes (in TEU Containers) from China

Figure 8. Port Volumes (in TEU Containers) from China

containers imported from China. As expected, the majority of the TEU containers are imported through West Coast ports, but it is interesting to note that about 17% of the total number of TEU containers imported does so through the Ports of New York, Savannah, and Norfolk. Figure 8 also shows the fraction of TEU containers through each of the ports that originates in China. It is not surprising that the West Coast ports have a high percentage of traffic coming from China, but perhaps it is more surprising that East Coast ports, such as Savannah and Norfolk, have almost 50% and 30% of their traffic originating in China, respectively.

Figure 9 gives an estimate of the number of TEU containers imported from China that are destined for each TAZ. Notice that the large economic areas in the U.S. attract a large number of TEUs. For example, there are almost 600,000 TEUs destined for the New York City TAZ from China. The model estimates that about 75% enters the U.S. through the Port of New York and about 25% through the Ports of Los Angeles and Long Beach. On the other hand, shipments from China headed to the TAZs near Savannah and Norfolk enter almost exclusively through these ports and are served via truck. However, these conclusions should be used with some caution. This formulation has significantly more decision variables than equations, and linear programs tend to produce solutions that have relatively small numbers of variables that take on positive values, thereby producing “lumpy solutions”. Therefore, individual TAZs may be served by a larger number of ports than indicated in the solution, though there is a strong basis to believe that the ports indicated in the solution do provide significant service.

Figure 9. Estimated Number of TEU Containers Imported from China to each TAZ

Figure 10 gives the estimated number of TEU containers (by truck and rail) destined for each TAZ from the Ports of Los Angeles and Long Beach, the Port of Oakland, and the Ports of Seattle and Tacoma. Given that all but one upper bound constraint was honored in the model, we can also infer that all of the container volumes destined for TAZs east of the Mississippi River were achieved with rail service. It is interesting to notice that the Ports of Los Angeles and Long Beach are estimated to provide significant service across the U.S., with the exception of the southeast, whereas the Ports of Seattle and Tacoma provide service mainly in the north.

Figure 11 gives the estimated number of TEU containers (by truck and rail) destined for each TAZ from the Ports of New York, Charleston, Norfolk and Savannah. It is interesting to notice that the vast majority of the containers that enter the U.S. through these ports are destined for TAZs on the east coast. Very few containers travel west of the Mississippi River. This is in contrast to the ports on the West Coast, which service a large portion of the continental U.S.

Figure 10. Flow of Containers from Key West Coast Ports to TAZs

Figure 11. Flow of Containers from Key East Coast Ports to TAZs

As mentioned previously, the STB Waybill indicates that more containers are destined for Chicago and Memphis than is likely to be correct, due to the practice of rebilling. We can use the model to infer the actual destinations for the containers that are labeled as destined for Chicago or Memphis in the STB Waybill. When doing this, it is important to understand that these flows are generally higher than those indicated by the 2003 STB Waybill because they include the growth that has occurred at these ports from 2003 to 2004 through Equation (6).

Figure 12 shows the estimated TEU container flows from both the Ports of Seattle and Tacoma and the Ports of Los Angeles and Long Beach to TAZs east of the Mississippi River, and that were indicated as terminating at Chicago or Memphis in the STB Waybill. The model concludes that some of this traffic does indeed terminate at the TAZs that include Chicago and Memphis, but much of it is destined for other TAZs. For example, the 2003 STB Waybill indicates that from the Ports of Seattle and Tacoma, about 600,000 TEU containers are destined for the TAZ that includes Chicago and about 35,000 are destined for the TAZ that includes Memphis. The model indicates that much of this traffic is really destined for the Northeast U.S. with significant concentrations in New York City, Boston, and to a lesser extent, Michigan and Ohio. On the other hand, the 2003 STB Waybill indicates that from the Ports of Los Angeles and Long Beach about 1,090,000 TEUs are destined for the TAZ that includes Chicago and about 400,000 TEUs are destined for the TAZ that includes Memphis. The model indicates that, just like the Seattle ports, much of this traffic is really destined for other TAZs east of the Mississippi River. Given the larger role of Memphis, substantial traffic is estimated to be destined for TAZs in the South.

Figure 12. Inferred Flows from the Ports of Seattle and Tacoma and the Ports of Los Angeles and Long Beach that STB Waybill Reports as Terminating in Memphis or Chicago.

Figure 13. Distribution of TEU Containers Across Regions of Origin for Each TAZ

Figure 13 gives the number of containers that are destined for each TAZ by originating region of the world (Asia, Europe, Central & South America, other). Clearly, Asia is the dominant region. Perhaps the most interesting observations in this figure is how constant the balance is between the four regions of the world across the continental U.S. Certainly, there is a slight increase in the percentage from Asia in the west, Europe in the east, and Central & South America in the south and gulf coast, but these shifts are still quite minor. For example, the TAZs with the largest percentage share from Asia are in California, Seattle, Oregon, Montana, Utah and Idaho (percentages in the low eighties). Whereas the TAZs with the smallest percentage share from Asia (percentages in the low sixties and among the highest from Europe) are in Maine, Florida, Georgia, South Carolina, Massachusetts, Pennsylvania, etc. Imports from Central & South America are relatively larger in Florida, Georgia, South Carolina, and the Gulf Coast Region (percentages in the mid-teens).

CHAPTER 4

CONCLUSIONS & FUTURE RESEARCH

This paper has created a method using optimization to synthesize information on U.S. international trade, the Carload Waybill from the Surface Transportation Board, and economic information to estimate an international origin-destination table for containerized imports. The estimated origin-destination table is consistent with the PIERs international trade data, a gravity model for the transportation of international sea containers based on economic data, and impedance computed from travel time, and is nearly consistent with the STB Carload Waybill. The exponent on the distance term in the gravity model was optimized to be as consistent as possible with data in the model. This yielded a value of 1.2 for that exponent, which is similar to values obtained in other studies.

The primary limitation of the analysis described in this paper is the data quality. The PIERs international trade dataset is quite detailed and appears to be accurate, whereas the STB Carload Waybill has a few significant problems. First, there is no clear indication of which railcar flows actually originate or terminate at a port, and therefore the spatial distribution of the railcar flows from a port is unknown. We have inferred this based on the county that the waybill originated in and Leechman's estimate of rail share (2005). Second, for STCC 46, the STB Waybill does not appear to have accurate information on the number of containers; rather, it focuses on the number of railcars. We have estimated the number of containers from the number of railcars. Third, due to the practice of "rebilling," the STB Carload Waybill does not accurately capture true destinations of as much as 50% of the railcars we have associated with

waterborne containerized imports. Finally, we have not integrated any information into the model pertaining to truck movements. There may be some opportunities to collect this data from the ports themselves. A few ports have focused on in-land transportation as part of defining their port development strategies.

This research can be extended in a few different directions. First, it is possible that additional data could be developed to augment the optimization. This data could be improvements to the types of data already included, or it could be the identification of new datasets to complement the data included. Second, the gravity model could be refined. Currently, we focus on aggregate measures of economic activity, but there is the opportunity to create other gravity models that might, potentially, be more representative of the demand for the transportation of waterborne sea containers. Third, there are a large number of solutions to this optimization model which have very similar values for the objective function. It could be interesting and useful to understand the patterns that exist in these solutions and possibly to develop a representation for the origin-destination table that is probabilistic based on these solutions. Fourth, the PEIRS data contains substantial information about the movements of individual commodities which could be effectively used if it could be complemented with other data at the commodity level. That other data could be in the form of demand models at the commodity level or on the spatial demand for those commodities inside the U.S. Finally, it is also important to develop an origin-destination table for U.S. exports through container seaports. This analysis should be readily adaptable to the development of this table.

APPENDIX

List of TAZs and Corresponding ID Number & Estimated Origin-Destination Table for U.S. Imports of Waterborne Containerized Freight

ID	TAZ Description
2	Portland, ME
4	Boston-Worcester-Lawrence-Lowell-Brockton, MA-NH-RI-VT
7	Albany-Schenectady-Troy, NY
8	Syracuse, NY-PA
9	Rochester, NY-PA
10	Buffalo-Niagara Falls, NY-PA
12	New York-No. New Jersey-Long Island, NYNJ-CT-PA-MA-VT
16	Pittsburgh, PA-WV
17	Harrisburg-Lebanon-Carlisle, PA
18	Philadelphia-Wilmington-Atlantic City, PANJ-DE-MD
19	Washington-Baltimore, DC-MD-VA-WV-PA
21	Charleston, WV-KY-OH
22	Richmond-Petersburg, VA
23	Norfolk-Virginia Beach-Newport News, VANC
24	Greenville, NC
25	Wilmington, NC-SC
27	Raleigh-Durham-Chapel Hill, NC
28	Greensboro-Winston-Salem-High Point, NCVA
29	Charlotte-Gastonia-Rock Hill, NC-SC
31	Greenville-Spartanburg-Anderson, SC-NC
32	Columbia, SC
34	Charleston-North Charleston, SC
36	Atlanta, GA-AL-NC
39	Savannah, GA-SC
41	Jacksonville, FL-GA
42	Orlando, FL
43	Miami-Fort Lauderdale, FL
44	Tampa-St. Petersburg-Clearwater, FL
47	Mobile, AL
49	Birmingham, AL
51	Chattanooga, TN-GA
53	Knoxville, TN
54	Nashville, TN-KY
55	Memphis, TN-AR-MS-KY
57	Louisville, KY-IN
58	Lexington, KY-TN-VA-WV
65	Cleveland-Akron, OH-PA
66	Columbus, OH

67	Cincinnati-Hamilton, OH-KY-IN
68	Dayton-Springfield, OH
70	Toledo, OH
71	Detroit-Ann Arbor-Flint, MI
73	Grand Rapids-Muskegon-Holland, MI
76	Fort Wayne, IN
79	Indianapolis, IN-IL
83	Chicago-Gary-Kenosha, IL-IN-WI
89	Milwaukee-Racine, WI
94	Green Bay, WI-MI
95	Duluth-Superior, MN-WI
96	Minneapolis-St. Paul, MN-WI-IA
104	Des Moines, IA-IL-MO
105	Kansas City, MO-KS
107	St. Louis, MO-IL
108	Springfield, MO
111	Little Rock-North Little Rock, AR
112	Jackson, MS-AL-LA
113	New Orleans, LA-MS
122	Houston-Galveston-Brazoria, TX
123	Austin-San Marcos, TX
125	Dallas-Fort Worth, TX-AR-OK
129	San Antonio, TX
131	Corpus Christi, TX
133	El Paso, TX-NM
137	Oklahoma City, OK
138	Tulsa, OK-KS
139	Wichita, KS-OK
143	Omaha, NE-IA-MO
146	Sioux Falls, SD-IA-MN-NE
152	Fargo-Moorhead, ND-MN
153	Billings, MT-WY
157	Denver-Boulder-Greeley, CO-KS-NE
160	Albuquerque, NM-AZ
162	Phoenix-Mesa, AZ-NM
163	Las Vegas, NV-AZ-UT
165	Salt Lake City-Ogden, UT-ID
167	Boise City, ID-OR
171	Seattle-Tacoma-Bremerton, WA
172	Portland-Salem, OR-WA
176	San Francisco-Oakland-San Jose, CA
177	Redding, CA-OR
178	Sacramento-Yolo, CA
179	Fresno, CA
180	Los Angeles-Riverside-Orange County, CA-AZ
181	San Diego, CA

ORIGIN	2	4	7	8	9	10	12
AMER. SAMOA	35	320	53	47	43	53	1,085
ARGENTINA	275	2,468	397	343	305	363	8,274
AUSTRALIA	285	2,584	428	378	343	426	8,761
AUSTRIA	262	2,329	370	303	260	307	7,438
BAHAMAS	53	483	84	70	60	73	1,957
BANGLADESH	246	2,206	357	307	273	326	7,212
BELGIUM	994	8,735	1,386	1,156	991	1,165	28,461
BRAZIL	2,062	18,734	3,000	2,520	2,220	2,629	64,640
CAMBODIA	93	841	139	122	110	137	2,848
CANADA	38	351	59	52	47	62	1,265
CHILE	554	5,083	863	741	677	856	18,140
CHINA MNLND	19,289	175,451	28,982	25,441	23,196	28,809	598,111
CHINA TWN	1,897	17,259	2,851	2,503	2,282	2,834	58,834
COLOMBIA	318	2,901	500	417	357	432	11,243
COSTA RICA	524	4,804	839	691	596	722	19,443
CZECH REP	110	979	156	127	110	129	3,128
DENMARK	237	2,083	334	272	233	275	6,656
DOM. REP	320	2,872	490	405	344	408	11,231
ECUADOR	282	2,606	447	378	350	448	9,518
EGYPT	116	1,026	166	140	122	145	3,356
EL SALVADOR	133	1,230	211	180	165	211	4,492
FINLAND	163	1,452	232	190	165	196	4,622
FRANCE	1,034	9,077	1,454	1,198	1,025	1,216	29,566
GERMANY	2,630	23,375	3,713	3,043	2,614	3,078	74,659
GREECE	106	945	151	127	111	131	3,064
GUATEMALA	440	4,055	695	594	544	696	14,788
HAITI	43	390	68	56	48	59	1,579
HONDURAS	485	4,473	767	655	600	768	16,314
HONG KONG	3,668	33,332	5,503	4,830	4,400	5,454	113,342
ICELAND	27	237	38	31	26	30	770
INDIA	1,309	11,651	1,892	1,618	1,426	1,711	38,204
INDONESIA	982	8,764	1,435	1,260	1,146	1,415	29,460
IRELAND	137	1,217	192	158	136	160	3,914
ISRAEL	453	4,018	649	548	478	570	13,143
ITALY	2,423	21,570	3,442	2,873	2,503	2,957	69,810
IVORY COAST	42	372	59	51	44	52	1,225
JAMAICA	39	361	63	52	45	54	1,460
JAPAN	2,392	21,798	3,605	3,165	2,891	3,623	74,680
MALAYSIA	974	8,684	1,412	1,214	1,074	1,290	28,497
MEXICO	78	722	128	105	93	125	2,862
NETHERLANDS	1,247	11,086	1,760	1,455	1,260	1,482	35,756
NEW ZEALAND	235	2,135	354	313	284	354	7,261
NICARAGUA	76	698	120	102	94	122	2,559
NORWAY	113	990	159	128	110	130	3,156
OMAN	21	186	30	26	23	27	609
PAKISTAN	414	3,705	599	514	453	541	12,146
PANAMA	54	493	86	71	62	75	1,879
PERU	117	1,077	184	156	143	183	3,887
PHILIPPINES	470	4,251	704	618	561	698	14,446
POLAND	200	1,778	283	233	201	237	5,689
PORTUGAL	184	1,635	258	214	182	214	5,319
RUSSIA	179	1,579	254	208	179	214	5,060
SINGAPORE	268	2,388	388	341	310	383	7,975
SOUTH AFRICA	292	2,607	418	360	321	379	8,630
SOUTH KOREA	1,624	14,784	2,443	2,145	1,957	2,435	50,512
SPAIN	860	7,625	1,204	998	850	996	24,808
SRI LANKA	181	1,617	262	224	199	237	5,280
SWEDEN	396	3,480	558	453	390	463	11,116
SWITZERLAND	106	945	150	123	106	124	3,020
THAILAND	1,388	12,595	2,077	1,823	1,652	2,048	42,640
TRINIDAD	23	211	35	29	25	30	772
TURKEY	638	5,685	911	767	671	796	18,453
UNITED ARAB	95	852	138	118	104	125	2,783
UK	1,122	9,961	1,576	1,294	1,116	1,309	32,048
US VIRGIN IS	22	201	35	29	25	30	814
VENEZUELA	192	1,758	293	244	213	253	6,570
VIETNAM	575	5,220	861	756	688	851	17,701

ORIGIN	16	17	18	19	21	22	23
AMER. SAMOA	100	56	271	414	53	52	57
ARGENTINA	695	407	2,017	3,037	379	381	420
AUSTRALIA	810	448	2,181	3,330	431	417	455
AUSTRIA	566	342	1,736	2,514	302	308	339
BAHAMAS	150	94	518	735	95	100	113
BANGLADESH	615	355	1,750	2,626	324	323	356
BELGIUM	2,188	1,327	6,694	9,661	1,157	1,184	1,317
BRAZIL	5,145	3,087	15,852	23,187	2,880	2,976	3,319
CAMBODIA	260	144	706	1,074	135	131	142
CANADA	120	64	321	481	61	58	61
CHILE	1,659	918	4,622	6,975	934	896	971
CHINA MNLND	54,850	30,405	148,630	225,775	28,618	27,538	29,695
CHINA TWN	5,395	2,991	14,620	22,209	2,815	2,709	2,921
COLOMBIA	876	548	2,926	4,225	541	561	618
COSTA RICA	1,488	937	5,152	7,307	942	994	1,126
CZECH REP	238	144	730	1,057	127	130	143
DENMARK	508	306	1,555	2,253	271	274	304
DOM. REP	835	520	2,887	4,125	507	555	612
ECUADOR	875	482	2,454	3,686	503	480	513
EGYPT	272	161	806	1,178	144	145	161
EL SALVADOR	413	227	1,158	1,740	238	227	245
FINLAND	364	217	1,087	1,588	192	195	214
FRANCE	2,260	1,374	6,944	10,001	1,196	1,238	1,364
GERMANY	5,681	3,430	17,427	25,234	3,030	3,091	3,407
GREECE	246	146	735	1,077	131	133	146
GUATEMALA	1,359	748	3,810	5,723	781	745	804
HAITI	121	76	418	593	76	81	91
HONDURAS	1,499	826	4,203	6,314	861	822	887
HONG KONG	10,380	5,760	28,138	42,770	5,418	5,218	5,636
ICELAND	55	34	176	250	29	29	33
INDIA	3,217	1,868	9,248	13,816	1,700	1,693	1,873
INDONESIA	2,691	1,491	7,300	11,110	1,401	1,356	1,469
IRELAND	297	181	927	1,330	159	163	182
ISRAEL	1,068	631	3,159	4,655	567	570	633
ITALY	5,519	3,304	16,687	24,334	2,938	3,005	3,312
IVORY COAST	99	59	296	436	54	55	61
JAMAICA	112	70	387	549	71	75	85
JAPAN	6,866	3,799	18,594	28,208	3,580	3,438	3,696
MALAYSIA	2,445	1,402	6,890	10,340	1,281	1,271	1,406
MEXICO	249	140	742	1,116	161	151	160
NETHERLANDS	2,759	1,671	8,504	12,285	1,473	1,505	1,675
NEW ZEALAND	673	372	1,817	2,762	359	347	378
NICARAGUA	235	129	661	1,003	136	130	140
NORWAY	238	144	735	1,061	127	129	143
OMAN	51	30	147	219	27	27	30
PAKISTAN	1,022	594	2,927	4,371	540	538	593
PANAMA	151	92	486	706	94	93	104
PERU	353	197	996	1,500	203	192	208
PHILIPPINES	1,328	734	3,585	5,451	690	665	719
POLAND	437	263	1,332	1,935	231	235	259
PORTUGAL	397	243	1,244	1,783	212	218	243
RUSSIA	392	235	1,188	1,730	209	210	234
SINGAPORE	729	405	1,977	3,008	379	367	398
SOUTH AFRICA	725	424	2,095	3,146	391	391	433
SOUTH KOREA	4,638	2,557	12,563	19,073	2,408	2,315	2,504
SPAIN	1,848	1,131	5,802	8,307	989	1,018	1,121
SRI LANKA	446	259	1,279	1,914	236	235	259
SWEDEN	847	516	2,596	3,760	452	456	508
SWITZERLAND	230	139	705	1,021	123	125	138
THAILAND	3,896	2,158	10,568	16,082	2,028	1,956	2,126
TRINIDAD	59	36	193	280	35	37	41
TURKEY	1,489	883	4,429	6,509	791	803	885
UNITED ARAB	234	136	674	1,006	124	124	136
UK	2,432	1,484	7,596	10,903	1,301	1,336	1,488
US VIRGIN IS	62	39	216	306	39	42	47
VENEZUELA	513	314	1,675	2,423	310	321	361

VIETNAM	1,619	899	4,389	6,677	845	815	882
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ORIGIN	24	25	27	28	29	31	32
AMER. SAMOA	21	22	82	52	77	61	44
ARGENTINA	150	157	578	359	538	414	310
AUSTRALIA	169	178	655	417	621	488	356
AUSTRIA	120	119	459	277	405	305	229
BAHAMAS	41	47	168	103	166	133	111
BANGLADESH	128	130	492	306	449	343	254
BELGIUM	463	457	1,777	1,071	1,565	1,177	885
BRAZIL	1,157	1,239	4,546	2,741	4,182	3,269	2,511
CAMBODIA	52	53	198	125	185	145	106
CANADA	22	21	83	52	75	61	43
CHILE	369	395	1,442	926	1,400	1,110	806
CHINA MNLND	10,801	11,078	41,470	25,966	38,769	30,343	22,214
CHINA TWN	1,062	1,090	4,079	2,554	3,814	2,985	2,185
COLOMBIA	226	254	904	571	899	711	573
COSTA RICA	411	464	1,672	1,026	1,652	1,317	1,102
CZECH REP	50	50	193	117	170	128	96
DENMARK	106	106	412	247	364	274	204
DOM. REP	218	243	880	517	819	633	514
ECUADOR	200	216	784	506	773	618	447
EGYPT	57	57	220	134	197	149	112
EL SALVADOR	94	102	370	239	365	292	211
FINLAND	76	76	292	177	259	196	147
FRANCE	479	472	1,838	1,106	1,615	1,213	913
GERMANY	1,200	1,198	4,607	2,785	4,069	3,065	2,302
GREECE	52	52	200	122	178	135	101
GUATEMALA	310	335	1,215	784	1,196	957	692
HAITI	33	38	136	83	134	107	89
HONDURAS	342	369	1,340	865	1,319	1,055	764
HONG KONG	2,051	2,105	7,874	4,933	7,329	5,754	4,195
ICELAND	11	11	44	26	38	28	21
INDIA	673	682	2,583	1,598	2,346	1,790	1,327
INDONESIA	533	559	2,061	1,310	1,951	1,523	1,115
IRELAND	63	62	244	145	214	160	120
ISRAEL	224	226	865	526	776	588	439
ITALY	1,171	1,165	4,498	2,732	3,996	3,018	2,260
IVORY COAST	21	22	83	50	75	57	43
JAMAICA	31	35	126	77	124	99	83
JAPAN	1,344	1,376	5,158	3,226	4,825	3,784	2,770
MALAYSIA	505	515	1,938	1,203	1,773	1,361	1,003
MEXICO	66	75	265	167	265	215	170
NETHERLANDS	583	582	2,261	1,351	1,992	1,499	1,117
NEW ZEALAND	141	149	548	347	521	408	297
NICARAGUA	54	59	212	137	210	168	123
NORWAY	50	50	193	116	170	128	96
OMAN	11	11	41	25	37	28	21
PAKISTAN	213	216	817	505	742	566	420
PANAMA	39	43	155	98	153	121	97
PERU	80	86	314	200	307	245	177
PHILIPPINES	261	272	1,004	637	949	742	543
POLAND	91	92	351	213	311	235	176
PORTUGAL	84	84	323	194	286	212	160
RUSSIA	83	82	317	192	281	213	159
SINGAPORE	145	149	556	349	519	405	297
SOUTH AFRICA	155	161	596	369	555	424	317
SOUTH KOREA	906	933	3,496	2,188	3,255	2,561	1,866
SPAIN	392	385	1,506	903	1,318	988	745
SRI LANKA	93	95	358	222	326	249	184
SWEDEN	179	177	687	415	607	457	343
SWITZERLAND	49	48	186	113	165	124	93
THAILAND	771	798	2,962	1,864	2,776	2,167	1,587
TRINIDAD	14	16	57	35	54	43	33
TURKEY	315	315	1,208	738	1,080	819	611
UNITED ARAB	49	50	188	116	171	130	97
UK	516	512	1,980	1,189	1,753	1,303	982
US VIRGIN IS	17	19	70	43	69	55	46
VENEZUELA	129	145	516	326	512	405	325
VIETNAM	321	331	1,232	773	1,151	903	658

ORIGIN	34	36	39	41	42	43	44
AMER. SAMOA	19	266	20	95	111	183	125
ARGENTINA	134	1,789	141	672	784	1,343	882
AUSTRALIA	151	2,135	160	760	892	1,477	1,008
AUSTRIA	101	1,279	101	459	530	901	589
BAHAMAS	47	640	55	314	318	564	335
BANGLADESH	109	1,445	113	518	614	1,042	693
BELGIUM	385	4,883	389	1,753	2,018	3,465	2,241
BRAZIL	1,090	14,488	1,156	5,787	6,517	11,236	7,237
CAMBODIA	45	633	48	225	265	439	299
CANADA	19	273	20	97	109	172	122
CHILE	347	5,135	367	1,827	2,218	3,670	2,600
CHINA MNLND	9,445	133,974	9,986	47,671	55,814	91,747	62,733
CHINA TWN	929	13,179	982	4,689	5,490	9,025	6,171
COLOMBIA	242	3,304	275	1,508	1,569	2,746	1,694
COSTA RICA	466	6,357	546	3,121	3,161	5,604	3,332
CZECH REP	42	538	42	193	223	379	248
DENMARK	89	1,139	91	412	476	810	529
DOM. REP	230	2,967	256	1,389	1,423	2,576	1,529
ECUADOR	192	2,925	206	1,041	1,268	2,102	1,525
EGYPT	48	627	49	226	264	449	295
EL SALVADOR	92	1,399	97	498	607	992	720
FINLAND	64	817	65	295	344	586	384
FRANCE	398	5,034	402	1,807	2,079	3,569	2,307
GERMANY	1,009	12,838	1,012	4,606	5,316	9,047	5,910
GREECE	44	566	45	204	239	404	267
GUATEMALA	300	4,574	318	1,627	1,983	3,246	2,351
HAITI	38	516	44	253	257	455	271
HONDURAS	331	5,046	351	1,795	2,188	3,581	2,594
HONG KONG	1,783	25,215	1,892	8,972	10,527	17,419	11,892
ICELAND	9	113	9	41	47	80	52
INDIA	571	7,532	589	2,702	3,197	5,420	3,598
INDONESIA	474	6,642	500	2,372	2,792	4,622	3,147
IRELAND	53	664	53	239	271	462	301
ISRAEL	190	2,470	195	890	1,038	1,767	1,162
ITALY	987	12,651	1,003	4,570	5,334	9,012	5,943
IVORY COAST	19	242	19	91	105	181	118
JAMAICA	35	477	41	234	237	421	250
JAPAN	1,179	16,817	1,248	5,984	6,978	11,413	7,828
MALAYSIA	429	5,947	446	2,116	2,493	4,130	2,810
MEXICO	74	1,163	84	456	548	847	693
NETHERLANDS	490	6,221	495	2,233	2,573	4,379	2,858
NEW ZEALAND	126	1,792	134	638	747	1,233	843
NICARAGUA	53	812	56	289	352	575	419
NORWAY	42	532	42	193	222	378	246
OMAN	9	119	9	43	50	86	57
PAKISTAN	181	2,382	186	858	1,011	1,714	1,138
PANAMA	41	558	47	248	276	469	349
PERU	76	1,137	81	405	492	810	587
PHILIPPINES	231	3,265	244	1,162	1,363	2,247	1,534
POLAND	77	983	77	356	411	700	458
PORTUGAL	71	897	71	322	373	635	413
RUSSIA	69	884	70	319	373	630	415
SINGAPORE	126	1,774	133	631	743	1,230	837
SOUTH AFRICA	136	1,819	143	678	794	1,366	895
SOUTH KOREA	794	11,287	844	4,016	4,694	7,735	5,272
SPAIN	329	4,133	327	1,500	1,718	2,952	1,902
SRI LANKA	79	1,047	82	375	445	754	501
SWEDEN	149	1,899	151	687	799	1,361	889
SWITZERLAND	41	519	41	186	215	366	239
THAILAND	674	9,482	711	3,374	3,972	6,575	4,476
TRINIDAD	15	190	16	82	89	157	97
TURKEY	266	3,436	271	1,238	1,452	2,455	1,622
UNITED ARAB	42	548	43	197	233	395	262
UK	432	5,451	436	1,958	2,247	3,825	2,491
US VIRGIN IS	20	266	23	131	132	235	139
VENEZUELA	138	1,830	155	822	886	1,549	936
VIETNAM	280	3,943	296	1,403	1,650	2,736	1,858

ORIGIN	47	49	51	53	54	55	57
AMER. SAMOA	51	114	21	43	93	91	73
ARGENTINA	323	756	136	282	594	556	462
AUSTRALIA	410	917	166	346	750	726	592
AUSTRIA	216	511	110	217	413	377	343
BAHAMAS	109	261	27	80	155	143	107
BANGLADESH	257	597	123	241	495	461	400
BELGIUM	820	1,960	425	827	1,569	1,442	1,295
BRAZIL	2,584	6,122	974	2,170	4,471	4,161	3,387
CAMBODIA	121	270	53	103	229	216	183
CANADA	58	121	25	45	109	99	90
CHILE	1,025	2,233	342	780	1,710	1,715	1,296
CHINA MNLND	25,877	57,382	11,303	21,522	48,441	45,783	38,868
CHINA TWN	2,545	5,644	1,112	2,117	4,765	4,504	3,823
COLOMBIA	575	1,396	162	448	888	852	645
COSTA RICA	1,085	2,594	265	798	1,545	1,417	1,068
CZECH REP	91	215	46	91	174	159	144
DENMARK	195	455	100	193	369	337	308
DOM. REP	514	1,253	153	395	779	733	563
ECUADOR	615	1,304	182	435	959	986	713
EGYPT	109	254	53	105	207	191	168
EL SALVADOR	290	616	86	205	453	465	337
FINLAND	141	331	71	138	268	247	223
FRANCE	850	2,017	439	853	1,613	1,481	1,332
GERMANY	2,164	5,124	1,106	2,173	4,147	3,785	3,443
GREECE	98	228	49	95	185	171	152
GUATEMALA	946	2,011	282	673	1,483	1,522	1,104
HAITI	88	211	22	65	125	115	87
HONDURAS	1,043	2,218	311	742	1,636	1,679	1,218
HONG KONG	4,848	10,833	2,136	4,079	9,149	8,644	7,338
ICELAND	19	45	11	20	38	34	32
INDIA	1,333	3,095	640	1,259	2,554	2,376	2,064
INDONESIA	1,273	2,847	552	1,079	2,363	2,263	1,894
IRELAND	110	263	58	113	212	192	175
ISRAEL	431	1,002	210	414	816	755	663
ITALY	2,181	5,116	1,087	2,122	4,102	3,781	3,368
IVORY COAST	43	101	19	39	79	73	61
JAMAICA	81	195	20	60	116	106	80
JAPAN	3,276	7,218	1,420	2,687	6,089	5,759	4,889
MALAYSIA	1,134	2,539	501	966	2,146	2,026	1,720
MEXICO	303	560	53	151	342	392	236
NETHERLANDS	1,046	2,478	541	1,054	2,002	1,826	1,651
NEW ZEALAND	346	771	138	289	628	613	495
NICARAGUA	170	358	49	118	261	270	196
NORWAY	90	212	47	90	171	157	144
OMAN	21	49	10	20	40	37	33
PAKISTAN	422	982	203	398	807	751	655
PANAMA	118	236	28	77	159	172	114
PERU	234	503	73	172	378	379	284
PHILIPPINES	628	1,397	272	526	1,165	1,110	938
POLAND	168	394	85	166	320	292	267
PORTUGAL	151	355	78	151	282	257	234
RUSSIA	152	357	77	149	288	266	240
SINGAPORE	339	758	150	287	640	604	513
SOUTH AFRICA	331	768	143	290	614	575	477
SOUTH KOREA	2,188	4,839	953	1,818	4,103	3,879	3,293
SPAIN	694	1,634	361	695	1,301	1,193	1,087
SRI LANKA	186	431	89	175	356	331	289
SWEDEN	326	765	166	321	614	565	514
SWITZERLAND	88	207	45	88	168	153	139
THAILAND	1,810	4,049	796	1,540	3,422	3,231	2,743
TRINIDAD	34	80	11	27	55	51	40
TURKEY	597	1,389	294	576	1,129	1,044	924
UNITED ARAB	97	226	47	92	186	173	151
UK	910	2,160	471	925	1,738	1,580	1,437
US VIRGIN IS	45	109	11	33	65	59	45
VENEZUELA	327	773	94	251	509	470	364
VIETNAM	755	1,685	332	639	1,423	1,344	1,141

ORIGIN	58	65	66	67	68	70	71
AMER. SAMOA	41	142	79	77	35	38	250
ARGENTINA	261	940	513	499	222	238	1,551
AUSTRALIA	326	1,144	637	623	284	305	2,011
AUSTRIA	191	760	413	384	180	195	1,294
BAHAMAS	61	184	109	117	49	50	295
BANGLADESH	226	846	463	440	202	217	1,445
BELGIUM	732	2,932	1,563	1,453	680	737	4,899
BRAZIL	1,915	6,718	3,596	3,639	1,596	1,664	10,752
CAMBODIA	101	367	205	197	90	98	645
CANADA	46	175	99	95	45	49	319
CHILE	715	2,361	1,358	1,349	600	629	3,995
CHINA MNLND	21,292	77,988	43,448	41,807	19,167	20,773	137,523
CHINA TWN	2,094	7,671	4,274	4,112	1,885	2,043	13,528
COLOMBIA	365	1,121	656	688	295	301	1,823
COSTA RICA	604	1,827	1,081	1,159	491	495	2,931
CZECH REP	80	320	174	162	76	82	544
DENMARK	173	688	371	345	161	175	1,162
DOM. REP	318	1,057	568	599	256	261	1,570
ECUADOR	385	1,254	728	732	324	337	2,106
EGYPT	96	368	199	187	87	93	622
EL SALVADOR	184	592	344	345	153	159	994
FINLAND	125	491	266	248	116	126	837
FRANCE	753	3,026	1,610	1,496	701	759	5,051
GERMANY	1,916	7,630	4,145	3,859	1,804	1,953	12,990
GREECE	86	335	180	169	78	85	564
GUATEMALA	604	1,946	1,130	1,134	502	522	3,271
HAITI	49	148	88	94	40	40	238
HONDURAS	666	2,147	1,246	1,251	554	576	3,608
HONG KONG	4,030	14,734	8,209	7,899	3,617	3,918	25,945
ICELAND	18	74	39	36	17	19	123
INDIA	1,171	4,418	2,403	2,276	1,050	1,132	7,528
INDONESIA	1,045	3,808	2,122	2,042	933	1,009	6,665
IRELAND	99	400	212	197	92	100	667
ISRAEL	377	1,449	783	736	341	368	2,464
ITALY	1,904	7,499	4,024	3,761	1,751	1,894	12,600
IVORY COAST	35	134	72	69	31	34	223
JAMAICA	45	137	81	87	37	37	220
JAPAN	2,665	9,796	5,457	5,251	2,413	2,618	17,323
MALAYSIA	949	3,458	1,927	1,854	847	916	6,072
MEXICO	122	365	220	229	99	101	599
NETHERLANDS	934	3,734	1,991	1,852	867	939	6,242
NEW ZEALAND	271	952	530	519	237	254	1,676
NICARAGUA	106	338	197	198	88	91	567
NORWAY	81	322	173	161	75	82	543
OMAN	18	70	38	36	17	18	119
PAKISTAN	370	1,397	763	722	332	358	2,380
PANAMA	64	194	115	120	52	53	322
PERU	154	504	294	294	130	136	858
PHILIPPINES	513	1,877	1,045	1,010	461	501	3,303
POLAND	149	588	320	298	139	151	1,002
PORTUGAL	131	535	284	263	124	134	891
RUSSIA	135	532	288	269	125	135	901
SINGAPORE	283	1,032	575	553	253	273	1,806
SOUTH AFRICA	270	989	538	515	233	251	1,656
SOUTH KOREA	1,800	6,572	3,679	3,540	1,625	1,762	11,603
SPAIN	609	2,492	1,321	1,224	575	624	4,147
SRI LANKA	163	614	335	317	146	157	1,046
SWEDEN	288	1,148	618	576	269	291	1,954
SWITZERLAND	78	309	168	156	73	79	525
THAILAND	1,512	5,494	3,072	2,956	1,351	1,462	9,651
TRINIDAD	22	76	42	43	19	19	117
TURKEY	522	2,030	1,095	1,028	477	515	3,425
UNITED ARAB	85	322	176	166	76	82	548
UK	812	3,251	1,743	1,617	759	822	5,469
US VIRGIN IS	25	76	45	49	21	21	123
VENEZUELA	206	647	378	389	170	174	1,054
VIETNAM	628	2,293	1,278	1,229	562	609	4,032

ORIGIN	73	76	79	83	89	94	95
AMER. SAMOA	72	52	127	475	120	50	10
ARGENTINA	441	318	761	2,733	692	285	53
AUSTRALIA	579	417	1,020	3,804	957	399	79
AUSTRIA	361	258	598	2,153	544	221	40
BAHAMAS	81	67	164	538	132	52	9
BANGLADESH	409	290	686	2,511	658	275	55
BELGIUM	1,376	976	2,261	8,125	2,051	833	150
BRAZIL	3,016	2,243	5,429	18,887	4,750	1,923	342
CAMBODIA	186	134	318	1,202	315	133	26
CANADA	94	70	164	667	184	80	17
CHILE	1,160	848	2,171	7,676	1,907	775	139
CHINA MNLND	39,680	28,519	67,734	259,223	68,345	28,704	5,728
CHINA TWN	3,903	2,805	6,663	25,499	6,723	2,824	563
COLOMBIA	506	406	990	3,314	819	326	55
COSTA RICA	808	667	1,632	5,345	1,308	516	85
CZECH REP	152	108	252	905	229	93	17
DENMARK	327	232	538	1,935	489	199	36
DOM. REP	435	352	858	2,902	715	284	47
ECUADOR	614	454	1,187	4,095	1,005	405	71
EGYPT	176	124	291	1,054	268	110	20
EL SALVADOR	290	214	560	1,954	479	193	34
FINLAND	234	166	387	1,396	356	145	26
FRANCE	1,418	1,005	2,327	8,357	2,108	855	154
GERMANY	3,622	2,588	6,006	21,610	5,459	2,219	398
GREECE	158	113	263	946	242	99	18
GUATEMALA	954	704	1,839	6,418	1,576	636	111
HAITI	66	54	133	434	106	42	7
HONDURAS	1,052	777	2,029	7,081	1,738	702	123
HONG KONG	7,481	5,371	12,765	48,491	12,821	5,380	1,072
ICELAND	35	24	56	201	50	20	4
INDIA	2,126	1,507	3,556	12,953	3,324	1,367	256
INDONESIA	1,926	1,380	3,284	12,416	3,259	1,371	271
IRELAND	185	133	306	1,089	277	112	20
ISRAEL	692	490	1,149	4,161	1,058	435	80
ITALY	3,524	2,516	5,859	20,990	5,353	2,181	394
IVORY COAST	62	45	104	376	96	39	7
JAMAICA	61	50	123	401	98	39	6
JAPAN	5,005	3,605	8,550	32,921	8,707	3,663	733
MALAYSIA	1,748	1,252	2,981	11,306	2,967	1,243	247
MEXICO	177	136	384	1,271	293	115	19
NETHERLANDS	1,739	1,243	2,882	10,280	2,616	1,063	190
NEW ZEALAND	483	349	854	3,190	796	326	65
NICARAGUA	165	122	322	1,118	274	110	19
NORWAY	153	108	251	901	227	92	17
OMAN	34	24	56	205	52	22	4
PAKISTAN	672	478	1,129	4,110	1,051	432	81
PANAMA	92	71	188	630	151	60	10
PERU	250	183	474	1,651	408	165	29
PHILIPPINES	952	686	1,625	6,195	1,630	684	136
POLAND	280	200	465	1,674	423	172	31
PORTUGAL	248	177	409	1,467	369	150	26
RUSSIA	254	180	418	1,509	382	157	28
SINGAPORE	522	374	890	3,367	884	372	74
SOUTH AFRICA	467	334	794	2,858	733	301	56
SOUTH KOREA	3,367	2,422	5,749	21,947	5,794	2,448	487
SPAIN	1,152	824	1,902	6,820	1,717	695	123
SRI LANKA	296	210	495	1,804	463	191	36
SWEDEN	545	386	896	3,225	815	334	60
SWITZERLAND	146	105	243	874	221	90	16
THAILAND	2,779	1,999	4,757	17,989	4,722	1,987	393
TRINIDAD	33	26	63	213	53	21	4
TURKEY	961	681	1,593	5,764	1,473	602	110
UNITED ARAB	155	110	260	943	242	99	19
UK	1,520	1,078	2,491	8,939	2,272	921	163
US VIRGIN IS	34	28	68	224	55	22	4
VENEZUELA	293	234	571	1,915	474	189	32
VIETNAM	1,162	833	1,981	7,505	1,980	830	165

ORIGIN	96	104	105	107	108	111	112
AMER. SAMOA	218	73	115	150	29	46	38
ARGENTINA	1,171	397	603	876	164	264	235
AUSTRALIA	1,735	583	916	1,201	235	365	306
AUSTRIA	909	309	440	648	113	177	155
BAHAMAS	210	72	115	188	34	59	67
BANGLADESH	1,185	390	575	773	148	226	191
BELGIUM	3,421	1,163	1,653	2,443	426	668	589
BRAZIL	7,882	2,683	4,139	6,214	1,157	1,901	1,809
CAMBODIA	573	188	276	370	71	108	90
CANADA	393	115	153	193	37	49	42
CHILE	3,161	1,108	1,702	2,593	484	784	733
CHINA MNLND	125,314	40,822	59,836	79,375	15,213	22,932	19,195
CHINA TWN	12,327	4,016	5,886	7,808	1,496	2,256	1,888
COLOMBIA	1,323	453	714	1,172	215	364	389
COSTA RICA	2,083	715	1,140	1,868	341	584	666
CZECH REP	382	130	185	273	48	74	65
DENMARK	817	278	396	583	102	158	140
DOM. REP	1,133	388	613	999	183	305	329
ECUADOR	1,659	589	913	1,440	267	437	428
EGYPT	452	153	222	320	57	90	79
EL SALVADOR	783	278	431	680	126	206	202
FINLAND	594	202	291	422	75	116	102
FRANCE	3,512	1,195	1,695	2,511	437	685	609
GERMANY	9,120	3,101	4,412	6,506	1,138	1,773	1,558
GREECE	407	137	198	287	51	81	71
GUATEMALA	2,577	914	1,416	2,228	413	676	660
HAITI	169	58	93	152	28	47	54
HONDURAS	2,843	1,008	1,562	2,458	456	746	729
HONG KONG	23,400	7,646	11,220	14,931	2,860	4,308	3,619
ICELAND	83	28	40	60	10	16	14
INDIA	5,638	1,910	2,788	3,962	722	1,144	985
INDONESIA	5,921	1,938	2,861	3,828	732	1,132	949
IRELAND	460	155	222	329	57	89	79
ISRAEL	1,786	606	877	1,264	226	357	313
ITALY	8,981	3,030	4,361	6,386	1,127	1,780	1,578
IVORY COAST	161	54	79	114	21	34	31
JAMAICA	156	54	86	140	26	44	50
JAPAN	16,115	5,218	7,630	10,057	1,931	2,889	2,421
MALAYSIA	5,366	1,764	2,594	3,474	664	1,013	849
MEXICO	465	181	326	493	96	183	184
NETHERLANDS	4,367	1,473	2,111	3,118	544	854	752
NEW ZEALAND	1,413	488	774	1,009	198	307	258
NICARAGUA	446	159	246	391	72	120	118
NORWAY	379	129	183	271	47	73	65
OMAN	89	30	44	63	11	18	16
PAKISTAN	1,788	606	881	1,257	229	361	311
PANAMA	245	89	140	235	42	72	77
PERU	677	239	365	571	105	173	165
PHILIPPINES	2,972	972	1,426	1,900	364	558	466
POLAND	709	241	343	505	89	137	121
PORTUGAL	614	209	295	440	76	119	107
RUSSIA	640	217	313	455	80	124	110
SINGAPORE	1,608	528	776	1,038	199	302	252
SOUTH AFRICA	1,244	420	630	908	171	275	243
SOUTH KOREA	10,724	3,466	5,074	6,748	1,294	1,935	1,629
SPAIN	2,852	971	1,373	2,044	353	549	495
SRI LANKA	787	266	389	552	101	160	137
SWEDEN	1,361	463	664	971	170	263	234
SWITZERLAND	369	125	178	263	46	72	63
THAILAND	8,585	2,808	4,130	5,546	1,061	1,615	1,354
TRINIDAD	86	29	46	72	13	22	22
TURKEY	2,482	837	1,210	1,748	313	495	435
UNITED ARAB	412	139	203	289	53	83	72
UK	3,779	1,275	1,821	2,682	469	735	651
US VIRGIN IS	87	30	48	78	14	24	28
VENEZUELA	767	262	407	653	120	202	213
VIETNAM	3,596	1,179	1,732	2,313	443	672	564

ORIGIN	113	122	123	125	129	131	133
AMER. SAMOA	139	299	69	362	75	33	61
ARGENTINA	850	1,716	389	1,962	411	189	285
AUSTRALIA	1,118	2,402	556	2,909	604	266	484
AUSTRIA	565	1,123	253	1,268	266	122	182
BAHAMAS	266	449	91	444	91	41	56
BANGLADESH	682	1,460	340	1,768	367	164	288
BELGIUM	2,145	4,255	955	4,792	1,005	460	689
BRAZIL	6,683	12,902	2,842	14,183	2,973	1,345	1,972
CAMBODIA	328	702	163	849	177	79	140
CANADA	164	367	79	446	85	37	84
CHILE	2,775	5,465	1,200	6,004	1,259	576	850
CHINA MNLND	70,337	151,431	35,017	183,626	38,122	16,772	31,007
CHINA TWN	6,919	14,896	3,445	18,063	3,750	1,650	3,050
COLOMBIA	1,504	2,780	578	2,838	595	280	372
COSTA RICA	2,641	4,458	905	4,411	905	409	553
CZECH REP	237	472	106	533	112	51	76
DENMARK	508	1,018	227	1,142	239	110	165
DOM. REP	1,277	2,249	468	2,295	481	218	296
ECUADOR	1,672	3,149	683	3,390	711	324	466
EGYPT	286	576	131	659	138	63	96
EL SALVADOR	789	1,507	322	1,600	335	153	225
FINLAND	371	743	168	844	176	81	122
FRANCE	2,204	4,366	978	4,909	1,029	471	705
GERMANY	5,667	11,275	2,534	12,729	2,669	1,223	1,823
GREECE	258	518	117	591	123	57	86
GUATEMALA	2,571	4,922	1,054	5,239	1,098	501	774
HAITI	214	362	74	358	73	33	45
HONDURAS	2,837	5,430	1,163	5,780	1,212	552	854
HONG KONG	13,221	28,419	6,579	34,419	7,151	3,145	5,736
ICELAND	49	97	21	110	23	10	15
INDIA	3,518	7,233	1,653	8,388	1,752	806	1,239
INDONESIA	3,449	7,394	1,715	8,937	1,859	827	1,470
IRELAND	287	566	127	640	132	61	90
ISRAEL	1,128	2,291	518	2,608	547	251	381
ITALY	5,723	11,444	2,581	12,980	2,704	1,240	1,869
IVORY COAST	113	227	51	255	54	25	37
JAMAICA	198	335	68	331	68	31	42
JAPAN	8,926	19,277	4,447	23,433	4,857	2,120	4,025
MALAYSIA	3,071	6,581	1,533	7,982	1,655	737	1,310
MEXICO	848	1,957	358	1,637	355	176	196
NETHERLANDS	2,736	5,434	1,220	6,124	1,284	584	875
NEW ZEALAND	946	2,037	471	2,470	513	224	415
NICARAGUA	462	876	186	936	194	88	126
NORWAY	236	468	105	528	111	51	75
OMAN	56	114	26	132	28	13	19
PAKISTAN	1,116	2,286	524	2,650	556	254	391
PANAMA	308	564	117	571	120	56	74
PERU	634	1,217	267	1,331	279	127	184
PHILIPPINES	1,704	3,661	848	4,434	921	407	742
POLAND	440	878	198	993	208	95	143
PORTUGAL	393	774	173	866	180	83	123
RUSSIA	397	799	179	906	189	87	130
SINGAPORE	918	1,968	458	2,388	495	220	393
SOUTH AFRICA	869	1,773	402	2,031	426	196	299
SOUTH KOREA	5,953	12,833	2,980	15,660	3,232	1,417	2,649
SPAIN	1,810	3,567	797	3,993	837	383	571
SRI LANKA	490	1,009	231	1,172	245	113	178
SWEDEN	846	1,696	379	1,914	399	183	274
SWITZERLAND	229	456	103	515	108	49	74
THAILAND	4,904	10,515	2,439	12,709	2,644	1,176	2,098
TRINIDAD	85	158	33	164	34	16	22
TURKEY	1,562	3,165	714	3,614	753	346	524
UNITED ARAB	257	526	121	610	127	59	90
UK	2,375	4,691	1,049	5,263	1,095	501	748
US VIRGIN IS	111	187	38	185	38	17	23
VENEZUELA	801	1,469	309	1,520	319	150	202
VIETNAM	2,046	4,409	1,018	5,311	1,109	490	881

ORIGIN	137	138	139	143	146	152	153
AMER. SAMOA	81	71	40	77	27	29	34
ARGENTINA	402	385	200	379	131	135	131
AUSTRALIA	644	564	322	615	214	231	271
AUSTRIA	266	262	139	281	96	101	94
BAHAMAS	77	79	35	65	20	21	17
BANGLADESH	390	348	201	395	145	157	179
BELGIUM	997	992	526	1,062	363	379	354
BRAZIL	2,762	2,709	1,343	2,512	838	860	794
CAMBODIA	188	166	97	191	70	76	89
CANADA	105	82	59	125	54	70	165
CHILE	1,193	1,164	583	1,067	356	351	340
CHINA MNLND	40,932	35,619	21,110	41,986	15,536	17,005	20,505
CHINA TWN	4,026	3,504	2,077	4,130	1,528	1,673	2,017
COLOMBIA	506	508	237	419	134	134	117
COSTA RICA	761	789	352	644	201	204	172
CZECH REP	112	110	59	118	40	42	40
DENMARK	240	238	126	254	87	91	86
DOM. REP	409	425	192	353	112	114	98
ECUADOR	643	646	313	564	184	178	169
EGYPT	137	134	72	143	50	52	50
EL SALVADOR	307	305	148	266	87	84	102
FINLAND	178	174	93	186	64	67	64
FRANCE	1,020	1,017	539	1,089	372	388	362
GERMANY	2,670	2,634	1,398	2,818	966	1,014	947
GREECE	122	119	64	127	44	46	44
GUATEMALA	1,008	1,000	485	876	286	278	349
HAITI	62	64	29	52	16	17	14
HONDURAS	1,112	1,103	535	966	315	306	385
HONG KONG	7,660	6,700	3,949	7,830	2,892	3,152	3,752
ICELAND	24	24	12	25	9	9	8
INDIA	1,768	1,693	917	1,805	635	663	742
INDONESIA	1,983	1,750	1,002	1,976	728	787	916
IRELAND	133	132	70	141	48	51	47
ISRAEL	541	528	284	564	196	205	198
ITALY	2,665	2,613	1,393	2,794	963	1,010	954
IVORY COAST	52	50	26	50	17	18	17
JAMAICA	57	59	26	48	15	15	13
JAPAN	5,241	4,513	2,705	5,414	2,011	2,235	2,751
MALAYSIA	1,764	1,565	909	1,791	659	712	828
MEXICO	258	259	114	192	55	49	45
NETHERLANDS	1,274	1,259	668	1,347	461	484	451
NEW ZEALAND	548	479	273	514	174	190	224
NICARAGUA	176	176	84	152	49	48	52
NORWAY	111	110	58	118	40	42	39
OMAN	28	27	14	29	10	10	10
PAKISTAN	558	535	290	570	201	210	207
PANAMA	101	100	47	83	26	25	23
PERU	258	256	125	227	76	74	71
PHILIPPINES	986	863	502	994	367	401	474
POLAND	209	205	109	220	75	79	74
PORTUGAL	177	176	93	188	64	67	62
RUSSIA	189	187	100	200	69	72	68
SINGAPORE	528	466	272	537	198	214	250
SOUTH AFRICA	422	402	211	398	138	145	142
SOUTH KOREA	3,477	3,028	1,804	3,577	1,333	1,465	1,788
SPAIN	820	815	431	873	297	312	287
SRI LANKA	247	237	128	252	90	97	111
SWEDEN	399	396	210	424	145	152	142
SWITZERLAND	108	107	57	114	39	41	38
THAILAND	2,820	2,489	1,453	2,855	1,055	1,142	1,331
TRINIDAD	31	31	15	27	9	9	8
TURKEY	748	728	390	778	270	283	271
UNITED ARAB	129	123	67	131	46	48	48
UK	1,091	1,083	573	1,159	395	415	383
US VIRGIN IS	32	33	15	27	8	9	7
VENEZUELA	275	279	130	237	76	78	68
VIETNAM	1,180	1,038	608	1,201	443	480	564

ORIGIN	157	160	162	163	165	167	171
AMER. SAMOA	234	52	216	126	104	89	253
ARGENTINA	1,096	229	858	456	398	303	818
AUSTRALIA	1,863	414	1,729	995	830	698	1,988
AUSTRIA	735	143	535	276	260	201	548
BAHAMAS	179	38	131	53	53	37	95
BANGLADESH	1,222	247	1,010	596	533	458	1,293
BELGIUM	2,767	538	2,004	1,025	969	746	2,039
BRAZIL	7,191	1,506	5,464	2,524	2,412	1,780	4,650
CAMBODIA	595	120	495	295	262	228	649
CANADA	555	75	359	329	339	1,015	13,198
CHILE	3,110	656	2,430	1,367	1,142	823	2,323
CHINA MNLND	132,869	26,418	111,069	67,664	60,384	54,195	156,365
CHINA TWN	13,070	2,599	10,925	6,656	5,940	5,331	15,381
COLOMBIA	1,230	262	907	385	371	264	676
COSTA RICA	1,778	381	1,297	531	526	370	944
CZECH REP	309	60	225	116	109	84	231
DENMARK	667	130	482	249	235	181	495
DOM. REP	995	209	734	305	300	213	552
ECUADOR	1,639	344	1,240	686	568	402	1,144
EGYPT	383	77	290	150	140	109	295
EL SALVADOR	781	193	882	492	395	267	771
FINLAND	494	97	361	189	177	137	375
FRANCE	2,828	553	2,043	1,043	993	764	2,076
GERMANY	7,376	1,438	5,366	2,768	2,613	2,013	5,504
GREECE	340	68	255	131	123	95	261
GUATEMALA	2,705	663	3,039	1,720	1,357	917	2,646
HAITI	144	31	105	43	43	30	77
HONDURAS	2,984	732	3,353	1,898	1,497	1,011	2,919
HONG KONG	24,614	4,913	20,533	12,404	11,076	9,825	28,181
ICELAND	65	12	45	23	22	17	46
INDIA	5,058	1,021	4,180	2,475	2,205	1,894	5,347
INDONESIA	6,140	1,259	5,212	3,093	2,716	2,351	6,674
IRELAND	365	71	261	134	127	98	268
ISRAEL	1,520	306	1,151	596	557	432	1,177
ITALY	7,395	1,483	5,524	2,822	2,653	2,051	5,607
IVORY COAST	140	29	109	53	50	38	103
JAMAICA	134	29	97	40	39	28	71
JAPAN	17,371	3,426	14,584	9,044	8,061	7,421	21,696
MALAYSIA	5,557	1,122	4,617	2,745	2,454	2,130	6,044
MEXICO	553	120	395	146	146	101	254
NETHERLANDS	3,516	689	2,552	1,314	1,242	956	2,614
NEW ZEALAND	1,577	356	1,496	850	713	581	1,652
NICARAGUA	441	98	442	250	202	138	392
NORWAY	307	59	220	114	108	83	226
OMAN	78	16	60	32	29	23	66
PAKISTAN	1,575	320	1,218	660	594	501	1,409
PANAMA	244	52	179	76	73	52	132
PERU	668	140	514	290	242	173	490
PHILIPPINES	3,135	632	2,640	1,585	1,401	1,239	3,548
POLAND	578	113	422	218	206	159	434
PORTUGAL	485	96	353	178	169	130	355
RUSSIA	528	103	385	201	189	146	397
SINGAPORE	1,670	337	1,389	828	740	642	1,834
SOUTH AFRICA	1,154	242	912	460	426	326	871
SOUTH KOREA	11,454	2,269	9,535	5,852	5,219	4,733	13,729
SPAIN	2,253	442	1,638	827	785	603	1,647
SRI LANKA	754	152	625	369	329	282	797
SWEDEN	1,109	216	802	416	393	303	823
SWITZERLAND	298	58	217	112	106	81	223
THAILAND	8,911	1,797	7,408	4,415	3,928	3,419	9,714
TRINIDAD	76	16	57	25	24	17	45
TURKEY	2,085	420	1,573	811	759	589	1,611
UNITED ARAB	363	74	281	148	137	109	305
UK	3,001	586	2,160	1,107	1,049	806	2,204
US VIRGIN IS	74	16	54	22	22	15	39
VENEZUELA	678	144	503	214	208	149	385
VIETNAM	3,750	755	3,122	1,869	1,670	1,463	4,172

ORIGIN	172	176	177	178	179	180	181
AMER. SAMOA	178	639	11	126	53	970	178
ARGENTINA	583	2,210	39	434	191	3,610	671
AUSTRALIA	1,396	5,037	89	989	419	7,735	1,420
AUSTRIA	377	1,263	23	249	109	2,067	376
BAHAMAS	65	254	4	51	24	458	85
BANGLADESH	891	2,987	55	588	250	4,451	806
BELGIUM	1,401	4,688	85	926	407	7,729	1,405
BRAZIL	3,191	12,130	212	2,395	1,082	20,726	3,780
CAMBODIA	447	1,483	27	291	124	2,201	397
CANADA	2,163	2,034	49	386	149	2,182	392
CHILE	1,669	6,619	115	1,297	584	11,241	2,140
CHINA MNLND	107,188	345,930	6,366	67,872	28,678	501,242	91,175
CHINA TWN	10,544	34,028	626	6,676	2,821	49,305	8,969
COLOMBIA	461	1,885	32	369	167	3,265	635
COSTA RICA	643	2,524	43	504	234	4,547	847
CZECH REP	158	531	10	105	46	869	158
DENMARK	340	1,141	21	225	98	1,867	339
DOM. REP	377	1,466	25	289	134	2,612	480
ECUADOR	829	3,392	57	663	300	5,843	1,132
EGYPT	204	691	12	136	60	1,136	206
EL SALVADOR	567	2,462	40	480	221	4,440	893
FINLAND	257	868	16	171	75	1,409	257
FRANCE	1,426	4,793	86	941	414	7,867	1,430
GERMANY	3,783	12,673	229	2,502	1,095	20,749	3,771
GREECE	180	606	11	120	53	999	182
GUATEMALA	1,947	8,497	138	1,655	765	15,376	3,103
HAITI	52	205	4	41	19	369	69
HONDURAS	2,148	9,374	152	1,825	844	16,963	3,423
HONG KONG	19,347	63,018	1,160	12,372	5,238	91,997	16,714
ICELAND	32	106	2	21	9	169	30
INDIA	3,686	12,357	227	2,430	1,034	18,416	3,335
INDONESIA	4,616	15,554	282	3,057	1,298	23,083	4,186
IRELAND	184	613	11	121	53	1,002	183
ISRAEL	811	2,756	50	544	240	4,526	821
ITALY	3,858	12,971	235	2,561	1,136	21,481	3,921
IVORY COAST	71	255	5	50	22	425	77
JAMAICA	48	190	3	38	18	341	64
JAPAN	14,822	46,872	861	9,183	3,864	66,827	12,187
MALAYSIA	4,161	13,846	254	2,722	1,151	20,494	3,715
MEXICO	173	702	12	139	66	1,313	243
NETHERLANDS	1,797	6,013	108	1,187	522	9,853	1,801
NEW ZEALAND	1,168	4,331	76	850	359	6,757	1,244
NICARAGUA	290	1,232	20	243	110	2,200	439
NORWAY	155	523	9	103	45	852	155
OMAN	45	153	3	30	13	242	44
PAKISTAN	972	3,279	60	645	275	4,915	889
PANAMA	91	377	6	74	33	656	128
PERU	351	1,415	24	277	125	2,412	463
PHILIPPINES	2,437	8,044	147	1,579	669	11,820	2,147
POLAND	299	1,002	18	198	86	1,637	297
PORTUGAL	244	813	15	161	71	1,354	248
RUSSIA	273	922	17	182	79	1,498	272
SINGAPORE	1,256	4,167	77	819	348	6,180	1,116
SOUTH AFRICA	601	2,201	39	435	192	3,610	654
SOUTH KOREA	9,398	30,293	553	5,940	2,488	43,584	7,885
SPAIN	1,131	3,770	68	744	330	6,278	1,142
SRI LANKA	550	1,842	34	362	154	2,746	497
SWEDEN	566	1,906	34	376	164	3,104	564
SWITZERLAND	153	513	9	101	44	839	152
THAILAND	6,686	22,202	407	4,364	1,853	32,950	5,948
TRINIDAD	31	118	2	23	11	207	38
TURKEY	1,109	3,746	68	740	327	6,166	1,119
UNITED ARAB	211	712	13	140	60	1,121	204
UK	1,513	5,050	91	997	439	8,299	1,519
US VIRGIN IS	27	106	2	21	10	190	35
VENEZUELA	263	1,020	18	201	93	1,806	331
VIETNAM	2,869	9,433	174	1,853	786	13,946	2,531

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