Detecting Abnormal Pricing in International Trade: The Greece-USA Case

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Government authorities, international lending agencies, and private sector firms try to detect abnormal pricing in international trade. Abnormal prices in international trade may indicate capital flight, import-duty fraud, income-tax evasion, or money laundering. We developed a framework for filtering all annual trades between two countries, which includes thousands of harmonized commodity codes and millions of import-export transactions. It produces a prioritized list of commodities traded at potentially abnormal prices and can help auditors to identify such items ranked according to likelihood of abnormal pricing. We estimated the economic impact of overinvoiced imports to Greece from the United States and underinvoiced exports from Greece to the United States. These transactions shift as much as $400 million in income annually out of Greece to the US (and well over $5.5 billion out of Greece to all other countries or about four percent of the GDP of Greece), lowering the level of taxable income and the tax liability of firms operating in Greece, thus increasing the public deficit and reducing domestic investments. The treasury of Greece is losing an estimated $1.4 to $2 billion revenues annually from worldwide trade shifted income. By auditing only the top 25 income-shifting items with the US (identified through a pricing filter), the Greek treasury could capture about 3/4 of the income shifted from exports and over 1/2 of the income shifted from all imports. (Government: tax policy. International trade.)

Capital flight is a major problem in many countries, including Greece. It has serious economic, political, and social implications; it erodes the country's tax base, increasing the public deficit, it reduces domestic investments, and it may destabilize financial markets. A common way to move capital out of a country is to overinvoice imports and underinvoice exports. In such schemes a fraudulent firm cooperates with a colluding trading partner in a foreign country. The overinvoicing of imports from the colluding partner results in paying import prices that are greater than the true market value of the product, thus shifting capital out of the country for other purposes, while at the same time increases the firm's cost basis and reduces income taxes. The underinvoicing of exports sold to the foreign colluding partner reduces his or her import duties on these products, which the colluding partner then sells profitably for their true higher value, thus effectively shifting capital abroad, while the exporting firm is taxed on reduced revenue.

Government authorities, international lending agencies, and private-sector firms engaged in international trade have long been concerned with detecting abnormal pricing in international trade. The governments of both developed and developing countries are interested in detecting abnormal prices in international trade transactions. Abnormal international-trade prices may be related to lack of knowledge of worldwide prices, to
income-tax evasion, to customs-duty fraud, to capital flight, and to money laundering. Over invoiced import prices may also serve to justify excessively high domestic prices in countries that have price controls. They could conceal illegal commissions that are hidden in the inflated prices. Underinvoiced export prices may be used to avoid or reduce export surcharges in countries where they exist. Pak and Zdanowicz (1994) found $33 billion in tax losses attributable to over invoiced imports and underinvoiced exports in the United States during 1993 (even after adjusting for potential 50 percent product heterogeneity of the US trade with the world). This underscores the 1992 heated debate between presidential candidate Bill Clinton, whose economic advisor Gene Sperling estimated tax losses of $45 billion over four years, and the US Treasury economists who estimated tax losses of at most $12 billion over the same four years (Wartzman 1992).

Government authorities and international lending agencies are interested in detecting abnormal prices as a means of promoting efficiency in government-procurement transactions. Economic growth and development are hindered when import commodities necessary for economic development and citizens' welfare are bought at inflated prices. Conversely, the export of domestic goods at below market prices, may divert revenue flowing to the country and its industries.

Private-sector firms and individuals engaged in international trade are also interested in detecting abnormal import and export prices. The international-trade market has been characterized as highly inefficient because of a lack of detailed information about global prices. In many countries, prices seem to be determined by whatever the market will bear. Benchmark prices are unavailable, and competitive market pricing is difficult to determine. Importers worry that they may be paying prices that are too high for commodities, while exporters worry that they may be selling for prices below market. In addition, private sector insurers find it difficult to determine the true value of insurable cargo.

The ability to determine the accuracy of international-trade pricing should be of great value to market participants in both developed and developing countries. Accurate international-trade prices are necessary to the success of economic-development programs initiated by international lending agencies. International-trade pricing based on well-informed market participants is the cornerstone of an efficient and competitive global market structure.

Capital flight may reflect money-laundering activities that are part of such criminal activities as drug dealing, smuggling, and white-collar crimes. Bhagwati (2000), Cuddington (1986), Varman-Schneider (1991), and Walter (1985, 1986) discuss the causes, methods, and impact of capital flight on developing countries. Chang, Stin, and Cumby (1997) and Stin (1997) explore capital-flight measurement.

Apart from individual greed, several factors contribute to international capital flights: economic uncertainty, fiscal deficits (Dornbusch 1984), financial repression, devaluation and threat of expropriation (Kahn and Haque 1985), and potential confiscation of wealth. These factors are compounded by differences among countries in tax rates, inflation, risk of default on government obligations, and, mainly, political risk and instability (Dooley and Isard 1980, Eaton and Turnovsky 1983, Lessard and Williamson 1987).

Several authors have examined the falsification of international-trade documents to facilitate capital flight (Bhagwati 1964, Bhagwati et al. 1974, De Wulf 1981, Gulati 1986). Abnormal trade pricing may be the least risky technique for shifting capital across borders because many government agencies do not have the ability to analyze import and export transactions and determine abnormal pricing. The sheer volume and intricacy of such transactions make such determinations intense computational expeditions.

The aim of our analysis was to develop a global price matrix for analyzing every import and export transaction between Greece and the United States and estimating the magnitude of capital flight due to abnormal pricing in 1995.

We compared the prices of Greece's imports from the United States to the average prices of similar products imported from the United States by all countries in the world. Similarly, we compared Greece's export prices to the United States to the average export prices of similar products exported to the United States from all countries in the world. We then adjusted the dollar
value of price deviations to account for different degrees of product heterogeneity that may exist among different countries. We estimated capital flight from Greece to the United States as ranging from $276 million to $332 million during 1995.

We conducted a similar analysis comparing Greece’s individual import and export transaction prices with the United States and determining the dollar value of price deviations from average Greece–United States import and export prices. We adjusted the dollar value deviations to account for varying degrees of product heterogeneity between trades of the two countries. We estimated capital flight from Greece to the United States as ranging from $97 million to $202 million during 1995.

**Data Base and Global Price Matrix**

Our research is based on the data contained in the United States Merchandise Trade Database, which is collected by the United States Department of Commerce, Bureau of Census. The 1995 annual database contains transactions data for over 15,000 import-harmonized commodity codes and over 8,000 export-harmonized commodity codes, and it contains the details of over 18 million import transactions and 13 million export transactions. Harmonized commodity codes have been adopted by countries engaged in international trade and are used to identify specific products being imported and exported between countries. The harmonized-commodity-code system assigns specific 10-digit codes to various products imported into and exported from the United States. The United States adopted the classification of commodities by 10-digit harmonized codes in 1989. In addition to price and quantity details for all harmonized commodity codes, the database contains information on trade between the 45 United States customs districts and approximately 235 countries, and also differentiates between air and sea transportation. The database does not contain the names of the individuals or firms making the transactions. The US Customs Service requires that all export values are declared FAS (free alongside ship), and import values are CV (customs value). They reflect only the values of the products being exported and imported and do not include insurance or freight costs.

The import database also contains information on insurance and freight for each transaction. The database does not identify the firms engaged in these transactions, but it does list the customs ports of entry. The size of this database is 10 to 12 gigabytes in 24 CDs for all trade records between the US and one other country over a year span (one monthly CD for exports and one monthly CD for imports).

We combined by harmonized commodity code and by country all the records from the 12 monthly United States import databases and the 12 monthly United States export databases for 1995. We also calculated for each harmonized commodity code the total United States–world trade. For each commodity code, we determined a frequency distribution of prices for all United States–world transactions during 1995. We then analyzed the total United States imports from the rest of the world and the total exports from the United States to the rest of the world and determined the average United States–world import and export prices for every commodity.

We recognize that the characteristics of import and export transactions may vary among countries. Therefore, we also investigated import and export transactions relative to United States–country trade for every commodity for all countries. We analyzed total United States–country imports and total United States–country exports and determined the average United States–country import price and the average United States–country export price for every commodity traded.

The result of this analysis is a global price matrix. Its dimensions are 236 columns denoting every country and the world, by over 23,000 rows representing every import harmonized code and every export harmonized code. The resulting matrix contains over 5.5 million cells. Each cell contains the average price based on the population of transactions related to the United States import or United States export of a particular commodity from and to a specific country, as well as from and to the world. Some cells are empty because no transactions existed between the United States and a country for a particular commodity. The enormous size of these databases and the intense computational requirements have prevented governmental agencies, including the US Customs Service and the Internal
Revenue Service, from systematically detecting transactions that are abnormally priced.

The products defined by a harmonized commodity code in the global price matrix have varying degrees of homogeneity. Harmonized commodity codes should not be confused with standard industrial classification (SIC) codes. SIC codes attempt to classify firms by industry and, in most cases, lead to misspecification in transfer-pricing issues. Industrial classifications are very broad and include firms with diverse markets and multiple product lines. Their use in transfer-pricing disputes has been discredited in prior litigation. Harmonized commodity codes relate to specific product classifications and are more useful than SIC codes for determining and analyzing transfer prices. However, some harmonized commodity codes are more detailed than others. Thus, harmonized commodity codes provide more meaningful information for some commodities than for others. In all cases, the information contained in the global price matrix, compiled from public US sources, is the most exhaustive and detailed information that can be used to determine comparable prices.

**Abnormal Pricing Examples in Greece-US Trade**

Our analysis of transaction prices between Greece and the United States revealed significant abnormalities in pricing. Many single records of transactions between the two countries during 1995 seem questionable. Some examples of undervalued exports from Greece to the US are mink furskins at $12.31 apiece or 1.08 percent of the average price of the same item imported to the US from all countries; men’s and boys’ jackets at $53.50 a dozen or 6.78 percent of the average US import price; marble slabs at $138.43 per ton and razor blades for $14.63 per thousand versus $831 and $80.90, respectively, for the average US worldwide import of same items. Some overvalued imports to Greece from the US are electric capacitors at $1,560 each or 30,316 times the average US export price to all countries for the same item; engine spark plugs at $423 each or 3,773 times the average US export price for the same item worldwide; a single telephone for $7,586 or 59 times overpriced; batteries at $12,540 each, compared to $5.24 for the same US-world average export item; and a dozen sunglasses at $7,534 versus $193 for the average US worldwide export price for the same item. Based on our prior research, such irregularities are occurring in all countries examined, not just in Greece.

One can imagine the effect that abnormal pricing of that magnitude would have on the annual trade of even a small country. Greece’s total 1995 trade is about $2 billion with the US (Table 1) and almost $40 billion with the world, or about 27 percent of its GDP. Government expenditures represent about 33 percent of the country’s GDP. Thus, lost tax revenue from abnormal price trades is substantial for the country’s budget and is detrimental to its public deficit and domestic investments.

**Methodology and Computational Procedure**

From the global price matrix, we selected the average prices for each commodity traded between the United States and Greece and the average prices for the same commodity traded between the United States and the world. We analyzed every import and export transaction between Greece and the United States during calendar year 1995.

We first analyzed Greece’s import prices for products purchased from the United States and compared them to the average import prices for identical products purchased from the United States by the world. This allowed us to determine the degree of over invoicing in Greece’s imports from the United States based on comparisons to the average prices all countries paid for imports from the United States. To allow for the heterogeneity of products being imported by other countries from the United States, we analyzed Greece’s import transactions allowing for various assumptions of country heterogeneity. For every one of
Greece's import transactions, we calculated the price deviation when the observed price was greater than the United States-world average import price and greater than the United States-world average import price plus 10, 20, 30, 40, and 50 percent. We estimated the dollar amount over invoiced for every United States-Greece import transaction for every commodity and calculated the total dollar amount over invoiced for each of the above percentage deviation assumptions of country heterogeneity. We conducted a similar analysis of Greece-United States export transactions to determine the amount of under invoicing in Greece's exports to the United States. For every Greek export transaction, we determined the deviation of price when the observed price was less than the world-United States average export price and less than the world-United States average export price less 10, 20, 30, 40, and 50 percent.

We also recognized that the degrees of heterogeneity might have been different for commodities imported into and exported from a particular country in 1995. To account for commodity heterogeneity within a country's trade with the United States, we also analyzed transaction prices assuming different degrees of commodity heterogeneity. We compared transaction prices to the historical average United States-Greece prices and allowed for deviations of +10, +20, +30, +40, and +50 percent for Greek imports from the United States and −10, −20, −30, −40, and −50 percent for Greece exports to the United States.

We undertook an additional investigation based on the lognormal and log-t distributions. First, we examined three export and three import items with high dollar volume in Greece-US trade: exports of marble slabs, marble nonslabs, and calcareous stone from Greece to the US, and imports of modems, airplane and helicopter parts, and cotton gins to Greece from the US. The appendix shows for each item the corresponding descriptive statistics, along with an estimate of the lognormal location parameter, “a” (Muralidhar and Zanakis 1992). The Kolmogorov-Smirnov and chi-square goodness of fit tests were applied on LN(XX) and LN(X-A) to test, respectively, the two- and three-parameter lognormal distribution fit to each item price variable X. The two-parameter lognormal provided a better fit than the three-parameter distribution, as it was not rejected for five of the six items at the 99 percent confidence level. Only airplane-helicopter other parts, an unusual item (mostly government users), did not fit the lognormal distribution. Since all the sample sizes are quite large, the log-t fit (Appendix) is slightly better than the lognormal fit in the smaller-sample cases. Hence, we computed the five, 10, and 25 percent log-t tails for each of the 23,000 export and import product transactions. The US Internal Revenue Service recommends the upper quartile values for locating abnormal prices. To facilitate this large number of computer calculations, we employed the Fisher and Cornish (1960) approximation to a t-deviate based on the corresponding Z score:

\[
t = Z + 0.25(Z^3 + Z^2)(1/(N - 1)) + (5Z^5 + 16Z^3 + 3Z)/(96(N - 1)^2).
\]

This approximation produces quite accurate values, for example, even with only nine degrees of freedom:

<table>
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<th>Tail</th>
<th>t approximation</th>
<th>t table</th>
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<td>2.821</td>
</tr>
<tr>
<td>0.025</td>
<td>2.258</td>
<td>2.262</td>
</tr>
<tr>
<td>0.050</td>
<td>1.832</td>
<td>1.833</td>
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<tr>
<td>0.100</td>
<td>1.383</td>
<td>1.383</td>
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<tr>
<td>0.250</td>
<td>0.703</td>
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**Summary Findings**

Based on average US trade prices with all countries, capital flight from Greece to the US in 1995 was $633 million. This resulted from $446 million over invoiced imports from the US and $187 under invoiced exports to the US. Even after allowing for 50 percent deviation from the US-world average, the total income shifted from Greece to the US was in excess of $275 million, of which $231 million were from over invoiced imports and $44 million were from under invoiced exports to the US (Table 2). All these represent the amounts by which all trades violated their allowance of ±50 percent deviation from the average price for each item, that is, amounts on which the Greek treasury did not collect any taxes.

A similar summary based on average US-Greece trade prices lowers the total 1995 income shifted from Greece to the US to $255 million or a conservative
$97 million if we allow a liberal 50 percent deviation (Table 3).

These amounts are all very significant for Greece in light of its total 1995 trade with the US: $1.917 million, resulting from $1,519 million in imports from the US and $398 million in exports to the US (Table 1). The total annual trade of Greece with the world consists of approximately $27 billion in imports and $12 billion in exports. If we extrapolate even the conservative 50 percent worldwide-price-deviation findings for the US-Greece annual trade (shifted income of $275 million—$231 million imports and $44 million exports) to Greece’s total trade with the world, the numbers become astonishing for the country’s economy. The shifted income of $4.1 billion from imports and $1.4 billion for exports (a total of $5.5 billion annually) is about four percent of the country’s GDP. That amount is about the same as the total economic aid that Greece receives annually from the European Union—a major contributor to the country’s economic development and infrastructure expansion. The marginal tax rate for many Greek businesses is 35 percent. Assuming a 25 percent average tax rate, which is a low estimate, the treasury of Greece is losing revenue of over $69 million annually just from US trades and over $1.4 billion from its trades with all countries, or about one percent of its GDP and three percent of the government’s total annual revenues. Note that a 25% deviation filter from the average US-world prices would raise the shifted income from worldwide trades of Greece to a staggering $8 billion annually or $2 billion annual revenue loss for the treasury of Greece.

An obvious question of interest to Greek authorities and trade agencies is which items represent the highest dollar amounts in income shifted to the US from Greece and how much could be accounted for by the top, say, 25 items? Assuming a conservative 50 percent deviation from the US-Greek average, Greece lost $6.4 million from the top 25 under invoiced exports to the US (accounting for 79 percent of the total for all items), mainly from fused magnesia ($1.6 million) and fur-skins ($1.2 million), clothing, marble slabs, aircraft parts, tobacco leaves, and software (Table 4). Based on the US-world average prices, we found a total of $33.8 million from the top 25 under invoiced exports to the US, mainly from single-edged razor blades ($11 million), paper machinery ($6 million), and vermiculite-chlorites ($5 million). Other under invoiced popular export items (among which are belt conveyors, self-adhesive tapes, and floor coverings) account for 76 percent of all export dollars shifted.

On the import side, the top 25 products include guns ($8 million shifted) and their cartridges ($5 million), cotton gins, antibiotics, blood, aircraft parts, coaxial cable, industrial refrigerators and freezers, modems, and stamp-impressed paper. The total amount shifted by these top 25 import items was $42 million, or 47 percent of all import dollars shifted. When the US-world average basis is used, the amount shifted by the top 25 products grows to $123 million, or 53 percent of the

Table 2: We show the income shifted from Greece to the US based on US-world average prices in 1995 (in US $ millions). A 50 percent deviation filter from the US-world average prices would capture $331.4 million in annual income shifted from over invoiced imports from the US and $111.7 million from under invoiced exports to the US, for a total of $443.2 million.

Table 3: We show the income shifted from Greece to the US based on US-Greece average prices (all 1995 trades). A 20 percent deviation filter from the US-Greece average prices would capture $143.1 million in annual income shifted from over invoiced imports from the US and $23.2 million from under invoiced exports to the US, for a total of $166.4 million.
total for all products imported from US. The top products in that list were new helicopters ($47 million), used aircraft ($16 million), gas-turbine engines ($9 million), cotton gins, radar, antibiotics, commercial vehicles, coaxial cables, lactones, blood, modems, corn, and industrial freezers and refrigerators.

The estimated amounts of income shifting based on a similar analysis, under the plausible assumption of a two-parameter log-t distribution (Appendix), are summarized in Tables 5 through 7 for 5, 10, and 25 percent log-t distribution tails. These tail areas are the screening levels (filters) that customs officials can set, depending on local circumstances and the detection rates to which they aspire. Our choice of these screening levels was influenced by the following observations. Exploratory box plots confirmed a frequent pattern of big gaps between several top outliers and large variances (a coefficient of variation of more than 100 percent). Therefore, screening based on five, three, or even two standard deviations would be extremely conservative and ineffective for combating tax evasion. Moreover, the US Internal Revenue Service uses the upper and lower quartile values for similar purposes.

Summing these over all Greece-US imports and exports provided corresponding estimates of total income shifted (Tables 5–6) and what an audit of just the top 25 items can detect (Table 7). Under the log-t assumption, a five percent filter would identify suspicious transactions shifting about $20 million from US-Greece trade and a 25 percent filter, $132 million. Auditing only the top 25 items in a 25 percent filter would capture about 57 percent of total income shifted; a minimal filtering of only five percent of the top 25 items would capture about 74 percent of total income shifted.

Our analysis identifies an ordered list of trades that are likely to be abnormally priced. It helps auditors identify items ranked according to likelihood of abnormal pricing; it does not prove that they are abnor-

<table>
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<tr>
<th>50% Deviation from</th>
<th>Imports US $ Millions</th>
<th>Exports US $ Millions</th>
<th>Total US $ Millions</th>
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</thead>
<tbody>
<tr>
<td>US-world average</td>
<td>$123.4 / $231.4 = 53%</td>
<td>$33.8 / $44.3 = 76%</td>
<td>$157.2 / $275.7 = 57%</td>
</tr>
<tr>
<td>US-Greece average</td>
<td>$41.7 / $89.3 = 47%</td>
<td>$6.4 / $8.1 = 79%</td>
<td>$48.0 / $97.4 = 49%</td>
</tr>
</tbody>
</table>

Table 4: We show the income shifted from the top 25 items in all Greece-US 1995 trades. Just auditing only the top 25 import items, identified by a conservative 50 percent price deviation filter from the US-world average prices, would capture $123.4 out of $231.4 million total imports or 53 percent. A similar export filter of the top 25 export items would capture $33.8 out of $44.3 million total exports or 76 percent. In total, $157.2 out of $275.5 million or 57 percent of all abnormally priced annual trades between the US and Greece would be captured.

<table>
<thead>
<tr>
<th>Price Deviation from</th>
<th>Overinvoiced Imports from US US $ Millions</th>
<th>Underinvoiced Exports to US US $ Millions</th>
<th>Total Trades with US US $ Millions</th>
</tr>
</thead>
<tbody>
<tr>
<td>US-world average</td>
<td>$446.2</td>
<td>$186.9</td>
<td>$633.1</td>
</tr>
<tr>
<td>25% tail</td>
<td>$118.2</td>
<td>$13.8</td>
<td>$132.0</td>
</tr>
<tr>
<td>10% tail</td>
<td>$29.6</td>
<td>$1.8</td>
<td>$31.4</td>
</tr>
<tr>
<td>5% tail</td>
<td>$19.1</td>
<td>$0.6</td>
<td>$19.7</td>
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Table 5: We show the income shifted from Greece to the US based on US-world average prices and log-t distribution (all 1995 trades in US $ millions). A quartile deviation filter from the US-world average prices would capture $118.2 million in annual income shifted from overinvoiced imports from the US and $13.8 million from underinvoiced exports to the US, for a total of $132 million. Upper and lower quartiles (25% tails) are the guidelines of the US Internal Revenue Service.

<table>
<thead>
<tr>
<th>Price Deviation from</th>
<th>Overinvoiced Imports from US US $ Millions</th>
<th>Underinvoiced Exports to US US $ Millions</th>
<th>Total Trades with US US $ Millions</th>
</tr>
</thead>
<tbody>
<tr>
<td>US-Greece average</td>
<td>$200.0</td>
<td>$54.9</td>
<td>$254.8</td>
</tr>
<tr>
<td>25% tail</td>
<td>$56.0</td>
<td>$4.8</td>
<td>$60.8</td>
</tr>
<tr>
<td>10% tail</td>
<td>$18.3</td>
<td>$1.3</td>
<td>$19.6</td>
</tr>
<tr>
<td>5% tail</td>
<td>$10.2</td>
<td>$0.7</td>
<td>$10.9</td>
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Table 6: We show the income shifted from Greece to the US based on US-Greece average prices and log-t distribution (all 1995 trades in US $ millions). A quartile deviation filter from the US-Greece average prices would capture $56 million in annual income shifted from overinvoiced imports from the US and $4.8 million from underinvoiced exports to the US, for a total of $60.8 million. Upper and lower quartiles (25% tails) are the guidelines of the US Internal Revenue Service.
mal. Customs investigators may skip items in that list, based on their experience with that commodity or the specific import-export firm. The small sample of certain transactions may render improper their identification as abnormally priced. This may also be the case for unusual items for a country, such as expensive military items. Our methods can be used to identify abnormal import-export pricing in the trade of any two countries; we do not imply that Greece’s trade incidence of abnormal pricing is lower or higher than any other country’s.

**Abnormal Pricing Detection, Audits, and Physical Inspections**

Detecting abnormal international trade prices can produce economic benefits for the country and assist the government with investigating and legally prosecuting individuals and organizations engaged in deceptive pricing schemes. Reducing capital flight can increase investment in a country’s private and public sector. Decreasing income-tax evasion adds revenues to a country’s treasury. Curtailing the laundering of money obtained through illegal activities can produce social benefits and enhance citizens’ quality of life or limit funding for terrorism.

In the past, customs services had difficulty conducting regular audits and inspections because they had no quick and systematic access to accurate and detailed price data. Business and governmental organizations can now obtain customs trade reports by item, country, or district at http://ustrade.fius.edu. Government authorities need to decide what and how much to inspect. Selecting trade transactions for inspection at random is generally a poor strategy, since a few transactions account for most of the income shifted. Identifying potential evaders is therefore crucial. Greek customs officials can confirm their suspicions that transactions were priced abnormally by auditing trade documents and by physically inspecting cargo. They can examine these trade documents covering products imported into and exported from Greece to determine whether the prices paid or charged reflect market values. Greece’s customs authorities could use a similar global pricing filter online to flag suspiciously priced records as they pass customs at any location. Alternatively, they could run such a filter in batch mode monthly (or less frequently) at a single installation to identify abnormally priced transactions during that period for the entire country. By auditing just the top 25 income shifting items (identified through a similar filter), the Greek treasury could capture about 3/4 of all income shifted...
through exports and 1/2 of all income shifted through imports.

Detecting abnormal international trade prices will also necessitate some expenditures. Countries that have their customs agencies conduct audits and inspections will incur costs for additional physical space, employees, and operating expenses. Physical inspections will also incur nonquantifiable costs, such as delays in the movement of goods. The audit and inspection process will vary by country because of different recording procedures, customs port characteristics, government policies, manpower constraints, inspector experience, and even patterns of evasion. The optimal level of audits and inspections should be determined by a cost/benefit analysis of local port conditions.

Iwasaki and Tone (1998) describe a study to identify which of 23 companies at a Japanese customs district to audit. Logit and probit models with inputs on company foreign trade data and ratings of importers (based on intangible criteria assessed via the analytic hierarchy process) provided estimates of the probability of detection. They used these results in a mathematical-programming model to identify potentially incorrect tax statements that would maximize tax-revenue collection subject to manpower constraints. Although Iwasaki and Tone report a 25 to 33 percent improvement for the Japanese customs location they studied, implementing such an approach for all products and customs locations would not be easy. It would require a fast DSS to filter out and rank-order questionable transactions so that custom inspectors could make a choice of what items to audit, based on the DSS output supplemented by their own expertise. Managers would seek fast and simple detection improvements, not an elusive optimum, and would reject any procedure they didn't understand (Zanakis et al. 1980). Our procedure could form the nucleus for such a system. Based on the resources available, the customs administrators would have to determine the screening level either as the tail probability (Tables 5–7) or as a price-deviation percentage above the average (Tables 2–4). They would need to analyze historical price data for every commodity traded and determine an average price and upper- and lower-bound prices as benchmarks for abnormality so they could flag suspicious transactions.

Conclusions

Based on our global price matrix and analysis of Greece's trade with the United States, we estimated that, through over invoiced imports and under invoiced exports, capital flight from Greece to the United States during 1995 was between $132 million and $276 million. We examined pricing abnormalities in the trade between Greece and the United States only. An analysis of trade pricing between Greece and other countries could reveal similar levels of capital outflows, estimated at $5.5 billion annually or about four percent of Greece's GDP. Based on our estimates of capital flight from Greece to the United States, the economic benefits of detecting and deterring abnormal transaction prices would be substantial, adding three percent to the government's annual revenues. This can be as high as $2 billion annual revenue loss for the treasury of Greece from $8 billion in worldwide annual trade shifted income detected by a 25% deviation filter from the average US-world prices.

The US Internal Revenue Service currently conducts random audits and character-based audits. Random audits waste resources because many audits result in no additional tax revenues. More widely used are character-based audits, which target firms that have certain characteristics. A transactions-based auditing system would be more productive and less costly, and it might cause importers and exporters to reconsider their manipulation of transfer prices.

A transactions-based auditing system would automatically compare all Greek import and export prices to statistical filter limits, identifying suspicious amounts. As a starting filter to flag abnormal trades, Greek customs may use the upper or lower quartile prices for each item, as the US IRS does. Customs offices implementing such systems should calibrate them via sensitivity experiments using additional settings based on the local circumstances and resources. We believe our filtering approach is easy to understand, examines all items, and for a user-defined filtering parameter, will lead to a quick improvement in detecting abnormally priced transactions; these are all ingredients for successful implementation in practice.

An international global-price-matrix system could assist the government in transfer price litigations and in negotiating advanced pricing agreements or uncover-
ing terrorist funds. It could even fuel debates about public policy on international trade at a government or legislative level. The information in the global price matrix could also help firms engaged in international trade to avoid unnecessary litigation about transfer pricing. Institutions that finance international trade would benefit from such a system of identifying abnormal import and export prices. In the US, the Bank Secrecy Act and the Money Laundering Controls Act require financial institutions to report suspicious transactions, a growing concern after September 11, 2001. More so after the collapse of Enron and Arthur Andersen, accounting firms are required to report illegal activities discovered during auditing. Both could benefit from a filtering system. Accounting and management-consulting firms would find the price matrix useful for helping clients to set transfer-pricing policies and to negotiate advanced pricing agreements. As a by-product, such a system could reveal growing foreign markets for some commodities and arbitrage profit opportunities due to price discrimination in what appears to be a very inefficient global market. Similar approaches could be used to estimate the US balance of trade and revised national income statistics and to detect fraudulent health-care or other insurance payments. In this research, we used the US Merchandise Trade Database, but one could add databases from other individual countries, the United Nations, the European Union, the Organization for Economic Development and Cooperation, and the Organization of American States to obtain detailed information on multilateral trade flows.

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Pak, S. J., and Z. Zdanowicz. 1994a. An estimate of lost US federal income tax revenues due to over-invoiced imports and under-invoiced exports. Report 9404–01, Trade Research Institute, Miami, FL.


A report released on November 21, 2001, by US Senator Byron L. Dorgan (D-ND) and shown at his Web site, http://dorgan.senate.gov, states the following: “... International corporations operating in the United States may have avoided paying up to $45 billion in federal income taxes in 2000 by using phony pricing schemes in order to move profits earned in the US to other countries where they would not be subject to US taxes. The senator's report was based on a study conducted by Simon J. Pak and John S. Zdanowicz of the Center for Banking and Financial Institutions at Florida International University in Miami, Florida. Under the scheme used to avoid U.S. taxes, the study found that international corporations moved profits out of the United States and into other countries where they would not be subject to U.S. taxes by frequently and significantly underpricing goods purchased by their foreign affiliates from their U.S. operations, and overpricing goods sold to their U.S. operations by foreign affiliates. Abnormally high-priced U.S. imports documented in the study included toothbrushes at $5,655.00... single-edge razor blades for shaving $461.00 each...”

“Dorgan said he included $2 million in the 2002 Treasury-General Government Appropriations bill to expand the study to help determine policies that will allow the Internal Revenue Service to collect taxes due but avoided under such pricing schemes. The legislation has been signed into law by President Bush. Drs. Pak and Zdanowicz will be the Principal Investigators for that study, Dorgan noted, building on their previous work.”

An exclusive reportage at the *South Florida Business Journal* (Freer, October 26, 2001) entitled “FIU study: Honey trade launderers Al Qaeda cash” indicated that US officials who believe that terrorists may have used the honey trade to move money between the US and the Middle East might find clues in a new report by FIU professors. They found that 12 shipments of honey from Charleston, SC totaled $479,473, which was $130,881 above the average world price of all US honey exports to all countries. The professors’ report was released on October 23, 2001, three days after federal authorities arrested two men at JFK International Airport trying to smuggle more than $100,000 in cash to Yemen in boxes of honey.
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