Overseas Assembly and Country Sourcing Choices

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Abstract:

The fragmentation of production has resulted in an increasing degree of vertical specialization across countries. This paper studies one venue that has facilitated growth in U.S. vertical specialization, the program known as 9802 in the current tariff code, or alternatively as the overseas assembly provision, or OAP, in earlier years. The empirical analysis examines how the cross-country pattern of OAP sourcing responds to changes in country costs. I find that changes in sourcing are driven by reactions on a number of dimensions. First, although anecdotal evidence focuses on the tendency of industries to relocate among developing countries, exit and entry are also found to exert an influence on the country pattern of OAP sourcing from the richer countries of the OECD. This entry and exit is influenced not only by changes in own country costs, but by cost changes in countries that can be regarded as competitors. The second level of adjustment is found in import values. Here too, both own country costs as well as the cost of competitors are found to be influential, with larger competitor responses noted among developing countries.

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Production and trade increasingly involves the flows of intermediate goods moved from one location to the next as multiple countries complete successive steps in the production process.[1] It is argued that advances in transportation and communications have facilitated this trend towards the dispersion of production activities. Casual observation of these production changes has fueled speculation that trade and foreign activities are placing increasing pressure on labor markets and depressing worker wages, at least for the least skilled. However, with the exception of Feenstra and Hanson (1997), there is scant evidence on the connection between outsourcing choices and wages.

While popular concerns assume that outsourcing places downward pressure on wages, outsourcing can only intensify labor market competition if firms are capable of quickly and easily changing their international sourcing choices as relative market costs change. However, the nature of international outsourcing may in fact, prevent quick firm changes. To begin, as highlighted by Rauch (1999), information seems to play a large role in determining trade volumes - especially for differentiated products. Even if country costs change, it is not obvious that firms know enough about other markets to quickly change their international sourcing decisions. Grossman and Helpman's (2002b) recent work on international outsourcing includes just such an informational feature; while Northern firms seek partners in the South they require information as they learn which potential partners offer a suitable match. In this context, Northern firms may be dissuaded from international outsourcing when the cost of gaining information on matches is high.

Other cost factors may also inhibit quick changes in international sourcing. As Grossman and Helpman (2002b) describe, an international outsourcing project is likely to require that foreign partners undertake relationship-specific investments. Due to incomplete contracts, the Northern partner may often face difficulties in gaining contracts that ensure their Southern outsourcing partners will perform the appropriate level of

[1] Feenstra (1998) provides a survey and description of trends in international sourcing. Hummels, Rappaport & Yi (1999) and Yi (1999) estimate that vertical specialization may now account for 30 percent of all trade flows.

relationship-specific investments. As a result, outsourcing is less likely to be moved to countries which have poor legal systems, even if these countries offer favorable production costs. Second, as has been noted in the general trade literature, if there are fixed costs of entry and exit from markets, trade is likely to exhibit a degree of hysteresis.[2] As a component of trade flows, it is not unreasonable to expect that outsourcing might also be characterized by similar factors, including fixed cost driven hysteresis.

To date, there is little systematic evidence to document whether firms' outsourcing decisions are "footloose" as popularly claimed, or whether information, contracting difficulties and fixed costs impede a high degree of sensitivity to changes in country cost conditions. To examine these questions, I study U.S. outsourcing conducted through the provisions of the offshore assembly program (OAP) which is now known as 9802 in the current tariff code. The OAP was designed to assist firms that perform assembly operations overseas using U.S. produced components. The primary benefit of the 9802/OAP program is that it limits duties on assembled items to the portion of the product's value that arises from foreign value-added. No duties are assessed against the portion of product value that originates from U.S. components. When products are returned to the U.S., firms operating through the OAP program are required to report both the U.S. and foreign dutiable value of their products. As a result, the conduct of OAP activities allows one to examine changes in one segment of U.S. sourcing. It also allows one to observe how cross-country sourcing patterns have changed. This paper seeks to provide new insight into this issue by documenting the degree to which production sharing facilitated by the U.S. 9802 program, also known as the Overseas Assembly Program (OAP), responds to changes in country cost conditions.

A second goal of this paper is to test whether the cost responsiveness of outsourcing is more pronounced in poorer countries than it is in the richer countries of the OECD, as it could be argued that more developed countries are potentially better

[2] Such hysteresis has been found in other trade activities including exporting. (see Tybout and Roberts 1999).

insulated from cost-based production shifts than are less developed countries. For example, due to the need for a highly skilled workforce, multinationals will generally conduct research and development, market distribution, and other proprietary activities in developed countries, and tend to retain their high value-added headquarters activities at home. In contrast, multinationals may conduct simple component production and assembly operations in countries that have less skilled workforces and much cheaper labor costs. To the extent that lower skilled workers are more interchangeable, there may be fewer frictions that prevent the movement of a simple assembly operation from one developing country to another.

In related work, Brainard and Riker (1997) study employment decisions of U.S. multinational firms and their foreign affiliates. Their findings indicate that the degree of substitution among a firm's numerous foreign affiliates is much higher than it is between parent firms and their foreign affiliates, which is relatively small. Their results suggest that foreign affiliate labor is not easily substituted for home labor, and that the two may even be complements. If the phenomenon is driven by the difference between the utilization of high and low skilled labor, we would expect to see a similar phenomenon in outsourcing choices.[3]

Many studies of trade and wages have focused on the effects of trade or foreign investment on developed country wages.[4] It is not clear however, that developed country experience provides a reasonable guide to effects that will be experienced in other countries. This concern has particular bite if multinational activities are less successfully completed at a distance. If assembly operations are more easily moved than other activities of the multinational enterprise, it is possible that such production shifts will exert greater downward pressure on wages in the developing countries.

[3] 9802 outsourcing encompasses both foreign assembly conducted by contract, as well as foreign assembly conducted through foreign affiliates.

[4] Other developed country studies include Head and Ries (1999) which studies the effects of Japanese firm foreign investments on Japanese firm labor, and Haskel and Slaughter's (1999) examination of the effects of trade on workers in the U.K.

The data in this paper measure the volume and country composition of dutiable imports brought to the U.S. through the 9802/OAP program between the years 1980 and 1994. The regression analysis evaluates how changes in country costs affect the amount of OAP sourcing from any particular country. The findings suggest that increased country costs, as measured by real exchange appreciation in the previous year, depress OAP sourcing from any particular country. However, changes in 9802/OAP imports are not only changed by changes in values and volumes, but by a high degree of country entry and exit from the program. In this dimension, developing countries appear to face a higher degree of risk that they may be selected in to or out of the program when their own costs change. Developing country 9802/OAP activities also seem to be more closely governed by costs changes in competitor countries. The data seem to imply that the pricing of 9802/OAP imports from developed countries is governed by the competing prices from other countries assembling the same products. In addition, when the costs in competing countries rise, developing countries see a larger increase in their probability of being selected for 9802/OAP activity than do developed countries. Nonetheless, developed as well as developing countries face strong cost pressures influencing their selection in to and out of the program.

1. A Description of OAP

While it is now referred to as 9802, U.S. Overseas Assembly Program originated with the Tariff Act of 1930.[5] The 9802 program allows firms to produce parts and components in the U.S. that are later shipped to other countries for assembly. After the product is assembled abroad, it may then be shipped to the U.S. Typically, imports to the U.S. face customs duties on the full value of the item shipped to the U.S. However, the 9802 Program recognizes that portion of the product originated in the U.S. As a result, when tariffs are levied on the final product, the tariffs are only levied on the part of the product value that was generated abroad, while the portion of product value that can be attributed to U.S. parts and components is exempt from U.S. duties.[6] Administration of the duties means that products entering through the 9802 program provide information on their product composition, and whether the value of the product is due to dutiable 9802 import, or non-dutiable U.S.-origin components. Throughout its history, the 9802 program has received the support of component makers, while raising the displeasure of U.S. based assemblers.

To motivate the regression analysis that follows, I begin by describing recent trends in 9802/OAP sourcing. Figure 1 displays the broad changes in the usage of the program as it follows the evolution of overall 9802/OAP imports, as well as the breakdown of those 9802/OAP imports between dutiable 9802/OAP imports and non-dutiable U.S. components. Between 1980 and 1994 there has been substantial growth of both non-dutiable U.S. inputs imported through 9802/OAP and dutiable 9802/OAP imports. For each year, the value of dutiable 9802/OAP activities conducted abroad exceeded the value of the U.S. inputs contained in 9802/OAP products. One unusual feature in Figure 1 is the large upward spike in program usage for 1987. This spike disappears by the early 1990's. Further examination of the data demonstrates that the

[5] This program was initially called the 806/807 provision of the U.S. tariff code, and is now called the 9802 provision of the Harmonized System code.

[6] The program was designed with the steel industry in mind, as it sought to accommodate the practices of U.S. steel firms, many of which had large international shipments of intermediate inputs from Canada. In later years, the program grew to include other industries and countries. See Hanson (1997) for a description of the program's development.

spike was generated by a surge in 9802/OAP activity in the auto industry. Since the large spike in 9802/OAP activities is attributable to automobile sourcing, Figure 2 displays the evolution of 9802/OAP activities, excluding the auto sector.[7] Examination of the overall non-auto figure demonstrates that the 9802/OAP program generally experienced sustained growth over entire the full time interval. As before, the use of dutiable 9802/OAP inputs and assembly from abroad exceeded the value of U.S. inputs, though the difference is smaller in this segment of 9802/OAP program usage.

The growth in 9082/OAP outsourcing is mirrored in work by other authors who have used other methods to impute how outsourcing has grown in recent years.[8] imports isIn contrast a higher degree of substitutability of inputs is implied by work including Feenstra and Hanson (1997) and Irwin (1996) for the U.S., or Campa and Goldberg (1997) for the U.S., U.K., Japan, and Canada, which documents that the usage of imported intermediate inputs has increased in almost all cases since the 1970's.

2.0 Summary Statistics

The data set follows U.S. production sharing conducted through OAP/9082 between the years 1980 and 1994. OAP/9802 imports are aggregated to the 4-digit SIC industry level. At this level of aggregation, there are 399 separate industries. The data set contains information on 66 countries.

In the final year of the sample, U.S. production sharing imports were valued at 59.3 billion dollars, which was 9.02 percent of all U.S. imports in that year. Of imports that entered through the 9802 program, 37.9 percent of the value originated from developed countries, while the remaining 62.1 percent were from developing countries.

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[7] OAP activites in the auto sector are defined to be all imports of products classified under the 3-digit SIC 371.

[8] Other work generally impute usage of imported intermediate inputs by combining information from input-output tables with information on the relative size of import flows compared with industry outputs. Or see Zeile for methods based on the activities of multinational firms.

Mexico represented the largest source of supply from the developing countries, supply 38.9 percent of production sharing imports in 1994 - a volume that was more than 10 times higher than the next largest developing country suppliers of 9802 products. The sample for this project ends with 1994, since Mexico plays such a disproportionate role in production sharing, but may not show up accurately in later years data. With the implementation of the NAFTA, products no longer need 9802 to receive favorable tariff treatment. As a result, while the production sharing arrangements may continue, their values may no longer be recorded in the 9802 data, if the imports are now entered under the provisions of the NAFTA instead. To avoid these issues, the data sample is ended with 1994.[9]

When country costs change, it is possible that outsourcing may change in a number of ways. First, the volume of outsourcing may change, rising if costs become more favorable. Second, if costs change in the country of assembly, the price of outsourcing activities may change if the U.S. importer is expected to absorb part of the cost shock. Finally, the entire operation may cease if an unfavorable cost shock causes the 9802 importer to decide to end assembly operations, possibly moving to another country.

When international sourcing relocates, it could in principle relocate to any other country. However, it is not clear that all countries are truly at risk of selection. Even if the country has low labor costs, the country may not provide suitable facilities or skills for the assembler's requirements. Even if the country is suitable for the activity, transportation or other costs for the product may rule the country out as a potential supplier.

[9] The recording of Canadian production sharing activities may have similarly changed with the introduction of the Canada-US Free Trade Agreement. However, Canada was never as large a supplier of production sharing as was Mexico. To examine whether the treatment of the Canadian data affected the subsequent regressions, alternative specifications were estimated that 1) eliminated Canada from the sample, 2) included a dummy variable for Canada in the years after the implementation of the Canada-US Free Trade Agreement.

In this paper, countries are considered *potential suppliers* of a particular 4-digit SIC product category if the country provided exported any 9802 products in that 4-digit SIC to the U.S. during any of the years in the 1980 to 1994 interval. Using this definition, Table 1 describes the range of supplier countries for the different products. Across the 399 4-digit SIC industries, the average industry was typified by 9802/OAP imports that originated from 16.6 different countries during the time span. The mean number of suppliers was generally similar to the median, which was 13 countries. If the dichotomy between developed and developing countries is defined by membership in the OECD, it is clear that most 4-digit products originated from both developed and developing locations. Here, 387 different 4-digit industries were represented in U.S. 9802/OAP imports from OECD countries, while the slightly lower number of 357 were imported from non-OECD locations.

The number of competitor countries differs substantially across 2-digit industries. As might be expected, the highest number of competing countries was seen in SIC 23 - Textiles and Apparel. Here, the typical 4-digit SIC industry received 9802/OAP imports from 35.6 countries, 8.9 of whom were members of the OECD, 26.7 who were not.

While Table 1 indicates the breadth of supply by industry over the full time period, it does not indicate how supplies changed over time. Table 2 provides more information on the flux of supply by industry by following entry and exit. In this context I define 9802/OAP sourcing entry and exit as:

Entry: $y_{ict} = 1$ if the U.S. sources for industry i from country c in year t, but did not do so in year t-1.

Exit: $y_{ict} = 1$ if the U.S. sources for industry i from country c in year t, but discontinues these purchases in year t+1.

In any given year in the data sample 7.6 percent of 9802/OAP import partners represented countries that had not sold products in the 4-digit SIC industry in the previous year. At the same time, 7.2 percent of 9802/OAP partners were at risk of not supplying products in the same 4-digit SIC industry in the next year. While there is some

variation across the 2-digit SIC sub-industries shown in Table 2, it is clear that the risks of entry or exit were comparable for most industry areas. Because the identity of 9082/OAP partners is subject to such a high degree of change over time, it is important to control for selection, as well as 9802/OAP import volumes in the estimation that follows.

3.0 Results

My basic estimating equation uses the dutiable OAP value D_{ict} located in country c, in industry i and year t as its dependent variable. The independent variables seek to characterize the economic conditions in various locations where U.S. OAP activities might be conducted. The initial estimating equation is thus:

$$\ln (D_{ict}) = \alpha + \beta * \ln(R_{c,t-1}) + \gamma * X_{ic\,t} + \varepsilon_{ic\,t}$$

The real exchange rate $R_{c,t-1}$ is used to capture the production costs in country c. In this paper, an increase in $R_{c,t-1}$ reflects an appreciation of country c's currency vis a vis the U.S. dollar. Since we expect that the presence of ongoing contracts or the requirement of informational searches will slow a firm's response to cost changes, the previous year exchange rate is used rather than the current value of the exchange rate. We expect that an increase in the real exchange rate, because it implies higher real costs in country c, will be associated with a decline in the volume of outsourcing activities conducted in country c. However, since the dependent variable reports the dutiable value of imports, in other words import volume multiplied by price, it is possible that dollar depreciation could cause dutiable value to rise. This could happen in a number of ways. First, if US 9802/OAP import volumes do not adjust to cost changes, and higher costs are passed through to U.S. import prices, dollar depreciation will increase the dollar cost of the observed value of 9802/OAP imports. Second, it is possible that 9802/OAP import volumes do fall when country c costs rise. However, the percentage change in costs

passed through to the price of 9802/OAP imports exceeds the decline in import volumes, we will still observe an increase in the value of 9802/OAP imports, even though the actual import volumes have declined. When the value of 9802/OAP imports declines following an appreciation of county c's currency we can be fairly certain that the change in import values is at least partially due to a decline in the quantity of items sourced from country c.

The remaining variables in the regression for dutiable value, X_{ict}, capture characteristics of the potential outsourcing country conducting the foreign assembly, and characteristics of the industry. One of the first variables included is the amount of 9802/OAP sourcing conducted worldwide. It is important to remember that if the exchange rate in country c appreciates, U.S. producers using the 9802/OAP program have two options. For example, consider an increase in the cost of Mexican production caused by a depreciation of the U.S. dollar against the Mexican Peso. The dollar depreciation may cause firms to move some of their sourcing out of Mexico as they relocate the very same operations to other countries. However, when the dollar depreciates against the Mexican Peso, the change in currency value may also represent a general weakening of the dollar internationally. In this case the firm may decide to relocate some activities back to the U.S. from Mexico, and also from all other foreign locations. To account for firm's general movement of 9802/OAP activities into or out of the U.S., I include the variable DW_{it} which measures the worldwide amount of 9802/OAP sourcing in industry i in year t. This amount will increase and decrease in response to the relative attractiveness of completing activities at home versus abroad, which in part reflects general cost changes. Another reason for including the worldwide sourcing term is to account for changes in 9802/OAP activities over the time interval of observation. Changes in technology may have enabled 9802/OAP firms to place an increasing fraction of their activities overseas. The inclusion of this term controls for these general changes. Since it is my primary interest to examine how countries gain or lose 9802/OAP activities when their costs increase, it is important to remove general changes in 9802/OAP sourcing that

are due to worldwide trends.[10] To capture the general attractiveness of country c as a location of outsourcing I also include country GDP as a regressor. The inclusion of GDP is motivated by its common usage in gravity equations for international trade based on trade in differentiated goods. As with trade generally, I expect that the level of 9802/OAP sourcing will increase with country GDP. Finally, since there is a noticeable difference in the dutiable value added to products assembled in developed countries, I include a dummy variable for countries that are members of the OECD.[11]

The data are aggregated to the 4-digit SIC level. Since capital intensity of an industry may condition the suitability of the industry for outsourcing, I include a measure of capital intensity in the regression specifications.

The analysis specification would be complete at this point if it weren't for the high degree of entry and exit observed in the data. It is clear that 9802/OAP sourcing is not continuous, as the data from Table 2 showed that countries faced roughly a 7% risk of entry or exit from 9802/OAP activities in any year. Second, if I take the full panel of countries at risk of providing 9802/OAP assembly for a particular industry, only 40% were engaged in outsourcing assembly in any given year. In other words, for most country-industry-year observations, there is a greater than 50 percent probability that no 9802/OAP imports will be observed. For that reason, it is critical that I control for selection, which I do using Heckman's techniques.[12]

The selection equation I use has the following features. First, I assume that country costs matter for selection as they do for observed dutiable value. However, since

[10] If this variable is excluded from the basic specification, the estimated coefficient on the exchange rate increases in magnitude.

[11] While a smaller volume of 9802/OAP imports originates from developed countries, developed countries are responsible for a disproportionately large portion of dutiable 9802/OAP value. For example, in 1994 37.9% of 9802 imports originated from developed countries. However, developed countries were responsible for 52.3% of dutiable value entering the U.S. through 9802 in that year.
I also experimented with inclusion of dummy variables for countries that had high per capita incomes, or high levels of education (more than 6 years). The general results are not qualitatively changed by this choice.

[12] If I run the equation for dutiable value, without using Heckman's selection techniques, the coefficients on the exchange rate variables are smaller than those that are reported in the tables.

informational requirements associated with location changes are arguably more detailed, and because moving in or out of a market may involved some fixed costs, I assume that the choice to enter or exit a country is influenced by costs two years prior to the sourcing volume decision. As a result, the cost variable in the selection equation is the exchange rate lagged two years.

As with the dutiable value equation, I assume that industry characteristics, and capital intensity in particular, may condition the flexibility of movement between countries. Since 9802/OAP outsourcing focuses on assembly, it is possible that assembly will not vary across industries to any large degree, if the capital intensity is associated with the production of components. However, if more capital intense component production results in components that are more highly differentiated or complex, the assembly of these components may also be more capital intense. While the data do not allow one to characterize the capital intensity of the various production stages, the estimation will show whether capital intense industries are less prone to changes in to and out of international outsourcing. Such evidence would be consistent with the implication that capital intense industries face higher costs of moving that cause them to wait for larger cost shifts before moving.

The selection regressions also include regional dummy variables. These regional variables are primarily motivated by the idea that distance is likely to inhibit all trade. As a result, the desirability of a location for 9802/OAP outsourcing will be lower if the country is distant from the U.S. I include individual sets of regional dummy variables for developing and developed countries. While distance is likely to inhibit the choice of a country for production sharing, distance will play a smaller role if the final goods produced abroad are sold in the producing country (and region), in addition to in the U.S. Since there is greater potential for alternate sales in developed country markets, the coefficients on regional dummy variables are allowed to differ for developed and developing countries. The coefficients on the dummy variables are allowed to differ for a second reason as well. When the U.S. imports 9802/OAP products from a developing country, the product is often produced by a U.S.-based firm that has contracted for

assembly in the developing country, or built a foreign affiliate in the developing country. However, much of the 9802/OAP activities originating from developed countries, is completed under the direction of a foreign-based firm. As a result, the general differences in ownership structure may influence the propensity for firms to use the provisions provided by the 9802/OAP programs.

I present the basic results in Table 3. The results in column (1) indicate that changes in a country's costs influence not only the value of 9802/OAP imports, but also the probability that a country will be selected for 9802/OAP activity. When a country's exchange rate appreciates, the value of dutiable 9802/OAP imports increases by a small though significant amount. As discussed earlier, while this increase could represent an increase in volume of imports as constant prices, it is more likely that the increase in 9802/OAP import value is driven by cost-driven price increases that are not fully offset by reductions in the volume of 9802/OAP import volume.

While the first result focuses on the effects of own costs on 9802/OAP activity, it is quite possible that changes in one country are influenced by changes in other countries. To account for this possibility, I have to develop a definition of *competitor* countries, and to find measures that represent the *competitive pressures* exerted by that set of countries.

In this paper, competition is defined at 4-digit SIC level. While it is possible that any country might provide any 4-digit SIC product, I choose to limit the definition of *competitors* to those countries that provided 9802/OAP imports in a 4-digit SIC category in at least one year during the 1980-1994 period of observation. By using this method of defining *competitors* I lose latent competitive forces, since I am excluding countries that might have been under consideration, and close to selection, but for a slight disadvantage that was not remedied during the sample period. However, there is no convincing method that would allow me to choose which countries were closely considered, though never part of the process between 1980 and 1994. The advantage of defining competitors more narrowly, rather than creating a measure of competition based on all developing

countries, or all low education countries, say, is that it excludes from the definition countries that never presented competitive pressures in the industry.

To quantify competitive pressures, I introduce two different variables in my regressions. The first variable measures the cost pressures exerted by *competitor countries*, as given by a weighted average of *competitor country* exchange rates. In this case, the competitor exchange rate measure for country c' in year t is defined as:

$$CompetitorExchangeRate_{c'it} = \sum_{c \neq c'} \left[\frac{DV(80-94)_{ci}}{\sum_{c \neq c'} DV(80-94)_{ci}} * R_{ct} \right]$$

The weights are based on the total dutiable value of 9802/OAP imports between 1980 and 1994 for all countries c producing in industry i, $DV(80\text{-}94)_{ci}$. The real exchange rate for country c is given by R_{ct} is measured against the U.S. dollar. As a result, when the *Competitor Exchange Rate* variable rises, it means that the costs of competitor countries are rising when measured in dollar terms. As with Goldberg and Knetter (1999), I expect that an increase in the competitor cost variable will benefit the country under consideration. The effect could operate through one of two dimensions, potentially boosting the probability that a currently inactive country will be selected, and for those countries that are selected, increasing the value of imports that will be demanded. I assume that the timing of competitor cost changes coincide with the timing of reactions to own exchange rate changes. As a result, the world competitor exchange rate is lagged once in the equation for dutiable value, and is lagged twice in the selection equation.

I also measure competition using a second variable that is the count of competitors. Here, I use the count of countries that are defined as *competitors* for each 4-digit SIC industry as described earlier, and summarized in Table 1. Here, I am assuming that country abilities to negotiate contracts and demand higher prices are related to the number of competitor countries that could assume the activity if it were to relocate. The competitor counts are used to form two separate variables - one that counts developed country competitors by industry, the second, which is the count of developing country

competitors by industry.[13] I draw a distinction between developed and developing countries, since these locations are likely to vary in their skill mix in ways that may influence their suitability for 9802/OAP assembly activities. If developed countries are more skilled generally, it is likely that they are performing activities that are more tailored, and that their particular skills might be more difficult to replace elsewhere. In the case of countries that are developed, I used the count of developed country competitors by industry, while similarly using the count of developing country competitors in the regressions for developing countries. In most of the regressions the dichotomy between developed and developing countries is given by country membership in the OECD. However, to test for robustness, alternative counts rely on alternative definitions of development based on per capita income differences or educational attainment.

Including variables that describe *competition* improves the fit of the estimating equations substantially. As the second column of Table 3 shows, the competitor exchange rate variable is found to be important both for selection and import value. In particular, a country is more likely to see itself selected for 9802/OAP activity when the costs in competitor countries has risen. Further, the value of 9802/OAP imports from that country rise when competitor costs rise. The rise in value may occur either because the country ships a higher volume of imports to the U.S., or because the country demands a higher price for its contribution.

The competition results also include estimates of the effect of competitor numbers on selection and import values. Here, the data show that selection appears to be more likely if there are a larger number of competitors. While this finding may seem counterintuitive at first, it may reflect two factors. First, there are more countries to select from, and the data set only includes country-industry pairs for which the country-industry was selected at least once during the data period. Second, if Grossman and Helpman (2002b) are correct, the ability to write contracts that bring about appropriate

[13] I also experimented with regression specifications that consider all competitors as a single group by industry. However, the fit is always better when distinctions are drawn between developing and developed countries.

amount of relationship-specific investment conditions the degree of outsourcing. In this context, observing a higher number of competitors in an industry during the sample period may indicate that the ability to write adequate contracts for the particular 4-digit industry is better than it is in others, facilitating selection changes over time.

For those countries that do supply 9802/OAP imports, the presence of many competitors unambiguously reduces the dutiable value of imports. The surprising finding here is that the prevalence of competitors exerts a stronger downward influence on the dutiable value of imports originating from developed countries than it does for developing countries. Finally, while competitor numbers have a positive influence on selection, and a negative effect on the dutiable value of 9802/OAP import values, the net effect on 9802/OAP dutiable import values is negative. Since the effects of competitor numbers is similar across specifications, I will not comment on these variables as I move to the later regressions and specification tests.

The initial measurement of competition is based on weighted exchange rates that include all countries that produce in a given industry. However, it may be the case that the cost changes that matter most, as measured by exchange rates, are the cost changes occurring in countries that are at a comparable level of development. To test this idea I formed a second exchange rate variable that I call the *Similar Competitor Exchange Rate*. As before, this variable is a weighted average of competitor exchange rates. However, for developed countries competitors are now defined as all other developed countries who produced in the given industry, and for developing countries, the exchange rate was formed as the weighted average of all other developing countries who produced for a given industry. Surprisingly, the results are less good when I move to more carefully tailored exchange rates, as shown by the inferior regression fit in the third column of Table 3.[14] In terms of 9802/OAP imports, the results are qualitatively similar. When competitor country costs rise, a country finds that it can ship a larger value of 9802/OAP goods to the U.S. However, the competitor coefficient in the selection equation is

[14] Moving to an even finer definition of *competitor*, which classifies countries as competitors if both produced 9802/OAP goods of a particular 4-digit SIC category, and are both in the same region as well as both being at comparable levels of development, did not improve the regression fit.

puzzling. The negative and significant competitor coefficient implies that when competitor costs rise, a country will become is likely to be selected for 9802/OAP activity.

While Table 3 allows competition to be measured differently for developed and developing countries, it assumes that the magnitude of selection of import value responses is the same for both types of countries. This assumption is abandoned in Table 4, where developing and developed countries are allowed to exhibit differential responses to all features of the environment. In the first two columns, the basic specification is re-estimated, again focussing on the effects of own country exchange rate changes. Here, developing countries, here based on an OECD designation, are shown to be much more sensitive to shifts in their own costs. If the currency of a developing country appreciates by 10 percent vis a vis the U.S. dollar it suffers a much larger reduction in its probability that it be selected for 9802/OAP activity than would a developed country with a comparable exchange rate appreciation. The differential response also shows up in the valuation of 9802/OAP imports. For developed countries, the value of 9802/OAP imports is found to decline somewhat when the country's currency appreciates against the dollar. In the case of the developing countries, the value of 9082/OAP imports for those countries that continue to provide imports, rises with the appreciation.

Taken together, this is evidence that suggests that the developing countries face a more competitive environment than do the developed countries. When their costs rise, developing countries are more likely to be eliminated from 9802/OAP activities. However, if the developing country remains in the market, it appears that they may pass-through a larger portion of the cost change, possibly since they began in a situation which was closer to perfect competition and are forced to pass on any and all cost changes they experience.

Table 4 also examines how adding measures of competition aids in estimating the levels of 9802/OAP sourcing. As before, adding competition measures improves the fit of the estimating equation markedly. And as with the own exchange variables,

developing countries are found to be more highly responsive to the movements of competitor costs than are developed countries. When their competitor's exchange rates appreciate, developing countries experience a larger boost in their probability of being selected for 9802/OAP activity. In addition, when their competitor's costs rise, it appears that developing countries benefit from an increase in the value of the 9802/OAP imports they can ship to the U.S. Such a rise is consistent with these countries increasing their prices when exchange rates force their competitors to raise prices.

To test the robustness of the general findings, a number of alternative specifications were tried. First, since developed and developing countries seem to react differently to cost shocks, both their own and those of others, Tables 5, 6, and 7 compare three definitions of developing countries. Table 5 relies on the OECD/non-OECD dichotomy, Table 6 is based on a high versus low education distinction, and Table 7 is based on high versus low per capita income.[15] I find that the general cost results remain the same regardless of the development definitions I choose. The selection of developing countries is always more sensitive to changes in own exchange rates, or those of competitors, than is the selection of developed countries. Second, the dutiable value of 9802/OAP imports from developing countries is also more positively influenced by the appreciation of competitors than is the dutiable value originating from developed countries. The effects of own exchange rates on dutiable import values are more mixed across equations and specifications, but this is because the dutiable import value results are driven by both volume and price responses to changes in currency value. Tables 5, 6, and 7 also compare the results found by using the world definition of competition, versus similar country based competition which implies the use of a narrower exchange rate measure. While the similar country competition was expected to provide better results, the contrary seems to be true. The fit of the regressions is generally worse, and the estimated effect of competitor exchange rates on selection is always the reverse of the expected sign.

[15] I adopt Riker and Brainard's (1997) use of 6 or more years education as the definition of a high education country. The determination is based on Barro and Lee's data for 1990.

As an additional check on the stability of the results, I estimated the effects separately for industries contained in the 3 biggest users of 9802/OAP - SIC23 (Apparel and Textiles), SIC 35 (non-Electrical Machinery) and SIC 36 (Electrical Machinery). The results are reported in Table 8. As before, there continues to be a noticeably larger response of developing country OAP activities to cost conditions than there is for developed countries.

In thinking about how these results relate to outsourcing more generally, it is important to remember that the 9802/OAP program is designed to facilitate foreign assembly that utilizes U.S. components and inputs. If assembly is generally less complex than the production of components, then the outsourcing frictions discussed by Grossman and Helpman (2002b) are likely to impose even greater restrictions on outsourcing flexibility more generally than are observed in the 9802/OAP program.

4.0 Conclusion

This paper analyzes use of the U.S. 9802/OAP program between the years 1980 and 1994 to see how cross-country outsourcing choices respond to changes in country costs. Country costs are measured by real exchange rates. The data show that changes in country costs act on two dimensions. First, when appreciation causes a country's costs to rise, the country becomes less likely to be a participant in 9802/OAP shipments to the U.S. As with all cost effects, the selection effect is more dramatic in the case of developing countries than it is for developed countries. Second, developing countries also exhibit stronger responses to changes in competitor's costs, both in terms of selection as well as import values. However, when competitor costs rise, both developed and developing countries become more likely to be selected for 9802/OAP activity, and the value of those 9802/OAP imports is predicted to rise.

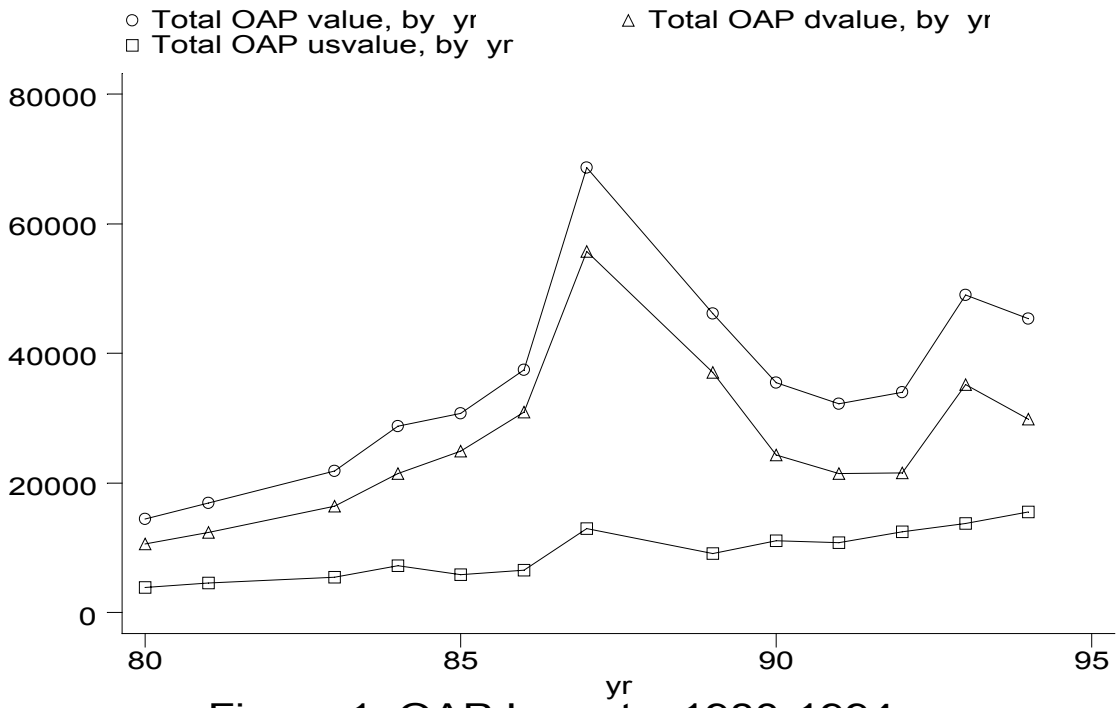

Figure 1: OAP Imports, 1980-1994

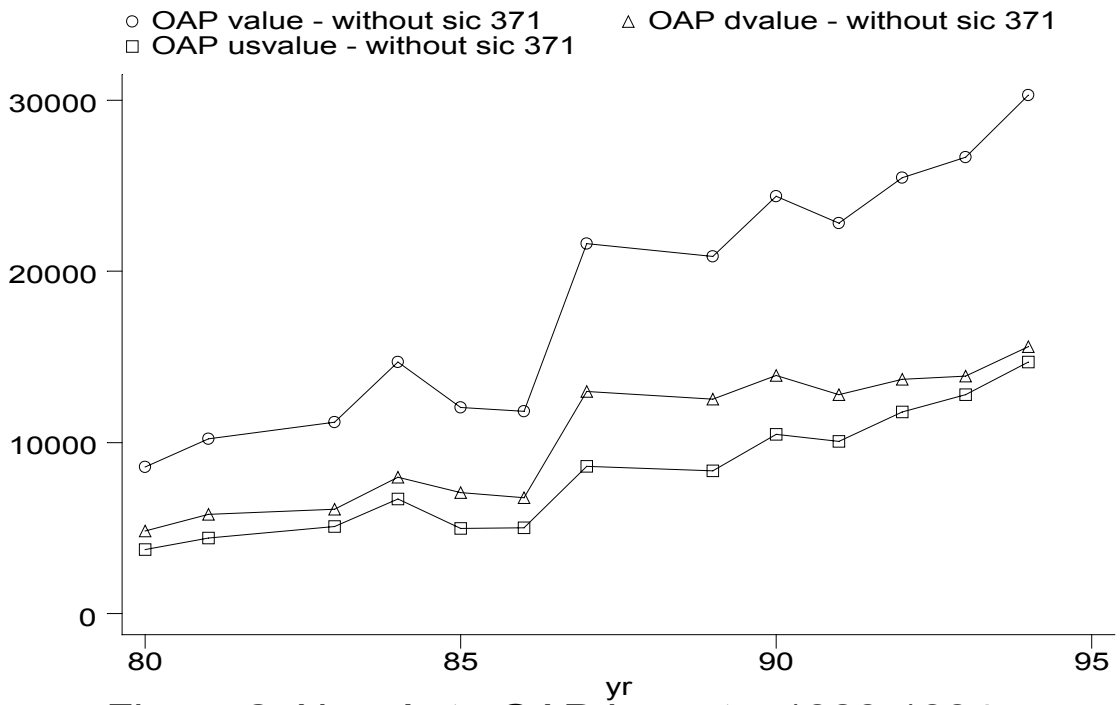

Figure 2: Non-Auto OAP Imports, 1980-1994

TABLE 1: COUNTRY COMPETITION BY INDUSTRY.

	ALL COUNTRIES			OECD			NON-OECD		
	# of SICs	# of Countries		# of SICs	# of Countries		# of SICs	# of Countries	
		Mean	Median		Mean	Median		Mean	Median
Industry									
All Industries	399	16.6	13	387	7.7	6	357	10.2	7
SIC 20	27	2.9	1	23	1.8	1	13	2.8	1
SIC 22	28	11.6	8	28	4.3	3	27	7.6	4
SIC 23	33	35.6	35	33	8.9	7	33	26.7	25
SIC 24	17	8.5	3	17	4.6	2	14	4.8	2
SIC 25	13	25	25	13	11	11	13	14	14
SIC 26	15	12.5	7	14	7.1	5	15	5.9	3
SIC 27	13	6.5	6	13	4	2	8	4	3
SIC 28	23	4.9	4	19	3.7	4	19	2.2	2
SIC 29	5	5	7	4	3.5	4	5	2.2	3
SIC 30	6	21	19.5	6	9.5	9	5	14	13
SIC 31	11	17.8	17	10	4.8	3.5	11	13.5	12
SIC 32	20	5.1	4	20	2.8	2.5	15	3.1	2
SIC 33	25	16.3	14	25	9.6	9	22	7.5	5
SIC 34	32	12.6	9	32	7.4	6	30	5.5	4
SIC 35	44	19.2	17	44	11.4	12	42	8.1	5
SIC 36	39	27.8	28	39	12.2	13	39	15.6	15
SIC 37	16	19.6	18	16	10.6	11	14	10.2	7
SIC 38	13	29.5	28	13	14.1	16	13	15.5	15
SIC 39	18	16.9	15.5	18	6.5	7	18	10.4	8

"# of SICs" is the count of 4-digit industries in each category. Counts of countries indicate how many countries exported products within a 4-digit SIC industry category during the sample period.

TABLE 2: Entry and Exit Rates for 4-digit SIC Industries

Industry	# of 4-digit SIC Industries	Entry Rate	Min Entry Rate	Max Entry Rate	Exit Rate
All Industries	399	.076	0	.231	.072
SIC 20	27	.067	0	.107	.077
SIC 22	28	.072	0	.115	.065
SIC 23	33	.084	.057	.107	.061
SIC 24	17	.079	.026	.231	.085
SIC 25	13	.068	0	.068	.074
SIC 26	15	.080	.038	.092	.085
SIC 27	13	.064	.038	.103	.074
SIC 28	23	.074	.026	.154	.066
SIC 29	5	.072	.051	.077	.078
SIC 30	6	.080	.038	.095	.062
SIC 31	11	.071	.050	.089	.064
SIC 32	20	.082	.026	.154	.084
SIC 33	25	.084	.058	.111	.078
SIC 34	32	.075	.038	.135	.073
SIC 35	44	.079	0	.154	.075
SIC 36	39	.071	.048	.096	.071
SIC 37	16	.078	.048	.103	.067
SIC 38	13	.078	.059	.106	.065
SIC 39	18	.076	.049	.099	.067

TABLE 3: COUNTRY COSTS AND PRODUCTION SHARING DECISIONS.

	(1)	(2)	(3)
Dutiable Value			
Own Exchange Rate (-1)	.088(.042)	-.062(.042)	.046(.044)
World Compet Exch Rate (-1)		.546(.039)	
Similar Compet Exch Rate (-1)			.268(.055)
Count of OECD competitors		-.220(.008)	-.255(.008)
Count of non-OECD competitors		-.050(.002)	-.054(.003)
Worldwide Sourcing	.702(.007)	.710(.008)	.692(.008)
GDP	.442(.010)	.328(.010)	.437(.011)
Capital Intensity	.530(.042)	.089(.040)	.117(.042)
OECD	-1.613(.056)	.383(.112)	.273(.117)
Constant	15.003(1.735)	21.718(1.763)	18.105(1.844)
Selection Equation			
Own Exchange Rate (-2)	-.176(.011)	-.296(.013)	-.253(.013)
World Compet Exch Rate (-2)		.531(.013)	
Similar Compet Exch Rate (-2)			-.079(.014)
Count of OECD competitors		.094(.002)	.092(.002)
Count of non-OECD competitors		.025(.001)	.027(.001)
Capital Intensity	-.161(.009)	.010(.010)	-.006(.010)
Region Dummies (OECD& non)	Yes	Yes	Yes
Log likelihood	-114,737	-110,595	-111,157

Notes: Standard Errors in ( ). 69714 Observations of which 28,228 are not censored.

TABLE 4: COUNTRY COSTS AND PRODUCTION SHARING DECISIONS.

	(1)		(2)	
	OECD	non-OECD	OECD	non-OECD
Dutiable Value				
Own Exchange Rate (-1)	-.018(.050)	.793(.087)	-.108(.050)	.484(.085)
World Compet Exch Rate (-1)			.293(.047)	.995(.058)
Count of OECD competitors			-.259(.009)	
Count of non-OECD competitors				-.052(.003)
Worldwide Sourcing	.715(.009)	.684(.010)	.787(.011)	.682(.011)
GDP	.205(.024)	.518(.011)	.127(.024)	.349(.012)
Capital Intensity	.786(.061)	.336(.057)	.707(.055)	-.373(.057)
OECD Dummy	.656(.789)		5.368(.798)	
Constant	1.9344(.542)		2.096(.545)	
Selection Equation				
Own Exchange Rate (-2)	-.078(.013)	-.447(.021)	-.145(.015)	-.595(.022)
World Compet Exch Rate (-2)			.341(.019)	.646(.019)
Count of OECD competitors			.096(.002)	
Count of non-OECD competitors				.024(.001)
Capital Intensity	.012(.013)	-.309(.013)	.067(.014)	-.041(.014)
Region Dummies	Yes	Yes	Yes	Yes
Log likelihood	-114,230		-110,011	

Notes: Standard Errors in ( ). 69714 Observations of which 28,228 are not censored.

TABLE 5: COMPETITION AND SOURCING CHOICES
OECD/NON-OECD COUNTRIES

	(1) WORLD DEF'N OF COMPETITION		(2) SIMILAR OECD DEF'N OF COMPETITION	
COUNTRY GROUP	OECD	NON-OECD	OECD	NON-OECD
Dutiable Value				
Own Exch Rate (-1)	-.176(.047)	.486(.081)	-.148(.049)	.796(.084)
Competitor Exch Rate (-1)	.261(.046)	.946(.057)	.109(.133)	.206(.059)
Count of Competitors	-.309(.009)	-.073(.003)	-.338(.009)	-.092(.003)
Worldwide Sourcing	.632(.012)	.711(.013)	.638(.013)	.775(.014)
GDP	.130(.022)	.364(.012)	.144(.023)	.549(.011)
Capital Intensity	-.448(.065)	-.143(.067)	-.399(.068)	-.023(.071)
Trend	-.061(.006)	-.061(.006)	-.044(.007)	-.065(.006)
Industry Dummies	Yes	Yes	Yes	Yes
Constant	1.362(.872)		2.544(.892)	
Selection Equation				
Own Exch Rate (-2)	-.143(.014)	-.574(.022)	-.099(.014)	-.554(.022)
Competitor Exch Rate (-2)	.340(.018)	.617(.018)	-.155(.038)	-.076(.016)
Count of Competitors	.094(.002)	.024(.001)	.090(.002)	.027(.001)
Capital Intensity	.074(.014)	-.039(.014)	.071(.014)	-.061(.014)
Region Dummies	Yes	Yes	Yes	Yes
Constant	-.779(.031)		-1.767(.039)	
Log Likelihood	-108708.9		-109,320	

Notes: Standard Errors in ( ). Equation (1) has 69653 Observations, of which 28,167 are uncensored. Equation (2) has 69,082 observations, of which 27,857 are uncensored.

TABLE 6: COMPETITION AND SOURCING CHOICES EDUCATIONAL DIFFERENCES

	(1) WORLD DEF'N OF COMPETITON		(2) SIMILAR EDUCATION-BASED DEF'N OF COMPETITION	
COUNTRY GROUP	HIED	LOED	HIED	LOED
Dutiable Value				
Own Exch Rate (-1)	-.090(.044)	.424(.086)	-.037(.045)	.677(.089)
Competitor Exch Rate (-1)	.283(.046)	.700(.062)	-.162(.080)	.390(.092)
Count of Competitors	-.207(.005)	-.056(.003)	-.229(.005)	-.076(.004)
Worldwide Sourcing	.704(.011)	.697(.014)	.722(.012)	.778(.016)
GDP	.128(.014)	.382(.012)	.154(.015)	.573(.012)
Capital Intensity	-.556(.060)	-.098(.008)	-.480(.063)	.003(.081)
Trend	-.053(.006)	-.049(.007)	-.030(.006)	.003(.082)
Industry Dummies	Yes	Yes	Yes	Yes
Constant	-1.155(.974)		.819(.980)	
Selection Equation				
Own Exch Rate (-2)	-.188(.014)	-.492(.022)	-.130(.013)	-.474(.022)
Competitor Exch Rate (-2)	.386(.016)	.595(.019)	-.042(.018)	-.005(.020)
Count of Competitors	.044(.001)	.019(.001)	.042(.001)	.022(.001)
Capital Intensity	.113(.012)	-.029(.016)	.105(.012)	-.042(.016)
Region Dummies	Yes	Yes	Yes	Yes
High-Education Dummy	-.804(.061)		-.002(.059)	
Constant	-.779(.031)		-.584(.032)	
Log Likelihood	-110,599		-110,901	

Notes: Standard Errors in ( ). Equation (1) has 71533 Observations, of which 28167 are uncensored. Equation (2) has 70,854 observations, of which 27,782 are uncensored.

TABLE 7: COMPETITION AND SOURCING CHOICES
PER-CAPITA INCOME DIFFERENCES

	(1) WOLRD DEF'N OF COMPETITON		(2) SIMILAR PCY BASED DEF'N OF COMPETITION	
COUNTRY GROUP	HIGH PCY	LOW PCY	HIGH PCY	LOW PCY
Dutiable Value				
Own Exch Rate (-1)	-.062(.044)	.657(.077)	-.099(.046)	1.120(.079)
Competitor Exch Rate (-1)	.283(.046)	.885(.058)	.060(.036)	.218(.033)
Count of Competitors	-.192(.006)	-.073(.003)	-.223(.006)	-.093(.003)
Worldwide Sourcing	.682(.013)	.731(.012)	.679(.014)	.805(.013)
GDP	.058(.022)	.334(.010)	.088(.024)	.487(.011)
Capital Intensity	-.717(.072)	-.098(.008)	-.828(.080)	-.176(.071)
Trend	-.041(.007)	-.049(.007)	-.021(.008)	-.047(.006)
Industry Dummies	Yes	Yes	Yes	Yes
Constant	-095(.913)		.195(.936)	
Selection Equation				
Own Exch Rate (-2)	-.207(.015)	-.416(.019)	-.150(.014)	-.366(.019)
Competitor Exch Rate (-2)	.429(.017)	.446(.016)	-.009(.008)	-.063(.007)
Count of Competitors	.041(.001)	.017(.001)	.041(.001)	.019(.001)
Capital Intensity	.155(.014)	.024(.016)	.161(.014)	.009(.013)
Region Dummies	Yes	Yes	Yes	Yes
High Per-Capita Income	-.534(.076)		-.468(.073)	
Constant	-.988(.046)		-.566(.026)	
Log Likelihood	-111,365		-108,522	

Notes: Standard Errors in ( ). (1) has 71533 Observations, of which 28167 are uncensored. In (2) there are 69,487 observations, of which 26,870 are uncensored.

TABLE 8: SOURCING CHOICES BY INDUSTRY
OECD/NON-OECD COUNTRIES - WORLD DEF'N OF COMPETITION

	SIC 23		SIC 35		SIC 36	
COUNTRY GROUP	OECD	NON-OECD	OECD	NON-OECD	OECD	NON-OECD
Dutiable Value						
Own Exch Rate (-1)	.046 (133)	.592 (.121)	-.134 (.103)	-.199 (.336)	-.056 (.109)	.223 (.235)
Competitor Exch Rate (-1)	.511 (.367)	1.143 (.152)	.326 (.199)	1.765 (.389)	.876 (.232)	1.553 (.156)
Count of Competitors	-.273 (.026)	-.075 (.005)	-.238 (.026)	-.078 (.013)	-.276 (.026)	-.010 (.009)
Worldwide Sourcing	.543 (.048)	.795 (.027)	.534 (.034)	.684 (.055)	.423 (.034)	.728 (.035)
GDP	.255 (.074)	.319 (.019)	.331 (.051)	.483 (.045)	-.082 (.048)	.325 (.027)
Capital Intensity	-.497 (.265)	-.049 (.132)	.426 (.043)	-.091 (.228)	-.904 (.166)	.071 (.160)
Trend	.004 (.021)	-.062 (.011)	-.077 (.014)	-.063 (.021)	-.091 (.016)	-.110 (.014)
OECD Dummy	-6.758(2.154)		4.263(2.236)		1.856(1.857)	
Selection Equation						
Own Exch Rate (-2)	-.012 (.040)	-.401 (.038)	-.189 (.036)	-.694 (.076)	-.167 (.039)	-.615 (.060)
Competitor Exch Rate (-2)	.086 (.092)	.349 (.046)	.602 (.074)	1.175 (.103)	.189 (.069)	.758 (.052)
Count of Competitors	.058 (.006)	.020 (.001)	.094 (.005)	.023 (.002)	.107 (.006)	.309 (.002)
Capital Intensity	-.041 (.068)	-.169 (.038)	-.039 (.043)	.128 (.053)	-.152 (.042)	-.063 (.039)
Region Dummies	Yes	Yes	Yes	Yes	Yes	Yes
OECD Dummy	-.176(.163)		-.211(.165)			
Log Likelihood	-19,699		-15,141		-20,268	
Observations	11,795		9,407		11,986	
Uncensored Observations	5,540		3,920		5,411	

Notes: Standard Errors in ( ). Equation constants are not reported.

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