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OUTSOURCING PRICE DECISIONS: EVIDENCE FROM U.S. 9802 IMPORTS

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ABSTRACT

This paper studies U.S. overseas assembly imports to identify whether factors related to information or search costs appear to condition outsourcing decisions. The data for 1991-2000 show that U.S. overseas assembly imports were characterized by incomplete pass-through of production and trade costs to import prices, though products assembled in more highly educated countries passed-through a much larger portion of their cost changes. In addition, the price of outsourcing imports responded to competing suppliers' prices, with the largest responses occurring for products in capital-intense industries. These differential price responses suggest that information issues play an important role in the mediation of outsourcing relationships.

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Introduction

A growing body of work in international trade focuses on the institutions and economic conditions that facilitate the formation of international trading relationships. For example, information is now recognized as a pivotal element in the globalization process. Nonetheless, the benefits of informational improvements, such as reduced costs of telephone calls or increasingly sophisticated bar code transmission and management tools, are not likely to affect all producers uniformly. Rauch and Trindade (2003) show that product differentiation in consumption or production produces a degree of "natural protection". As a result, improvements in information technology are likely to render the greatest increases in the global integration for those markets where the matching of differentiated partners is critical to the formation of successful international partnerships.

Overseas outsourcing is a component of the globalization process that has attracted particular concern as the public has become familiar with the idea that improvements in information technologies enable companies to reduce costs by outsourcing inputs and assembly from lower cost overseas locations.[1] Indeed, the growth in overseas outsourcing has contributed significantly to the growth of trade volumes.[2]

It is certainly true that internationally fragmented production processes allow producers to take advantage of factor price differences, and may even facilitate factor

[1] Popular attention is especially focused on the domestic employment impacts of overseas outsourcing. However, Amiti and Wei (2004) provide evidence showing that the presumption of outsourcing job loss may be reversed if one also accounts for the simultaneous job gains associated with international "insourcing".

[2] Hummels, Ishii and Yi (2001) present evidence from 10 OECD and four emerging markets which indicates that increases in vertical specialization accounts for 30% of export growth between 1970 and 1990. By 1990 vertical specialization accounted for 21% of these countries' exports. A broad review of the trends is contained in Feenstra (1998). In related work Hanson, Mataloni and Slaughter (2003) document that U.S. multinationals increased their vertical activities in the 1990's, while Gorg (2000) and Swenson (2004) study the empirical determinants of outsourcing location choices.

price equalization.[3] However, Grossman and Helpman (2004) show that country cost differences are not sufficient in of themselves to generate overseas fragmentation. Search and customization costs, in conjunction with incomplete contracting issues, also influence the outsourcing location choice. This is because the magnitude of search and adaptation costs ultimately influences the market thickness of potential partners, which helps determine whether Northern firms search for partners at home or in the lower-cost South.

A key goal of this paper is to examine whether outsourcing relationships exhibit characteristics that are consistent with international trade theories based on information search and matching issues. To set the stage, this paper documents pricing regularities that characterize the pricing decisions for U.S. outsourcing imports that arrived via the 9802 overseas assembly program, which assists firms that use U.S.-origin parts, materials or components in their overseas assembly operations.

The empirical estimates of pricing decisions are based on a simple Bertrand model with differentiated goods which is modified to account for the cost structure and tariff treatment facing outsourcing producers who participated in the 9802 program. This framework allows one to pay particular attention to the pass-through of production costs and the degree to which producers emulate their competitors' price changes. A major benefit of studying the 9802 program is that heterogeneity in producer input choices provides rich variation in the production and trade cost measures which can be exploited to identify the price responses for these outsourcing imports.

Use of these cost measures enables me to verify that U.S. 9802 assembly imports between 1991 to 2000 exhibited a number of pricing regularities. First, only twenty to forty percent of the changes in production costs were passed through to product prices.

[3] See Jones and Kierkowski (1990), Arndt (2001) and Deardorff (2001).

More notably, the degree of production cost pass-through differed across country suppliers. The pass-through was highest for products assembled in countries that had more highly, and likely more diversely, educated workforces. There was also a weak positive relationship between the capital-intensity of the industry, and the degree of production cost pass-through. Finally trade costs were generally passed-through at a higher rate than assembly costs, suggesting that firms can pass through costs that are commonly borne by all producers to a greater degree than they pass through idiosyncratic cost increases.

The prices chosen by producers of U.S. 9802 imports also responded to the prices selected by competing assemblers in other countries. A ten percent increase in prices chosen by competitors resulted in a two to four percent increase in prices chosen. In addition, the responsiveness to competitor prices differed across industries in a manner related to industry differences in capital-intensity: prices were strongly correlated with competitors' prices in capital-intense industries, while there was little correlation for industries that were not capital-intense. Making the reasonable assumption that industry capital-intensity is correlated with matching costs and information uncertainty, this evidence suppports theories in which matching and information gathering problems lead to differential trade elasticities. Furthermore, to the extent that capital-intensity drives firms to choose intra-firm rather than arm's length transactions, it suggests that the identity of traders in international transactions has implications for trade prices.[4]

[4] Antras(2003) provides a model based on difficulties in contracting to explain the prevalence of intra-firm trade in capital-intense industries, and for capital abundant countries. However, while Antras shows how capital will affect the mode of trade relationships, he does not explore whether the methods selected influence other transaction characteristics that may affect country welfare.

These findings contribute to the growing empirical literature in international trade, which shows how the identity of traders and the features of trading relationships affect trade outcomes. Other work in this vein includes Feenstra and Hanson's (2001) examination Hong Kong entrepot trader markups. Feenstra and Hanson find that variation in mark-ups, both across products and across countries, is consistent with an economic story in which entrepot traders add value, by providing quality sorting services for Chinese-origin products. Another example is the work of Besedes and Prusa (2004) which shows that heterogeneity in the duration of trading relationships is consistent with the predictions from Rauch and Watson's (2003) model of trading relationships. In particular, most trade relationships appear to start small, suggesting that search costs cause traders to test suppliers first, only expanding their order volume once the supplier's reliability is ascertained.

The rest of this paper is structured as follows. Section two describes characteristics of 9802 outsourcing activities to help provide an overview of the outsourcing relationships that are examined in this paper. Section 3 provides a model of pricing, and the associated regression framework. It also develops detailed measures of cost which are based on the procedural features of the 9802 program. The empirical analysis in section four quantifies how production costs, trade costs and competitor prices affected the prices of 9802 imports. It also examines the importance industry and country characteristics for these responses and discusses their economic implications. The paper ends with a brief conclusion.

2. Overseas Assembly and the 9802 program

To gain insight into outsourcing relationships I use data from the US program often referred to as the Overseas Assembly Provision, which is codified in section 9802 of the current harmonized system (HS) of tariffs. The 9802 program is designed to assist firms that use U.S.-origin parts or materials in their overseas assembly operations, by providing a tariff exemption for the U.S.-origin parts and materials contained in the final products.[5] While the Overseas Assembly Provision, or 9802, comprises only one strand of outsourcing activities – it does not capture U.S. assembly of foreign parts, or overseas contract manufacturing that is based on U.S. designs and specifications – it represents a non-negligible portion of U.S. trade. Almost 8.5 percent of all U.S. imports during the sample period, 1991-2000, entered through the 9802 program. In comparison with the broad outsourcing measures presented in Hummels, Ishii and Yi (2001) or Yi (2003), 9802 outsourcing did not grow more rapidly than overall trade. However, the general decline in U.S. manufacturing activity may explain why this form of outsourcing, which is based on the use of U.S. parts and materials, did not grow faster than U.S. trade.

The major benefit of examining 9802 activities, is that the import data enable one to observe outsourcing relationships at the product level. During the sample period, the U.S. imported 4,676 distinct 8-digit HS (HS8) products through the 9802 program. Table 1 displays the country composition for these import transactions. Geographical proximity appears to have played an important role in determining 9802 participation. While U.S. 9802 imports arrived from 182 different countries, many countries had only a slight participation in the program. In contrast, Canada and Mexico were the most frequent

[5] See Hanson (1997) to see a description of the program's evolution.

participants, registering 3,518 and 7,940 unique (HS8-product)-year transactions, respectively.

Measured by frequency, the majority of 9802 transactions involved assembly in a developing country. If development is defined by membership in the OECD, only 19% of the positive HS8-year pairs involved developed country activity. If development is defined instead by country educational attainment averaging six or more years, 37% of the positive HS8-year import observations were shipped from developed countries.

To provide a snapshot of the industry composition of overseas assembly, Table 2 displays 9802 activity for 2-digit HS industries (HS2). When the data are sorted by the value of U.S. inputs in the 9802 products, the top three 9802 outsourcing industries were electrical machinery (85), transportation equipment (87), and apparel and clothing, not knitted or crocheted (62).[6] For each of the HS2 categories, the table also lists the identity of the primary country supplier, where the primary supplier is defined as the country that shipped the largest total value of 9802 products in that HS2 category. This cut of the data also suggests that the location of 9802 activities is greatly influenced by geographical proximity. Of the thirty largest 9802 industries, either Mexico or Canada was the prime location for nineteen. However, more distant country sources do top the list for some industries. The fact that the biggest supplier for footwear (64) was Malaysia, imitation jewelry (71) was Hong Kong, and clocks and watches (91) was Switzerland, suggests that production decisions are also influenced by traditional notions of comparative advantage.

[6] These are followed by, non-electrical machinery (84), apparel and clothing, knitted or crocheted (61), Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus (90), Aircraft and spacecraft (88), and footwear (64). Table 2 is based on activity in 1993 to prevent the possibility that the composition was affected by Mexico's joining the NAFTA.

Finally, to characterize input usage Table 2 reports the U.S. percentage, which is defined as the percentage of total product value attributable to U.S. parts and materials. In order to reap the tariff benefits of the 9802 program, firms are required to record the portion of product value that derives from dutiable 9802 import as opposed to non-dutiable U.S. components and parts. The benefit of using these declarations is that one can observe the relative reliance on foreign inputs at a product-country level, rather than making an estimate that relies on input-output tables, and the undesirable assumption that imported inputs are used in production in a proportion that is exactly equal to ratio of imports relative to domestic consumption. The average U.S. percentage for products in the sample of 9802 imports was 36%. A cross-industry comparison of the U.S. percentage shows that industries varied dramatically in their relative reliance on U.S. inputs. This variation could be driven by a number of factors, including cross-industry differences in U.S. comparative advantage, in organizational form, or in the relative importance of parts and assembly. Cross product tariff differences should also influence the incentive to use U.S.-origin parts and materials. However, while the U.S. percentage of product value and MFN tariffs have the expected positive correlation, it is only 0.075.

Because the value of U.S. percentage varies greatly across products and countries, it is possible to construct detailed cost measures at the product-country level that are based on variation in production, tariff and transportation costs. For example, consider a range of products produced in Mexico through the 9802 program. Each product i is characterized by the percentage U.S. content associated with its production, or $\alpha_{us,ic}$.[7] If Mexican wages rise, production cost increases will be especially pronounced for those

[7] The subscript c refers generally to the country of assembly, which in this case is Mexico.

products with the highest percentage (1- $\alpha_{us,ic}$) of their production activities located in Mexico. A high percentage of activity in Mexico is also costly for those products that face the highest U.S. import duties. In contrast, products characterized by a high value of (1- $\alpha_{us,ic}$) benefit from lower transportation costs since there is less back and forth shipment of U.S.-origin parts and material.

3. A model of pricing decisions

In this section I provide a model of outsourcing prices that I modify to examine issues related to the roles of information and search in outsourcing relationships. I begin by introducing measures of outsourcing costs that account for the unique input and tariff structure of imports shipped through the 9802 program. I then modify a Bertrand model of competition in internationally differentiated goods to relate the pricing of 9802 imports to a producer's outsourcing costs as well as the pricing decisions of its competitors. Finally, I add interaction terms to the common pass-through framework to test whether price responses are related to country or industry characteristics, and more importantly whether such interactions are related to theories based on information and matching.

3.1 Production

Following Mendez (1993), 9802 assembly is modeled as a Leontieff production process. To produce product i in country c, 9802 producers combine a fixed bundle of U.S. inputs with a fixed bundle of foreign inputs and assembly. To characterize input bundles, I assume that 9802 assembly involves a set of tasks on the unit interval that must be completed in sequence. A firm's decision to participate in 9802 indicates that the

U.S. has comparative advantage in the early stage tasks, while the foreign country has comparative advantage in the later tasks and assembly. If the point on the unit interval at which U.S. processing ends and foreign production begins is denoted by β_{ic}, and each task requires physical labor input L_i, then U.S. input requirements are given by $\beta_{ic}*L_i$ while the foreign input requirement is $(1- \beta_{ic})* L_i$. Assume the price of U.S. inputs is given by w_{us}, while the U.S. dollar price of foreign inputs is w_c. If U.S. inputs are transported to the foreign assembler at ad valorem cost g_{ic}, the resulting production cost when product i is assembled in country c is:

(1) $C_{ic} = [\beta_{ic}*w_{us}* (1+g_{ic}) + (1- \beta_{ic})*w_c]*L_i$.

Since assembly countries differ in their abilities and distance from the U.S., the value of β_{ic} will not be the same for all countries involved in the assembly of good i.[8]

When 9802 products are shipped from the assembly country to the U.S. two further costs arise. First, the appropriate U.S. import tariff τ_i is applied to the foreign contribution to product value, $(1- \beta_{ic})*w_c*L_i$. In addition, the return of the completed product to the U.S. incurs the ad valorem shipping cost g_{ic}.

As the description of production indicates, the underlying cost of 9802 imports will differ across assembly locations for a number of reasons, including cross-country differences in factor and transportation costs for the movement of parts and materials. Cross-country variation is also generated by differences in production techniques that cause the Leontieff input choices to vary by location as dictated by skills, endowments and production costs. Finally, while time subscripts have been excluded for notational

[8] Distance matters not only due to transportation costs, which are directly included in the measure of costs, but also due to time costs associated with distance, as highlighted by Hummels (2001) and Evans and Harrigan (2003).

simplicity, the costs related to overseas assembly will also change over time as wages, transportation costs and tariffs change.

3.2 Demand

To model pricing decisions, I assume that product market competition is Bertrand. Each country produces a unique variety of the outsourced good, which is an imperfect substitute for the products arriving from other country locations. This implies that the producer of any particular good faces product demand $q_{ic} = d(P_{ic}^{C}, P_{ic}^{C*}, E_i)$, where the demand for each product is negatively related to the producer's own choice of consumer price P_{ic}^{C}, and positively related to the price vector of its competitors' consumer prices P_{ic}^{C*} and to overall expenditure E_i on product i.

Although firm profit depends the producer price, product demand depends on the consumer price. If we now define $\alpha_{us,ic}$ as the U.S. share of product value that is exempt from tariff, the relationship between the consumer and producer (P_{ic}^{P}) price is given by:[9]

$$(3)\quad P_{ic}^{C} = [P_{ic}^{P} *(1+g_{ic}) + (1-\alpha_{us,ic})* P_{ic}^{P} * \tau_i].$$

This can be rearranged to yield,

$$(3')\quad P_{ic}^{P} = P_{ic}^{C} * [(1+g_{ic}) + (1-\alpha_{us,ic})* \tau_i]^{-1}.$$

Firms now choose P_{ic}^{P} to maximize profits:

[9] The U.S.-origin contribution to product value is given by: $\alpha_{us,ic} = [\beta_{ic}*w_{us}* (1+g_{ic})]/[\beta_{ic}*w_{us}* (1+g_{ic}) + (1-\beta_{ic})*w_c]$.

$$(4)\ \ \pi = P_{ic}^{C} * [(1+g_{ic}) + (1-\alpha_{us,ic})* \tau_i]^{-1} * d(P_{ic}^{C}, P_{ic}^{C}*, E_i) - C_{ic}*d(P_{ic}^{C}, P_{ic}^{C}*, E_i).$$

This generates the familiar first order condition:

$$(5)\ P_{ic}^{C} (1+ 1/ \eta) = [(1+g_{ic}) + (1-\alpha_{us,ic})* \tau_i]*C_{ic}.$$

Prices are determined by a markup over marginal cost. The marginal cost has two components: trade costs are given by $[(1+g_{ic}) + (1-\alpha_{us,ic})* \tau_i]$, while marginal production costs are represented by C_{ic}. The markup is determined by the elasticity of demand (η) for product i. For purposes of estimation, we can follow Feenstra (1989) and arrive at the reduced form relationship (6).

$$(6)\ P_{ic}^{C} = \Gamma [\{(1+g_{ic}) + (1-\alpha_{us,ic})* \tau_i \}*C_{ic}), P_{ic}*, E_i]$$

Restoring time subscripts and adopting a log-linear form generates the familiar pass-through regression framework:

$$(7)\ \ lnP_{ict}^{C} = \alpha + \beta_1 ln([(1+g_{ict}) + (1-\alpha_{us,ic})* \tau_{it}]) + \beta_2 ln(C_{ict}) + \gamma ln(P_{ict}*) + \delta lnE_{it} + \varepsilon_{ict}$$

However, this equation needs to be modified since recent work on import price data demonstrates that cross country differences in quality are present even when trade data are disaggregated to the fine product level.[10] To account for unobserved differences in product quality that are correlated with country development I add a measure of development D_c to the basic specification. This yields the primary estimating equation that is to analyze the prices of outsourcing imports.

$$(7') \quad \ln P_{ict}^{C} = \alpha + \beta_1 \ln([(1+g_{ict}) + (1-\alpha_{us,ic})^* \tau_{it}]) + \beta_2 \ln(C_{ict}) + \gamma \ln(P_{ict}^*) + \delta \ln E_{it} + \lambda \ln D_c + \varepsilon_{ict}$$

As in the pass-through literature, the coefficients β_1 and β_2 are both expected to be in the interval [0,1], which run the gamut from no pass-through of cost changes to complete pass-through of any changes in cost.[11] In addition, the coefficients on competitor prices γ and country development λ are both expected to be positive.

3.3 Heterogeneous Product Responses

The primary estimating equation assumes that pass-through and market reactions are the same for all products in the sample. However, these assumptions fail if market characteristics condition the degree of competition in product markets. Such differential product elasticities are a feature of Rauch and Trindade's (2003) model of matching in which improved information increases the elasticity of substitution between internationally differentiated product varieties, since improved information enables firms to rule out unacceptably poor matches before conducting international partner searches.

[10] See Hummels & Skiba (2002), Hummels and Irwin (2002) and Schott (2003).

[11] Blonigen and Haynes (2002) predict and discover pass-through rates exceeding one in magnitude for products that are subject to anti-dumping treatment. However this exception is caused by the incentives created by the administration of anti-dumping cases.

See Goldberg and Knetter (1997) for a thorough discussion of the literature on pass-through. While I examine the pass-through of costs converted to dollars, rather than the separate exchange rate and cost terms, this is motivated by the idea that the majority of cost changes are driven by currency movements rather than underlying changes in country production costs denominated in national currency.

While Rauch and Trindade explore the implications of informational improvements for the evolution of trade relationships, their ideas can be applied to comparisons of trading relationships across products. In particular, the effect of informational uncertainty in reducing product trade elasticities should be greatest for those products where informational uncertainty is the greatest. While Rauch and Trindade provide a model of international joint ventures, it seems reasonable to expect that informationally-based matching frictions will be every bit as critical to the formation of overseas outsourcing relationships.

Grossman and Helpman's (2004) work provides further reasons to expect different pricing responses for different product outsourcing relationships. When search costs are sufficiently high, Northern firms may seek partners in the high-wage North, if the costs of search and adaptation have hindered the entry of potential partners in the South. In particular, a greater number of Northern firms to attempt a Northern search, since thinness of potential Southern partners reduces the probability of a successful match, and consequently expected profits associated with search in the low-wage South. While Grossman and Helpman (2004) focus on a particular equilibrium in which partner search occurs in both the North and the South, one can imagine extending their framework to a multiple country setting with wage shocks. In particular, if the relative wage of one country's workers rise, the interest in seeking a replacement country location for assembly is likely to be greatest for products in industries that involve the lowest search and modification costs.

Since there are no straightforward measures of search costs or uncertainty by industry, I assume that the costs of search and modification, as well as search uncertainty, are highest for technologically sophisticated industries and for partner searches in more highly skilled countries. Search and adaptation costs are likely to be especially high in sophisticated industries, for example, since these industries are likely to be characterized by a large set of search criteria whose presence is difficult to verify. To examine whether pricing decisions respond in a fashion that is consistent with the notion of costly or uncertain search, I add interaction terms to examine whether industry capital-intensity K_i influences the degree of response to competitor price changes or the degree of production cost pass-through.

$$(8)\quad \ln P_{ict}^{C} = \alpha + (\beta_1 + \beta_{1K}*\ln(K_i))*\ln([(1+g_{ict})+ (1-\alpha_{us,ic})* \tau_{it}])+ (\beta_2 + \beta_{2K}*\ln(K_i))*\ln(C_{ict}) + (\gamma + \gamma_K*\ln(K_i))*\ln(P_{ict}*) + \delta \ln E_{it} + \theta*\ln(K_i) +\lambda \ln D_c + \varepsilon_{ict}$$

The choice of specification (8) is further motivated by work on the organizational form of international production. A notable contribution in this area is Antras's (2003) work demonstrating how greater reliance on intra-firm trade transactions can emerge to solve contracting problems in settings that involve more capital. Including capital-intensity terms in specification (8) allows me to explore whether capital-intensity, which correlated with differences in the organizational form of trade transactions, is also related to transaction characteristics that may affect country welfare.

Of course, industry capital-intensity is only one transaction characteristic that affects search and modification costs as well as incentives that affect the organizational form of trade. Another way to proxy matching issues is to use education as a measure of skill. While lower levels of education generally comprise a common set of skills, higher education levels are likely to result in more heterogeneous skill outcomes in the educated populace.[12] When a firm seeks more highly skilled workers, its managers are likely to face a more difficult search, since their criteria are no longer based on a minimum education, but on identifying workers who possess training in particular skills and methods. To account for this possibility I also investigate the effects of including interaction terms based on country education HE_c.

$$(9)\quad \ln P_{ict}^{C} = \alpha_{ic} + (\beta_1 + \beta_{1HE}*HE_c)*\ln([(1+g_{ict})+(1-\alpha_{us,ic})*\tau_{it}]) + (\beta_2 + \beta_{2HE}*HE_c)*\ln(C_{ict}) + (\gamma + \gamma_{HE}*HE_c)*\ln(P_{ict}*) + \delta \ln E_{it} + \lambda HE_c + \varepsilon_{ict}$$

4. Results

I estimate the pricing relationship using both OLS and panel regression techniques that control for serial correlation. The findings support the price predictions emerging from a Bertrand model of competition. In particular, unit import prices for 9802 products are positively related to production and trade costs. They are also positively related to the prices charged by competitors. In addition, price levels and responsiveness are found to vary with industry capital-intensity and country education levels.

[12] While low grades of education commonly provide students with an ability to read or do calculations, higher education is more likely to be characterized by differentiation. (E.g., think of college educated workers who choose not only majors, but subspecialties, or highly skilled technicians who have received training in particular techniques and procedures.)

4.1 Data

My primary data for this project follow U.S. 9802 imports between 1991 and 2000. To quantify price responses in an outsourcing context, I use unit import values for 9802 imports as the dependent variable. These data are also used to construct competitor prices P* which are defined as the average unit import value for competing country producers in the same HS8 industry in that year. Finally, I use the U.S. and foreign content declarations to create measures of $\alpha_{us,ic}$, which are fundamental to construction of the production and trade cost measures. The data appendix provides more details regarding the construction of the data set, including the sources for the other variables used in the analysis.

4.2 Estimation

Table 3 presents the benchmark estimates for price equation (7'). The estimated coefficients uniformly show that 9802 import prices were positively related to production costs, though the implied degree of pass-through was only ten to forty percent. The regressions also imply that trade costs were incompletely passed through. In each of the specifications the pass-through of trade costs was somewhat higher than the pass-through of production costs. The difference in estimated pass-through of producer costs versus trade costs is statistically distinct, though the weakest results which are displayed in column (3) are only statistically different at the 6% level. The greater pass through of trade costs suggests that firms are able to pass-through common cost changes to a greater extent than idiosyncratic cost changes.[13]

The results in Table 3 also show that there was a strong positive relationship between prices charged by 9802 assemblers and the prices charged by their competitors. The OLS regressions imply that assemblers incorporated forty percent of competitor price changes in their own prices, while the later panel regressions in columns (2), (3) and (4) imply that 9802 producers mimicked twenty-five percent of their competitors' price changes.

Similar to Schott (2003), Hummels and Irwin (2002) and Hummels and Klenow (2002), 9802 import prices were highly correlated with country development. The positive and significant coefficient on the OECD variable indicates that even within fine 8-digit HS products, those imported from developed countries commanded higher prices. The most likely interpretation of the development coefficient is that developed countries produced higher quality varieties of the HS8 goods. To examine whether the correlation between assembler country development and product import values was robust, I turned to two alternative development measures - an indicator variable for highly educated countries, and the log of country per capita income.[14] The coefficients on alternative development measures were always positive and significant, while the remaining coefficients in the price regression were qualitatively unchanged by the choice of development measure.

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[13] Gron and Swenson (2000) find a similar phenomenon in U.S. car prices, while Besanko, Dranove, and Shanley (2001) provide empirical evidence showing that firms pass-through common shocks to a greater degree than they pass through idiosyncratic cost shocks.

[14] Following Riker and Brainard (1997), countries are defined as "highly educated" if the average education level for the country is six or more years.

The only coefficient that changed in magnitude as the definition of development was changed was the coefficient on production cost. The coefficient magnitude rose when development was measured by country education, and fell when country development was represented by per capita GDP. Since per-capita GDP is highly correlated with wages, and hence, country costs, the coefficient on per-capita GDP may have picked up some of the effects of production costs, thus causing the estimated coefficient on production cost to fall in size. In contrast, when country development was measured by the country education variable, the apparent pass-through of production costs rose. This result is sensible since accounting for country education helps to control for differences in country costs that were related to otherwise unmeasured differences in worker quality.

Recent work on outsourcing such as Grossman and Helpman (2004) emphasizes that the initiation and development of outsourcing relationships can be complicated by issues related to partner search. Firms will only seek outsourcing partners, rather than completing projects in house, when an outsourcing relationship is expected to yield higher profits. In this context the relative attractiveness of outsourcing relationships depends on the difficulty and cost of finding a partner in addition to the relative costs of outsourcing versus in house production. On the industry dimension, I assume that the difficulty and cost of finding a partner is highest for products that require complex and highly specified production skills.

Before turning to the full capital interaction specification (8), I first examined how the estimated pass-through changed if controls for capital were included in the regression. To proxy production skill-intensity and specificity, I added the capital output ratio as a control in the regressions displayed in table 4.[15] The results in the first three columns of table 4 show that industry capital-intensity was highly correlated with the unit values of 9802 imports. In addition, the results show that magnitude of the effect of industry capital-intensity on the unit import values differed for developed and developing countries. The most notable effect of including capital-intensity in the regressions, is that the estimated production cost pass-through rises somewhat, to roughly 28 percent. In contrast, the magnitude of the coefficient on competitor prices remains unchanged.

The one coefficient that becomes unstable when industry capital-intensity is directly included in the estimating equation is the coefficient measuring the pass-through of trade costs. The most likely reason for the instability of the trade cost term was the underlying correlation between industry capital-intensity and the level of tariffs, which are a component of trade costs. In particular, U.S. tariffs were higher in less capital-intense industries.[16] When capital-intensity is directly included in the estimating equation, the capital-intensity term may pick up some of the variation that was related to tariffs, consequently changing the apparent magnitude of the trade cost coefficient.

To examine whether industry capital-intensity influenced the degree of response to competitor price changes or the degree of production cost pass-through, I estimated interaction specification (8). The estimates reveal a positive coefficient on the interaction between industry capital-intensity and competitor prices, indicating that the tendency to mimic competitor country price increases was positively related to industry

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[15] The number of observations declines since it is not possible to map all HS 8 codes to a 1987-value SIC code, which is needed to connect the product data to industry variables.

[16] In this sample, the regression of an industry's tariff rate on the industry's capital-intensity and time yields: $\text{Tariff Rate}_{it} = .185(.015)-.031(.001)*\ln(\text{average KY})_i - .0016(.0002)*\text{yr}$. This regression is based on the 24,253 unique HS8 product-year combinations.

capital-intensity. If capital-intensity increases search uncertainty, or search costs, then producers in those industries may have felt confident that they could match their competitors' price increases without losing their assembly work to other country suppliers.

To examine whether the availability of alternative outsourcing partners was conditioned by industry capital-intensity, I regressed the count of competitors on measures of industry capital-intensity.[17] The negative coefficient on average industry capital-intensity shown in specification (1) documents that the number of competing source countries was negatively related to the capital-intensity of 9802 products.

The Effect of Capital-intensity on the Number of Countries Providing Products: Negative Binomial Regressions			
		Independent Variable	
Specification	**Dependent Variable**	$\ln(\text{Average KY})_i$	$\ln(KY)_{it}$
(1)	Count of Competitors 1991-2000	-1.033 (.038)	
(2)	Count of OECD Competitors 1991-2000	-.690 (.083)	
(3)	Count of Non-OECD Competitors 1991-2000	-6.478 (.329)	
(4)	Number of Countries Supplying HS8 product in year 1991-1996		-.287 (.060)

To further explore how capital-intensity conditioned the number of competing 9802 country suppliers, I created separate competitor counts for OECD and non-OECD suppliers. This distinction makes sense if developed countries were better suited for

[17] "Competitors" were measured by the count of countries that provided a particular HS8 product for at least one of the years between 1991 and 2000.

some assembly tasks, while developing countries were better suited for others. When the count of competitors was defined by OECD membership status, as in specifications (2) and (3), the regression results show that capital-intensity exerted a much greater barrier to the presence of non-OECD suppliers than it did to the presence of competing OECD suppliers. This could mean that products assembled in non-OECD locations were better substitutes for each other, than were products assembled in OECD locations. Alternatively, if OECD countries were more heavily engaged in the most skill-intensive activities of skill-using capital-intense industries, they may have faced less risk of displacement based on costs.

Since the capital-intensity data are only available through 1996 it is not feasible to track the connection between yearly changes in capital-intensity and changes in competitor counts for the entire sample period. However, examination of the time-series data for 1991-1996 in specification (4), shows that the number of countries providing overseas assembly assistance declined for U.S. industries that became more capital-intense.

Each of the auxiliary regressions demonstrates that the presence of competing country locations was smaller in capital-intense industries. This may explain why firms in more capital-intense industries were more likely to match their competitor's price changes. If these producers raised their prices, the greater difficulties and requirements involved in successfully switching partners in capital-intense industries may have insulated them from displacement by competitors from other countries. Alternatively, the correlation may have arisen from market power, if an industry's capital-intensity elevates market power. This view of competition bears resemblance to Feenstra, Gagnon and

Knetter's (1996) finding that exchange rate pass-through for passenger cars was higher for producers with higher market share. While it would be attractive to run a comparable analysis to test whether their market share model explains pricing relationships in 9802 data, the lack of similarly disaggregated U.S. industry production data for each of the HS8 products precludes the creation of appropriate market share terms.[18]

An alternative way to look for evidence that industry matching matters is to include industry skill requirements rather than capital-intensity in the regressions. Table 5 does this by examining whether industry skill requirements affected product prices or price sensitivity. To measure industry skill intensity, I defined the skilled wage percentage at the industry level as $[\text{non-production worker wages}]_i/[\text{Total wages}]_i$. Columns (1) and (2) begin the inquiry by examining the direct effects of including skill measures in the regressions. The coefficients on the skill measures show that the unit values for 9802 imports were higher in industries that were characterized by a relatively high skilled wage percentage. In addition, unit import values were higher for products assembled in countries with more highly educated workforces.

Grossman and Helpman's work on outsourcing shows how low search costs enable firms to conduct more intensive searches, and how in general equilibrium the expansion of search efforts will create a "thick markets" externality, due to the greater entry of potential partners. In the 9802 context, we might expect that the search costs for highly skilled assembly partners would have been the highest in countries that had highly

[18] The data in this sample do reveal a high correlation between capital-intensity and 9802 market share, defined as a country's share of 9802 product exports in a given industry. In this sample, OLS regression of a country's average market share in an industry on the industry's average capital-intensity and a set of country dummies yielded: $\text{Average Market Share}_{ic} = .216(.006)*\ln(\text{average KY})_i + \sum C_C$. When I estimated the regression using panel techniques and random effects for country-industry pairs , or $\text{Market Share}_{ict} = 177(.006)*\ln(KY)_{it} + \varepsilon_{ict}$, the results show that for the years of available data to 1996, that country market shares grew as the capital-intensity of the U.S. rose.

educated workforces, since the types of skills matter as much as the level of education. If this is the source of the "thick markets" externalities, then country education should matter the most for those industries that most heavily utilized skilled workers. To test this idea, columns (3) and (4) added an interaction term multiplying the industry skilled wage percentage by an indicator variable denoting whether the country's population was highly educated. In support of the "thick markets" idea, the strong positive coefficient on the interaction term suggests that unit values were particularly high when a skilled industry product was produced in a more highly educated country.

Finally, I estimated interaction equation (9) to determine whether country education levels affected the pricing responses. The results show that country education levels influenced the ability of assemblers to pass-through production costs to prices. Column (6) of Table 5 suggests that assemblers located in low education countries could only pass-through thirty percent of their production costs changes. In contrast, producers located in highly educated countries were able to pass-through 97 percent of their production cost changes.

To further investigate the effects of education, I replaced the indicator variable for highly educated countries with the actual educational attainment for each country's adult population aged 25 or over. Overall, the results reported in Table 6 echo the findings from Table 5. However, the use of a direct schooling measure allows one to ask whether an additional year of education had a uniform effect on low and high education countries. In particular, did an additional year of schooling provide a greater boost to the product value of high or low education countries? To look at this issue, column (4) adds an interaction term to measure the benefits of extra education for those countries that had 6 years or greater education. The results show that extra education proved especially valuable to producers in more educated locations. While a 10% increase in educational attainment for countries whose attainment was less than 6 years, implied a 3.5% increase in product prices, a 10% increase in educational attainment was correlated with a 7.5% increase in product prices for products imported from countries whose residents averaged 6 or more years of education.

As before, I tested for evidence consistent with Grossman and Helpman style "thick market" externalities by adding an interaction term to the regression reported in column (3), which multiplied the industry skilled wage measure with country educational attainment.[19] The strong positive coefficient on the new interaction term, indicates that product prices were especially high when a skill-intensive product was assembled in a country with a highly educated workforce.

Finally, I tested whether the level of education affected the pass through of production costs. As column (6) of Table 6 shows, the ability to pass through production cost changes to import prices was strongly related to the education level of the assembly location. The coefficients imply that the median country was able to pass through 25% of its cost changes. In contrast, a country in the top 25%, by education, was able pass through 94% of its cost changes, while a country in the top 10% was able to pass through 99%.

[19] I assume here that the supply of high skilled assemblers is greater in countries that have highly educated workers, and that the cost of locating a match is highest for industries that require skilled workers. The effect may be more complicated if, as in Grossman and Helpman (2003), the compensation paid to the foreign assembler depends on the assemblers' outside options, which are themselves correlated with education levels. The indicator variables HE_c in equation (9) are now replaced with HE_c*ln(Education)$_c$.

4.3 Robustness Checks

To check the stability of the pass-through results, I ran a number of robustness checks. In each case, I employed the same estimating equation, as that reported in column (2) of Table 3.

I began by running individual regressions for each of the HS2 industries rather than the pooled sample, to learn whether there was significant heterogeneity in pass-through across industries. However, while estimation at the HS2 industry level does reveals heterogeneity in the value of the production cost pass-through coefficient the median value for the HS2 production cost coefficients was 0.229, which was very similar to the result in the pooled sample. In addition, since textiles and footwear are believed to be among the most footloose industries, I also estimated the pass-through equation for this group of products (HS2 chapters 61 to 64). It is interesting to note that the production cost pass-through for those sectors was a bit lower, with a coefficient of 0.158. However, this degree of pass-through was not statistically distinct from the full sample value of 0.200.

A second question is whether the production cost measures, which were based on country price deflators, rather than country-industry deflators, provided too little variation in the production cost to get good identification. While it would have been desirable to use industrial production indices for each country-industry pair, no such comprehensive and internationally comparable measure exists. However, to get an idea whether measurement error in the cost term affected the results, I replaced the general U.S. price measure used in the creation of the production cost measure with 4-digit SIC U.S. price deflators from Bartlesman, Becker and Gray. Since their data end with 1996, estimation is limited to the years 1991-1996. However, when I run the regression for those years with the old cost measure, and the modified cost measure, the coefficients on the production cost terms are 0.253(.048) and 0.339(.047), respectively. While the degree of measured pass-through is a bit higher with the new cost measure, the similarity of the results seems to suggest that measurement error did not dramatically affect the results.

It may be noted that both regressions based on 1991-1996 prices yielded production cost coefficients that were slightly higher than those arriving from estimation covering the full sample period, 1991-2000. This may indicate that the degree of production cost pass-through declined over time. However, when I added interaction terms to equation (8) which replaced the capital-intensity interactions with interactions based on a time trend, the interaction terms failed to reveal any time trend in the pass through of production costs.

Another question is whether the availability of alternative trade programs, such as the NAFTA, affected the results.[20] The phase-in of alternative trade programs is only problematic if there was a correlation between pricing behavior, and the identity of those producers who decided to enter their U.S. imports through NAFTA rather than 9802. To provide a crude indication whether NAFTA participation affected the results, I estimated the pricing equation without Mexico or Canada. In their absence, the estimated production cost pass-through coefficient is 0.259(.003), which is again very similar to the estimate in the full sample. This suggests that there were no systematic differences between the pricing behavior of firms that left the 9802 program in lieu of NAFTA trade

[20] Provisions regarding the general custom's user's fee continued to provide benefits to 9802 participants, even after NAFTA was in force. In addition, U.S. tariffs on Mexican imports were generally non-zero during the sample period, since they were undergoing the phase-in process.

provisions and the pricing behavior of firms that continued to participate in 9802.

Finally, I experimented with changes in the expenditure term in the regressions. While the regressions are run with HS8 expenditures as a control, it may be preferable to use more aggregated measures of expenditure. However, when I ran the regressions with HS6 or HS4 expenditure instead, the primary coefficients of interest were hardly changed, suggesting that the choice of expenditure measure had no effect on the estimated pass-through or emulation effects.

5. Conclusion

I document pricing regularities in U.S. 9802 imports to provide stylized facts related to outsourcing decisions, and to examine whether the pricing responses are consistent with economic theories of international trade that feature search and modification costs or search uncertainty.

Pricing decisions for U.S. 9802 outsourcing imports show that changes in production costs were only partially passed through to import prices; the full sample results imply that a country assembling 9802 products was only able to pass-through 20 to 40 percent of any production cost shock it faced. However, assemblers located in countries with highly educated workforces were able to pass-through a much larger percentage of production cost changes than were assemblers located in countries whose workers were less educated. The results also show that the degree of price response to competitor price changes was magnified for products produced by capital-intense industries. If search costs and search uncertainty are increasing in industry capital-intensity, then the greater emulation of competitor price changes is consistent with informational theories in which the elasticity of substitutions between internationally differentiated products is diminished by search costs and difficulties. In additions, since auxiliary regressions show that there were fewer competing country suppliers in capital-intense industries, it appears that capital-intensity was negatively related to Grossman and Helpman (2004) style market thickness externalities, in the market for 9802 sourcing locations.

There are a number of reasons to be cautious in applying the lessons from 9802 imports to the full range of overseas outsourcing relationships. Since 9802 is designed to promote the use of U.S.-origin parts in foreign assembly, assembly represents a large portion of many foreign countries' contributions. If 9802 assembly tasks are well defined and simpler to match and conduct than other forms of overseas outsourcing, then the effects of search costs or search uncertainty are likely to be much larger in other outsourcing contexts.

Table 1: 9802 Providers, 1991-2000					
MEXICO	7940	VIETNAM	284	MAURITIUS	45
CANADA	3518	NICARAGUA	225	URUGUAY	44
CHINA	2993	BANGLADESH	219	BOLIVIA	41
DOMINICAN REPUBLIC	2434	TURKEY	212	MONACO	40
HONGKONG	2103	BARBADOS	191	THE CZECH REPUBLIC	38
KOREA	1698	NETHERLANDS	190	BELARUS	38
TAIWAN	1686	BRAZIL	190	GREECE	34
INDIA	1602	SWITZERLAND	188	FINLAND	33
COSTARICA	1580	IRELAND	169	NORWAY	33
COLOMBIA	1535	POLAND	155	NEW ZEALAND	32
GUATEMALA	1498	TRINIDAD AND TOBAGO	150	MONTSERRAT	31
ELSALVADOR	1437	PERU	136	VENEZUELA	30
PHILIPPINES	1326	PORTUGAL	126	LITHUANIA	29
JAPAN	1270	BELGIUM	123	OMAN	25
HONDURAS	1230	SPAIN	115	SLOVENIA	24
HAITI	1140	SWEDEN	109	SLOVAKIA	23
ITALY	1057	RUSSIA	101	DOMINICA	21
JAMAICA	718	AUSTRALIA	100	TUNISIA	20
UNITED KINGDOM	700	EGYPT	100	MALDIVE ISLANDS	19
THAILAND	649	UKRAINE	98	LESOTHO	18
GERMANY	595	PANAMA	98	MACEDONIA	17
INDONESIA	559	AUSTRIA	96	UZBEKISTAN	16
MALAYSIA	530	ST.VINCENT	95	BURMA	15
PAKISTAN	503	NETHERLANDS ANTILLES	95	MALTA	15
SRILANKA	503	ROMANIA	83	ARGENTINA	14
SINGAPORE	483	BELIZE	70	CROATIA	13
FRANCE	463	UNITED ARAB EMIRATES	65	SIERRA LEONE	11
MACAO	349	ISRAEL	64	KENYA	11
ST. LUCIA	327	DENMARK	59	QATAR	11
ECUADOR	318	MOROCCO	54	SOUTH AFRICA	11
ST.KITTS NEVIS	312	CHILE	50	PARAGUAY	10
GUYANA	302	BULGARIA	47	MOZAMBIQUE	10
HUNGARY	300	NEPAL	46	GRENADA	10

The table displays the number of distinct HS8 product-year observations of 9802 unit import values that are available for each country.

Table 2: 9802 Sourcing Activity by HS Industry, 1993

HS2	Total Value of 9802 Imports ($mill)	U.S.-origin Value of 9802 Imports ($mill)	U.S. %	Largest Source Country	HS2	Total Value of 9802 Imports ($mill)	U.S.-origin Value of 9802 Imports ($mill)	U.S. %	Largest Source Country
85	14,255	6,910	48.5	Canada	91	98	30	31.1	Switzerland
87	27,879	3,660	13.1	Canada	86	64	27	43.1	Canada
62	3,840	2,131	55.5	Peru	48	36	19	51.2	Canada
84	4,303	1,236	28.7	Canada	65	28	16	56.6	Canada
61	1,331	977	73.4	Mexico	82	40	15	37.6	Taiwan
90	1,503	674	44.8	Canada	59	41	15	37.0	Canada
88	712	299	42.0	Canada	92	105	15	12.1	Japan
76	274	218	79.7	Canada	40	18	13	69.0	Mexico
64	1,135	194	17.1	Malaysia	89	84	12	12.0	Canada
29	155	149	95.8	France	70	23	10	40.4	Canada
63	204	124	61.0	Peru	44	21	9	44.2	Canada
94	191	107	56.0	Canada	58	11	9	39.2	India
72	160	105	65.7	United Kingdom	49	10	4	43.8	Mexico
73	268	97	36.3	Canada	69	16	4	25.7	Mexico
83	109	77	70.8	Mexico	56	5	4	67.3	Mexico
95	143	70	49.1	Mexico	93	15	4	20.8	Japan
39	114	69	60.9	Canada	30	8	3	33.8	Germany
71	72	61	85.6	Hong Kong	28	5	3	49.8	Germany
37	116	58	50.3	Netherlands	54	2	2	77.8	China
74	63	48	76.6	Canada	36	4	2	39.3	Mexico
42	106	46	43.9	Mexico	81	3	2	57.9	Germany
96	65	34	53.7	China	68	2	1	68.0	Italy

Notes: Largest Source Country denotes the country which had the largest total value shipped through 9802. U.S. % is computed for each HS2 category as, 100*[US Value of 9802 Imports]/ [Total Value of 9802 Imports].

Table 3: The Effect of Costs and Competitor Prices on 9802 Prices				
	(1)	(2)	(3)	(4)
ln(Production Cost)	.197 (.015)	.200 (.030)	.413 (.031)	.097 (.038)
ln(Trade Cost)	.913 (.037)	.630 (.063)	.549 (.064)	.696 (.064)
ln(P*)	.415 (.006)	.253 (.004)	.247 (.004)	.253 (.004)
Development Measure	OECD	OECD	Highly Educated	Ln(Per-Capita GDP)
Development	1.587 (.033)	1.693 (0.039)	1.017 (.035)	.685 (.024)
ln(Expenditure)	-.097 (.004)	.003 (.004)	-.003 (.004)	-.002 (.004)
Year and HS2 Dummies	Yes, Yes	Yes, No	Yes, No	Yes, No
Rho		.347	.347	.347
R2	.553	.362	.342	.343
Observations	47,573	47,573	47,573	47,573

Notes: Standard Errors in ( ). Regression (1) is estimated by OLS. Regressions (2), (3), (4) are estimated by random effects panel methods which allow for a first-order autoregressive error term.

Table 4: The Effect of Capital-intensity on Price Responses					
	(1)	(2)	(3)	(4)	(5)
ln(Production Cost)	.275 (.022)	.281 (.021)	.275 (.039)	.217 (.043)	.178 (.067)
ln(Production Cost)*ln(KY)				.321 (.186)	.363 (.206)
ln(Trade Cost)	1.611 (.132)	1.659 (.132)	-.342 (.172)	3.527 (.243)	1.229 (.319)
ln(Trade Cost) * ln(KY)				-7.888 (.988)	-5.284 (.934)
ln(P*)	.400 (.008)	.400 (.008)	.197 (.005)	.355 (.015)	.123 (.010)
ln(P*)*ln(KY)				.177 (.041)	.224 (.026)
OECD	1.528 (.041)	1.852 (.098)	2.122 (.097)	1.723 (.111)	1.982 (.113)
ln(KY)	-.606 (.045)				
ln(KY) *OECD		-.404 (.071)	-.718 (.060)	-.340 (.083)	-.751 (.074)
ln(KY) * (1-OECD)		-.665 (.044)	-.886 (.036)	-.521 (.054)	-.832 (.050)
ln(Expenditure)	-.099 (.004)	-0.098 (.004)	-.007 (.004)	-.095 (.004)	-.008 (.004)
Year and HS2 Dummies	Yes, Yes	Yes, Yes	Yes, No	Yes, Yes	Yes, No
Rho			.394		.394
R2	.548	.549	.350	.554	.354
Observations	31,888	31,888	31,888	31,888	31,888

Notes: Standard Errors in ( ). Regressions (1), (2), and (4) estimated by OLS. Regressions (3), and (5) estimated by random effects panel methods which allow for a first-order autoregressive error term.

Table 5: The Effect of Country Education on Price Responses						
	(1)	(2)	(3)	(4)	(5)	(6)
ln(Production Cost)	.338 (.023)	.406 (.040)	.349 (.023)	.416 (.040)	.078 (.025)	.301 (.043)
ln(Production Cost)* Highly Educ					1.284 (.056)	.672 (.086)
ln(Trade Cost)	.747 (.141)	.199 (.176)	.975 (.141)	.303 (.175)	1.212 (.158)	1.123 (.215)
ln(Trade Cost) *Highly Educ					-1.513 (.298)	-2.518 (.370)
ln(P*)	.416 (.146)	.224 (.005)	.413 (.008)	.221 (.005)	.395 (.009)	.225 (.007)
ln(P*)* Highly Educ					.024 (.011)	-.001 (.009)
Skilled Wage Percentage	.401 (.146)	.768 (.143)	-.713 (.150)	-1.244 (.193)	-.383 (.150)	-1.078 (.193)
Highly Educated	.934 (.029)	1.018 (0.44)	-.087 (.084)	-.562 (.111)	.381 (.112)	-.088 (.128)
Skilled Wage % * Highly Ed			2.833 (.251)	4.337 (.279)	1.989 (.255)	3.668 (.285)
ln(Expenditure)	-.102 (.004)	-.004 (.004)	-.104 (.004)	-.005 (.004)	-.101 (.004)	-.003 (.004)
Year and HS2 Dummies	Yes, Yes	Yes, No	Yes, Yes	Yes, No	Yes, Yes	Yes, No
Rho		.394		.394		.394
R2	.530	.313	.534	.319	.543	.333
Observations	31,888	31,888	31,888	31,888	31,888	31,888

Notes: Standard Errors in ( ). Regressions (1), (3), and (5) estimated by OLS. Regressions (2), (4), (6) estimated by random effects panel methods which allow for a first-order autoregressive error term.

Table 6: The Effect of Country Education Levels on Price Responses						
	(1)	(2)	(3)	(4)	(5)	(6)
ln(Production Cost)	.394 (.023)	.467 (.040)	.459 (.040)	.345 (.041)	.021 (.027)	.249 (.045)
ln(Prod'n Cost)* ln(Education)* Highly Educated					.637 (.029)	.331 (.043)
ln(Trade Cost)	1.431 (.138)	.475 (.178)	.570 (.177)	.217 (.179)	1.078 (.163)	1.371 (.220)
ln(Trade Cost)* ln(Education)* Highly Educated					-1.028 (.148)	-1.610 (.177)
ln(P*)	.415 (.008)	.220 (.005)	.218 (.005)	.219 (.005)	.390 (.009)	.229 (.007)
ln(P*)* ln(Education)* Highly Educated					.007 (.005)	-.005 (.004)
Skilled Wage Percentage	.530 (.148)	.867 (.147)	-10.889 (.644)	.841 (.147)	.515 (.145)	.672 (.146)
Ln(Country Education)	1.062 (.029)	1.080 (.052)	-1.176 (.131)	.345 (.079)	.557 (.030)	.329 (.080)
ln(Country Education)*Highly Educated				.405 (.033)	.408 (.029)	.556 (.038)
Skilled Wage % * ln(Country Education)			6.628 (.353)			
ln(Expenditure)	-.099 (.005)	.001 (.005)	.002 (.005)	.001 (.005)	-.097 (.004)	.004 (.005)
Year and HS2 Dummies	Yes, Yes	Yes, No	Yes, No	Yes, Yes	Yes, No	Yes, No
Rho		.396	.396	.396		.396
R^2	.532	.306	.318	.310	.547	.330
Observations	30,868	30,868	30,868	30,868	30,868	30,868

Notes: Standard Errors in ( ). Columns (1) and (5) are estimated by OLS, while the remaining regressions in this table are estimated using random effects panel methods which allow for a first-order autoregressive error term.

Data Appendix

Trade data

Data on U.S. 9802 imports for 1991-2000 were taken from United States International Trade Commission (USITC) trade data as reported in the December editions of the IM146A. While the data are recorded at the 10-digit HS level, the 10-digit data were first aggregated to the 8-digit level. The dependent variable for the analysis is the CIF unit value of imports, based on the 8-digit aggregates. Unit values were defined for each country-product year observation and calculated as, Unit $Value_{cit}$ = $[\text{Import value}]_{cit}$ /$[\text{Import quantity}]_{cit}$. The subscripts refer to country (c), product (i) and year (t), respectively.

Competitor prices P* were given by the average price of similar 8-digit HS products imported from all other countries in that year through the 9802 program. Expenditure was defined by overall spending for 9802 imports from all countries within an HS 8 grouping in the year, though other higher industry levels of aggregation were also tested for robustness.

The 9802 data were also used to construct the U.S percentage of product value, $\alpha_{us,ic}$, which is defined in footnote 9. The U.S. percentage $\alpha_{us,ic}$ was used in the creation of the production and trade cost measures. To avoid endogeneity problems, the sample average of $\alpha_{us,ic}$ for each county-product pair was used when I applied the cost formulas.

To facilitate the use of industry data, the connection between HS product codes and 4-digit SIC industry identifiers was made feasible by Peter Schott's "HTS10 to SIC4 Concordance, 1989 to 2001" available on his web site: http://www.som.yale.edu/faculty/pks4/sub_international.htm. Tariff rates and transportation costs used to create the trade cost measure, $[(1+g_{ict}) + (1-\alpha_{us,ic})^* \tau_{it}]$, were also collected from Schott's website. A detailed description of Schott's data is contained in Feenstra, Romalis and Schott (2002).

Industry Characteristics

Data on 4-digit SIC industry capital-intensity, and skill requirements were collected from the NBER Manufacturing Database, which is available from the National Bureau of Economic Research data site, at http://www.nber.org/data_index.html, as constructed by Bartlesman, Becker and Gray. Capital-intensity was measured as the ratio of Capital to output, while worker skill requirements were measured by the ratio of non-production worker wages to total wages.

Macroeconomic Variables

Macroeconomic Variables were collected from the Penn World Tables: Alan Heston, Robert Summers and Bettina Aten, Penn World Table Version 6.1, Center for International Comparisons at the University of Pennsylvania (CICUP), October 2002. The variable p, the price level of GDP, was used to measure country input costs when I used cost equation (1) to calculate production costs.

Education

Data on educational attainment were taken from Barro and Lee's data, which are maintained at the, National Bureau of Economic Research, at http://www.nber.org/data_index.html. Following Riker and Brainard (1997), the high education indicator variable was set to one for all countries whose education level for adults 25 and older averaged 6 or more years in 1990.

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