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THE CHOICE OF AN EXCHANGE RATE INDEX

by

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Abstract

This paper examines exchange rate pass-through into U.S. import prices in 29 manufacturing industries focusing on the choice of the exchange rate index. We create eight different exchange rate indexes. These vary by the number of countries whose currencies are included, whether the weight given to each currency is based on total trade with the United States or U.S. imports only, and whether the weights vary by industry. Our results support previous findings that pass-through is generally incomplete but varies across industries. Moreover, we find that pass-through estimates are sensitive to the choice of the exchange rate index. Using bootstrapped J tests we show that major currency indexes perform better than their broad currency counterparts. In addition, when using a major currency index, industry-specific exchange rate indexes are preferred to aggregate indexes.

JEL classification: F14, F31

Keywords: pass-through, index choice

Outline

Non-Technical Summary

Exchange rate pass-through refers to the extent to which exchange rate changes are reflected in the destination-currency (local) prices of traded goods. In the present study we examine how changes in the foreign exchange value of the U.S. dollar alter the prices of goods imported into the United States. Studies of pass-through commonly find that local currency prices do not respond fully to exchange rate changes. In a literature review Goldberg and Knetter (1997) concluded that pass-through into U.S. import prices was centered around 60 percent. In other words, when the U.S. dollar appreciated (depreciated) ten percent, U.S. imports prices on average decreased (increased) six percent (i.e., 60 percent of the exchange rate change).

Our study estimates the rate of pass-through for numerous industries in the manufacturing sector. We focus on an issue that has received little attention—which exchange rate index should be used in pass-through studies. Because U.S. imports arrive from various destinations, the exchange rate measure used in most pass-through studies is an average foreign value of the dollar relative to a group of other currencies. Numerous trade-weighted exchange rate indexes for the U.S. dollar exist.

We explore the sensitivity of pass-through estimates to eight exchange rate indexes. The Board of Governors of the Federal Reserve System produces two of the indexes, while the other six were calculated specifically for the current analysis. The indexes vary across four dimensions: 1) number of countries/currencies included, 2) multilateral versus bilateral weighting, 3) weighting by exports and imports versus imports only, and 4) weighting by industry level trade versus aggregate trade.

Not surprisingly, we find that pass-through estimates are sensitive to the exchange rate index. Relative to the issue of the preferred index, we find that major currency indexes perform better than their broad currency counterparts. Major currency indexes calculate the value of the dollar relative to the euro plus the currencies of Australia, Canada, Japan, Sweden, Switzerland, and the United Kingdom, while broad currency indexes use the currencies in the major currency indexes plus the currencies of 19 additional countries. Some support is found that exchange rate indexes constructed using exports and imports perform better than those using imports only. In addition, when using a major currency index, industry-specific exchange rate indexes are preferred to aggregate indexes.

1. Introduction

Numerous studies have examined the extent to which firms pass-through exchange rate changes into the prices of internationally traded goods. Studies generally have found that pass-through is incomplete, supporting the observation that import prices are less volatile than exchange rates. In their literature review, Goldberg and Knetter (1997) concluded that pass-through into U.S. import prices was centered around 60 percent. Despite the voluminous pass-through literature, few studies have generated pass-through estimates for the U.S. across a broad section of industries. A key finding demonstrated by Antzoulatos and Yang (1996), Yang (1997) and Olivei (2002) is that the rate of pass-through varies across industries. Our study adds to this literature.

Pass-through studies for the United States. can be divided into two groups. The first set generally focus on pass-through from one country's firms into U.S. import prices and use bilateral exchange rates. Most of these studies concentrate on a particular product or industry. For example, Feenstra (1989) examined the pass-through in Japanese shipments of cars, trucks and motorcycles into U.S. prices of these goods. Gron and Swenson (1996) also focused on shipments of Japanese automobiles to the United States. Bernhofen and Xu (2000) examined the exchange rate pass-through into U.S. petrochemical imports from Germany and Japan. Blonigen and Haynes (2002) concentrated on imports of iron and steel products from Canada.

The second group of studies focus on U.S. imports from all sources and use a composite exchange rate. These include Feinberg (1989), Yang (1997), Campa and Goldberg (2002) and Olivei (2002). Woo (1984), Ohno (1989) and Feinberg (1991) estimate pass-through using two or more composite exchange rate indexes. The results reveal that the pass-through estimates are sensitive to the exchange rate index utilized.

For example, Woo estimated pass-through into nonfood and energy import prices using two 10-currency trade-weighted exchange rate indexes. One index assigned a weight to each currency based on that country's share of total trade among all countries in the index.[1] The other index assigned weights based solely on that country's share of U.S imports. Pass-through was 39 percent using the former index and 74 percent using the latter index.

Ohno examined Japanese and U.S. firms' pass-through into export prices for 19 industries using two 16-currency exchange rate indexes -- an index with the weights based on

[1] This index was produced by the Board of Governors of the Federal Reserve System.

multilateral manufacturing export shares and an industry-specific index with weights based on bilateral export shares.[2] Ohno finds that the magnitude of pass-through estimates generally do not depend on the exchange rate index used. Nonetheless, there are a few industries in which pass-through estimates are sensitive to the index used. Pass-through in primary metal products, for example, ranged from 42 percent using an industry index to 19 percent using the aggregated index for the U.S. and 26 percent to 5 percent, for Japan.

Feinberg (1991) examined pass-through into the domestic prices of 81 industries using three exchange rate indexes—the 10-currency index used by Woo, a 101-currency index and industry-specific indexes.[3] The industry and 10- currency indexes produced similar estimates of pass-through, 13 and 14 percent, respectively. Pass-through using the 101-currency index, however, was 24 percent.

Neither Woo, Ohno, nor Feinberg addressed systematically which exchange rate measure yields the best results. Their comments on the sensitivity of their estimates to the exchange rate index utilized were limited to informed speculation. For example, Woo states that an import-share index might be best for estimating pass-through into import prices. Feinberg argued that changes in his industry-specific exchange rate index might measure best the demand-side pressures on domestic prices from import competition. Changes in the broader currency index, he argued, measure best the effects of changes in prices of imported inputs on domestic prices.

To date, Goldberg (2002) has done the only systematic analysis concerning the importance of the exchange rate index. She showed that industry specific exchange rates, which are not readily available, can move differently over time than an economy-wide exchange rate index that is readily available. Thus, for analyses focused on specific industries, strong consideration should be given to using industry exchange rates.

Our study extends the scrutiny of different exchange rate indexes by examining the effect of specific exchange rate indexes on estimates of pass-through into U.S. import prices. This topic is especially important because the magnitude of pass-through is crucial for quantifying the macroeconomic and microeconomic effects of exchange rate changes. For

[2] The former index was produced by the International Monetary Fund.
[3] The 101-currency index was produced by the Federal Reserve Bank of Dallas. The industry-specific indexes were based on fixed-weight import shares for the 31 countries that had at least a 10 percent share of the import market for one of the 81 industries.

example, the magnitude of pass-through is crucial for identifying the effect of exchange rate changes on inflation and for analyzing the international transmission of shocks.[4] In addition, the extent of pass-through is important for quantifying the production, employment and international trade effects experienced by individual industries after exchange rate changes.

A noteworthy feature underpinning our analysis is the construction of a dataset. In fact, the lack of suitable data is undoubtedly the primary reason for the small number of pass-through studies encompassing numerous industries. With respect to foreign exchange indexes, Goldberg (2002) noted that "Construction of such industry-specific series is a non-trivial undertaking, with cumbersome data requirements." As we detail later, not only have we constructed various exchange rate indexes (some of which are industry specific), but we also constructed a number of other variables for our empirical analysis. Using the International Standard Industrial Classification (ISIC) system, we construct numerous variables at a quarterly frequency over 1978 to 2000 for 9 two-digit and 20 three-digit manufacturing industries.

Using a model based on monopolistic competition, we explore the sensitivity of pass-through estimates to different exchange rates. We find that pass-through estimates are sensitive to the choice of the exchange rate index. Nevertheless, pass-through varies more across industries than across exchange rate indexes.

We also compare systematically the informational content of various exchange rate measures to explain pass-through for a number of industries in the manufacturing sector. We find, based on bootstrapped J tests, that major currency indexes perform better than their broad currency counterparts. Some support is found that exchange rate indexes constructed using exports and imports perform better than those using imports only. In addition, when using a major currency index, industry-specific exchange rate indexes are preferred to aggregate indexes.

To provide the background for the dataset we construct, in the next section we discuss a model of import prices. The following section provides key details on the construction of the variables used in our empirical analysis. Special attention is focused on the various exchange rate indexes. A discussion of our pass-through estimates and our analysis comparing the

[4] See, for example, Betts and Devereux (2000) and Corsetti and Dedola (2002).

usefulness of alternative exchange rate indexes completes the body of our paper. A final section contains a summary of our major findings.

2. Model

Partial pass-through requires that firms have market power. Our model follows Blonigen and Haynes' (1999) extension of Feenstra (1989).[5] There are two countries, Home and Foreign. In Foreign, a monopolist produces a good, x, for both the domestic and export market, where x^F indicates Foreign consumption and x^H indicates exports to Home. Demand for good x in Foreign is determined by the local (Foreign) currency price of the good and income (or expenditures on all goods): $x^F(p^F, I^F)$. In Home, the Foreign firm faces competition from a domestic substitute good, y. Demand in Home is determined by the Home currency price of good x, the Home currency price of the good y and income (or expenditures on all goods): $x^H(p^H, p^y, I^H)$. For simplicity it is assumed that all production of good x occurs in Foreign. The cost of producing good x depends on the total quantity produced, $X = x^H + x^F$, and factor prices: $c(X, w)$.

The Foreign firm sets the export price in the Home currency, but maximizes profits in its own currency, as given by equation (1):

$$\max_{p^F,\, p^H} \Pi = p^F x^F + e p^H x^H - c(X, w), \tag{1}$$

where e is the Foreign currency price of the Home currency. As shown in Appendix A, profit maximization produces the standard condition that the marginal revenue (in the Foreign currency) from selling in each market equals marginal cost.

Assuming the second order conditions are met, equations for the optimal prices are:

$$p^F = f(w, e,\ I^F, I^H, p^y) \tag{2}$$

$$p^H = g(w, e,\ I^F, I^H, p^y). \tag{3}$$

Changes in the exchange rate affect prices in both markets. As shown in Appendix A, an appreciation of the Home currency ($\uparrow e$) results in a decline in p^H. The extent of pass-through, however, depends on the effect of a change in the exchange rate on prices in Foreign. The response of p^F to a change in e depends on marginal costs. If marginal costs are decreasing in output, an appreciation of the Home currency results in a fall in p^F. If marginal costs are increasing in output, an appreciation of the Home currency results in a rise in p^F. If marginal costs are constant, a change in the exchange rate has no effect on the Foreign price.

As Blonigen and Haynes (1999) note, because the exchange rate may affect prices in both countries, an observation of less than complete pass-through does not necessarily violate the law of one price. Indeed, if marginal costs are increasing, for the law of one price to hold $\left(p^F = ep^H\right)$ pass-through into p^H must be less than complete. On the other hand, if marginal costs are falling and the law of one price holds, pass-through into p^H will be more than complete. Only in the case where marginal costs are constant is full pass-through consistent with the law of one price. Moreover, as shown in Appendix A, full pass-through requires not only constant marginal costs but also a constant markup of the import price, p^H, over marginal costs.

3. Estimation and Dataset Construction Details

For estimation purposes, we express equation (3) in log first differences. Taking the United States as the Home country gives the basic regression equation:

$$\Delta \ln p_{i,t}^{US} = \underset{-}{\beta_{1,i} \Delta \ln e_{i,t}} + \underset{+}{\beta_{2,i} \Delta \ln p_{i,t}^{y}} + \underset{+}{\beta_{3,i} \Delta \ln w_{i,t}} + \underset{?}{\beta_{4,i} \Delta \ln I_{i,t}^{US}} + \beta_5 q1 + \beta_6 q2 + \beta_7 q3 + \beta_8 q4 \quad (4)$$

where i refers to the industry and t is the year. The expected signs of the key independent variables are given under the equation. An increase in e (appreciation of the dollar) at time t should lower the import price of good i. An increase in the dollar price of the U.S. substitute good should raise the import price, as should an increase in the Foreign marginal cost of production. The theoretical link between the expenditure (income) measure and prices is less certain. Because our data are not seasonally adjusted we add quarter dummy variables (*q1* to *q4*). In addition, because quarterly industry level domestic expenditure data were not available for the foreign countries in our sample, we dropped this variable from our estimates of equation (3).[6]

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[5] See Olivei (2002) for a review of the microeconomic foundations of exchange rate pass-through.

[6] We were able to estimate domestic expenditures for the foreign countries in our dataset using annual data. In regressions using annual data for all variables, the foreign domestic expenditures variable was rarely significant. Moreover the qualitative results were similar to those reported in this paper.

Our dataset covers 29 International Standard Industrial Classification (ISIC) revision 2 manufacturing industries: 9 industries at the two-digit and 20 industries at the three-digit level of classification, as listed in Table 1.[7] The sample period is 1978.q1 through 2000.q4 for all industries except the following four, which start at later date: 322 (1980.q4), 352 (1979.q3), 353 (1981.q3) and 356 (1980.q4).

Exchange Rate Indexes

To determine the importance of the exchange rate index choice in pass-through estimates, we consider eight variations of the exchange rate index. The Board of Governors of the Federal Reserve System (Board) produces two of the indexes, while the other six were calculated specifically for the current analysis.[8] The general formula for constructing each exchange rate index is

$$e_{i,t}^{b} = e_{i,t-1}^{b} \prod_{j=1}^{n} \left(\frac{s_{j,t}}{s_{j,t-1}} \right)^{\omega_{j,i,t}}, \qquad (5)$$

where *b* denotes the specific index, *i* is the industry (level of aggregation), *t* is the time period, *j* is the foreign currency (country), *s* is the foreign currency/U.S. dollar bilateral exchange rate, and ω is the weight assigned to each foreign currency. The weights are based on annual trade data. Each index is a Paasche chain. Previous industry level indexes have all used fixed weights.

As summarized in Table 2, the exchange rate indexes constructed by equation (5) differ in four dimensions:

1. Number of countries/currencies included
2. Multilateral vs. bilateral weighting
3. Weighting by exports and imports vs. imports only
4. Weighting by industry level trade vs. aggregate (goods) trade.

The Board indexes are the only two that use a multilateral weighting scheme. The weights in these indexes not only are based on U.S. imports from and exports to each country in the index, but also incorporate a measure of the competition between U.S. exports and those of each country in the index in the markets of the other countries.[9] Aggregate trade data are

[7] Details for the construction of all variables in our dataset are available from the authors.
[8] See Coughlin and Pollard (1996) for a review of the issues underlying the construction of exchange rate indexes.
[9] See Leahy (1998) for the details.

used. The only difference between the two indexes is the number of countries included. The Major index includes the currencies of 17 countries, 11 of which adopted the euro in January 1999.[10] The Broad index includes the currencies of 19 additional countries.

Using the same exchange rates, *s*, as in the Board indexes, we constructed the other six indexes. MajorM and BroadM are identical in construction to the Major and Broad indexes, respectively, with one exception: In the former indexes, the weight, ω, given to each country's currency is based solely on that country's share of U.S. merchandise imports.[11]

Four indexes—MajorInd, BroadInd, MajorIndM and BroadIndM are constructed using industry-level trade data in the weights.[12] ISIC industry trade data for all countries except Belgium and Luxembourg in 1999 and all years except 2000 were obtained from the World Bank's Trade and Production database.[13] The remaining trade data were obtained from the United Nation's COMTRADE database and converted from SITC revision 2 to ISIC revision 2 by the authors.[14]

The weights in each of the 29 industry-level MajorInd and BroadInd indexes are based on each country's trade (exports and imports) in that industry with the United States relative to U.S. trade with all countries in the index. MajorInd and BroadInd use the same countries as in Major and Broad, respectively. MajorIndM and BroadIndM are identical to MajorInd and BroadInd, respectively, except the weights in the former two indexes are based only on the share of U.S. imports from each country.

Import Prices

U.S. import prices are from the U.S. Bureau of Labor Statistics (BLS) and are based on the free on board (fob) foreign port price.[15] The BLS data are based on the Standard International Trade Classification (SITC) revision 3 and were converted to ISIC revision 2 codes. The use of import price data avoids the measurement problems associated with unit value data.[16]

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[10] Greece adopted the euro in January 2001 and was added to the major currency index at that time, which is after the endpoint of our dataset.

[11] These weights were obtained from the Board of Governors <www.federalreserve.gov/releases/h10/weights>.

[12] The idea for constructing industry-level exchange rates came from Linda Goldberg. Goldberg (2002) constructs industry-specific exchange rates based on the 2-digit SIC system.

[13] Data may be downloaded form the World Bank's website <<www1.worldbank.org/wbiep/trade/data/TradeandProduction.html>>.

[14] COMTRADE is the original source of the World Bank data.

[15] The fob price excludes freight, insurance or duties.

[16] As Alterman (1991) notes, unit values do not take into account differences in product composition or quality.

Prices for the Substitute Goods and Production Costs

The prices for the U.S. substitute goods and the foreign marginal production costs were proxied by producer price indexes. Industry level (ISIC) data for the U.S. and other OECD countries were obtained from the OECD Indicators of Industrial Activity database.[17] Where industry-level data were unavailable, a general producer price index was used; lacking that, the consumer price index was used.

Foreign cost of production indexes are calculated to match the exchange rate indexes. The weight given to the cost data for each of the countries is identical to that used in the exchange rate index. So that for each index *b* and industry *i*

$$w_{i,t}^{b} = \sum_{j=1}^{n} \omega_{i,j,t}^{b} PPI_{i,j,t} \qquad (6)$$

where PPI is the producer price index and all other variables are as in equation (5).

Domestic Expenditures

Domestic expenditures are measured by industry-level output plus imports minus exports. Output is measured by industry shipments data obtained from the Census Bureau. Industry trade data were obtained from the Census Bureau and the U.S. International Trade Commission. Data were converted from an SIC basis to an ISIC basis.

To summarize, the U.S. import price, domestic substitute price and domestic expenditures series vary by industry, but not by the exchange rate index used. The foreign producer costs series vary both by industry and by the exchange rate index used, as the weights given to the individual country data and the number of countries included are determined by the weights used in each exchange rate series. Thus, it is the exchange rate and the foreign producer costs variables that will drive differences in pass-through results across the indexes.

4. Does the Exchange Rate Index Matter?

To examine how the choice of an exchange rate index will affect pass-through, we first examine correlations in the log first differences of these indexes. As shown in Table 3, when the exchange rate index does not vary across industries, changes in the indexes are highly correlated (0.90 and above) regardless of the number of currencies or the weighting scheme.

[17] Data for 1999 and 2000 are available only on an ISIC revision 3 basis. These were converted to an ISIC revision 2 basis. Eurostat data were also used when OECD industry-level data were unavailable.

When the exchange rate index is industry specific, the number of currencies in the index may make a difference. The correlation between the MajorInd and BroadInd ranges from .40 to .97 depending on the industry. When only U.S. imports are used to create the weights assigned to each country's currency, the range of correlations between the major and broad currency indexes (MajorIndM and BroadIndM) increases. When the choice of using exports plus imports or imports only is the primary difference, such as MajorInd and MajorIndM, correlations between the indexes continue to be high.

Holding the number of currencies fixed in the index, the choice of aggregate or industry specific weights also may make a difference. As shown in the bottom third of Table 3, correlations between the aggregate and industry specific indexes range from .41 to .997, with correlations between the import only indexes generally lowest.

These correlations indicate that we should expect pass-through estimates to be most similar between indexes that differ only in whether exports and imports are used for weighting each country's currency versus only imports. In addition we should expect the estimates from the Major and Broad indexes to be more alike than those from the aggregate and industry-level indexes.

Pass-through Estimates

Our focus is on the estimate of β_1, the pass-through coefficient in equation (4). Regardless of the exchange rate index, β_1 is statistically significant for nearly all the industries, as shown in Table 4. The pass-through relationship was statistically significant for, at least, 25 of the 29 industries using every exchange rate index except BroadIndM. The regression using BroadIndM index resulted in 7 industries where pass-through was not statistically significant. Even using this index, however, the pass-through estimates were significant for more than 75 percent of the industries. Pass-through was never statistically significant for industries 341 (paper and paper products), 351 (industrial chemicals) and 384 (transport equipment). Nevertheless, pass-through estimates for the more general industry groups, 34 (paper and paper products, printing and publishing) and 38 (fabricated metal products, machinery and equipment) were statistically significant for all indexes. The significance results for industry 35 (chemicals and chemical, petroleum, coal, rubber and plastic products) were mixed.

The coefficients on the other variables in equation (4) were statistically significant much less frequently, as shown in Table 5 and detailed in Appendix B Tables 1 through 8. The proxy for the U.S prices of domestic substitute goods was statistically significant for less than half of the industries. When the exchange rate index was based on the major currencies, the proxy for foreign marginal production costs was statistically significant more frequently than the proxy for the prices of U.S. substitute goods. Even then, however, this proxy was statistically significant in, at most, 59 percent of the industries. Changes in U.S. domestic expenditures were significant for only a few industries. Finally, with the exception of the first quarter using the broad indexes, the dummy variables were statistically significant for only a few industries.

Turning to our estimates of pass-through for specific industries, we find, as expected, that the sign of the pass-through coefficient is nearly always negative (see Table 4). There are only four cases where pass-through is positive and in all four the estimates are not statistically significant and close to zero in measure.[18] Likewise pass-through is almost always less than complete, $|\beta_1| < 1$. Pass-through is more than complete, $|\beta_1| > 1$, for industry 353 (refined petroleum products) when using the four aggregate indexes and MajorInd. Using the Broad index, $|\beta_1| > 1$ also for industry 383 (electrical machinery). Recall that a finding of more than complete pass-through requires the industry to operate under decreasing marginal costs.

Pass-through estimates averaged across all 29 industries varied from 32 percent (BroadIndM) to 42 percent (Broad and BroadM), as shown in the bottom section of Table 4. Our estimates are slightly above the 30 percent pass-through found by Olivei, and most are slightly higher than the 32 percent pass-through found by Yang. Average pass-through at the three-digit level was greater than at the two-digit level with the differences most pronounced for the aggregated indexes. At the three-digit level average pass-through ranged from 33 percent (BroadIndM) to 47 percent (Broad).

Average pass-through using the industry indexes declined slightly when moving from an index based on exports and imports to one based solely on imports, but varied little when moving from a major to broad currency index. In contrast, the most pronounced differences in average pass-through were between the major and the broad aggregate indexes. In these indexes, moving from a major currency to broad currency index raised average pass-through by 7 to 8 percentage points.

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[18] These are industry 341 using the Broad and BroadM indexes and industry 351 using the BroadM and BroadInd indexes.

We also find that the pass-through estimates vary more across industries than across exchange rate (and foreign) cost indexes, as shown in Table 6. At the two-digit industry level the standard deviation of the pass-through estimates varied from 0.02 to 0.13 when holding the industry fixed but varying the exchange rate index. In contrast the standard deviation of the estimates varied from 0.12 to 0.18 when holding the index fixed but varying the industry. Similarly, at the three-digit level the standard deviation across indexes, holding the industry fixed, varied from 0.03 to 0.22 — with the exception of industry 353 (refined petroleum products) where the standard deviation was 0.31. The standard deviation holding the index fixed and varying the industry ranged from 0.23 to 0.36. These results support the findings of Knetter (1993) that export firms within an industry behave similarly and that industry rather than source country appears to matter more for pass-through behavior. Although Knetter's study was limited to four industrial countries (Germany, Japan, United Kingdom and United States) our results indicate this behavior applies more generally.[19]

Despite the narrow range of differences in average pass-through rates, there were some clear differences at the industry level. Most notable were industries 353 (refined petroleum) where pass-through varied from 58 percent using the BroadIndM index to 143 percent using the Broad index and industry 383 (electrical machinery) where pass-through varied from 43 percent using the MajorIndM to 106 percent using the Broad index.

Results Using Other Specifications

Equation (4) assumes that firms react to exchange rate changes only in the quarter in which they occur. The presence of existing contracts, the delay between ordering and receiving goods, and the costs of changing prices may mean that import prices respond with a lag to exchange rate changes. To test for this possibility, we adjusted equation (4) to include up to four lags of the exchange rate change. Import prices may also respond with a lag to changes in the cost of production, w, and/or to changes in the price of competing goods in the U.S. market, p^y. To allow for this possibility, we reestimated equation (4) adding a one-quarter lag of the dependent variable.

Tables 7 and 8 summarize these results. The results are similar to our original specification both in terms of the number of industries in which pass-through is statistically

[19] Campa and Goldberg (2002) also find that the industry composition of a country's imports is a primary determinant of the extent of pass-through into aggregated import prices.

significant and the size of the pass-through. None of the lag specifications increases the number of statistically significant pass-through estimates; for the broad industry indexes adding exchange rate lags produces a noticeable drop.[20]

Adding lags generally raises the estimated pass-through, particularly for the major currency indexes. The pass-through estimates from the lagged exchange rate equations can be seen as proxies for the long-run pass-through. Regardless of the index, these estimates do not approach full pass-through. For the major currency indexes, long-run average pass-through estimates are about 50 percent. For the broad currency indexes, long-run average pass-through varies from near 60 percent (BroadM) to less than 40 percent (BroadIndM). In general our estimates are below the 60 percent average cited by Goldberg and Knetter (1997).

Our results support the findings of Feenstra (1989) and Campa and Goldberg (2002) that import prices adjust quickly to exchange rate changes. More than two-thirds of the long-run pass-through occurs within the first quarter of the change and nearly all of the remaining adjustment occurs within two lags.

Pass-through increases when moving from a major to a broad currency index when lags are added, which was the result in the no-lag case. Adding lags, however, increases the average long-run pass-through estimates for the major industry level indexes by much more than the estimates for the broad industry level indexes. As a result, long-run pass-through is noticeably higher when using the former indexes. This is most obvious with the industry import only indexes.

The lagged import price regression was most similar to the original specification both in terms of the number of industries for which pass-through was statistically significant and their size of the pass-through estimates. Somewhat surprisingly, the long run pass-through estimates when a lagged import price is included are generally no larger than the no-lag specification.[21]

A common assumption in the pass-through literature is that foreign firms respond symmetrically to changes in their input costs, *w*, and the exchange rate, *e*. As a result the estimated pass-through coefficients should be the same regardless of whether *w* and *e* are estimated separately, as in this paper and Blonigen and Haynes (2002), or jointly, as in

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[20] The results in Tables 7 and 8 are based on the sum of the coefficients on the exchange rate variables.

[21] Long run pass-through is calculated as $\beta_1 /(1-\rho)$ where ρ is the coefficient on the lagged import price.

Feenstra (1989) and, Gron and Swenson (1996). Blonigen and Haynes fail to reject the symmetry restriction, as does Feenstra in most industries. Gross and Schmitt (2000), in contrast, find "no clear evidence that the data would support the restriction of symmetric pass-through" and hence separately estimate the foreign cost and exchange rate coefficients. Using a Wald test we find support for the symmetry restriction in most industries. Nevertheless, regardless of the exchange rate index or the lag structure, symmetry does not hold for all industries. For example, the Wald test always rejects the symmetry hypothesis (at the 5 percent significance level) for industry 352 (other chemicals). These results support our specification.

5. Choosing an Index

A priori we would expect the BroadIndM index to be the best choice. A broad currency index seems preferable to a major currency index as the former incorporates more trading partners of the United States. However, if firms appear to behave similarly across countries, as argued by Knetter and supported by our estimates, then a major currency index would provide sufficient information if currency fluctuations are similar. An import weight index might better track the behavior of import prices, as argued by Woo (1984). Finally, an industry-based index should be preferable to an aggregate index, as the currency weights better reflect actual trading patterns. As long as there are differences across industries in trading partners and differences in bilateral exchange rate changes, an industry-specific index should provide a better measure of pass-through than an aggregate index.

To determine if any index is preferable to the others, we use the J test procedure developed by Davidson and MacKinnon (1981). Based on the results in the previous section we chose to use the model without lags. The J test compares the following two hypotheses:

$$H_0: \quad \Delta \ln p_{i,t}^{US} = \beta_{1,i}\Delta \ln e_{i,t}^{\alpha} + \beta_{2,i}\Delta \ln p_{i,t}^{y} + \beta_{3,i}\Delta \ln w_{i,t}^{\alpha} + \beta_{4,i}\Delta \ln I_{i,t}^{US} + \text{dummies} + u_{i,t}$$

$$H_1: \quad \Delta \ln p_{i,t}^{US} = \beta_{1,i}\Delta \ln e_{i,t}^{\xi} + \beta_{2,i}\Delta \ln p_{i,t}^{y} + \beta_{3,i}\Delta \ln w_{i,t}^{\xi} + \beta_{4,i}\Delta \ln I_{i,t}^{US} + \text{dummies} + v_{i,t}$$

where α and ξ refer to any two of the eight possible exchange rate series. The J test for H_0 consists of first estimating H_1 and then estimating H_0 incorporating the fitted values from H_1 as an additional right-hand-side variable. If the fitted values from model H_1 are statistically significant in model H_0, then H_0 is rejected. Reversing the process will determine if H_1 can be rejected.

The finite sample distribution of the J test may deviate from its standard normal asymptotic distribution causing it to often over-reject. As a result we used a bootstrapped J test as suggested by Davidson and MacKinnon (2002). The bootstrap test for H_0 consists of estimating H_0 and then resampling the rescaled residuals to form 9999 bootstrap samples.[22] The bootstrap test statistic is calculated in the same way as the J test statistic.

The method of determining a preferred index is illustrated in Figure 1. We begin by comparing the major and broad indexes. In all four pairings, the broad currency index was rejected far more than the major currency index. Indeed, the major currency index was rejected, at most, one time. These results indicate, contrary to our priors, that a major currency index is preferable to a broad currency index.

Next we compare the indexes weighted by exports plus imports with those weighted by imports alone. The bootstrapped J test results are not as clear-cut. The results weakly favor the use of indexes based on both exports and imports. Given the slightly lower rejection rate for the export plus import–weighted indexes, we use these for our last comparison. We compare the Major and the MajorInd indexes. Using the bootstrapped J test the Major index was rejected 15 times, while the MajorInd index was rejected six times. [23] These results indicate that the MajorInd index is the preferred index among the eight. Overall our results support our a priori belief that an industry-level index would perform better than an aggregate index. There is little evidence that trade weights based on imports only is preferable. Moreover, there is clear evidence for preferring a major currency over a broad currency index.

6. Conclusion

This paper examined the choice of the exchange rate index in industry-level pass-through estimates. In the process we contribute to the small literature that has generated estimates of pass-through for numerous industries. In addition, we provide a systematic analysis of the importance of the choice of an exchange rate index for pass-through results.

We find, regardless of the exchange rate index, pass-through in both the long and short run is generally incomplete but varies across industries and across indexes. Average pass-through was highest when using a broad aggregate index and this result was robust to the lag

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[22] The rescaled residuals are calculated by multiplying the estimated residuals, $\hat{u}$, by $\left(\frac{n}{n-k}\right)^{1/2}$, where n is the number of observations and k is the number of variables in the regression equation.

[23] Similar results are found through a comparison of MajorM and MajorIndM.

specification. Using industry-level indexes the number of currencies did not have a noticeable effect on short-run average pass-through. Long-run average pass-through, however, was higher when using a major currency industry-level index than when using the broad currency counterparts.

We used bootstrapped J tests to determine which if any of the eight indexes was preferable. Our results showed a clear dominance of the major currency indexes over the broad currency indexes. Within the group of major currency indexes the industry-level index was preferable to the aggregate index. There was weak support for using exports and imports for the trade weights rather than imports only. In sum, our results indicate that the MajorInd index is the preferred index.

Based on this index, average pass-through was 36 percent in the short-run and 48 percent in the long-run. There were, however, sharp variations across industries with pass-through ranging from near zero to over 100 percent. Further research is needed to explore the causes of these industry-level differences.

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Table 1

Manufacturing Industries in Pass-through Regressions

ISIC rev. 2	Description
311	Food products
321	Textiles
322	Wearing apparel except footwear
323	Leather products
331	Wood products except furniture
341	Paper and paper products
351	Industrial chemicals
352	Other chemicals
353	Refined petroleum products
354	Misc. petroleum and coal products
355	Rubber products
356	Plastic products
371	Iron and steel
372	Non-ferrous metals
381	Fabricated metal products
382	Machinery except electrical
383	Electrical machinery
384	Transport equipment
385	Professional and scientific equipment
390	Other manufactured goods
31	Manufacture of food, beverages and tobacco
32	Textiles, wearing apparel and leather industries
33	Wood and wood products, including furniture
34	Paper and paper products, printing and publishing
35	Chemicals, chemical, petroleum, coal, rubber and plastic products
36	Non-metallic mineral products, except coal and petroleum
37	Basic metals
38	Fabricated metal products, machinery and equipment
39	Other manufactured goods

Table 2

Exchange Rate Indexes — Construction Features

Index	Countries and Currencies*	Multilateral vs. Bilateral	Exports & Imports vs. Imports Only	Aggregate vs. Industry
Major	17/7	Multilateral	Exports & Imports	Aggregate
Broad	36/26	Multilateral	Exports & Imports	Aggregate
MajorM	17/7	Bilateral	Imports Only	Aggregate
BroadM	36/26	Bilateral	Imports Only	Aggregate
MajorInd	17/7	Bilateral	Exports & Imports	Industry
BroadInd	36/26	Bilateral	Exports & Imports	Industry
MajorIndM	17/7	Bilateral	Imports Only	Industry
BroadIndM	36/26	Bilateral	Imports Only	Industry

* The 17 countries in the Major index are: Australia, *Austria*, *Belgium*, Canada, *Finland*, *France*, *Germany, Ireland, Italy,* Japan, *Luxembourg, Netherlands, Portugal, Spain*, Sweden, Switzerland, and the United Kingdom. The 11 countries in italics adopted the euro in January 1999. The 36 countries in the Broad index are those in the Major index plus the following countries: Argentina, Brazil, Chile, China, Colombia, Hong Kong, India, Indonesia, Israel, Korea, Malaysia, Mexico, Philippines, Russia, Saudi Arabia, Singapore, Taiwan, Thailand, and Venezuela.

Table 3

Correlations of Log First Differences of Exchange Rate Indexes

Type	Indexes Compared	Correlation Coefficient or Range
Aggregate Indexes	Major and Broad	.90
	MajorM and BroadM	.91
	Major and MajorM	.996
	Broad and BroadM	.992
Industry Indexes	MajorInd and BroadInd	.40 to .97
	MajorIndM and BroadIndM	.27 to .98
	MajorInd and MajorIndM	.86 to .999
	BroadInd and BroadIndM	.89 to .995
Aggregate vs. Industry	Major and MajorInd	.81 to .997
	Broad and BroadInd	.57 to .98
	MajorM and MajorIndM	.45 to .994
	BroadM and BroadIndM	.41 to .98

Table 4:
Pass-through Estimates

ISIC	Major	MajorM	MajorInd	MajorIndM	Broad	BroadM	BroadInd	BroadIndM
31	-0.226 **	-0.235 **	-0.244 **	-0.283 **	-0.275 **	-0.303 **	-0.210 *	-0.104
32	-0.132 **	-0.134 **	-0.112 **	-0.095 **	-0.134 **	-0.131 **	-0.115 **	-0.090 **
33	-0.260 **	-0.275 **	-0.488 **	-0.517 **	-0.344 **	-0.374 **	-0.601 **	-0.545 **
34	-0.115 *	-0.117 *	-0.172 *	-0.218 *	-0.139 *	-0.139 *	-0.172 *	-0.180 *
35	-0.169 *	-0.156	-0.219 *	-0.219 *	-0.235 *	-0.238 *	-0.192	-0.161
36	-0.359 **	-0.374 **	-0.410 **	-0.351 **	-0.454 **	-0.478 **	-0.517 **	-0.467 **
37	-0.203 **	-0.227 **	-0.259 **	-0.240 **	-0.326 **	-0.325 **	-0.266 **	-0.212 **
38	-0.357 **	-0.377 **	-0.384 **	-0.336 **	-0.424 **	-0.425 **	-0.435 **	-0.404 **
39	-0.486 **	-0.470 **	-0.427 **	-0.422 **	-0.482 **	-0.468 **	-0.472 **	-0.448 **
311	-0.232 **	-0.243 **	-0.249 **	-0.300 **	-0.326 **	-0.325 **	-0.281 **	-0.130 *
321	-0.249 **	-0.261 **	-0.223 **	-0.194 **	-0.295 **	-0.305 **	-0.293 **	-0.263 **
322	-0.242 **	-0.244 **	-0.262 **	-0.264 **	-0.307 **	-0.300 **	-0.198 *	-0.170
323	-0.279 **	-0.276 **	-0.264 **	-0.226 **	-0.312 **	-0.299 **	-0.121 *	-0.088 *
331	-0.227 **	-0.237 **	-0.333 **	-0.219	-0.247 **	-0.244 **	-0.290 *	-0.120
341	-0.014	-0.012	-0.061	-0.178	0.010	0.004	-0.067	-0.184
351	-0.055	-0.067	-0.038	-0.034	-0.031	0.025	0.030	-0.002
352	-0.406 **	-0.433 **	-0.335 **	-0.305 **	-0.595 **	-0.552 **	-0.454 **	-0.387 **
353	-1.093 **	-1.094 **	-1.112 **	-0.989 *	-1.430 **	-1.420 **	-0.676 *	-0.576 *
354	-0.278 *	-0.286 *	-0.341 *	-0.311 *	-0.372 *	-0.380 *	-0.388 **	-0.296 *
355	-0.144 **	-0.147 **	-0.176 **	-0.151 **	-0.201 **	-0.209 **	-0.218 **	-0.178 **
356	-0.239 **	-0.254 **	-0.265 **	-0.250 **	-0.315 **	-0.316 **	-0.298 **	-0.221 **
371	-0.118 *	-0.126 *	-0.125 *	-0.111 *	-0.193 **	-0.198 **	-0.131 *	-0.110 *
372	-0.626 **	-0.663 **	-0.784 **	-0.803 **	-0.715 **	-0.658 **	-0.480 **	-0.300 *
381	-0.357 **	-0.374 **	-0.410 **	-0.357 **	-0.433 **	-0.443 **	-0.502 **	-0.461 **
382	-0.637 **	-0.654 **	-0.589 *	-0.503 *	-0.688 *	-0.651 *	-0.614 *	-0.581 *
383	-0.866 **	-0.698 *	-0.534 *	-0.433 *	-1.058 **	-0.992 **	-0.884 **	-0.744 *
384	-0.247	-0.294	-0.392	-0.349	-0.236	-0.282	-0.369	-0.350
385	-0.678 **	-0.706 **	-0.573 **	-0.534 **	-0.797 **	-0.755 **	-0.703 **	-0.649 **
390	-0.636 *	-0.647 *	-0.562 *	-0.492 *	-0.845 *	-0.883 *	-0.826 *	-0.788 *
Mean 2-digit ISIC	-0.256	-0.263	-0.302	-0.298	-0.313	-0.320	-0.331	-0.290
Mean 3-digit ISIC	-0.381	-0.386	-0.381	-0.350	-0.469	-0.459	-0.388	-0.330
Mean all ISIC	-0.342	-0.348	-0.357	-0.334	-0.421	-0.416	-0.371	-0.317

* denotes significance at the 5 percent level based on a one-tailed test.
** denotes significance at the 1 percent level based on a one-tailed test.

Table 5
Number of Industries in Which Other Regressors are Statistically Significant

Index	p^y	w	I^{us}	q1	q2	q3	q4
Major	7	17	4	3	3	1	6
MajorM	9	17	4	4	4	1	5
MajorInd	9	15	2	4	4	3	6
MajorIndM	10	16	4	5	5	3	6
Broad	12	13	4	14	7	5	6
BroadM	13	10	4	14	6	4	7
BroadInd	13	8	4	14	6	3	9
BroadIndM	11	8	4	12	5	4	8

Note: Significance at the 5 percent level based on one-tailed tests for p^y and w and two-tailed tests for the other coefficients.

Table 6

Standard Deviation Across Indexes and Industries

Across Indexes		**Across Industries -- 2 digit ISIC**	
ISIC	**Std. Dev.**	**Index**	**Std. Dev.**
33	0.129	Major	0.123
36	0.062	MajorM	0.122
31	0.062	MajorInd	0.129
34	0.035	MajorIndM	0.125
37	0.047	Broad	0.128
38	0.035	BroadM	0.130
35	0.033	BroadInd	0.176
39	0.024	BroadIndM	0.175
32	0.018		
353	0.306	**3- digit ISIC**	
383	0.217	Major	0.284
372	0.167	MajorM	0.273
390	0.145	MajorInd	0.257
352	0.100	MajorIndM	0.230
385	0.088	Broad	0.359
323	0.084	BroadM	0.351
341	0.078	BroadInd	0.253
311	0.064	BroadIndM	0.231
331	0.061		
384	0.058		
382	0.057		
381	0.052		
322	0.047		
354	0.044		
321	0.038		
356	0.036		
351	0.036		
371	0.036		
355	0.029		

Table 7
Statistically Significant Pass-through: Number of Industries

	Original	Lags of exchange rate				Lag of Import Price
Index	β_1	$s_{i,1}$	$s_{i,2}$	$s_{i,3}$	$s_{i,4}$	$\beta_1/(1-\rho)$
Major	26	24	25	23	24	25
MajorM	25	22	24	22	24	24
MajorInd	26	22	23	23	23	25
MajorIndM	25	22	23	21	22	24
Broad	26	24	24	21	22	26
BroadM	26	24	24	21	22	26
BroadInd	25	20	19	19	19	23
BroadIndM	22	18	20	16	17	21

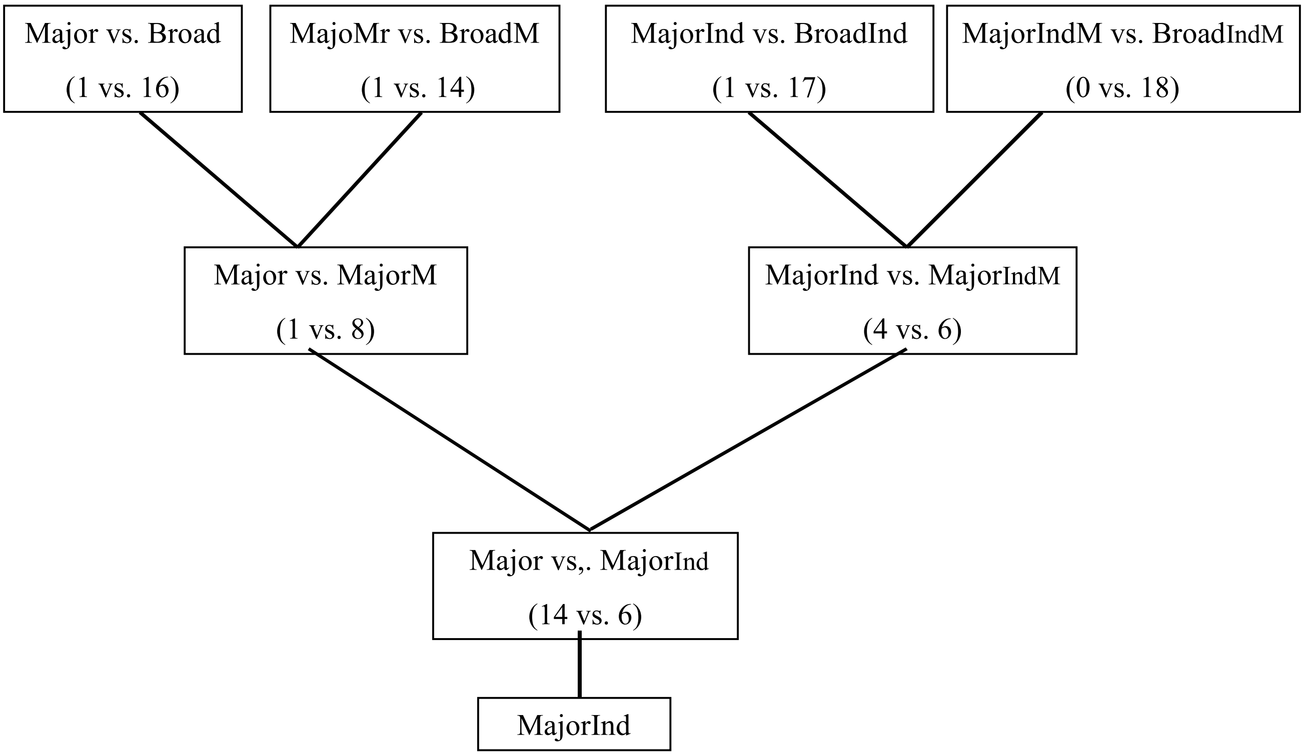
Notes: $s_{i,m} = \sum_{k=0}^{m} \Delta \ln e_{i,t-k}$ and ρ is the coefficient on lagged import prices.

Table 8
Average Pass Through: All Industries

	Original	Lags of exchange rate				Lag of Import Price
Index	β_1	$s_{i,1}$	$s_{i,2}$	$s_{i,3}$	$s_{i,4}$	$\beta_1/(1-\rho)$
Major	-0.34	-0.37	-0.45	-0.43	-0.50	-0.35
MajorM	-0.35	-0.37	-0.45	-0.45	-0.50	-0.36
MajorInd	-0.36	-0.37	-0.44	-0.44	-0.48	-0.38
MajorIndM	-0.33	-0.35	-0.42	-0.41	-0.46	-0.36
Broad	-0.42	-0.43	-0.52	-0.48	-0.54	-0.43
BroadM	-0.42	-0.43	-0.53	-0.54	-0.57	-0.43
BroadInd	-0.37	-0.36	-0.41	-0.41	-0.43	-0.38
BroadIndM	-0.32	-0.30	-0.35	-0.35	-0.36	-0.32

Notes: $s_{i,m} = \sum_{k=0}^{m} \Delta \ln e_{i,t-k}$ and ρ is the coefficient on lagged import prices.

Figure 1-- J-test Pairs



The numbers in parentheses indicate how many times each index was rejected in the bootstrapped J tests for the 29 industries.

Appendix A -- Model

First Order Conditions

Maximizing equation (1) with respect to prices in each market give the first order conditions

$$p^F : \quad x^F + p^F \frac{\delta x^F}{\delta p^F} - c' \frac{\delta x^F}{\delta p^F} = 0$$

(A1)

$$p^H : \quad ex^H + ep^H \frac{\delta x^H}{\delta p^H} - c' \frac{\delta x^H}{\delta p^H} = 0$$

(A2)

These can be rewritten as:

$$\begin{aligned} p^F : \quad & \frac{\delta x^F}{\delta p^F}\left[p^F\left(1 - \frac{1}{\varepsilon^F}\right) - c'\right] = 0 \\ & \frac{\delta x^F}{\delta p^F}\left(r^F - c'\right) = 0 \\ & r^F = c' \end{aligned} \tag{A3}$$

$$\begin{aligned} p^H : \quad & \frac{\delta x^H}{\delta p^H}\left[ep^H\left(1 - \frac{1}{\varepsilon^H}\right) - c'\right] = 0 \\ & \frac{\delta x^H}{\delta p^H}\left(er^H - c'\right) = 0 \\ & er^H = c' \end{aligned} \tag{A4}$$

where $\varepsilon^a \equiv -\left(\frac{\delta x^a}{\delta p^a}\frac{p^a}{x^a}\right)$ for $a = H, F$ and r^F and er^H are the marginal revenue, in foreign currency, from selling in Foreign and Home, respectively.

Second Order Conditions

The second order conditions for profit maximization are

$$\begin{vmatrix} \frac{\delta^2\Pi}{\delta p^{F^2}} & \frac{\delta^2\Pi}{\delta p^F \delta p^H} \\ \frac{\delta^2\Pi}{\delta p^H \delta p^F} & \frac{\delta^2\Pi}{\delta p^{H^2}} \end{vmatrix} > 0, \quad \frac{\delta^2\Pi}{\delta p^{F^2}} < 0, \text{ and } \frac{\delta^2\Pi}{\delta p^{H^2}} < 0,. \tag{A5}$$

Expanding the second inequality in (A5) yields:

$$\frac{\delta^2\Pi}{\delta p^{F^2}} = \frac{\delta\left[\frac{\delta x^F}{\delta p^F}\left(r^F - c'\right)\right]}{\delta p^F} \tag{A6}$$
$$= \frac{\delta^2 x^F}{\delta p^{F^2}}\left(r^F - c'\right) + \frac{\delta x^F}{\delta p^F}\left(\frac{\delta r^F}{\delta p^F} - c''\frac{\delta x^F}{\delta p^F}\right) < 0$$

By the first order condition, (A3), $\left(r^F - c'\right) = 0$. Thus the sign of (A6) depends on the sign of

$\frac{\partial x^F}{\partial p^F}\left(\frac{\delta r^F}{\delta p^F} - c''\frac{\delta x^F}{\delta p^F}\right)$. If demand is well behaved, $\frac{\delta x^F}{\delta p^F} < 0$. Therefore, $\left(\frac{\delta r^F}{\delta p^F} - c''\frac{\delta x^F}{\delta p^F}\right) > 0$.

Similarly, expanding the third inequality in (A5) yields:

$$\frac{\delta^2\Pi}{\delta p^{H^2}} = \frac{\delta\left[\frac{\delta x^H}{\delta p^H}\left(er^H - c'\right)\right]}{\delta p^H} \tag{A7}$$
$$= \frac{\delta^2 x^H}{\delta p^{H^2}}\left(er^H - c'\right) + \frac{\delta x^H}{\delta p^H}\left(e\frac{\delta r^H}{\delta p^H} - c''\frac{\delta x^H}{\delta p^H}\right) < 0$$

By the first order conditions (A4), $\left(er^H - c'\right) = 0$. Thus, the sign of (A7) depends on the sign

of $\frac{\delta x^H}{\delta p^H}\left(e\frac{\delta r^H}{\delta p^H} - c''\frac{\delta x^H}{\delta p^H}\right)$. Given a downward sloping demand curve $\frac{\delta x^H}{\delta p^H} < 0$ so

$\left(e\frac{\delta r^H}{\delta p^H} - c''\frac{\delta x^H}{\delta p^H}\right) > 0$.

Effect of a Change in the Exchange Rate on Prices

Starting with the first order conditions given by equations (A3) and (A4), the implicit function theorem can be used to calculate the effect of a change in the exchange rate on prices in the two markets.

$$\begin{bmatrix} \frac{\delta F_1}{\partial p^F} & \frac{\delta F_1}{\partial p^H} \\ \frac{\delta F_2}{\partial p^F} & \frac{\delta F_2}{\partial p^H} \end{bmatrix} \begin{bmatrix} \frac{\delta p^F}{\delta e} \\ \frac{\delta p^H}{\delta e} \end{bmatrix} = \begin{bmatrix} -\frac{\delta F_1}{\partial e} \\ -\frac{\delta F_2}{\partial e} \end{bmatrix}$$

where $\begin{matrix} F_1 \equiv r^F - c' = 0 \\ F_2 \equiv er^H - c' = 0 \end{matrix}$ and

$$\frac{\delta F_1}{\delta p^F} = \frac{\delta r^F}{\delta p^F} - c'' \frac{\delta x^F}{\delta p^F}, \quad \frac{\delta F_1}{\delta p^H} = -c'' \frac{\delta x^H}{\delta p^H}, \quad \frac{\delta F_2}{\delta p^F} = -c'' \frac{\delta x^F}{\delta p^F}, \quad \frac{\delta F_2}{\delta p^H} = e\frac{\delta r^H}{\delta p^H} - c'' \frac{\delta x^H}{\delta p^H}$$

,

$\frac{\delta F_1}{\delta e} = 0$ and $\frac{\delta F_2}{\delta e} = r^H$.

The Jacobian determinant of the system is $|J| = \begin{vmatrix} \frac{\delta F_1}{\partial p^F} & \frac{\delta F_1}{\partial p^H} \\ \frac{\delta F_2}{\partial p^F} & \frac{\delta F_2}{\partial p^H} \end{vmatrix}$.

The effect of a change in the exchange rate on the price of good *x* in Foreign is

$$\frac{\delta p^F}{\delta e} = \frac{\begin{vmatrix} 0 & -c'' \frac{\delta x^H}{\delta p^H}, \\ -r^H & e\frac{\delta r^H}{\delta p^H} - c'' \frac{\delta x^H}{\delta p^H} \end{vmatrix}}{|J|} = \frac{-r^H c'' \frac{\delta x^H}{\delta p^H}}{|J|} \begin{matrix} < 0 \text{ if } c'' < 0 \\ = 0 \text{ if } c'' = 0 \\ > 0 \text{ if } c'' > 0 \end{matrix} \quad \text{(A8)}$$

The effect of a change in the exchange rate on the price of good *x* in Home is given by

$$\frac{\delta p^H}{\delta e} = \frac{\begin{vmatrix} \frac{\delta r^F}{\delta p^F} - c'' \frac{\delta x^F}{\delta p^F} & 0 \\ -c'' \frac{\delta x^F}{\delta p^F} & -r^H \end{vmatrix}}{|J|} = \frac{-r^H \left(\frac{\delta r^F}{\delta p^F} - c'' \frac{\delta x^F}{\delta p^F} \right)}{|J|} < 0 \quad \text{(A9)}$$

In both (A8) and (A9) the denominator is positive by the second order conditions. Therefore the sign of the numerator determines the signs of the derivative. The first order condition, given by equation (A4) requires that $r^H > 0$, as long as marginal costs are non-negative. A downward sloping demand curve gives $\frac{\delta x^H}{\delta p^H} < 0$. Thus, the effect of a change in the exchange rate on the price of good

x in the Foreign market depends on whether marginal costs are decreasing, constant or increasing, as shown.

The effect of a change in the exchange rate on p^H is easier to determine. As noted above, r^H >0 and the term in parentheses in the numerator of (A9) is positive by the second order conditions. Thus, a rise in the exchange rate (appreciation of the Home currency) always lowers p^H.

Conditions for full pass-through

If marginal costs are constant, $c'' = 0$, then $\frac{\delta p^F}{\delta e} = 0$, so a change in the exchange rate only affects p^H. Rewriting (A9) under the assumption of constant marginal costs gives

$$\frac{\delta p^H}{\delta e} = \frac{-r^H}{e\frac{\delta r^H}{\delta p^H}} = \frac{-\frac{p^H}{e}\left(1-\frac{1}{\varepsilon^H}\right)}{1-\frac{1}{\varepsilon^H}-\frac{\delta\varepsilon^H}{\delta p^H}\frac{p^H}{\left(\varepsilon^H\right)^2}}$$

(A10)

If the firm's markup over marginal cost is constant, $\frac{\delta\varepsilon^H}{\delta p^H} = 0$, then (A10) can be rewritten as

$$\frac{\delta p^H}{\delta e}\frac{e}{p^H} = \frac{-\left(1-\frac{1}{\varepsilon^H}\right)}{\left(1-\frac{1}{\varepsilon^H}\right)} = -1$$

(A11)

Under the assumption of constant marginal costs and a constant markup, the exchange rate elasticity is -1, pass-through is complete.

Appendix Table B1

Regression Coefficients -- Major

ISIC	e	p^y	w	I^{US}	q1	q2	q3	q4	$\bar{R}^2$
31	-0.226 **	0.087	0.577	-0.031	0.140	-0.492	-0.040	0.687	0.09
32	-0.132 **	0.474 **	0.327 *	0.016	0.071	0.166	0.025	0.331	0.50
33	-0.260 **	0.069	0.792 **	0.040	1.006 +	0.639	-0.907	-0.327	0.45
34	-0.115 *	1.079 **	0.572 **	0.142	-0.999	-1.120 ++	-0.822	-1.112 ++	0.68
35	-0.169 *	-0.168	0.558 **	0.404 ++	-1.939 ++	-1.193	0.679	0.223	0.39
36	-0.359 **	-0.287	0.777 **	-0.075	0.187	1.822 ++	0.625	0.066	0.43
37	-0.203 **	0.619 **	0.399	0.171 +	-0.299	-0.005	0.488	-1.184 +	0.49
38	-0.357 **	0.084	0.642 **	-0.027	0.280	0.282	-0.161	0.322	0.63
39	-0.486 **	-0.122	2.176 **	0.052	0.994	-0.922	-1.065	-0.963	0.37
311	-0.232 **	0.069	0.377	-0.157	0.826	0.770	0.432	1.481 ++	0.20
321	-0.249 **	0.403 *	0.368 *	0.047	0.167	-0.339	0.324	0.390	0.54
322	-0.242 **	0.696	0.050	-0.010	0.231	0.191	0.215	-0.370	0.13
323	-0.279 **	0.052	0.599 **	-0.045	-0.338	0.503	0.721	0.273	0.45
331	-0.227 **	0.291 *	0.509 **	0.055	0.679	0.866	-0.307	-0.789	0.45
341	-0.014	0.230	0.513 **	0.099	0.233	0.295	0.100	-0.051	0.49
351	-0.055	0.803 *	-0.208	0.248	-1.456	-2.185	3.250 +	-0.487	0.04
352	-0.406 **	0.294	-0.909 *	-0.172	1.510	0.445	0.116	-2.379 ++	0.18
353	-1.093 **	-0.248	1.889 **	0.362	-0.145	-0.881	-0.949	-5.927 ++	0.54
354	-0.278 *	0.012	0.124	0.146 +	1.979 +	0.643	0.117	-1.346	0.22
355	-0.144 **	0.002	0.378 **	0.057	0.242	0.014	0.077	0.144	0.33
356	-0.239 **	0.021	-0.019	0.004	0.756	0.282	-0.319	0.744	0.19
371	-0.118 *	0.826 **	0.166	-0.033	-0.362	0.522	0.081	-0.044	0.46
372	-0.626 **	-0.217	0.878 **	0.248 +	0.071	0.156	0.719	-1.541	0.48
381	-0.357 **	0.206	0.359 *	-0.020	0.492	0.355	0.042	-0.196	0.54
382	-0.637 **	0.846	5.519 **	0.205	-2.770	-5.936 +	-2.866	-4.486 +	0.23
383	-0.866 **	2.019	3.232	0.153	-0.263	-3.266	-0.588	-1.617	0.22
384	-0.247	0.158	0.003	0.167	1.155	0.025	2.331	-3.078	-0.05
385	-0.678 **	-0.508	0.127	0.158	2.191	-0.125	0.307	-1.433	0.24
390	-0.636 *	-0.021	1.788	-0.139	-1.451	-1.058	3.521	-1.978	0.01

* denotes significance at the 5 percent level based on a one-tailed test.
** denotes significance at the 1 percent level based on a one-tailed test.
+ denotes significance at the 5 percent level based on a two-tailed test.
++ denotes significance at the 1 percent level based on a two-tailed test.

Appendix Table B2

Regression Coefficients -- MajorM

ISIC	e	p^y	w	I^{us}	q1	q2	q3	q4	$\bar{R}^2$
31	-0.235 **	0.084	0.570	-0.036	0.113	-0.506	-0.028	0.719	0.09
32	-0.134 **	0.491 **	0.308 *	0.015	0.061	0.153	0.043	0.331	0.49
33	-0.275 **	0.036	0.736 **	0.033	1.091 +	0.739	-0.870	-0.285	0.45
34	-0.117 *	1.084 **	0.544 **	0.140	-1.004	-1.111 ++	-0.797	-1.093 ++	0.68
35	-0.156	-0.142	0.501 **	0.429 ++	-2.030 ++	-1.336	0.732	0.309	0.38
36	-0.374 **	-0.187	0.652 **	-0.075	0.213	1.775 ++	0.636	0.079	0.42
37	-0.227 **	0.588 *	0.432 *	0.165 +	-0.307	0.009	0.488	-1.187 +	0.50
38	-0.377 **	0.143	0.491 **	-0.031	0.320	0.279	-0.144	0.372	0.62
39	-0.470 **	0.199	1.585 **	0.053	1.195	-0.849	-0.949	-0.862	0.32
311	-0.243 **	0.054	0.434	-0.164	0.759	0.704	0.421	1.503 ++	0.20
321	-0.261 **	0.380 *	0.412 *	0.040	0.120	-0.345	0.328	0.389	0.53
322	-0.244 **	0.749	-0.063	-0.010	0.252	0.175	0.231	-0.342	0.12
323	-0.276 **	0.062	0.513 *	-0.041	-0.278	0.495	0.732	0.332	0.42
331	-0.237 **	0.272 *	0.463 **	0.052	0.720	0.921	-0.279	-0.765	0.45
341	-0.012	0.208	0.518 **	0.101	0.226	0.301	0.124	-0.025	0.50
351	-0.067	0.853 *	-0.301	0.248	-1.412	-2.202	3.231 +	-0.480	0.04
352	-0.433 **	0.285	-0.896 *	-0.172	1.487	0.381	0.077	-2.426 ++	0.18
353	-1.094 **	-0.215	1.795 **	0.381	-0.282	-1.175	-0.799	-5.617 +	0.54
354	-0.286 *	0.026	0.083	0.158 +	2.003 +	0.525	0.140	-1.275	0.22
355	-0.147 **	0.005	0.349 **	0.056	0.237	0.013	0.091	0.168	0.32
356	-0.254 **	0.012	-0.007	0.002	0.725	0.259	-0.328	0.728	0.19
371	-0.126 *	0.834 **	0.147	-0.033	-0.374	0.524	0.087	-0.047	0.46
372	-0.663 **	-0.254	0.893 **	0.244 +	-0.052	0.131	0.788	-1.521	0.49
381	-0.374 **	0.229	0.326	-0.021	0.460	0.316	0.040	-0.194	0.54
382	-0.654 **	1.504 *	3.389 *	0.187	-1.096	-4.886 +	-2.237	-3.838	0.18
383	-0.698 *	4.059 **	-0.543	0.404	1.168	-5.066 +	-1.962	-2.950	0.19
384	-0.294	0.190	-0.060	0.168	1.170	0.008	2.366	-3.152	-0.05
385	-0.706 **	-0.373	-0.348	0.173	2.495 +	-0.157	0.320	-1.422	0.25
390	-0.647 *	-0.075	1.960	-0.146	-1.709	-1.130	3.536	-1.968	0.01

* denotes significance at the 5 percent level based on a one-tailed test.
** denotes significance at the 1 percent level based on a one-tailed test.
+ denotes significance at the 5 percent level based on a two-tailed test.
++ denotes significance at the 1 percent level based on a two-tailed test.

Appendix Table B3

Regression Coefficients -- MajorInd

ISIC	e	p^y	w	I^{us}	q1	q2	q3	q4	$\bar{R}^2$
31	-0.244 **	0.111	0.529	-0.040	0.079	-0.401	0.019	0.692	0.09
32	-0.112 **	0.733 **	-0.032	0.018	0.238	0.250	0.065	0.405	0.50
33	-0.488 **	-0.045	0.518 **	0.045	1.348 ++	0.961	-0.689	0.121	0.45
34	-0.172 *	0.996 **	0.494 **	0.163	-0.752	-1.093 ++	-0.937 +	-1.156 ++	0.73
35	-0.219 *	-0.210	0.629 **	0.360 ++	-1.866 ++	-0.968	0.602	0.088	0.42
36	-0.410 **	-0.049	0.512 *	-0.065	0.418	1.712 ++	0.602	0.126	0.41
37	-0.259 **	0.653 **	0.333 *	0.154	-0.171	0.104	0.476	-1.163 +	0.50
38	-0.384 **	0.143	0.521 **	-0.033	0.268	0.284	-0.149	0.375	0.63
39	-0.427 **	0.166	1.486 **	0.046	1.409	-0.613	-0.875	-0.913	0.36
311	-0.249 **	0.143	0.098	-0.129	0.956	0.896	0.529	1.497 ++	0.20
321	-0.223 **	0.696 **	-0.063	0.059	0.261	-0.315	0.409	0.448 +	0.55
322	-0.262 **	0.814 *	0.030	-0.015	0.217	0.253	0.318	-0.394	0.21
323	-0.264 **	0.055	0.420 **	-0.047	-0.122	0.674 +	0.718 +	0.295	0.49
331	-0.333 **	0.193	0.324 **	0.054	0.848	1.094	-0.119	-0.414	0.42
341	-0.061	-0.097	0.635 **	0.043	0.462	0.427	0.070	-0.071	0.57
351	-0.038	0.697	-0.015	0.246	-1.529	-2.156	3.267 +	-0.530	0.04
352	-0.335 **	0.259	-0.772 *	-0.172	1.432	0.438	0.139	-2.377 ++	0.16
353	-1.112 **	-0.272	1.449 **	0.435	0.708	-1.417	-1.211	-4.823 +	0.50
354	-0.341 *	0.028	0.052	0.164 +	2.143 ++	0.582	0.184	-1.244	0.22
355	-0.176 **	-0.001	0.355 **	0.062	0.092	0.022	0.122	0.135	0.37
356	-0.265 **	0.035	-0.007	0.005	0.752	0.308	-0.282	0.802	0.19
371	-0.125 *	0.864 **	0.092	-0.036	-0.335	0.582	0.107	-0.045	0.47
372	-0.784 **	-0.258	0.777 **	0.215	0.239	0.276	0.817	-1.280	0.50
381	-0.410 **	0.276 *	0.252	-0.024	0.520	0.389	0.069	-0.145	0.56
382	-0.589 *	2.457 **	-0.371	0.214	2.057	-3.136	-0.854	-2.859	0.15
383	-0.534 *	4.168 **	-0.975	0.468	1.161	-5.675 +	-2.356	-3.345	0.20
384	-0.392	0.138	0.111	0.166	1.097	-0.009	2.301	-3.154	-0.05
385	-0.573 **	-0.299	-1.213 *	0.204	3.140 ++	0.035	0.390	-1.461	0.27
390	-0.562 *	0.576	0.593	-0.131	-0.709	-0.690	3.694	-1.968	0.01

* denotes significance at the 5 percent level based on a one-tailed test.
** denotes significance at the 1 percent level based on a one-tailed test.
+ denotes significance at the 5 percent level based on a two-tailed test.
++ denotes significance at the 1 percent level based on a two-tailed test.

Appendix Table B4
Regression Coefficients -- MajorIndM

ISIC	e	p^y	w	I^{us}	q1	q2	q3	q4	$\bar{R}^2$
31	-0.283 **	0.065	0.606 *	-0.047	0.041	-0.467	-0.073	0.671	0.09
32	-0.095 **	0.861 **	-0.169 *	0.020	0.302	0.295	0.079	0.456 +	0.53
33	-0.517 **	-0.043	0.389 **	0.050	1.508 ++	1.030	-0.608	0.227	0.38
34	-0.218 *	1.067 **	0.405 **	0.163	-0.766	-1.083 ++	-0.938 ++	-1.148 ++	0.73
35	-0.219 *	-0.182	0.588 **	0.379 ++	-1.878 ++	-1.075	0.621	0.101	0.41
36	-0.351 **	-0.130	0.622 **	-0.058	0.541	1.617 ++	0.552	0.103	0.42
37	-0.240 **	0.748 **	0.222	0.167 +	-0.198	0.094	0.512	-1.196 ++	0.49
38	-0.336 **	0.151	0.512 **	-0.039	0.311	0.307	-0.142	0.438	0.63
39	-0.422 **	-0.237	1.795 **	0.034	1.191	-0.413	-0.696	-0.761	0.57
311	-0.300 **	0.135	-0.046	-0.122	1.141 +	1.118 +	0.660	1.644 ++	0.19
321	-0.194 **	0.713 **	-0.096	0.062	0.272	-0.299	0.396	0.453 +	0.55
322	-0.264 **	0.796 *	0.032	-0.017	0.260	0.312	0.348	-0.389	0.24
323	-0.226 **	0.091 **	0.278 *	-0.043	0.073	0.745 ++	0.755 +	0.383	0.48
331	-0.219	0.228	0.193 *	0.050	0.929	1.130	-0.060	-0.385	0.36
341	-0.178	-0.091	0.599 **	-0.020	0.588	0.553	0.171	-0.091	0.58
351	-0.034	0.619	0.124	0.244	-1.593	-2.144	3.271 +	-0.567	0.04
352	-0.305 **	0.300	-0.858 *	-0.160	1.388	0.291	-0.029	-2.442 ++	0.17
353	-0.989 *	-0.195	1.166 **	0.514 +	1.352	-2.361	-1.191	-4.070	0.47
354	-0.311 *	0.028	0.048	0.169 ++	2.127 ++	0.465	0.128	-1.284	0.22
355	-0.151 **	-0.002	0.356 **	0.065	0.043	0.002	0.147	0.152	0.38
356	-0.250 **	0.046	-0.011	0.010	0.728	0.278	-0.284	0.788	0.19
371	-0.111 *	0.878 **	0.066	-0.036	-0.342	0.597	0.111	-0.051	0.46
372	-0.803 **	-0.303	0.783 **	0.204	0.306	0.269	0.844	-1.134	0.51
381	-0.357 **	0.269 *	0.296 *	-0.017	0.514	0.316	0.035	-0.211	0.56
382	-0.503 *	2.262 **	0.607	0.204	1.039	-3.709	-1.266	-3.179	0.15
383	-0.433 *	3.725 **	0.046	0.338	0.610	-4.885 +	-1.720	-2.582	0.17
384	-0.349	0.035	0.367	0.157	0.961	-0.063	2.110	-3.008	-0.05
385	-0.534 **	-0.282	-0.704	0.139	2.072 +	-0.183	0.117	-1.603	0.28
390	-0.492 *	0.853	0.090	-0.123	-0.472	-0.640	3.733	-1.911	0.01

* denotes significance at the 5 percent level based on a one-tailed test.
** denotes significance at the 1 percent level based on a one-tailed test.
+ denotes significance at the 5 percent level based on a two-tailed test.
++ denotes significance at the 1 percent level based on a two-tailed test.

Appendix Table B5

Regression Coefficients -- Broad

ISIC	e	p^y	w	I^{us}	q1	q2	q3	q4	$\bar{R}^2$
31	-0.275 **	0.104	0.782 *	-0.054	0.323	-0.433	0.013	0.777	0.10
32	-0.134 **	0.730 **	-0.090	0.017	0.515 +	0.418	0.279	0.617 ++	0.47
33	-0.344 **	0.177	0.722 **	0.069	1.527 +	0.592	-0.656	-0.119	0.39
34	-0.139 *	1.334 **	0.418 *	0.118	-1.205 +	-1.095 +	-0.767	-1.167 ++	0.65
35	-0.235 *	-0.167	0.588 **	0.430 ++	-1.679 +	-1.180	0.886	0.454	0.37
36	-0.454 **	-0.157	0.524 *	-0.082	1.263 +	2.341 ++	1.103 +	0.568	0.37
37	-0.326 **	0.698 **	0.349	0.189 +	0.205	0.237	0.827	-0.933	0.51
38	-0.424 **	0.144	0.226	-0.031	1.275 ++	0.843 ++	0.412	1.068 ++	0.52
39	-0.482 **	0.444	1.044 *	0.045	2.187 +	-0.322	-0.436	-0.334	0.28
311	-0.326 **	0.116	0.220	-0.142	1.467 +	1.176 +	0.822	1.836 ++	0.22
321	-0.295 **	0.521 **	0.129	0.059	0.773 ++	-0.042	0.702 ++	0.797 ++	0.51
322	-0.307 **	0.821 *	-0.185	-0.014	0.944	0.647	0.815	0.183	0.11
323	-0.312 **	0.101 **	0.427 *	-0.036	0.310	0.752 +	0.982 +	0.639	0.41
331	-0.247 **	0.364 **	0.473 *	0.065	1.022	0.863	-0.120	-0.569	0.41
341	0.010	0.450 *	0.399 *	0.094	-0.044	0.109	-0.053	-0.327	0.46
351	-0.031	0.843 *	-0.334	0.248	-1.318	-2.068	3.395 +	-0.269	0.04
352	-0.595 **	0.089	-0.764	-0.250	2.863 ++	1.668	1.574	-1.243	0.18
353	-1.430 **	-0.145	2.192 **	0.336	2.089	0.421	0.826	-4.136	0.51
354	-0.372 *	0.029	0.079	0.155 +	2.687 ++	1.009	0.632	-0.755	0.22
355	-0.201 **	0.025	0.291 **	0.054	0.613	0.193	0.285	0.384	0.29
356	-0.315 **	-0.015	-0.038	0.013	1.342 +	0.640	0.171	1.273 ++	0.18
371	-0.193 **	0.842 **	0.143	-0.024	-0.058	0.705	0.307	0.153	0.48
372	-0.715 **	0.128	0.588 *	0.297 ++	1.228	0.908	1.361	-1.015	0.47
381	-0.433 **	0.231	0.159	-0.008	1.368 ++	0.878 +	0.641 +	0.469	0.45
382	-0.688 *	1.337 *	3.875 **	0.088	-0.495	-4.697 +	-2.909	-3.758	0.20
383	-1.058 **	3.206 **	1.512	0.179	1.629	-3.067	-0.240	-1.074	0.22
384	-0.236	0.098	0.075	0.164	1.501	0.244	2.553	-2.572	-0.06
385	-0.797 **	-0.558	-0.181	0.158	3.947 ++	0.976	1.511	0.000	0.19
390	-0.845 *	-0.024	1.783	-0.180	-0.406	-0.213	4.405	-1.226	0.02

* denotes significance at the 5 percent level based on a one-tailed test.

** denotes significance at the 1 percent level based on a one-tailed test.

\+ denotes significance at the 5 percent level based on a two-tailed test.

++ denotes significance at the 1 percent level based on a two-tailed test.

Appendix Table B6

Regression Coefficients -- BroadM

ISIC	e	p^y	w	I^{us}	q1	q2	q3	q4	$\bar{R}^2$
31	-0.303 **	0.099	0.587	-0.041	0.558	-0.327	0.135	0.876	0.10
32	-0.131 **	0.765 **	-0.117	0.017	0.479 +	0.377	0.245	0.597 ++	0.48
33	-0.374 **	0.145	0.644 **	0.060	1.706 ++	0.686	-0.624	-0.092	0.39
34	-0.139 *	1.332 **	0.388 **	0.125	-1.153 +	-1.133 +	-0.785	-1.174 ++	0.65
35	-0.238 *	-0.171	0.553 **	0.446 ++	-1.669 +	-1.307	0.879	0.464	0.37
36	-0.478 **	-0.161	0.514 *	-0.083	1.270 +	2.257 ++	1.052 +	0.517	0.38
37	-0.325 **	0.778 **	0.220	0.193 +	0.192	0.211	0.823	-0.953	0.50
38	-0.425 **	0.181	0.124	-0.025	1.281 ++	0.732 +	0.379	1.027 ++	0.51
39	-0.468 **	0.390	1.110 *	0.051	2.182 +	-0.541	-0.599	-0.440	0.27
311	-0.325 **	0.136	0.066	-0.130	1.530 ++	1.196 +	0.844	1.853 ++	0.22
321	-0.305 **	0.520 **	0.142	0.054	0.740 ++	-0.107	0.646 ++	0.746 ++	0.52
322	-0.300 **	0.860 *	-0.249	-0.014	0.860	0.576	0.756	0.173	0.11
323	-0.299 **	0.117 **	0.235	-0.030	0.469	0.778 +	0.979 +	0.718 +	0.39
331	-0.244 **	0.360 **	0.358 *	0.062	1.126	0.920	-0.075	-0.545	0.39
341	0.004	0.427 *	0.390 *	0.106	0.007	0.113	-0.030	-0.290	0.47
351	0.025	0.957 *	-0.530	0.248	-1.399	-2.121	3.348 +	-0.212	0.05
352	-0.552 **	0.101	-0.681	-0.224	2.481 +	1.322	1.211	-1.476	0.17
353	-1.420 **	-0.147	1.950 **	0.425	2.505	-0.593	0.652	-3.782	0.50
354	-0.380 *	0.038	0.044	0.163 +	2.696 ++	0.857	0.582	-0.754	0.22
355	-0.209 **	0.013	0.323 **	0.054	0.600	0.124	0.231	0.337	0.31
356	-0.316 **	0.000	-0.058	0.010	1.278 +	0.569	0.103	1.236 ++	0.19
371	-0.198 **	0.856 **	0.100	-0.027	-0.050	0.698	0.294	0.148	0.48
372	-0.658 **	0.262	0.377	0.307 ++	1.071	0.805	1.199	-1.167	0.45
381	-0.443 **	0.255 *	0.134	-0.007	1.326 ++	0.754	0.563	0.408	0.46
382	-0.651 *	1.289 *	3.763 **	0.070	-0.200	-4.739 +	-3.000	-3.677	0.18
383	-0.992 **	3.332 **	1.194	0.215	1.726	-3.478	-0.499	-1.279	0.20
384	-0.282	0.093	0.088	0.164	1.555	0.218	2.541	-2.586	-0.06
385	-0.755 **	-0.489	-0.354	0.183	3.883 ++	0.662	1.318	-0.195	0.17
390	-0.883 *	-0.103	1.857	-0.173	-0.292	-0.474	4.234	-1.343	0.02

* denotes significance at the 5 percent level based on a one-tailed test.

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++ denotes significance at the 1 percent level based on a two-tailed test.

Appendix Table B7

Regression Coefficients -- BroadInd

ISIC	e	p^y	w	I^{us}	q1	q2	q3	q4	$\bar{R}^2$
31	-0.210 *	0.144	0.211	0.000	0.802	0.077	0.497	1.199 +	0.05
32	-0.115 **	0.757 **	-0.104	0.012	0.573 +	0.488 +	0.403	0.755 ++	0.46
33	-0.601 **	-0.009	0.571 **	0.059	2.239 ++	1.076	-0.453	0.375	0.41
34	-0.172 *	1.109 **	0.480 **	0.169	-0.724	-1.147 ++	-0.944 +	-1.170 ++	0.70
35	-0.192	-0.105	0.473 **	0.450 ++	-1.833 +	-1.293	0.890	0.541	0.36
36	-0.517 **	-0.007	0.314	-0.071	1.567 ++	2.282 ++	1.111 +	0.662	0.37
37	-0.266 **	0.848 **	0.082	0.194 +	0.474	0.487	1.029	-0.678	0.49
38	-0.435 **	0.210 *	0.074	-0.022	1.159 ++	0.667 +	0.355	0.965 ++	0.53
39	-0.472 **	0.259	1.361 **	0.046	1.998 +	-0.652	-0.729	-0.770	0.31
311	-0.281 **	0.119	0.218 *	-0.086	1.793 ++	1.331 +	0.984	2.052 ++	0.24
321	-0.293 **	0.626 **	-0.083	0.057	0.886 ++	0.026	0.824 ++	1.004 ++	0.47
322	-0.198 *	0.608	-0.178	-0.008	0.808	0.548	0.668	0.464	0.02
323	-0.121 *	0.148 **	0.146	-0.015	0.312	0.686	0.846	0.729 +	0.31
331	-0.290 *	0.223	0.335 **	0.059	1.194 +	1.135	-0.017	-0.283	0.39
341	-0.067	-0.034	0.681 **	0.049	0.453	0.257	-0.043	-0.195	0.55
351	0.030	0.723 *	-0.060	0.246	-1.594	-2.215	3.235	-0.498	0.04
352	-0.454 **	0.071	-0.529	-0.211	2.320 +	1.202	0.973	-1.834 +	0.16
353	-0.676 *	0.393	0.481	0.429	4.885	-1.200	1.624	-0.372	0.42
354	-0.388 **	0.043	0.006	0.170 ++	2.962 ++	1.140	0.767	-0.544	0.23
355	-0.218 **	0.042 *	0.157 *	0.045	0.711	0.304	0.366	0.476	0.27
356	-0.298 **	-0.055	0.023	0.039	1.150 +	0.220	-0.050	1.205 ++	0.14
371	-0.131 *	0.878 **	0.014	-0.037	0.060	0.891 +	0.388	0.280	0.46
372	-0.480 **	0.374 *	0.177	0.328 ++	1.269	1.030	1.343	-0.744	0.43
381	-0.502 **	0.292 *	0.080	0.000	1.308 ++	0.719	0.563	0.434	0.47
382	-0.614 *	2.324 **	-0.105	0.207	2.608	-2.742	-0.326	-2.123	0.13
383	-0.884 **	3.767 **	-0.110	0.337	2.423	-3.913	-0.558	-1.249	0.19
384	-0.369	0.174	-0.147	0.171	1.665	0.312	2.726	-2.693	-0.05
385	-0.703 **	-0.443	-0.772	0.209	3.843 ++	0.588	1.142	-0.604	0.23
390	-0.826 *	0.139	1.439	-0.166	-0.157	-0.296	4.360	-1.444	0.03

* denotes significance at the 5 percent level based on a one-tailed test.
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Appendix Table B8

Regression Coefficients -- BroadIndM

ISIC	e	p^y	w	I^{us}	q1	q2	q3	q4	$\bar{R}^2$
31	-0.104	0.129	0.218	0.017	0.590	-0.132	0.326	1.090	0.03
32	-0.090 **	0.832 **	-0.157 *	0.012	0.501 +	0.490 +	0.414	0.777 ++	0.47
33	-0.545 **	0.045	0.390 **	0.057	2.368 ++	1.161	-0.303	0.478	0.34
34	-0.180 *	1.129 **	0.392 **	0.168	-0.653	-1.065 ++	-0.900 +	-1.106 ++	0.71
35	-0.161	-0.059	0.378 *	0.486 ++	-1.924 +	-1.493	0.920	0.585	0.34
36	-0.467 **	0.002	0.202	-0.068	1.721 ++	2.306 ++	1.097 +	0.630	0.37
37	-0.212 **	0.919 **	-0.013	0.199 +	0.338	0.486	1.034	-0.692	0.48
38	-0.404 **	0.221 *	0.162	-0.031	0.914 ++	0.463	0.110	0.752 ++	0.59
39	-0.448 **	0.311	1.137 **	0.036	2.007 +	-0.455	-0.530	-0.589	0.31
311	-0.130 *	0.103	0.112	-0.082	1.574 +	1.261 +	0.903	1.997 ++	0.17
321	-0.263 **	0.623 **	-0.052	0.061	0.832 ++	-0.051	0.783 ++	0.973 ++	0.45
322	-0.170	0.592	-0.171	-0.005	0.710	0.499	0.572	0.429	0.01
323	-0.088 *	0.160 **	0.069	-0.015	0.335	0.710	0.873	0.767 +	0.29
331	-0.120	0.345 *	0.124	0.058	1.084	1.037	0.009	-0.383	0.34
341	-0.184	-0.028	0.582 **	-0.014	0.792	0.602	0.235	-0.013	0.57
351	-0.002	0.692	-0.008	0.246	-1.548	-2.168	3.269 +	-0.499	0.04
352	-0.387 **	0.201	-0.781 *	-0.192	1.987 +	0.825	0.558	-2.030 +	0.17
353	-0.576 *	0.380	0.452	0.467	4.682	-1.486	1.423	-0.334	0.42
354	-0.296 *	0.041	0.004	0.178 ++	2.736 ++	0.948	0.581	-0.758	0.22
355	-0.178 **	0.000	0.346 **	0.058	0.445	0.113	0.247	0.322	0.37
356	-0.221 **	-0.050	0.016	0.039	0.960	0.100	-0.171	1.105 +	0.11
371	-0.110 *	0.876 **	0.019	-0.038	0.040	0.871 +	0.358	0.258	0.46
372	-0.300 *	0.341	0.227	0.318 ++	0.955	0.732	1.098	-0.858	0.41
381	-0.461 **	0.273 *	0.171	-0.005	1.151 ++	0.537	0.340	0.182	0.50
382	-0.581 *	2.286 **	0.352	0.196	1.740	-3.337	-0.933	-2.730	0.14
383	-0.744 *	3.572 **	0.480	0.275	1.691	-4.150	-0.888	-1.558	0.18
384	-0.350	0.051	0.282	0.161	1.326	0.039	2.273	-2.815	-0.05
385	-0.649 **	-0.374	-0.665	0.161	2.661 ++	0.193	0.649	-0.972	0.27
390	-0.788 *	0.344	0.996	-0.175	0.003	0.012	4.694	-1.104	0.02

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