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Abstract

This paper documents a sustained decline in exchange rate pass-through to U.S. import prices, from above 0.5 during the 1980s to somewhere in the neighborhood of 0.2 during the last decade. This decline in the pass-through coefficient is robust to the measure of foreign prices that is included in the regression (i.e., CPI versus PPI), whether the estimation is done in levels or differences, and whether U.S. prices are included as an explanatory variable. Notably, the largest estimates of pass-through are obtained when commodity prices are excluded from the regression. In this case, the pass-through coefficient captures both the direct effect of the exchange rate on import prices and an indirect effect operating through changes in commodity prices. Our work indicates that an increasing share of exchange rate pass-through has occurred through this commodity-price channel in recent years. While the source of the decline in pass-through is difficult to pin down with certainty, our work points to several factors, including the reduced share of (commodity-intensive) industrial supplies in U.S. imports and the increased presence of Chinese exporters in U.S. markets. We detect a particular step down in the pass-through coefficient around the time of the Asian financial crisis and document a shift in the export pricing behavior of emerging Asian firms around that time.

Keywords: Pass-through; Import prices; Exchange rates.

JEL Classification: E31, F3, F41.

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1. Introduction

Since early 2002, the dollar has fallen markedly, but the response of U.S. import prices to the dollar's move has been slow and apparently muted. This outcome has raised important questions regarding the magnitude and stability of exchange rate pass-through to import prices. The answers to such questions have implications for U.S. inflation, as import prices are a principal channel through which movements in the exchange rate affect domestic prices and hence also the variability of inflation and output. These considerations may ultimately have implications for the appropriate stance of monetary policy.[1] In addition, the degree to which import prices adjust to the exchange rate will be a key factor determining the path of U.S. external adjustment. The extent of exchange rate pass-through will influence U.S. demand for real imports and thus contribute to the adjustment (or non-adjustment) of U.S. real net exports. The implications of pass-through for the current account balance, however, are less certain. For example, given a price elasticity of import demand near one, an increase in import prices lowers the quantity of imports but, because their price is higher, leaves total expenditures on imports about unchanged.[2] By similar reasoning, if the price elasticity of import demand is greater than one, a decline in pass-through would tend to inhibit nominal adjustment.[3]

This paper discusses recent work that we have done on issues related to exchange rate pass-through to U.S. import prices. In the context of other papers on this topic, we approach this issue from a macroeconomic perspective, and our work is primarily empirical in nature. We estimate a wide range of econometric specifications relating the exchange rate to U.S. import

[1] See, for example, Cunningham and Haldane (2000).

[2] In this case, the effects of an exchange rate change on the nominal trade balance will come through the exchange rate's effects on exports.

prices and document a pronounced decline in the pass-through coefficient over time. We systematically assess the robustness of this decline and consider a number of possible explanations for the fall. We also study data on foreign export prices as a way of gaining a complementary perspective on the pricing behavior of foreign firms in the U.S. market.

The remainder of this paper is divided into four sections. The first section summarizes the results of our research. The second section briefly outlines an analytical framework that highlights some of the factors that are likely to play a role in determining exchange rate pass-through and that identifies particular relationships that describe pass-through. The third section focuses directly on evidence regarding the pass-through of exchange rates into U.S. import prices. The final section examines data on foreign export prices. The recent literature on this topic is summarized in the appendix.

1.1 Pass-through to U.S. import prices: Key Results

The benchmark empirical model that we have used to estimate pass-through takes U.S. import prices of core goods as the key variable to be explained. (Core goods imports exclude oil, computers, and semiconductors.)[4] The explanatory variables in the model include the exchange rate, foreign CPIs (a proxy for foreign production costs), and an index of primary commodity prices expressed in dollars (another proxy for foreign production costs that also controls for the cost of imported commodities).[5] By the term "pass-through," we mean the direct effect of the exchange rate on U.S. import prices, and we estimate pass-through as the coefficient on the

[3]Obstfeld and Rogoff (2004) consider this case.

[4]We strip out the prices of computer and semiconductor imports because they are hedonically adjusted and, thus, tend to have different properties than other import prices. Oil import prices are excluded because of their marked volatility.

[5]We provide an analytical basis for this framework in the second section of the paper.

exchange rate in the empirical model just outlined. Although this definition does not capture the indirect effects of exchange rate changes, such as those operating through commodity prices, we also consider such channels in the discussion below.

The most striking result of our empirical work is that exchange rate pass-through to U.S. core import prices has registered a sustained decline, from above 0.5 during the 1980s to somewhere in the neighborhood of 0.2 during the last decade. This decline in the pass-through coefficient is robust to the measure of foreign prices that is included in the regression (i.e., CPI versus PPI), whether the estimation is done in levels or differences, and whether U.S. prices are included as an explanatory variable. Notably, we get our largest estimates of pass-through--a bit above 0.3 for the past decade--when we exclude commodity prices from the regression. In this case, the pass-through coefficient captures both the direct effect of the exchange rate on import prices and an indirect effect operating through changes in commodity prices. Our work indicates that in recent years an increasing share of exchange rate pass-through has occurred through this commodity price channel.

While the evidence of a decline in exchange rate pass-through to U.S. import prices seems compelling, the more difficult question is what factors have caused the decline. We have considered a number of possible explanations.[6] One explanation is that the composition of imports has shifted toward goods whose prices are less sensitive to exchange rate movements. Our analysis indicates that pass-through has fallen across a wide range of goods. That said, we

[6]Mann (1986) documented the early evidence of this decline in pass-through and noted that "a trend toward buying worldwide by U.S. and foreign multinationals, newly established distributor networks in the United States, and a greater ability to hedge foreign currency exposure in international credit markets could imply a smaller long-run pass-through of exchange rate changes to import and export prices."

do find evidence that the decreasing share in core imports of non-oil industrial supplies--the prices of which are quite sensitive to the exchange rate (once indirect effects through commodity prices are taken into account)--may explain some of the observed decline in pass-through.

Another explanation, which is not easily dismissed, focuses on China's increasing presence in the U.S. market. Given China's fixed exchange rate regime, Chinese exporters have been insulated from the fall in the dollar, and competition from Chinese firms may very well have constrained exporters from other countries from raising their prices in response to the dollar's decline. We find that across categories of U.S. imports, larger increases in China's market share over the past decade have been associated with more significant declines in pass-through. Moreover, the threat of potential competition from China may have been a more general factor constraining exporters from increasing their dollar prices in response to a rise in their currencies against the dollar.[7] As a related point, we also find recurring evidence of a step down in pass-through around the time of the Asian financial crisis of 1997-98, suggesting that the pricing behavior of Asian firms was affected by the crisis and subsequent developments in the region.

The extent to which import price pass-through has declined in other countries as well is an open issue. Empirical work that we have done for Japan and Germany indicates that import price pass-through in these countries--as in the United States--is now quite low. For Japan, we find that pass-through has declined sharply over the past few decades, but the results for Germany are less clear in this regard. Campa and Goldberg (2004) find that pass-through to import prices declined in the 1990-2003 period relative to the 1975-1989 period for fifteen of the

twenty-one countries that they study; however, these declines are not statistically significant in many cases.

The evidence of a cross-country decline in pass-through to consumer prices is somewhat stronger, however. For example, Gagnon and Ihrig (2004) provide regression-based evidence of declines in pass-through to consumer prices for a large cross section of industrial countries over the past couple of decades. Goldfajn and Werlang (2000) present evidence suggesting that pass-through to consumer prices may have fallen in the emerging market countries as well. Taylor (2000) postulates that this cross-country decline in pass-through to consumer prices is attributable to the prevailing environment of low inflation, which has served to reduce the "perceived persistence" of cost shocks.

1.2 Evidence from foreign export prices

To gain an alternative perspective on the decline in pass-through to U.S. import prices, we have studied the behavior of export prices for a number of major foreign economies. A key issue to bear in mind is that low pass-through to import prices (denominated in the importer's currency) implies that export prices (denominated in the exporter's currency) are very sensitive to the exchange rate. Thus, given the observed decline in U.S. pass-through, we would expect to find evidence that foreign export prices are sensitive to the exchange rate and that this sensitivity has increased over time.

Our basic conclusions from this work are three-fold. First, our regressions indicate that exporters in Japan, Canada, Europe (in aggregate), and the Asian NIEs (Hong Kong, Korea,

[7]It is very much an open issue, however, why exporters from other countries did not cut their dollar prices more aggressively during the period when the dollar was appreciating.

Singapore, and Taiwan) do in fact vary their multilateral export prices, i.e., the prices charged in all markets, in response to exchange rate changes. A related result is that the prices charged for exports to the U.S. market (denominated in the exporting-country's currency) appear to be much more sensitive to the exchange rate than is the case for export prices charged to other markets.

Second, we find that the exchange rate sensitivity of multilateral export prices (in terms of the exporter's local currency) has been relatively stable on balance over the past couple of decades for Japan, Germany, and the United Kingdom, but it appears to have moved up sharply in recent years for the Asian NIEs.[8] This result is strongly consistent with the view that the Asian financial crisis and its aftermath significantly affected the pricing behavior of the region's exporting firms. Canadian export prices have also become more sensitive to the exchange rate in recent years.

Third, for exports to the United States, profit margins--denominated in the exporter's local currency--appear to have narrowed since the dollar peaked in early 2002. In other words, the low level of pass-through in the U.S. market does seem to be taking a toll on profit margins. This result comes with an important caveat, however. It remains an open issue as to whether profits margins on exports to the United States are now "too narrow" or if margins were unusually high several years ago.

2. An Analytical Framework

This section briefly outlines an analytical framework that provides intuition regarding the key economic factors that determine the extent of exchange rate pass-through. We consider a foreign firm that produces a single differentiated product for sale in ***n*** segmented markets. The

firm and all of its production are located in market ***1***. Sales in markets ***2*** through ***n*** are exports. The firm's profits are given by:[9]

$$(1) \qquad \sum_{i=1}^{n} p_i \, q_i \; - C\left[\sum_{i=1}^{n} q_i, pd_1, pm_1 \right]$$

where p_i is the price (in the firm's local currency) charged for sales to market i; q_i is the quantity sold in market i; and $C[\ ]$ is total cost as a function of total output (Σq_i), the price of domestic inputs (pd_1), and the price of imported inputs in terms of the firm's local currency (pm_1).[10]

Demand in each market (equation (2)) is a function of the price of the good relative to the average price of competing goods in the buyer's market. The exchange rate, e_i, is defined as the number of units of country i currency for each unit of country 1 currency. The competitors' price in terms of country i currency is pc_i. In principle, the competitors' price includes the prices of domestic producers in the destination market as well as the prices of third-country exporters to that market. This demand curve reflects not only consumer behavior in the destination market, but also market features such as the degree of concentration and the exporter's market share. Consumer demand, in turn, may depend on the state of the business cycle or other conditions in the destination market.

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[8]Sufficient data are not available to conduct this test for China.

[9]This model is used in Gagnon and Knetter (1995) and derived more formally in Knetter (1995).

[10]An appreciation of the exporter's currency may reduce the price of imported intermediates and, thus, reduce the costs borne by the exporting firm. Gron and Swenson (2000) show that this is one reason why pass-through may be less than one.

$$(2) \qquad q_i = Q_i\left[\frac{e_i\, p_i}{pc_i},\ other\ factors\ in\ country\ i\right] \quad i=1,....,n \qquad \frac{\partial q_i}{\partial\left[\frac{e_i p_i}{pc_i}\right]} < 0$$

Maximization of (1) subject to (2) and taking a first-order logarithmic approximation yields the following relationship for the price charged by the exporting firm (expressed in the firm's local currency):

$$(3) \qquad \ln(p_i) = \mu_i + \beta_i \ln(MC) + (1-\beta_i)\ln\left(\frac{pc_i}{e_i}\right), \quad s.t.\ p_i \geq MC$$

where μ_i and β_i are destination-specific coefficients that are functions of the demand curve in each market, and ***MC*** is marginal cost expressed in the exporter's local currency. Differences in μ_i (for $i=1,...,n$) reflect differences in markups across markets that are not related to prices and costs, whereas differences in β_i determine the responsiveness of markups to changes in marginal cost and competitors' prices in each market. A key feature of equation (3) is the restriction that the coefficients on marginal cost and competitors' prices sum to one. This "homogeneity" restriction is necessary for long-run monetary neutrality, an important feature of most modern macroeconomic models.

For most plausible demand curves, β is expected to lie between 0 and 1. As such, the constant markup model is a special case of equation (3) in which β=1 and μ is the markup over marginal cost.[11] For β<1, the markup of price over marginal cost depends on both μ and β. In

[11]The familiar constant markup model is derived by setting β=1 and using the approximation $\ln(1+\mu)=\mu$, yielding $p = (1+\mu)MC$. When marginal cost equals average cost, then μ is the profit margin.

this case, producers find it optimal to adjust their markups in response to competitors' prices, and they do not fully pass-through changes in marginal cost because of the competitive disadvantage that implies. In general, as β declines, competitive conditions in the import market become more intense; as a result, exporting firms have reduced scope for passing through shifts in their marginal costs and are increasingly faced with the choice of matching their competitors' price or exiting the market.

Note that the price of imports in terms of country ***i***'s currency is just the export price in terms of country ***I***'s currency multiplied by the exchange rate. Thus, equation (3) can be translated into an equation for country ***i***'s import prices by adding the logarithm of the exchange rate to both sides:

(4) $$\ln(e_i\ p_i) = \mu_i + \beta_i \ln(e_i\ MC) + (1-\beta_i) 1n(pc_i)$$

where all three variables (the price of the good, the firm's marginal cost, and the competitor's price) are now expressed in terms of the currency of country ***i***.

Differentiating equations (3) and (4) yields the following expressions for the direct effect of the exchange rate on export prices (equation (3')) and import prices (equation (4')):

(3') $$\%\Delta p_i = (\beta_i\text{-}1)\ (\%\Delta e_i)$$

(4') $$\%\Delta(e_i\ p_i) = \beta_i\ (\%\Delta e_i)$$

The exchange rate's direct effect on the price of exports (denominated in the exporter's local currency) is β_i -1, whereas the direct effect of the same exchange rate move on the price of imports (in term of the importing-country's currency) is β_i. Given the definition of exchange

rate pass-through outlined above, we would thus equate β_i in this framework with pass-through to import prices and β_i -1 with pass-through to export prices. With this observation in hand, we can sketch out the implications of various values of β_i for pricing behavior. These observations will ease interpretation of our results later in the paper:

- If β_i=1, pass-through to import prices is complete. Correspondingly, exporters do not adjust the price in their local currency in response to an exchange rate move.
- If β_i=0, the import price (in the importing country's currency) is unaffected by the exchange rate move, and the exporters' local-currency price moves one-for-one with the exchange rate.
- As an intermediate case, if β_i=0.2, a one percent depreciation of the importing country's currency would raise import prices 0.2 percent and reduce the local-currency price of exports 0.8 percent.

Finally, note that equations (3) and (4) describe *bilateral* trade prices between country ***1*** and country ***i***. It is a relatively straight-forward exercise, however, to aggregate these equations across trading partners to find expressions for the multilateral export price of country ***1*** and the multilateral import price of country ***i***. Indeed, aggregate versions of these equations are the basis for much of the empirical work that is reported in the next two sections of this paper.

3. Pass-through to U.S. Import Prices

This section presents our empirical work examining pass-through to U.S. import prices. The benchmark specification used in this work is an empirical counterpart of equation (4):

(5) $$\Delta \ln(PM_t) = \mu + \beta\, \Delta \ln(PF_t * E_t) + \gamma\, \Delta \ln(PCOM_t) + \text{lags} + v_t$$

On the left-hand side of this equation are quarterly observations on the log change in NIPA import prices of core goods, denoted PM. (As noted above, core goods exclude oil, computers, and semiconductors.) The first of the explanatory variables, PF*E, is the foreign price level expressed in terms of dollars.[12] In our benchmark specification, we use foreign headline CPIs as the measure of foreign prices, and the exchange rate variable is an index of the dollar's nominal value against the currencies of 35 countries weighted by rolling shares of non-oil U.S. imports.[13] The foreign CPIs are aggregated in a similar manner.[14] The second explanatory variable, PCOM, controls for primary commodity prices and is also expressed in dollars.[15] The specification includes lags as needed.[16]

Interpreted in light of equation (4), both PF*E and PCOM control for shifts in the production costs borne by foreign firms, and, as such, can be viewed as empirical counterparts to

[12]The econometric model that we estimate is slightly less restrictive than equation (5). We impose a constraint that the sum of the coefficients on the exchange rate is equal to the sum of the coefficients on foreign prices--we do not constrain the two sets of coefficients to be equal on a period-by-period basis. (For the results presented below, this constraint typically is not rejected by the data.)

[13]We use non-oil import weights because they can be calculated back to the early 1970s; core import weights can be calculated beginning only in the late 1980s.

[14]As discussed below, our benchmark model uses CPIs rather than PPIs because the CPI data are available for more countries and in longer time series.

[15]Our baseline specification includes two measures of commodity prices. The first variable aggregates the IMF's commodity price indexes for food, beverages, agricultural raw materials, and metals, weighting by rolling U.S. import shares of each commodity. The second variable is an index of natural gas prices. (Our specifications generally include the contemporaneous value of the commodity price index plus three lags and the contemporaneous value of the natural gas price plus one lag.)

[16]The various specifications generally include two lags of the exchange rate and foreign prices. Similar to Campa and Goldberg (2002 and 2004), we find that pass-through tends to occur rapidly and in our regressions is fully captured by two lags. (The issue of lag structure is taken up in more detail in section 3.5.)

MC. PCOM also accounts for the direct effect of commodity prices on import prices. We have excluded competitors' prices from our benchmark model, but these will be added below.

The pass-through coefficient--denoted β--is the direct effect of exchange-rate adjusted foreign prices on import prices (including lagged effects). Of course, changes in the exchange rate also influence import prices indirectly through their effect on commodity prices, and we consider such channels in the discussion below as well. Where possible, we employ rolling regressions to trace the evolution of the estimated pass-through coefficient over time.

3.1 Benchmark results and robustness checks

The upper panel of Exhibit 1 reports estimated exchange-rate pass-through to import prices of U.S. core goods, as a ten-year backward-looking sample is rolled forward.[17] For example, pass-through of roughly 0.65 in 1990 represents the estimate of β in a regression over the period 1981 to 1990. It implies that a 10 percent increase in the dollar value of foreign prices would lead to a 6.5 percent increase in U.S. import prices of core goods. The gray shading indicates the 95 percent confidence interval around the estimated pass-through coefficient.

The pass-through coefficient obtained in the most recent ten-year period is estimated to be 0.12. The lower standard error band crosses zero in early 2003, indicating that the pass-through estimates for the latest ten-year samples have not been statistically different from zero. The lower panel shows that since 1990, the effect of primary commodity prices on import prices has climbed steadily and has remained statistically significant. Notably, this simple model is able to explain much of the variance in import prices, with the R^2 for these rolling regressions hovering around 0.8.

The decline in import price pass-through seems robust to a variety of specifications. For instance, the fall in pass-through depicted in Exhibit 1 is not specific to only imports of core goods. The upper panel of Exhibit 2 reports ten-year rolling regression estimates of pass-through to increasingly inclusive (broader) measures of aggregate U.S. import prices: a) non-oil goods, b) all goods, and c) all goods and services.[18] The pass-through estimates for these aggregate measures of U.S. import prices all manifest a common downward trend for samples ending over the past decade.[19]

To further gauge the robustness of the decline in pass-through, the thin blue line in the lower panel of Exhibit 2 depicts rolling pass-through estimates that are obtained when primary commodity prices (PCOM) are excluded from the regression. The pass-through coefficient now incorporates the indirect effects of exchange rate moves working through commodity prices. The downward trend in pass-through since the early 1980s remains. That said, relative to the estimates in Exhibit 1, the pass-through coefficient starts higher--at 0.8 or above for ten-year samples ending in 1983-85--and then falls in the most recent ten-year period to a little over 0.3, still somewhat above the estimate in Exhibit 1. Notably, the pass-through coefficient steps down markedly as 1997 and 1998, the years coincident with the Asian financial crisis, roll into the sample window. Other evidence presented in this paper is consistent with the view that the

[17]The first ten-year sample begins in 1972:Q4, and the last ten-year sample ends in 2004:Q4.

[18]The regressions for all goods and for all goods and services include the price of oil as an additional explanatory variable (as the dependent variable in these cases encompasses oil imports).

Asian crisis had important effects on pass-through to U.S. import prices. In contrast to our benchmark results (Exhibit 1), the pass-through coefficients obtained when commodity prices are excluded from the regression have moved down only slightly in the ten-year samples ending over the past four or five years. The fact that pass-through estimated without controlling for commodity prices has been somewhat more stable of late is another recurrent feature of our empirical work and suggests that an increasing share of the exchange rate's effect on import prices has recently occurred through a commodity price channel.[20]

We estimate that a 1 percent depreciation of the dollar has on average over the past several decades led to a 0.8 percent rise in dollar-denominated commodity prices. With this in mind, the thick green line in the lower panel of Exhibit 2 displays the sum of the pass-through estimate from Exhibit 1 plus 0.8 times the commodity price effect from Exhibit 1. A change in the exchange rate may affect import prices directly (β) or indirectly through shifts in commodity prices. Note that in the bottom panel of Exhibit 2, the thin blue line and the thick green line generally move together. The fact that since late 2001 the thick green line has fallen below the

[19]Since the early 1980s, NIPA trade prices have been constructed mainly from import prices published by the BLS. Before then, these prices were based on Census unit value indexes. To rule out the possibility that this change in methodology has contributed to the observed decline in pass through, we ran a regression using the BLS measure of non-oil goods import prices as our dependent variable. The results are depicted by the dashed blue line in the upper panel of Exhibit 2. Note that the dashed blue line closely tracks the solid black line (the results for its NIPA counterpart), thus confirming that this change in methodology does not explain the decline in pass-through.

[20]We have also estimated a specification in which commodity prices are included in the regression but denominated in units of foreign currency rather than in dollars. In this case, the pass-through coefficient trends down as in other specifications, falling to 0.25 in the latest ten-year samples.

thin blue line suggests that commodity prices may have become more sensitive to the exchange rate of late.[21]

As noted above, our rolling regressions are done with a ten-year estimation window. Exhibit 3 shows that the decline in pass-through can also be seen when other estimation windows are used. As displayed in the upper panel, when we take 15-year samples, the pass-through coefficient steadily declines from above 0.6 in the early 1990s to just below 0.3 in the most recent 15-year periods. With a five-year regression window, the pass-through coefficient moves above 0.8 in 1987 and 1988, then declines to about 0.4 in the mid-1990s, steps down further to about 0.2 in the late 1990s and early this decade, and finally ebbs to zero during the most recent five-year samples. We conclude that the decline in pass-through is not an artifact of our choice of estimation windows.

Foreign PPIs--as opposed to foreign CPIs--may be a more appropriate proxy for the production costs of firms exporting to the United States (i.e., for MC in equation (4) above). The upper panel of Exhibit 4 thus reports estimates identical to those in Exhibit 1 except that foreign CPIs are replaced with foreign PPIs. The PPI data, however, are not available for as many countries or in as long a time series as is the case with the CPI data. As a result, the rolling regression results do not go back as far as in the previous exhibits, and the foreign price and exchange rate variables include just fifteen countries (weighted by shares of U.S. non-oil

[21]We examined this hypothesis directly using our rolling regression framework. We found that our index of commodity prices has, in fact, become more sensitive to the exchange rate in recent years, although the estimated coefficients are somewhat volatile. (Part of this increased sensitivity appears to be due to a secular decline in the import share of beverages--a category whose price shows little sensitivity to the exchange rate.)

imports), rather than the broader set of 35 countries that are available when CPIs are used. Nevertheless, the downward trend in pass-through remains.

When pass-through is studied in the context of optimal pricing behavior, as in equation (4), an important variable is the price of competing goods. Thus, the lower panel of Exhibit 4 adds the contemporaneous headline U.S. PPI to the rolling regressions as a proxy for the price of such goods.[22] Including a measure of U.S. costs may also be justified by the fact that many U.S. imports are produced abroad using intermediate inputs that were originally produced in the United States. The exhibit reveals that the U.S. PPI was not statistically significant for many years. However, this coefficient has moved up in the most recent ten-year samples and has now approached statistical significance.[23] The estimate of pass-through in this case continues to show a trend decline since the early 1990s.

It is possible that exchange rate changes have largely served to shift the geographical composition of U.S. imports away from high-wage countries toward low-wage countries. These low-wage countries--given their cost advantages--may have been able to continue to provide goods to the U.S. market at or near the price that prevailed before the exchange rate change. To the extent that this has been the case, exchange rate changes would have had muted effects on the price of U.S. imports but, instead, would have shifted the weights in the exchange rate and foreign price indexes toward low-wage countries. In an effort to assess this hypothesis, we have fixed the country weights in our exchange rate and foreign price variables first at their 1982 values and then at their 2003 values, thus attenuating this channel.

[22]Equation (4) would require the estimate of pass-through and the coefficient on the U.S. PPI to sum to one. However, we have tested this restriction, and it is rejected in most samples.

The results of this exercise, shown in the upper panel of Exhibit 5, are almost identical to those in Exhibit 1. This provides little evidence for the view that a shift in the country composition of U.S. imports--such as that described in the previous paragraph--is a key element in explaining the decline in pass-through.[24] (We return to the issue of the geographical composition of U.S. imports below.) In addition, these results suggest that the decline in pass-through is broadly robust to the choice of weights used to aggregate the exchange rates and foreign CPIs.

Finally, the lower panel of Exhibit 5 replicates the results of Exhibit 1 with the variables specified in levels rather than as log changes.[25] Pass-through estimated in this way exhibits the same downward trend as in our benchmark results shown in Exhibit 1. Moreover, in the last ten-year period, pass-through is estimated to be a bit lower than when the variables are expressed in differences.

3.2 Pass-through by type of good

A potential explanation for the fall in pass-through to core import prices is a shift in the composition of imports toward goods whose prices are less sensitive to the exchange rate.[26] Employing the same methodology as in the benchmark equation, we explore this issue in more detail by estimating pass-through coefficients for dis-aggregated categories of imports. The

[23]The U.S. PPI could itself be influenced by movements of the exchange rate. To the extent that this prevailed, resulting collinearity would make it difficult to estimate these coefficients with precision.

[24]This conclusion does not rule out the possibility that exchange rate moves and resulting shifts in the geographical composition of U.S. imports have had important implications for wages and profits in various foreign economies.

[25]This specification is estimated using an AR(1) process on the residuals.

[26]See, for example, Campa and Goldberg (2002 and 2004).

exchange rate and foreign CPI variables used in this examination are industry specific--that is, they take as weights each trading partner's bilateral share of U.S. imports in each category.

Our work focuses on pass-through to core import prices (on a NIPA basis) dis-aggregated according to one-digit end-use codes. Exhibit 6 displays the pass-through estimates for these categories when commodity prices are included in the regression (our benchmark model), and Exhibit 7 shows the results when commodity prices are excluded.

With commodity prices in the regression (Exhibit 6), the pass-through estimates for imported consumer goods, capital goods, and automotive products all post steep declines. Estimates of pass-through for imported foods and beverages and non-oil industrial supplies have been volatile, but both have moved down since the late 1980s.[27]

When we exclude commodity prices (Exhibit 7), pass-through for consumer goods, capital goods, and automotive products still declines markedly. For non-oil industrial supplies, however, the estimated pass-through coefficients are much higher than those shown in Exhibit 6 and--if anything--appear to have stepped up in recent years. This result suggests that the exchange rate's effect on the import prices of industrial supplies comes principally through its indirect effect on commodity prices. This is consistent with the commodity-intensive nature of these imports. The results for foods and beverages also show little evidence of a decline through the past decade or so.

[27]The commodity price variables included in the regressions for foods and beverages and non-oil industrial supplies are tailored to reflect the commodity-intensive nature of these goods. Specifically, the regression for the price of imported foods and beverages includes only the IMF indexes for foods and beverages, while the regressions for the price of non-oil industrial supplies includes the IMF indexes for metals and agricultural raw materials as well as an index of natural gas prices.

Exhibit 8 explores the implications of these results for aggregate pass-through. In the upper panel, the solid black line is the pass-through estimate for core import prices shown in Exhibit 1, and the dotted green line is a weighted average of the one-digit sectoral pass-through estimates from Exhibit 6. (The weights used reflect each category's rolling share of nominal imports over the preceding ten years.) As we would anticipate, the weighted-average of our sectoral pass-through estimates is close to the estimate of aggregate pass-through.

The dashed red line in the upper panel of Exhibit 8 is derived by weighting up the one-digit sectoral pass-through estimates from Exhibit 6 using average trade shares from 1972 to 1982. If the fall in aggregate pass-through largely reflected a shift in the composition of imports toward goods with prices that were less sensitive to the exchange rate, the dashed red line would remain relatively stable and above the solid black and dotted green lines. However, the dashed red line closely tracks the dotted green line--and both lines follow the solid black line.[28]

The lower panel repeats this exercise using the results obtained when commodity prices are excluded from the regression. The solid blue line is the estimate of aggregate pass-through shown in the lower panel of Exhibit 2 (the benchmark model with commodity prices excluded). The dotted green line is a weighted average of the one-digit pass-through estimates from Exhibit 7. Finally, the dashed red line weights up the results of Exhibit 7 using average trade shares from 1972 to 1982. In this instance, the dashed red line falls on balance but has been noticeably above the solid blue line in the most recent ten-year samples. Given the relatively high pass-through estimates for industrial supplies shown in Exhibit 7, the decline in the share of these goods in U.S. core imports--from 33 percent during the 1970s to under 20 percent at present--

appears to be one factor that has contributed to the decline in aggregate pass-through. Nevertheless, as the dashed red line has clearly moved down, this shift in the composition of core imports is only a partial explanation for the observed fall in aggregate pass-through.

3.3 Pass-through by country of origin

Another possible explanation for the decline in pass-through to U.S. import prices is a shift in the geographical orientation of imports toward countries that manifest lower exchange rate pass-through.[29] With this issue in mind, we use data on bilateral U.S. import prices published by the BLS to estimate country- or region-specific pass-through coefficients for the past decade. These coefficients capture, for each country or region, the sensitivity of the prices charged in the U.S. market to movements in the nominal value of their currency against the dollar. These data are available since the early 1990s for the European Union, Japan, Canada, and the Asian NIEs (which include Hong Kong, Korea, Singapore, and Taiwan).[30,31] Given the relatively short time series, however, we cannot do rolling regressions as we have done above. We also note that these data are import prices for all goods; bilateral import prices for just core goods are not available.

Our results, shown in the upper panel of Exhibit 9, indicate that for a sample beginning in the early 1990s exchange rate pass-through from all four sets of trading partners has been quite

[28]We have replicated these results using SITC data and have obtained broadly similar results.

[29]Exporters from one country may evidence lower pass-through than exporters from another country as a result of differences in the composition of the goods that they export. We also conjecture that differences in exchange rate regimes, financing arrangements (including the scope for hedging currency risk), and general supply and demand conditions in the home market might play a role.

[30]These four sets of trading partners account for about 60 percent of U.S. non-oil imports.

[31]Bilateral import price data begin for Latin America in December 1997 and for a number of other countries (including China) in December 2003.

low. For the European Union, Japan, and the Asian NIEs, the estimated pass-through coefficients are a touch above 0.2. The general features of the results for these three economies do not depend on whether commodity prices are included or excluded from the regressions. In contrast, the pass-through estimate for Canada swings from zero when commodity prices are included in the regression to over 0.3 when commodity prices are excluded, apparently reflecting the importance of commodities in Canadian exports. Note that all of these estimates are well below the values of 0.5 or higher that are obtained with aggregate data for the preceding decades. Thus, a shift in the geographical orientation of trade could--at best--be only a partial explanation for the decline in pass-through. Instead, this evidence points to a widespread decline in pass-through across trading partners.

3.4 Has China contributed to the decline in pass-through?

Over the past decade, China's share of U.S. merchandise imports has risen 7.6 percentage points, from 5.8 percent in 1994 to 13.4 percent in 2004. China has posted large gains in steel and other finished metal products; high-tech, telecom, and business machines; and consumer durables. If U.S. imports from China showed zero pass-through, and imports from countries losing import share showed complete pass-through, the direct arithmetic effect of China's increased presence in the U.S. market would lower the aggregate pass-through coefficient just 0.076, only a fraction of the observed decline. And this calculation almost certainly overstates the direct arithmetic effect. In those product categories in which China has gained the most ground, import shares for Japan and the emerging Asian economies have typically experienced the largest losses. As was shown in the previous section, pass-through from these economies is much closer to zero than to unity.

This discussion suggests that if China's increased presence in the U.S. market is to be a key explanation for the decline in pass-through, the main influences must have come through China's effects on the competitive conditions within U.S. markets. At present, China's import share exceeds 50 percent in six five-digit (end-use) categories and 25 percent in another fifteen categories. Together, these twenty-one categories represent 22 percent of total U.S. merchandise imports. Certainly in these categories, competitors from other countries have had good reason to be hesitant to pass through cost shocks from the recent appreciation of their currencies, given that China's peg to the dollar insulates its exporters from such shocks. An open issue is why exporters from other countries did not cut their dollar prices more aggressively as the dollar strengthened from 1995 to 2002. Instead, as will be shown below, these exporters apparently chose to pad their profit margins (in terms of their local currencies) during that period.

The lower panel of Exhibit 9 provides some empirical evidence linking China to the decline in pass-through. For the 1985-1994 and 1995-2004 periods, we estimated separate pass-through coefficients for 34 five-digit import categories and--where five-digit price data were not available--another 22 two- and three-digit categories. (It was not clear how to appropriately specify the commodity price variables for each of the disaggregated sectors, so these regressions did not include commodity prices.) Together, these 56 categories account for more than 80 percent of U.S. non-oil imports. We have found a statistically significant correlation between the rise in China's U.S. import shares over the past decade and the decline in pass-through across these product categories. In other words, pass-through has tended to post relatively steep declines in those categories in which China has expanded its market share most rapidly. For example, in categories where China's import share has risen more than 10 percentage points

since 1994, the median decline in the pass-through coefficient was 0.341 versus a median decline of 0.157 in other categories. The difference in mean declines is even more striking--0.362 in those categories in which China's share grew at least 10 percentage points versus a mean change of zero in other categories. We replicated this exercise for Mexico, another emerging market economy that gained U.S. import share over the past decade, but did not find a significant relationship.

Our work examining the robustness of this correlation between the gains in China's share and the decline in pass-through indicates that most of this association comes as a result of the differential pass-though performance of finished goods imports compared with material-intensive goods imports (see Exhibit 7). China's import share posted a median increase over the last decade of 7.2 percentage points in the former categories but of only 3.5 percentage points in the latter categories.[32] This suggests that the relatively rapid increase in China's presence in the finished goods categories may have been one factor contributing to the greater decline in pass-through observed in those categories.

China's effects on pricing behavior likely extend well beyond product categories in which Chinese firms have already gained large market share. Chinese producers have shown a remarkable propensity to win market share, with their exports posting large gains in both simple, commodity-like products and in more sophisticated products. Thus, even in those categories in which China does not already account for a significant fraction of U.S. imports, the threat of

[32]The difference in means is even wider: China recorded an average gain in import share over the past decade of 13.3 percentage points in the finished goods categories versus 4.3 percentage points in the material-intensive goods categories.

potential competition from China may very well have been a factor constraining exporters from other countries from passing through exchange rate shocks.

3.5 Exchange rate hedging: Is there evidence of longer lags?

If exchange rate hedging has become more prevalent in recent years, we might very well find evidence of longer lags from changes in exchange rates to changes in import prices. For this reason--as well as to shed further light on the features of our econometric specification--Exhibit 10 focuses on the lag structure of the benchmark pass-through estimates presented in Exhibit 1.

As displayed in the upper panel, when the specification includes the contemporaneous change in the exchange rate and two quarterly lags, we obtain a sustained secular decline in all three coefficients. The contemporaneous coefficient falls from above 0.3 to around 0.1; the first lag falls from above 0.2 to just above zero; and the second lag, although volatile initially, falls from just under 0.2 to near zero (for ten-year samples ending in 1998 and thereafter).

The lower panel shows results for an alternative specification that includes the contemporaneous exchange rate and four lags. Notably, the results for the contemporaneous change and the first two lags are quite similar to those in the upper panel. The estimates for the third and fourth lag are initially negative and thereafter hover near zero.

Taken together, these results strongly suggest that exchange rate pass-through occurs quite rapidly; in recent years, pass-through appears to have been complete with only a quarter lag. We find no evidence to support the hypothesis that hedging activities have lengthened the lags between exchange rates changes and moves in import prices.

3.6 Non-linearities and threshold effects

We have also considered the possibility that the relationship between the exchange rate and U.S. import prices is non-linear. That is, pass-through is higher for large exchange rate changes than for small ones. The basic intuition is that firms exporting to the United States have a desired price denominated in their domestic currencies. In response to small exchange rate moves, firms are willing to hold their dollar price to maintain U.S. market share or, perhaps, to avoid incurring costs associated with re-pricing their menu of products or adjusting the quantity of their production. Under this hypothesis, however, firms do shift their dollar-denominated prices in response to large exchange rate moves as they do not want the price in terms of their domestic currencies to stray too far from the optimum.

Using a range of econometric models, we find little evidence of such non-linearities in the U.S. import price data. More specifically, dummy variables for various threshold effects of exchange rate movements do not suggest that pass-through is higher for large moves in the dollar than for more moderate moves. In addition, including quadratic and cubic exchange rate terms yields results for the United States that are difficult to interpret and sometimes implausible.[33] These conclusions are broadly consistent with what other researchers have found for the United States (see the Appendix). We also find no compelling evidence that the response of import prices to the exchange rate is asymmetric--that is, that the magnitude of pass-through differs depending on whether the dollar has appreciated or depreciated.

[33]That said, working with import price data for the G-7 countries, Bussiere (2004) finds that a quadratic exchange rate term is statistically significant for Germany and that a cubic term is statistically significant for Canada, Germany, and Italy.

3.7 Transfer prices

With over one-third of U.S. merchandise trade consisting of transactions within firms, an important issue is the extent to which transfer prices may be part of the explanation for the observed decline in pass-through. What is certain is that the way transfer prices are utilized in the construction of import price data changed in 1998. Before that time, only transfer prices that were deemed to be sufficiently "market based" were included in the indexes. Since 1998, all transfer prices have been included.

By law, transfer prices are required to meet an arm's-length standard, i.e., they should be the prices that would have prevailed if the transaction had occurred between two unrelated parties. Relatively rigorous enforcement of transfer pricing laws by customs and tax authorities appears to be improving the quality of transfer prices. However, there continues to be a range of views as to how well these inherently counter-factual prices reflect underlying economic reality.[34] As an empirical matter, we note that the decline in pass-through is evident in the data both before 1998 and afterwards. As such, we see no clear link between the decline in pass-through and the shift in the way that transfer pries are used in constructing the trade data.

3.8 Import price pass-through in Japan and Germany

This section briefly presents the results obtained when we use our benchmark model to estimate import price pass-through for Japan and Germany. Specifically, the dependent variable in these regressions is the price of non-oil imports. The explanatory variables are import-weighted indexes of foreign CPIs and nominal exchange rates against the currencies of 35

[34]See Clausing (2001) and Diewert, Alterman, and Eden (2004).

countries. As in the benchmark specification, we also control for movements in commodity prices (denominated in each country's local currency).

Japanese exchange-rate pass-through to non-oil import prices is shown in the upper panel of Exhibit 11. The results from our benchmark model (the thick black line) show that Japanese pass-through has fallen dramatically, from around unity in the 1980s to about 0.2 in recent years.[35] A large share of this decline came during the second half of the 1990s, when pass-through plunged from above 0.7 to its current value of 0.2, again appearing to show the imprint of the Asian financial crisis. Notably, with commodity prices excluded from the regression (the thin red line), the estimate of pass-through posts a significant drop but--as for the United States--remains above the estimates obtained when commodity prices are included.

Exchange-rate pass-through to German non-oil import prices is shown in the lower panel.[36] The pass-through estimates obtained from our benchmark model (the thick black line) appears to have cycled around 0.3 through much of the 1980s and 1990s, but has declined in recent years to 0.1. Excluding commodity prices (the thin red line), the pass-through coefficient has remained surprisingly stable at about 0.4. These pass-through estimates for Germany are somewhat lower than those obtained by other researchers, e.g., Bussiere (2004) and Campa and Goldberg (2004). This difference reflects the fact that we are working with non-oil import prices, while they worked with import prices of all goods. In addition, both Campa and Goldberg and Bussiere use IMF effective exchange rate indexes, which include only the currencies of

[35]Campa and Goldberg (2002) also detect a significant decline in exchange rate pass-through to Japanese import prices.

[36]In estimating pass-through for Germany, we found evidence of longer lags from exchange rates changes to import prices than is the case for the United States or Japan. Accordingly, these regressions include four lags of the exchange rate and foreign prices.

industrial countries, while our exchange rate index is much broader in its country coverage. (Our work indicates that the IMF index does yield higher pass-through estimates for Germany.)

We make the following three additional comments about these results. First, the estimates of import price pass-through for the most recent ten-year samples are strikingly similar for the United States, Japan, and Germany. In all three cases, exchange rate pass-through is estimated to be around 0.1 to 0.2 when commodity prices are included in the regression and somewhat higher and more stable when commodity prices are excluded. Second, the difference between the pass-through estimates obtained in a specification with commodity prices and one without commodity prices has tended to widen in recent years, suggesting that the effects of the exchange rate on commodity prices are an increasingly important channel for pass-through. Third, while pass-through coefficients have posted significant declines for the United States and Japan, the evidence for Germany in this regard is somewhat less compelling.

4. Exchange Rate Sensitivity of Foreign Export Prices

To shed further light on the decline in U.S. import price pass-through, we now turn to an examination of foreign export prices. We begin with the following remark. In interpreting the results that are presented below, it is helpful to keep in mind the discussion of equations (3') and (4') of our analytical framework. In particular, low import price pass-through (measured in the importer's currency) implies that export prices (denominated in the exporter's currency) are very sensitive to the exchange rate. Thus, given the observed decline in U.S. import price pass-through, we would expect to find evidence that foreign export prices are sensitive to the exchange rate and that this sensitivity has tended to increase over time.

4.1 Empirical framework

The baseline model that we use to examine the responsiveness of foreign export prices to changes in the exchange rate is an empirical analog of equation (3) above. We take foreign export prices (denominated in the exporter's currency), PX, as the dependent variable. The first explanatory variable is the exporting country's nominal effective exchange rate (a trade-weighted average against the currencies of 35 countries, with a rise indicating a depreciation of the exporter's currency).[37] The second explanatory variable is the PPI of the exporting-country, denoted PF, which serves as a proxy for the costs borne by exporting firms. The model is thus as follows:

$$\Delta \ln(PX_t) = \mu + \delta\, \Delta \ln(E_t) + \beta\, \Delta \ln(PF_t) + \text{lags} + u_t \qquad (6)$$

where δ is the exchange rate sensitivity of foreign export prices (denominated in the exporter's currency), and β captures the sensitivity of foreign export prices to shifts in the exporting country's domestic price level. Both of these coefficients are expected to be positive.

Note that equation (3) of our analytical framework implies that δ equals $(1-\beta)$.[38] This, in turn, suggests that δ and β should sum to unity--a relationship that arises as a result of the homogeneity restriction that is imposed on equation (3). We will explicitly test this implication of the homogeneity restriction in our empirical work below.

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[37]The number of countries included in the exchange rate calculation is reduced to the extent that the number of countries in a regional aggregate exceeds one. For example, the regional aggregate for the Asian NIEs includes four countries, so the exchange rate in this case is a trade-weighted average against the currencies of 32 other countries.

[38]In equation (3), the coefficient on the exchange rate is $-(1-\beta)$. In equation (6), however, the definition of the exchange rate has been inverted so that an increase in the index is a depreciation of the exporter's currency, and this yields the relationship between δ and β indicated in the text. (This definition of the exchange rate is consistent with the definition used in the previous section and allows our estimated exchange rate coefficients to have positive sign.)

We should make several other comments regarding equation (6). First, a feature of our analytical framework above is that the parameter β_i governs the extent of exchange rate pass-through into country ***i***'s import prices (shown in equation (4)) as well as the extent to which shifts in marginal cost are reflected in country ***I***'s export prices (shown in equation (3)). In other words, the pass-through of exchange rate changes into import prices (expressed in the importing country's currency) is posited to be equivalent to the pass-through of cost shocks into export prices (expressed in the exporting country's currency). To the extent that this is the case empirically, the estimated coefficient on PF, our proxy for marginal cost, will provide an alternative metric for assessing exchange rate pass-through into import prices. Second, relative to equation (3) above, the specification in equation (6) does not include competitors' prices in export markets; we have attempted to control for these prices in a variety of regressions, and the estimated coefficients are almost uniformly insignificant. Third, similar to our results for U.S. import prices, we find that pass-through to foreign export prices tends to occur quite rapidly, with the effects of the exchange rate fully captured by its contemporaneous value and one lag. (We include two lags in our regressions for the Asian NIEs.) Finally, in contrast to the empirical work in the previous section, we are able to estimate equation (6) using PPIs as the proxy for foreign costs without significantly narrowing the sample period or the set of countries that we study.[39] One important implication is that--as PPIs account for commodity prices to a much greater extent than do CPIs--we do not include commodity price indexes as separate variables in these regressions.

4.2 Export price data and the profit margins of foreign exporters

In estimating this model, we use two complementary sources of data. First, with an eye toward examining the pricing behavior of firms exporting to the United States, we again employ the BLS data on bilateral U.S. import prices by region. These bilateral data are available in sufficiently long time series for the European Union, Japan, Canada, and the Asian NIEs (which include Hong Kong, Korea, Singapore, and Taiwan). Second, we also study the multilateral export price data for these countries--that is, the prices charged to all destinations; these data are drawn from country sources. We express the BLS data in terms of the exporting country's currency in order to be comparable with the multilateral export price data.

The BLS data on prices charged in the U.S. market may differ from the multilateral export price data for several reasons. First, the product composition and/or quality of exports to the United States may differ from that to other destinations. Second, the pricing behavior of exporting firms may differ across export destinations, i.e., exporters may engage in price discrimination across their various export destinations. Third, there may be differences in the methodology used to construct the price indexes.

As shown in Exhibits 12-13, the foreign export price data (the dotted red lines) and the BLS data (the dashed blue lines) at times move in different directions, but some common trends are apparent nevertheless. In particular, since the dollar's peak in early 2002, both measures have posted declines for the EU and Japan, although the prices charged in the United States have fallen more in both cases. For Canada, the U.S. dollar did not decline in earnest against the

[39]Equation (5) required price data for a broad group of U.S. trading partners, while equation (6) requires PPI data only for the smaller set of exporting countries that we explicitly consider.

Canadian dollar until early 2003, and Canadian export prices and the BLS measure have both fallen on balance since that time. For the Asian NIEs, multilateral export prices have climbed over the past year, but the BLS measure of prices charged in the U.S. market has continued to drift down. In general, the BLS data have shown marked declines over the past couple of years, while multilateral export prices for these economies have fallen less or posted modest increases.

Exhibits 12-13 also display measures of economy-wide unit labor costs. To the extent that such measures reflect the costs borne by foreign exporters, movements in profit margins may be proxied by changes in export prices relative to changes in unit labor costs.[40] As shown in Exhibit 14, given this proxy for profit margins, the BLS data suggest that foreign margins in the U.S. market have generally recorded sizable declines since the dollar's peak in early 2002. However, similar calculations using multilateral export prices indicate that exporting firms in Japan, Canada, and East Asia have eked out small gains in their margins over the same period, with a moderation in unit labor costs helping to offset soft or declining multilateral export prices. The European Union is the one region for which multilateral profit margins appear to have declined.

This configuration of results suggests that foreign exporters may have seen their margins compressed in the United States, but they have apparently been able to offset this in other markets--perhaps in markets in which their currencies have remained more competitive. (Of course, exporters from the euro area have had little scope to pursue this strategy, as the euro has moved up against essentially all currencies.) Although pass-through may vary across export

[40]This index of gross profit margins is subject to some caveats: It excludes the cost of materials and of capital, and it does not capture any differences between the reported unit labor costs for the economy as a whole and the unreported unit labor costs for the export sector alone.

destinations, these results are strikingly consistent with what we might see in a world with relatively low import price pass-through in all markets. Profit margins would tend to narrow for exports to countries whose currencies were depreciating but would widen for exports to countries whose currencies were appreciating, with the implications for multilateral profitability depending on the relative importance of exports to countries in each of the two categories.

While profit margins on exports to the United States appear to be more narrow than was the case in early 2002, we do not have sufficient evidence to conclude that the level of profit margins is "too narrow" at present--profits several years ago might have been unusually high. As just one case in point, the first three columns of Exhibit 14 compare movements in export prices and unit labor costs over the preceding period, 1995-2002. This exercise suggests that the profit margins of firms exporting to the United States posted a dramatic run-up between the dollar's trough in the spring of 1995 and the dollar's peak in early 2002. Indeed, despite the unwinding of U.S. profit margins that has occurred over the last couple of years, profit margins for Japanese exporters to the United States appear to have remained well above those that prevailed in the second quarter of 1995, while those for European Union, Canadian and Asian NIE exporters seem to be either up some or little changed on balance. It is also worth noting that the profit margins of exporters from all these economies appear to have moved up to varying degrees on a multilateral basis relative to the spring of 1995.

4.3 Sensitivity of foreign export prices to the exchange rate

Exhibit 15 reports the results obtained when we estimate equation (6). Foreign multilateral export prices denominated in the exporter's currency are regressed on the exporting

country's nominal effective exchange rate (hereafter, referred to as the NEER) and its PPI.[41] For purposes of comparison, Exhibit 16 displays results of a model in which foreign multilateral export prices are regressed on the bilateral exchange rate against the dollar. Finally, Exhibit 17 shows estimates obtained when our benchmark specification is run with the BLS bilateral import price indexes (expressed in terms of the exporter's currency) as the dependent variables.[42]

Exhibit 15 shows that foreign multilateral export prices in most cases do respond to movements in the NEER, but the degree of sensitivity varies across regions. Specifically, the estimated coefficients for the European Union as a whole, the United Kingdom, Canada, and the Asian NIEs are all in the neighborhood of 0.3, while the coefficient for Japan is about 0.5.[43,44] These results suggest that a 10 percent nominal effective depreciation of the EU currencies, the Canadian dollar, or the Asian NIE currencies would raise the price of exports from these regions about 3 percent (in terms of their own currencies), whereas a similar decline in the nominal effective yen would boost the yen price of Japanese exports 5 percent. (Equivalently, in terms of the currencies of importing countries, European, Canadian, and Asian NIE export prices would decline 7 percent, and Japanese export prices would decline 5 percent.)

In contrast, German domestic-currency export prices have shown essentially no responsiveness to the NEER, implying almost complete pass-through in terms of importing

[41]As noted above, the NEER is a trade-weighted average against the currencies of 35 countries.

[42]Similar results were reported in the previous section, but these results show how the translation between currencies affects the estimated coefficients. (There are also small differences in the underlying specification.)

[43]The Canadian export price index is constructed using the producer price index, rather than independently sampled export prices. Thus, there is a high correlation between export prices and the PPI by construction. For this reason, we have used Canada's CPI as our proxy for the country's domestic prices.

[44]Multilateral export prices for the United Kingdom exclude oil.

countries' currencies. The results for Germany indicate that the country's export prices move essentially one-for-one with the domestic price level. Notably, the responsiveness of U.S. export prices to the NEER, shown in the last line of Exhibit 15, is a bit higher than that for Germany but is nevertheless quite low. These results, however, do not rule out the possibility that the exchange rate may influence U.S. or German export prices indirectly through effects on the PPI. We also note that the results for Germany and the United States contrast markedly with what we have obtained for Japan and for Europe as a whole. The explanation for this divergence is very much an open issue.

As mentioned above, the homogeneity restriction in equation (3) implies that the coefficients on the exchange rate and the price level in the exporting country should sum to one. Hypothesis tests indicate that our results are generally consistent with this restriction. We are able to reject the homogeneity condition only for the United Kingdom and the Asian NIEs.

To examine the robustness of these results, the upper panel of Exhibit 16 reports estimates obtained when the NEER is replaced by the nominal bilateral exchange rate against the dollar. Two key results emerge from this specification. First, in most cases, foreign multilateral export prices actually appear to be about as sensitive to the dollar as they are to the NEER, and the coefficients are generally estimated with somewhat greater precision. Second, and even more striking, the R^2 statistics for this model are as high as--or higher than--those for the baseline model. These results point to the importance of the dollar--and, perhaps, to the centrality of the U.S. market--in influencing the evolution of the price of traded goods internationally. The lower panel of Exhibit 16 provides further support for this conclusion. When foreign multilateral export prices are regressed on a streamlined model that includes just the nominal bilateral dollar,

the exchange rate sensitivities remain near those shown in Exhibit 15, and--with the notable exception of Germany--the R^2 statistics are broadly similar.

Exhibit 17 reports estimates obtained when BLS indexes of U.S. import prices from the European Union, Japan, Canada, and the Asian NIEs are regressed on the nominal bilateral dollar and the exporting country's PPI. The estimated coefficients indicate--without exception--that the prices charged in the U.S. market (denominated in the exporting country's currency) are more sensitive to the exchange rate than is the case for multilateral export prices. Estimates for all four regions suggest that over the last decade or so, a 10 percent appreciation of the exporter's currency against the dollar has been associated with a 7 to 8 percent decline in export prices denominated in the currency of the exporting country.[45] In contrast, the results in Exhibit 15 and Exhibit 16 suggested that for these same four regions a 10 percent appreciation of their currencies would result in a decline in multilateral export prices ranging from just under 3 percent to 5 percent. The divergence between these two sets of results suggests that import price pass-through is lower for the United States than for other economies on average. This may reflect different pricing strategies in the U.S. market or differences in the composition or quality of exports to the United States.

As noted above, an implication of our analytical framework is that the coefficient β reflects both the extent of exchange rate pass-through to country **i**'s import prices and the extent to which shifts in marginal cost are reflected in export prices. As such, the estimated coefficient

[45]Equivalently, the results suggest that a 10 percent appreciation of these currencies against the dollar would raise the price of U.S. imports from these trading partners about 2 to 3 percent. By comparison, the "Specification 2" results in the upper panel of Exhibit 9 are quite similar. (Specification 2 is the appropriate comparison because its coefficients--like those in Exhibit 17--are estimated with a model that does not include commodity prices.)

on foreign prices, which proxy for marginal cost, provides an additional window into import price pass-through. Notably, for the bilateral export price results shown in Exhibit 17, the estimated coefficients on the exporting country's prices are broadly similar to the pass-through estimates shown in the upper panel of Exhibit 9 for the EU and Canada but lower for Japan and the Asian NIEs. These coefficients are also much lower than their multilateral counterparts in Exhibits 15 and 16, again suggesting that import price pass-through in the U.S. market is more muted than in other markets on average. Finally, it is worth noting that for every specification in Exhibit 17, we fail to reject the homogeneity condition that requires the coefficients on the exchange rate and the exporting country's price level to sum to unity.

4.4 Rolling regressions

Given evidence of a decline in U.S. import price pass-through since the 1980s, as well as broadly similar evidence for Japan (if not for Germany), it is reasonable to ask which countries have seen their export prices (denominated in their local currencies) become more sensitive to exchange rate movements. With this idea in mind, we employ the baseline specification outlined in equation (6) to conduct rolling regressions for those U.S. trading partners where sufficient data are available. The rolling regressions use a ten-year window and show how the domestic-currency price of multilateral exports responds to movements in the NEER.

The results for Germany, which are reported in the top panel of Exhibit 18, suggest that the exchange rate sensitivity of German export prices has been low and stable over time. The Japanese response to the exchange rate, although markedly higher than for Germany, has moved up only slightly on balance over the last twenty years. For the United Kingdom, the effect of the exchange rate on export prices manifests an upward trend through much of the sample period,

but this is rapidly reversed in 2002. It is reasonable to conjecture that the sharp decline in the exchange rate sensitivity of UK export prices in 2002 reflects that the fact that the 1992 ERM crisis had rolled out of the regression window. In the most recent ten-year samples, however, the responsiveness of UK import prices to the NEER has again begun to move up.

For Canada, we find a clear upward trend in the rolling regression results (shown in the upper panel of Exhibit 19). The exchange rate sensitivity of Canadian export prices has steadily risen from near zero for ten-year windows ending in the first half of the 1990s to nearly 0.5 for windows ending in the late 1990s, apparently reflecting the effects of NAFTA and deepening integration with the United States. The estimated pass-through coefficient dipped early this decade but has since climbed to around 0.6. For the Asian NIEs, the exchange rate sensitivity of export prices jumped from 0.2 to 0.5 in the late 1990s, about the time of the Asian financial crisis. In subsequent years, this sensitivity has increased further, to over 0.7. Given the effects of the financial crisis, the subsequent softness in domestic demand in many Asian economies, and the increasing prominence of China, Asian NIE exporters have shown increased willingness in recent years to absorb exchange rate shocks into their profit margins. Taken together, these results suggest that the pricing behavior of Canadian and emerging Asian exporters has likely played an important role in contributing to the decline in U.S. import price pass-through.

5. Conclusions

This paper has documented a striking and robust decline in the pass-through of exchange rate changes to U.S. core import prices, from above 0.5 in the 1980s to somewhere in the neighborhood of 0.2 over the past decade. The source of this decline is difficult to pin down

with certainty, but our work points to several related factors. First, as an arithmetic matter, the decline in the share of industrial supplies--from one-third of core goods imports in the 1970s to less than one-fifth at present--has likely played some role. These goods are commodity intensive and have continued to manifest relatively high pass-through (when pass-through is estimated without commodity prices in the regression). A second factor appears to be the increasing presence of China in the U.S. market. Using dis-aggregated data, we find that over the past decade, pass-through has tended to post bigger declines in those product categories in which China has posted larger increases, and the threat of potential competition from China has likely also played some role. Third, we find evidence suggesting that in recent years export prices for the Asian NIEs and Canada (denominated in the exporter's currency) have shown increased sensitivity to exchange rate changes, a result that is consistent with declining pass-through to import prices. For the Asian NIEs, much of this increase occurred at the time of the Asian financial crisis in the late 1990s, and we have found a roughly parallel decline in U.S. import price pass-through around that time. For Canada, this result may be attributable to the effects of NAFTA and deepening trade ties with the United States.

We should also make two related points. First, the pass-through estimates that we obtain when primary commodity prices are excluded from the regression--while still declining--are somewhat larger and more stable than when commodity prices are included. We interpret this result as indicating that an increased share of the exchange rate's effects on import prices is now occurring through a commodity price channel. Second, our empirical work for the foreign economies suggests that the dollar--and, perhaps, competition within the U.S. market more generally--plays a special and significant role in the determination of global traded goods prices.

The key remaining question regards the durability of the decline in pass-through, but we cannot answer this question with any confidence. On the one hand, the forces of global integration and increased competition that seem--at root--to be contributing to the decline are unlikely to abate. On the other hand, in order to maintain market share, exporting firms may be willing to accept narrowing margins for some time--or alternatively, to use profits earned in one market to subsidize operations in another market--but this is unlikely to continue indefinitely. Thus, given a large enough further depreciation of the dollar, foreign firms will eventually need to raise their dollar prices or exit the U.S. market.

Appendix: Review of the Recent Literature on Exchange Rate Pass-through

In their comprehensive review of the literature on pass-through, Goldberg and Knetter (1997) reported that "a price response equal to one half the exchange rate change" was at that time "near the middle of the distribution of the estimated responses for shipments to the U.S." This appendix summarizes the empirical literature on exchange rate pass-through since the review of Goldberg and Knetter.

We find that several papers report estimates of a linear pass-through equation similar to what we have used in this paper, usually considering various levels of dis-aggregation. Those papers that do not allow for a decline in pass-through find estimates similar to those reported by Goldberg and Knetter. Olivei (2002) allows for declining pass-through, and finds results broadly consistent with ours. Despite this evidence, however, low estimates of pass-through are often viewed with suspicion. We consider four criticisms drawn from the literature that form much of the basis for this suspicion:

1. Even in the most dis-aggregated data examined, low pass-through estimates could reflect composition changes or other measurement problems, rather than low pass-through at the individual product level.

2. The specification assumes that pass-through is linear. It may be, for example, that large exchange rate changes elicit greater pass-through.

3. Because the estimates are based on *ad hoc* formulations, they shed little light on why it might be rational for exporting firms to allow their prices (denominated in their home currency) to vary so widely with the exchange rate.

4. If the low pass-through estimates truly reflect low pass-through at the product level, exchange rate variation should be reflected in the profits and market valuation of exporting firms. Some have questioned whether we observe the implied movements in equity valuations.

Criticism 1: Since the first criticism applies to even the finest level of dis-aggregation in the literature, the only direct evidence we can cite is that low pass-through is observed consistently across all levels and types of dis-aggregation thus far examined.

Criticism 2: Nonlinear pass-through. There is relatively little work on the issue of whether pass-through effects are nonlinear. What literature there is provides no clear support for the view that there are important non-linearities or that large exchange rate changes elicit greater pass-through. Olivei (2002) tests whether the pass-through coefficient is symmetric for appreciations and depreciations across 34 U.S. industry groupings. He finds that pass-through is symmetric in all but two industry groupings. Pollard and Coughlin (2004) look for asymmetries and threshold effects using quarterly U.S. data from 1978Q2 to 2000Q4 for twenty, three-digit industries. They check whether the pass-through of exchange rate changes greater than 3 percent is different from smaller changes. Their results provide little support for the existence of important non-linearities.

Criticism 3: Pass-through and optimal firm behavior. Several papers start with the theory of the firm and derive the optimal pass-through for exporters. Basic theory of the firm suggests that under imperfect competition, firms will set price as a markup over marginal cost. Thus, pass-through will be determined by factors affecting the optimal markup (e.g., closeness of substitutes to the firm's product and market concentration) and by factors relating the exchange rate to marginal cost (e.g., the use of imported inputs).

Yang (1997) and Bodnar et al. (2002) derive an explicit expression for optimal pass-through, and they find this expression to be less than one under their maintained assumptions. Specifically, in the face of an appreciation of the exporter's currency, complete pass-through--a

one-for-one increase in the price (expressed in terms of the importing country's currency)--would maintain the profit margin (profits per unit stated in the exporter's currency) but would decrease total profits due to a decline in export sales. Thus, by decreasing its margin to maintain sales, the firm maximizes profits. Using data from 1986 to 1995, Bodnar et al. estimate the implications of their model for eight Japanese export industries. They find optimal pass-through values ranging from 0.15 for film to 0.81 for construction machinery.

It is important to emphasize that deriving exact expressions for pass-through requires very strong assumptions. Their contribution to our understanding is in the clear formalization of optimal pass-through. The papers illustrate that observed pass-through estimates could in principle be consistent with profit-maximization by exporters.

Criticism 4: Pass-through, profits, and the equity value of exporters. The low observed values of pass-through combined with the wide swings in exchange rates seem to imply very wide variation in profit margins, and, hence, market valuations of exporting firms. We did not find much literature considering profits directly. Gagnon (2004), however, focuses on the response of profits in the United Kingdom during the 1990s, a period when large and sudden exchange rate movements had no apparent impact on overall consumer prices. Gagnon shows that the stability of U.K. consumer prices was made possible in part by offsetting movements in the price-cost margins of foreign exporters and in part by offsetting price-cost margins in the U.K. distribution sector.

There is a sizable literature estimating the response of the equity value of exporting firms to exchange rates, a response known as "exposure." For example, using the same framework discussed above, Bodnar et al. derive the response of the value of the exporting firm

(denominated in the exporter's currency) to exchange rate changes, under the assumption of optimal pass-through. They then test whether pass-through and exposure as observed in the data are mutually consistent. For 3 of 8 industries, the observed exposure was too low to be reconciled with the low pass-through values; the remaining five were consistent with the theory.

A number of papers take a more reduced form approach to measuring exposure. For example, Allayannis and Ihrig (2001) estimate exposure for the U.S. industrial sector at the four-digit SIC level. They find that a one percent appreciation of the dollar decreases the return of the average U.S. industry by 0.13 percentage points.

While very little of the work on exposure has attempted to shed light on the decline in pass-through, there are two exceptions: Glaum et al. (2000) and Entorf and Jamin (2002). These papers find an increase in exposure of German firms in the 1990s as would be expected if pass-through declined in the 1990s. These papers make no attempt to assess, however, whether the magnitude of exposure is consistent with any particular value for pass-through.

Overall, some of the evidence on exposure of firm value and profits to exchange rate changes is consistent with low and even falling pass-through, but the exposure evidence does not uniformly support these findings.

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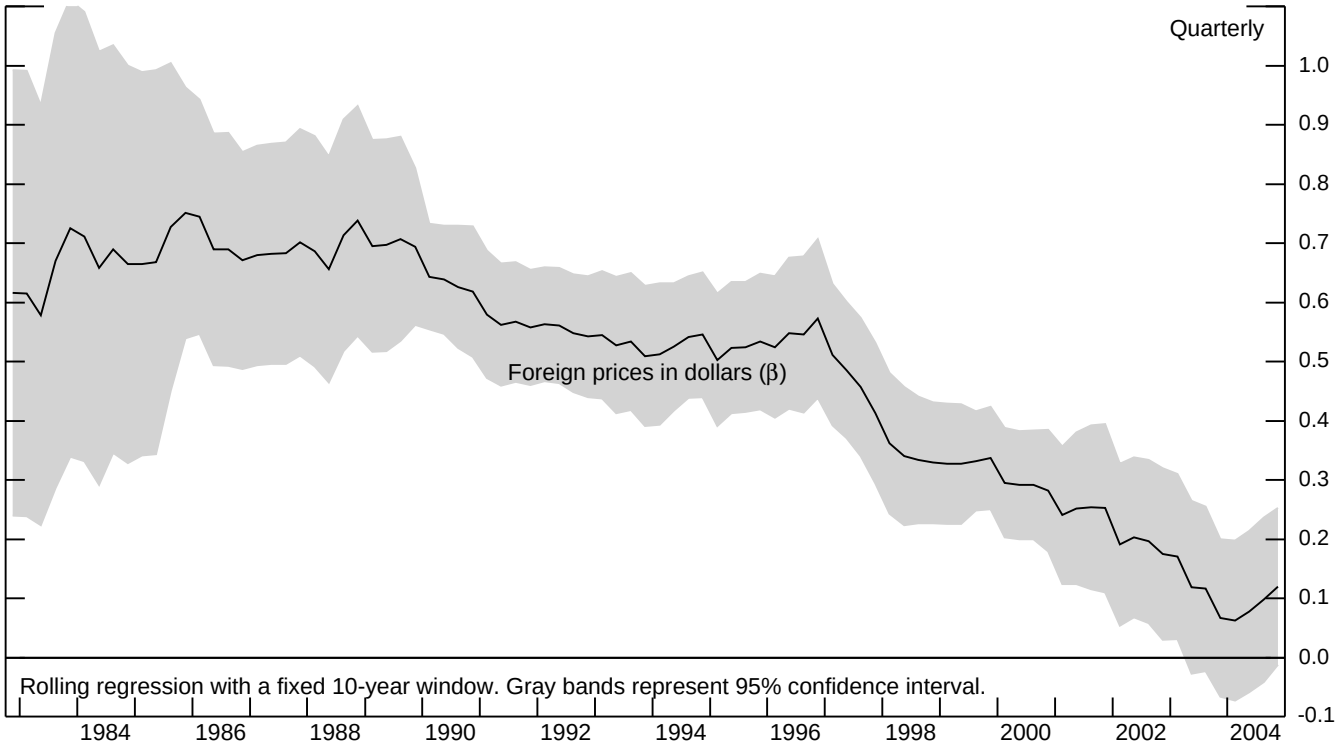
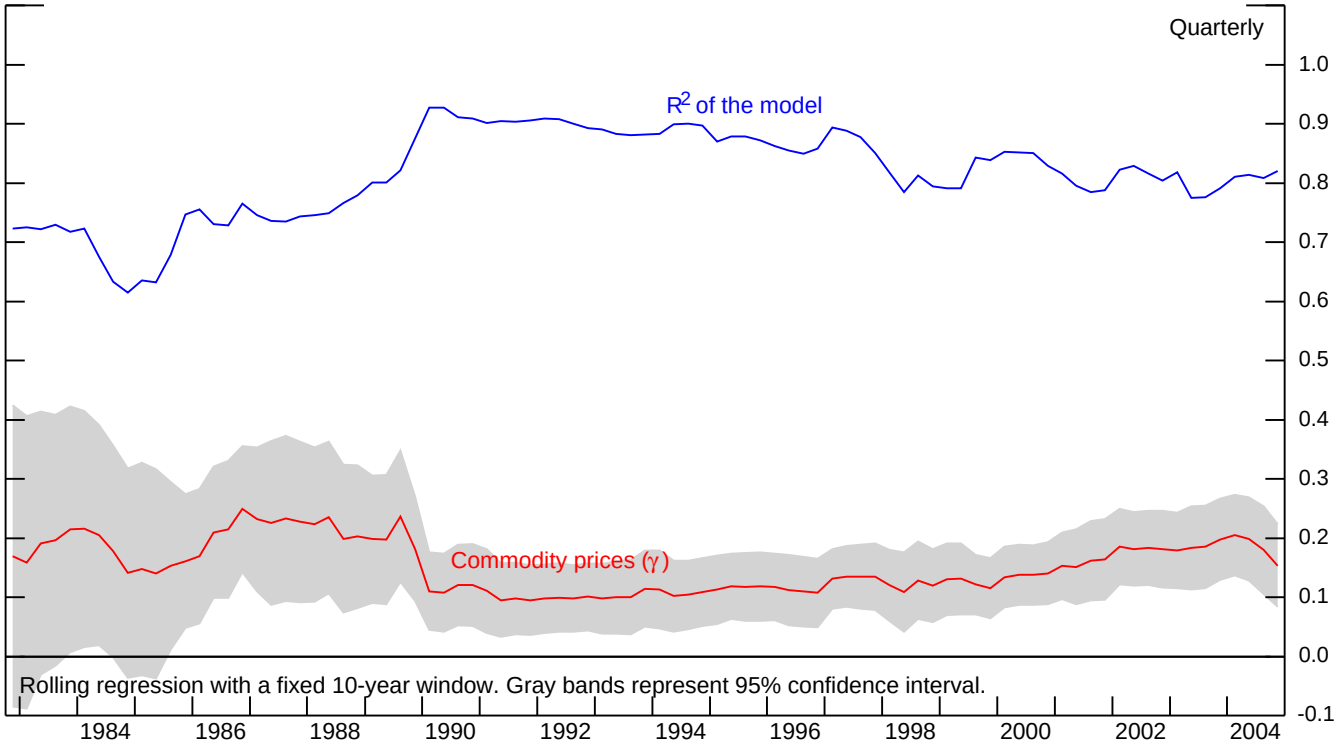
The Secular Decline in Pass-through to U.S. Import Prices

Pass-through to Prices of Imported Core Goods*

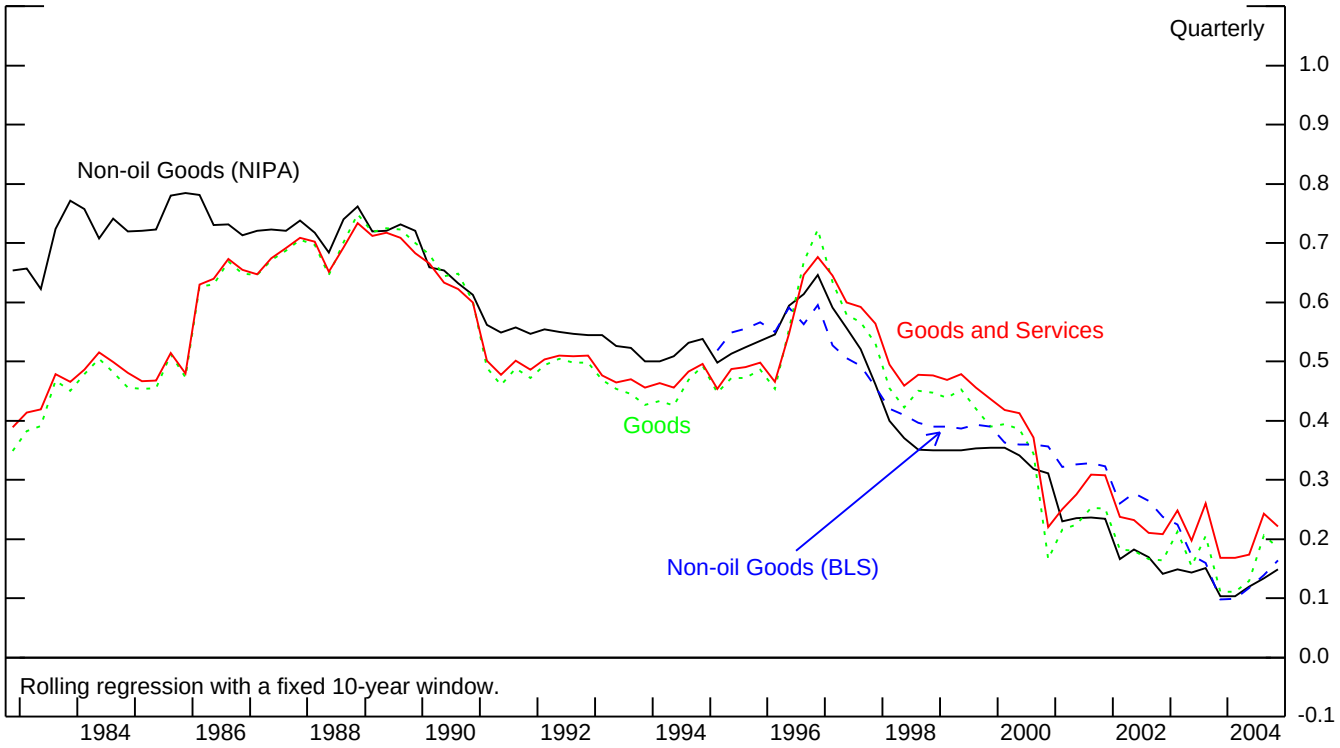


* Excludes petroleum, computers, and semiconductors. The exchange rate is an index of the dollar's nominal value against the currencies of 35 countries, weighted by bilateral shares of U.S. non-oil imports.

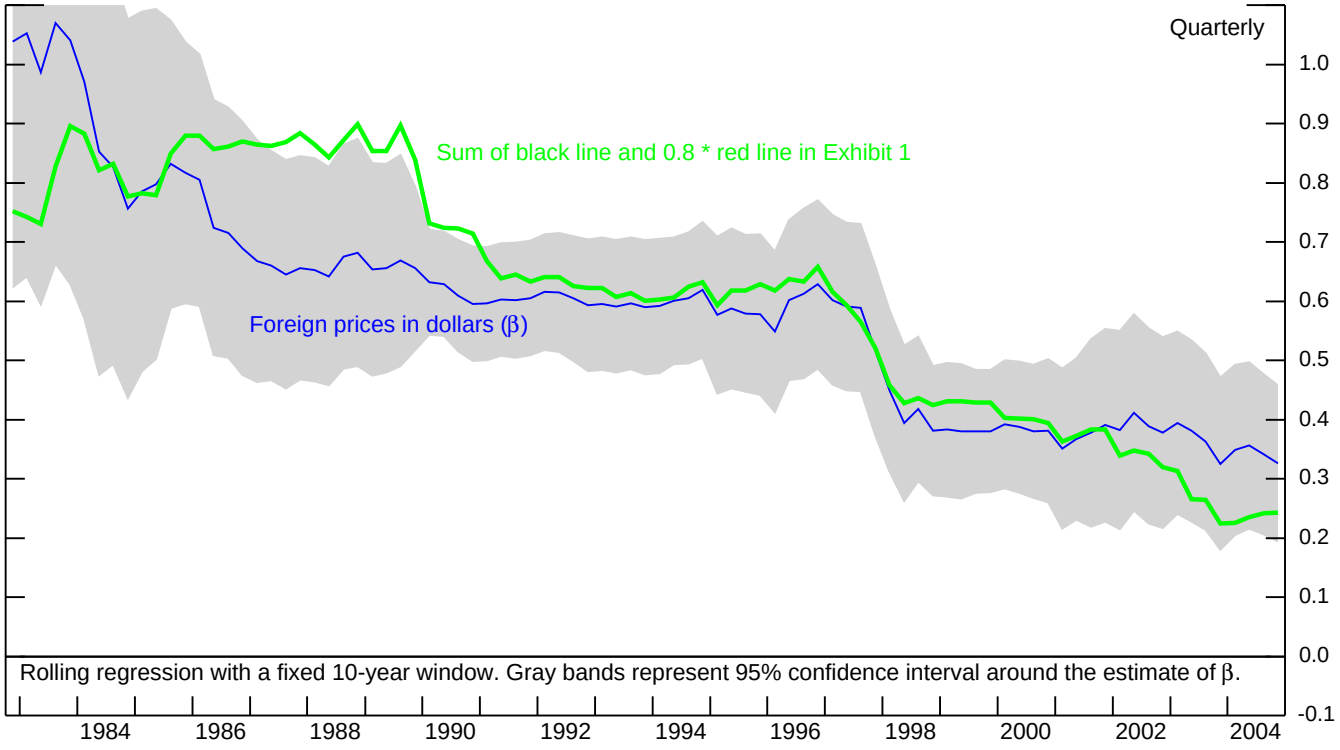


Robustness Tests

Pass-through (β) to Other Aggregate U.S. Import Price Measures

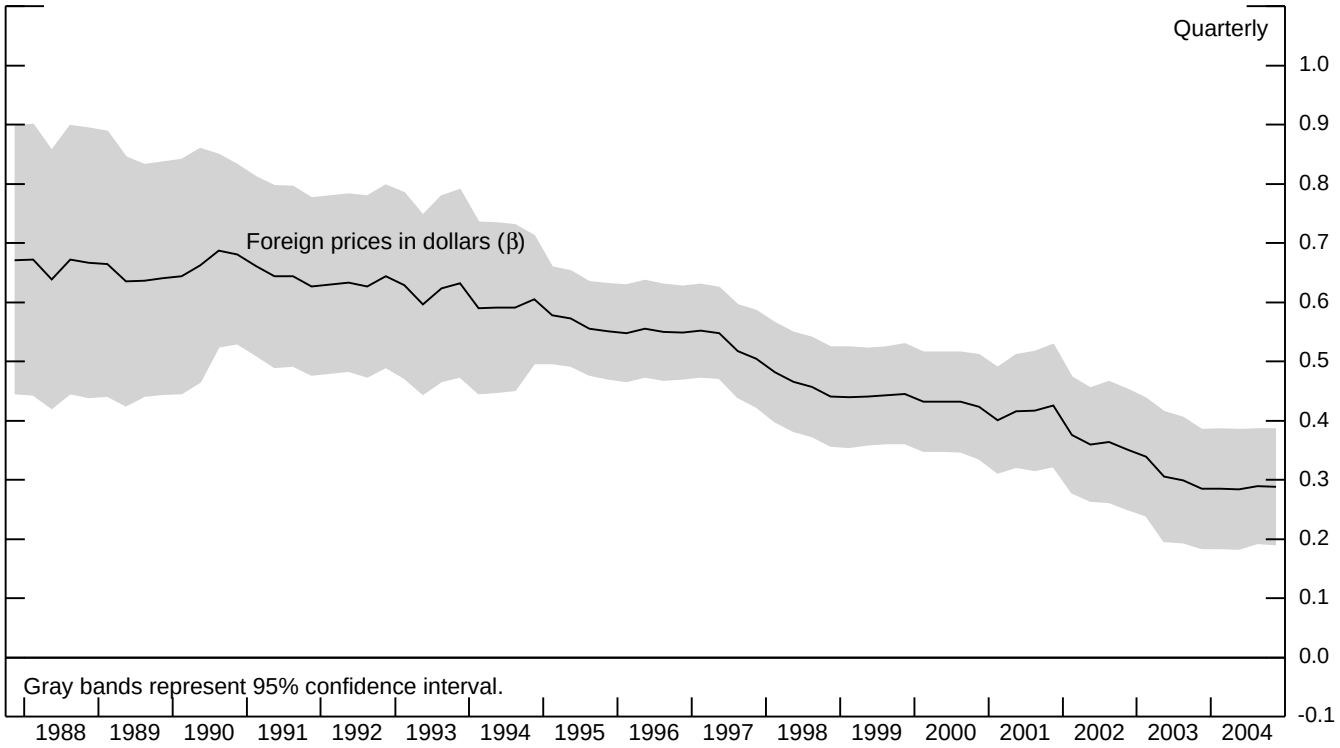


Excluding Commodity Prices

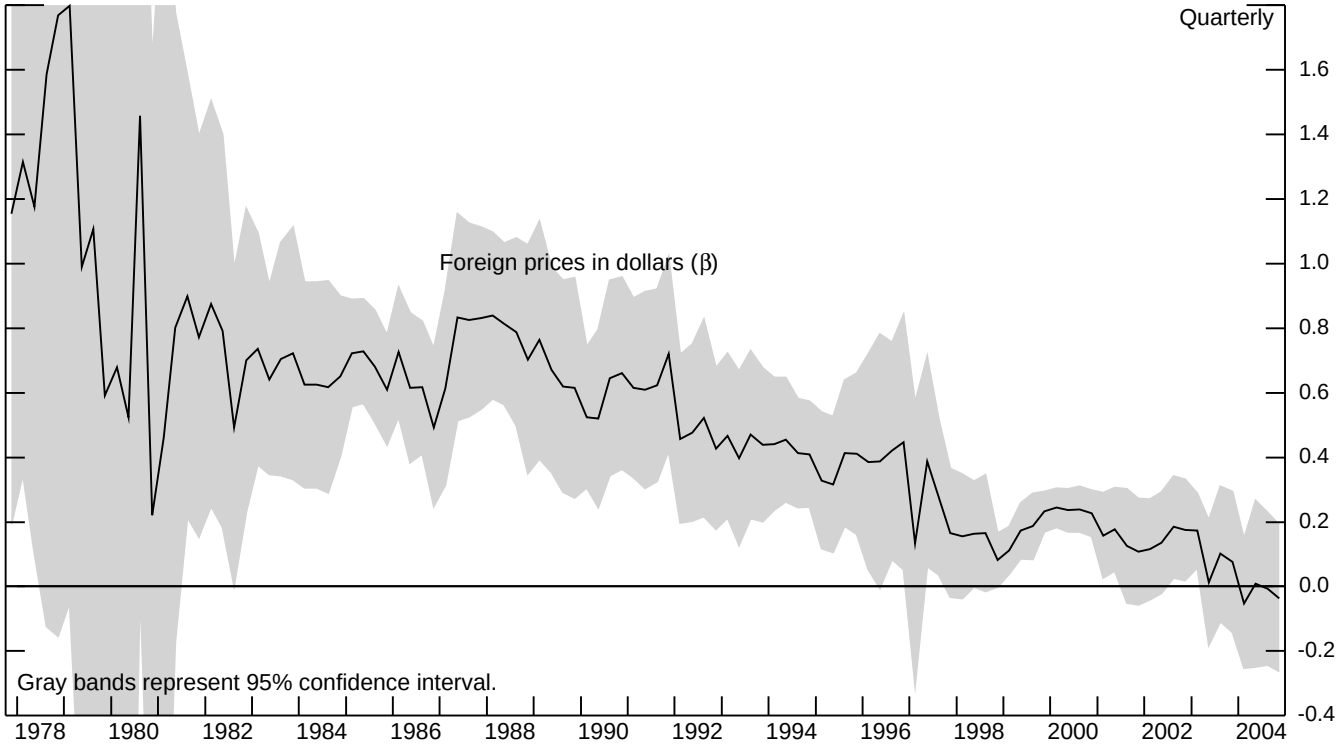


Robustness Tests (continued)

Rolling Regression with a Fixed 15-year Window

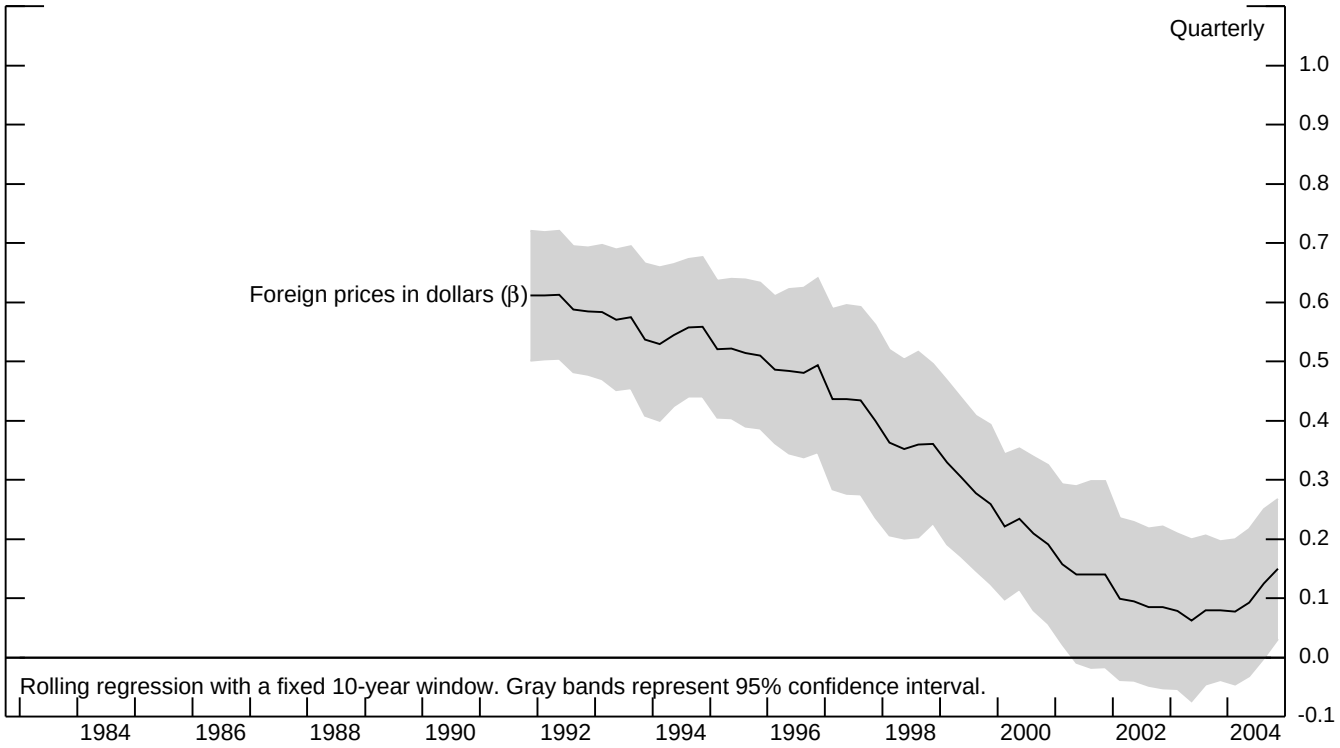


Rolling Regression with a Fixed 5-year Window

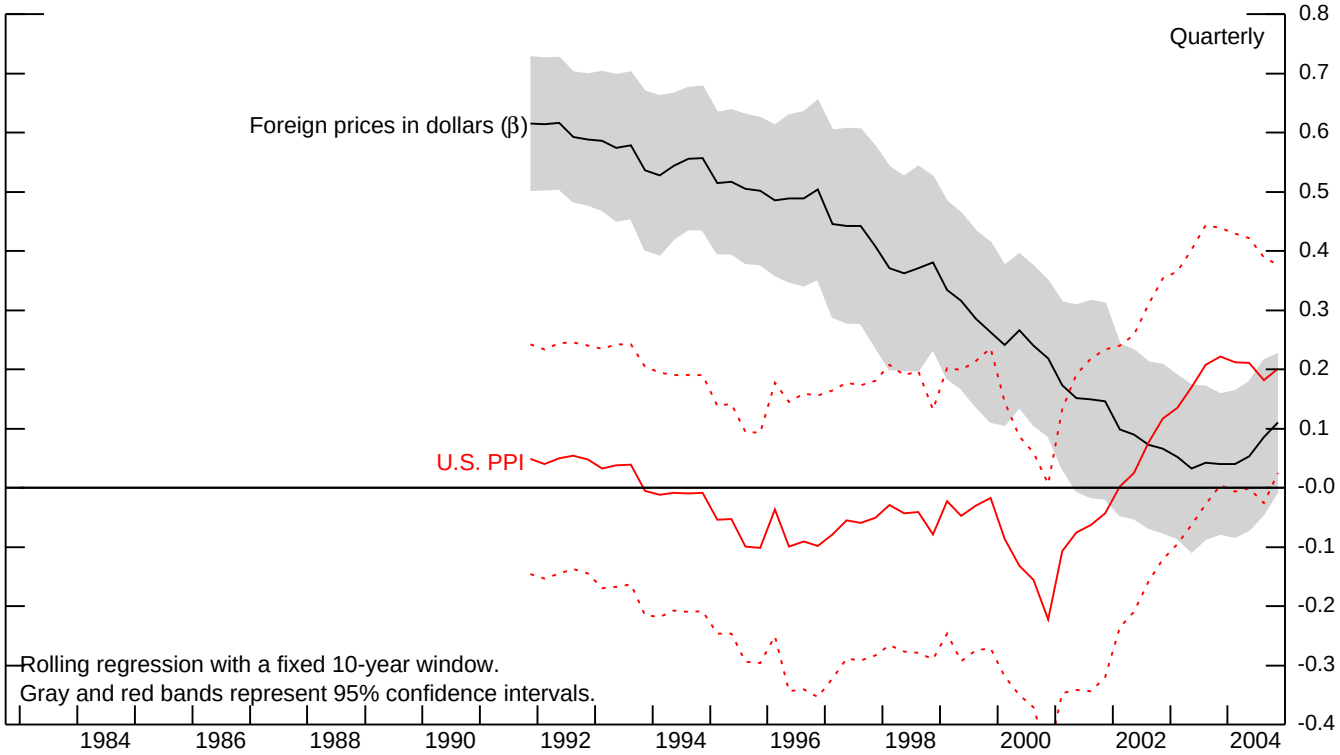


Robustness Tests (continued)

Using Foreign PPIs, instead of CPIs

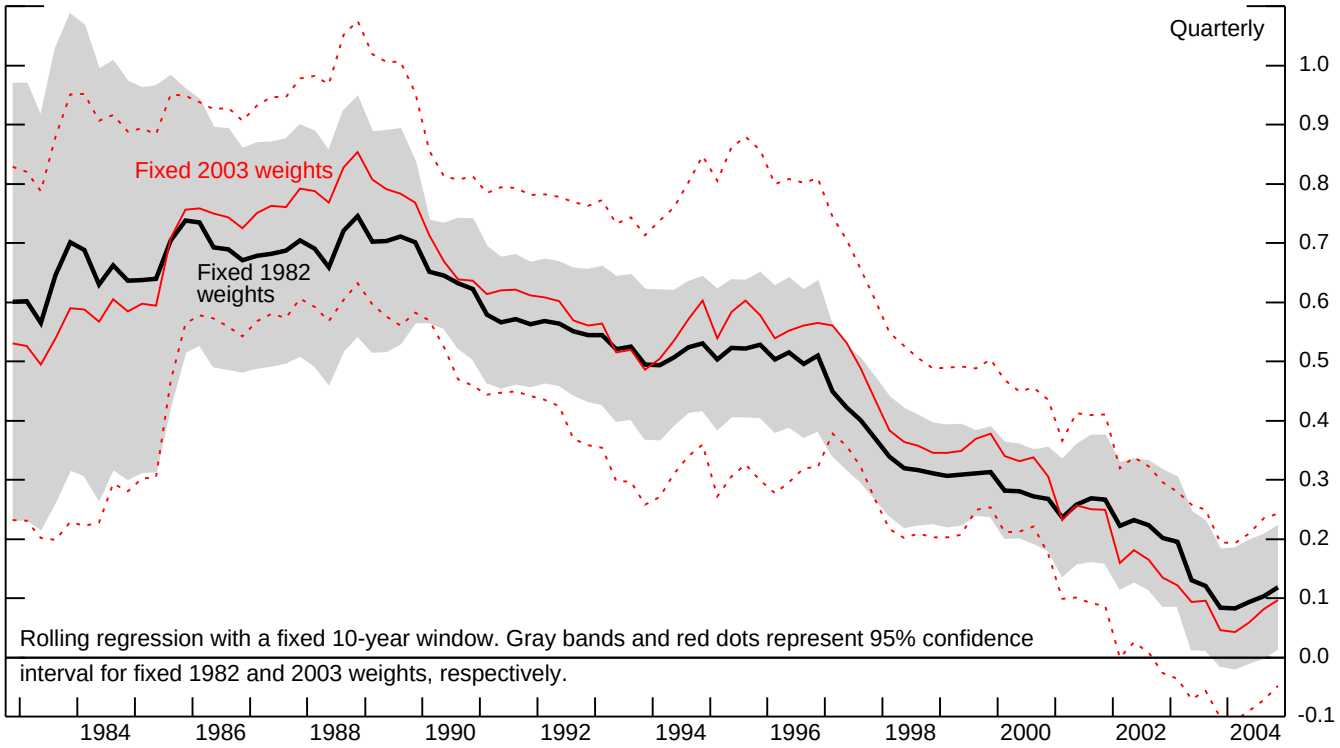


Including U.S. PPI

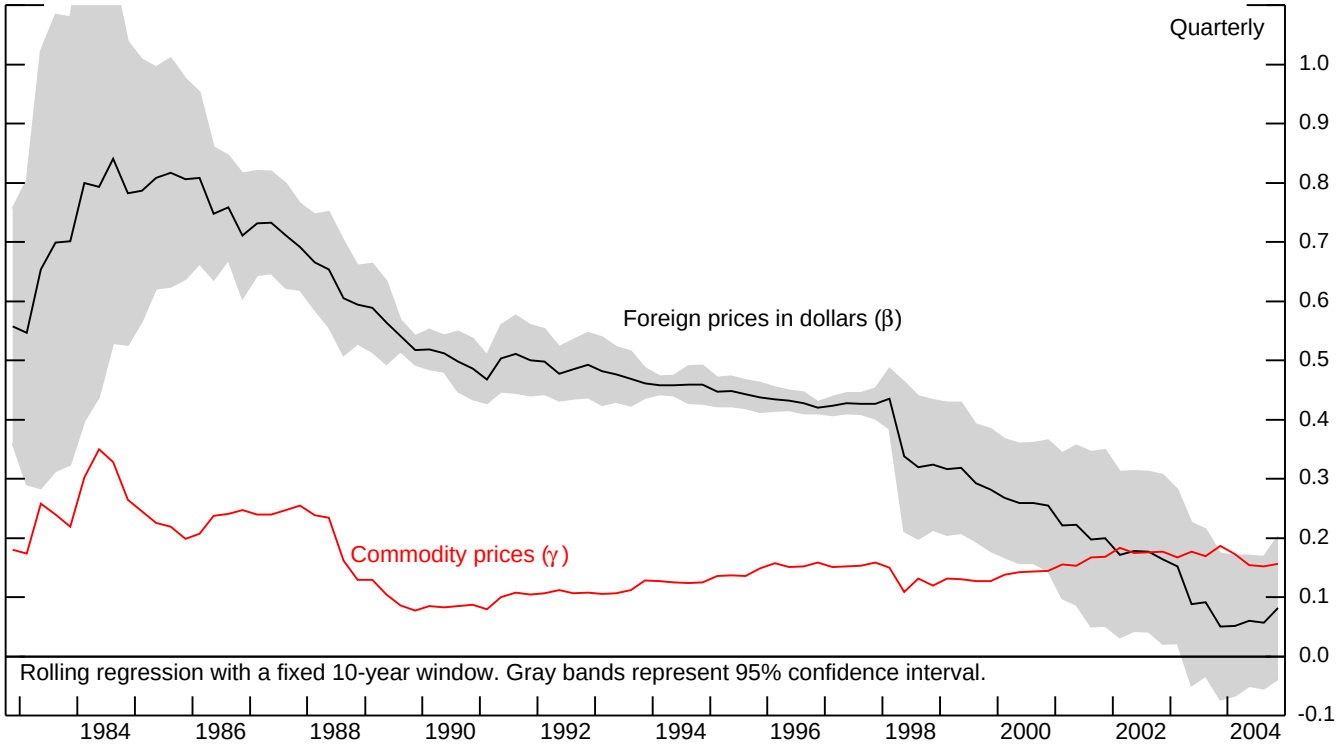


Robustness Tests (continued)

Estimating β Using Fixed Weights for Exchange Rates and Foreign CPIs

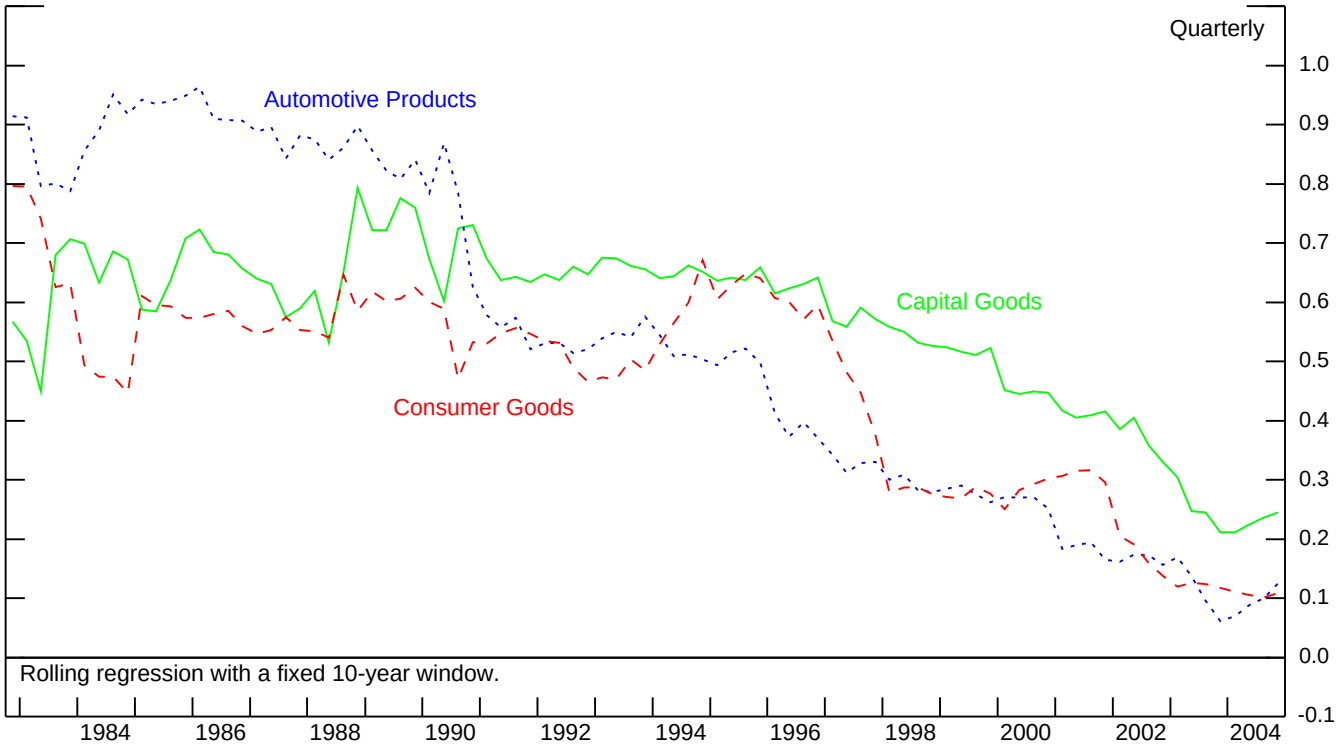


Estimation in Levels



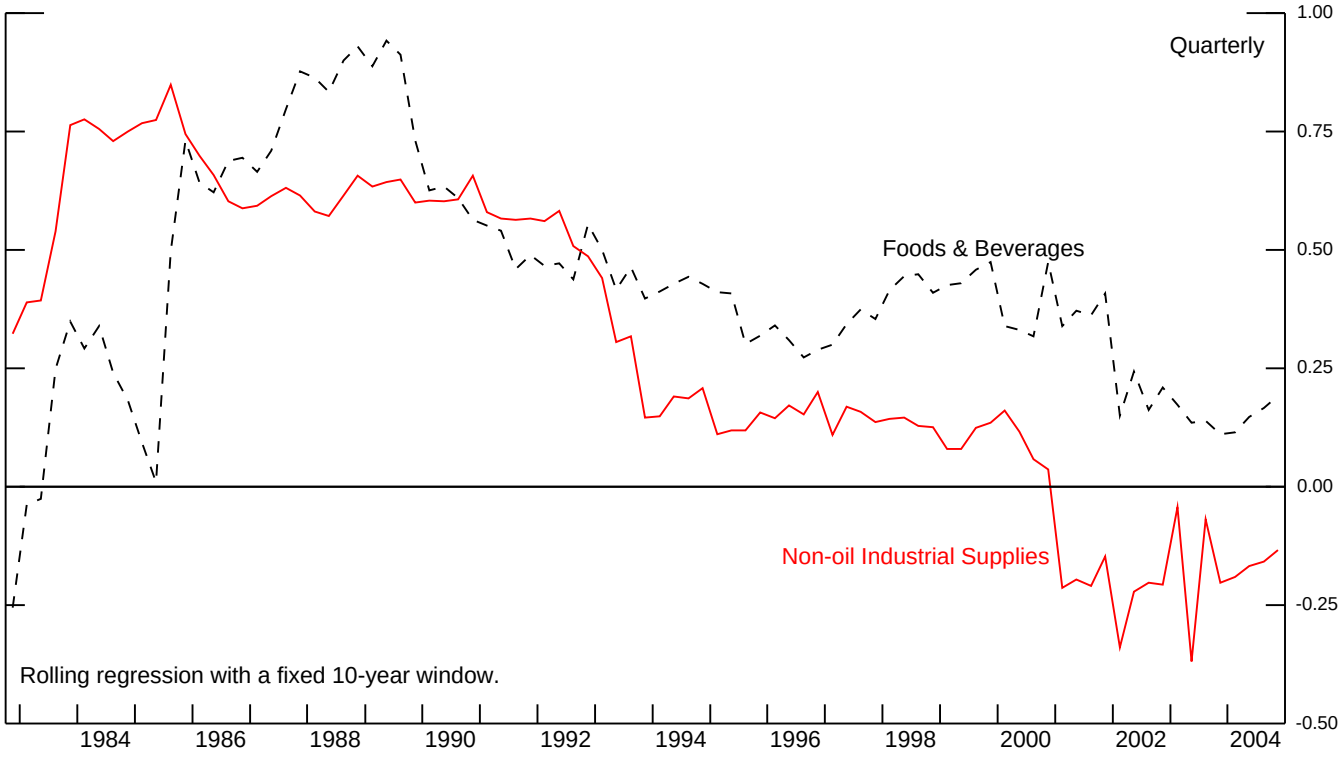
Pass-through by Type of Good*

Finished Goods



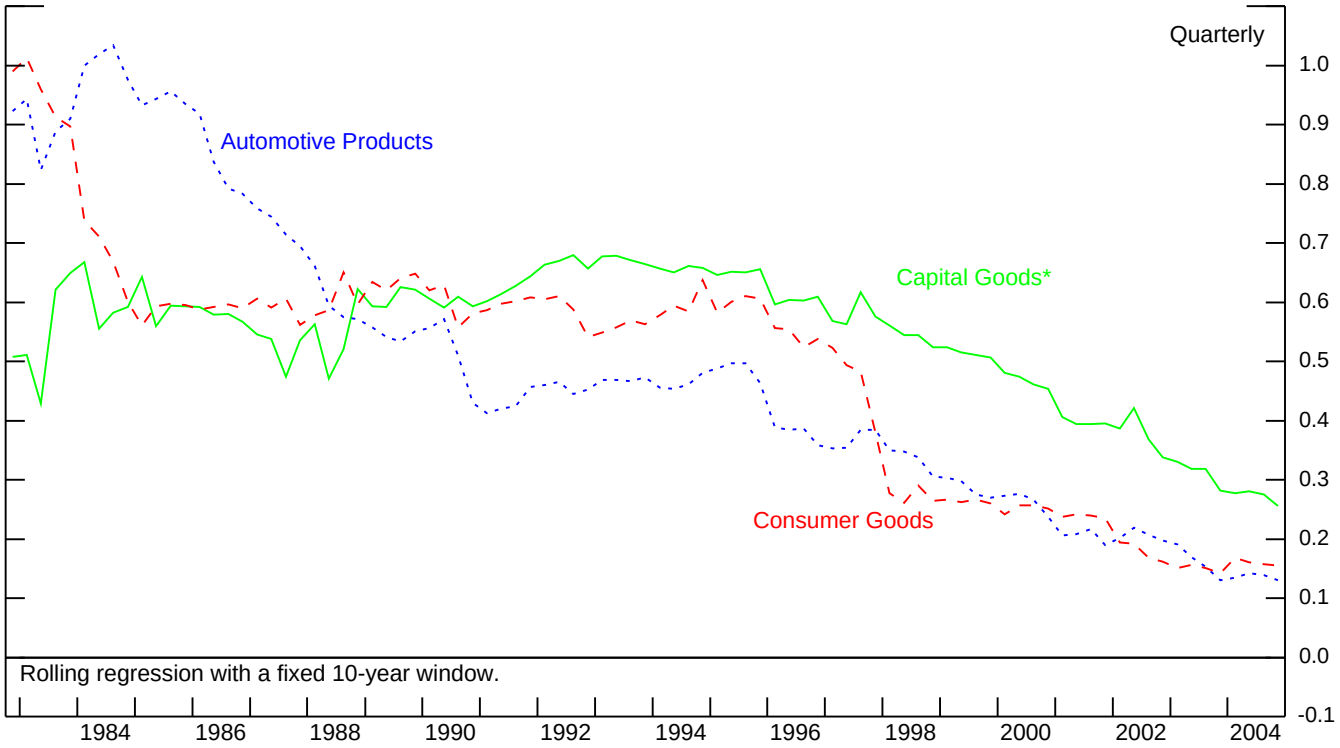
* The exchange rate is an index of the dollar's nominal value against the currencies of 35 countries, weighted by bilateral shares of U.S. imports in each product category. Capital goods exclude computers and semiconductors.

Material-intensive Goods



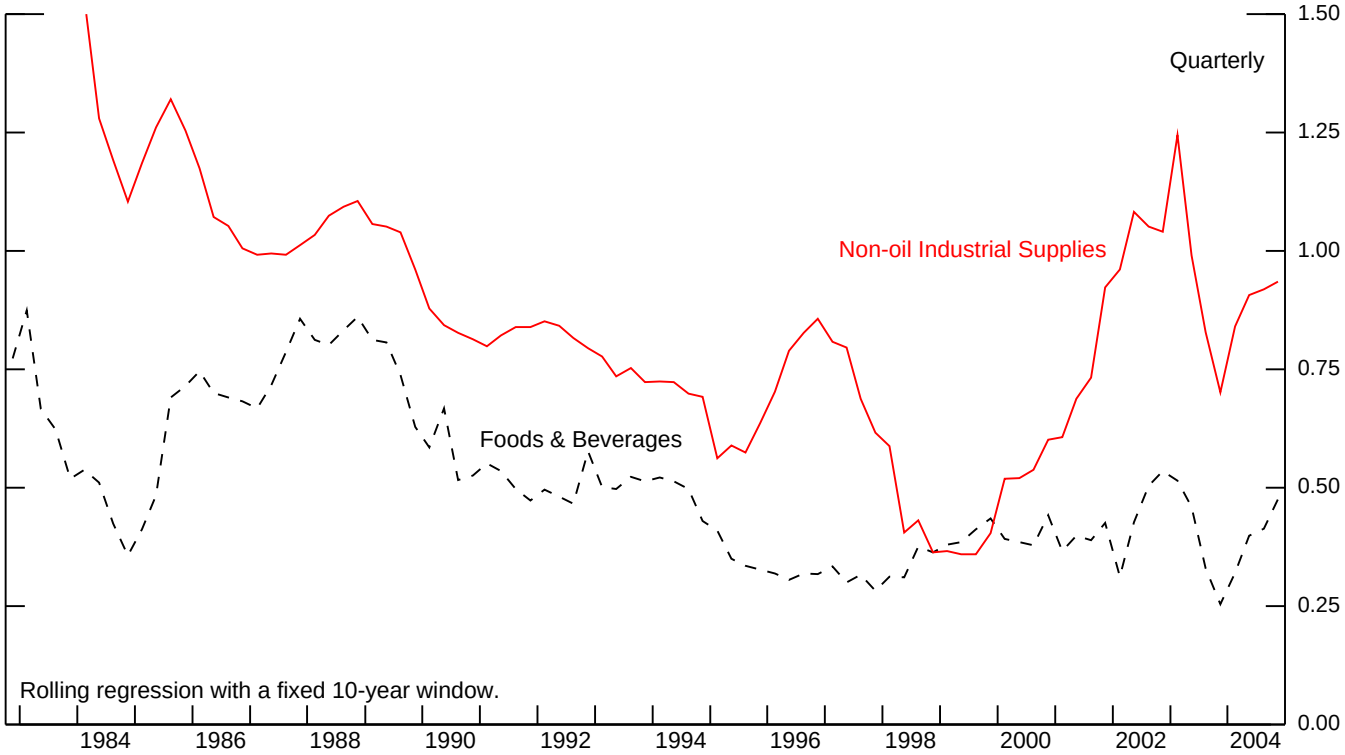
Pass-through by Type of Good (continued)

Finished Goods (excluding commodity prices)



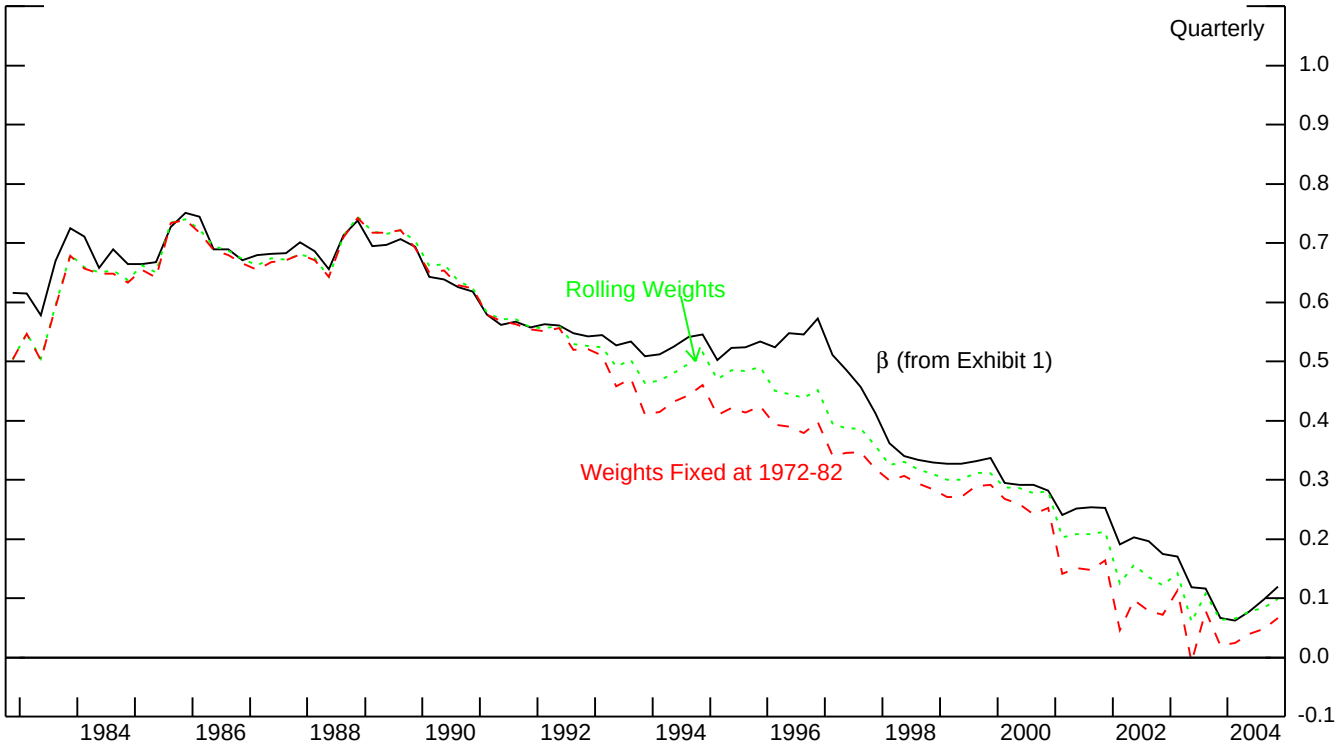
* Capital goods exclude computers and semiconductors.

Material-intensive Goods (excluding commodity prices)

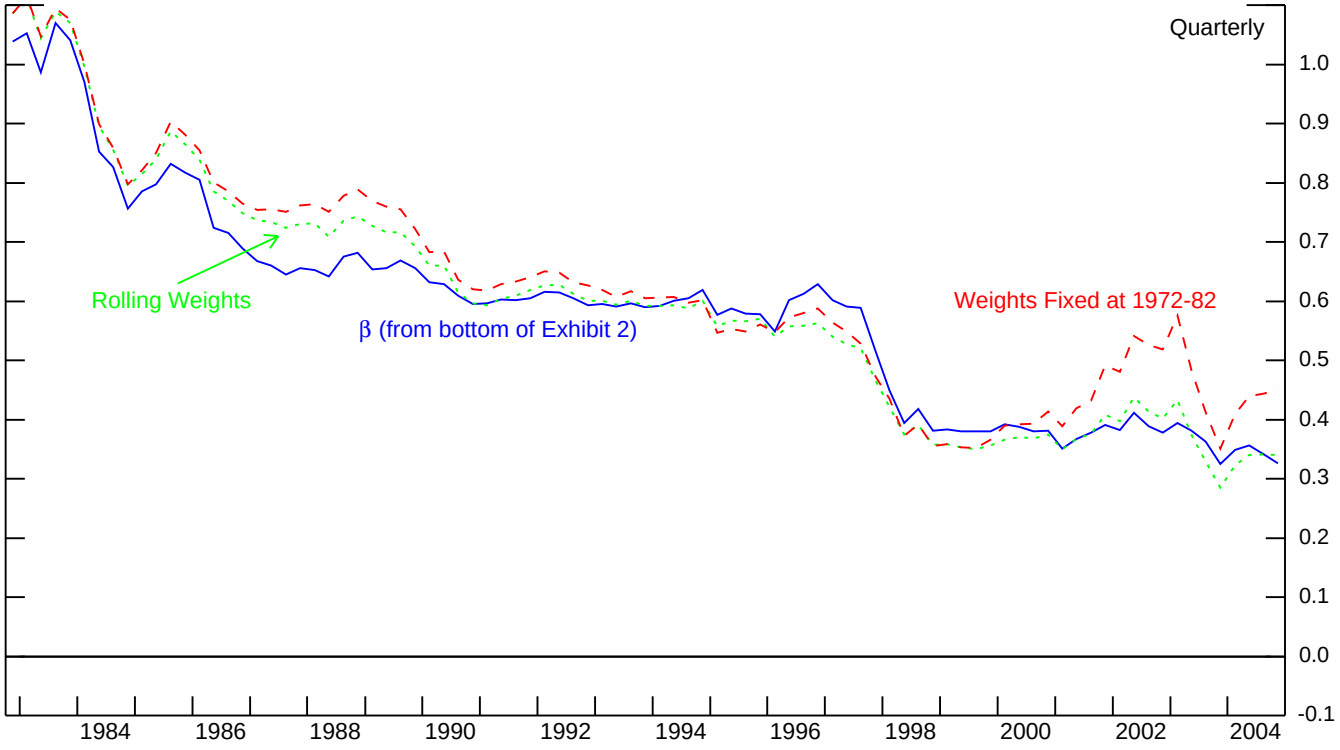


Weighted Estimates of Pass-through by Type of Good

Including Commodity Prices



Excluding Commodity Prices



Bilateral Pass-through to Import Prices of All Goods

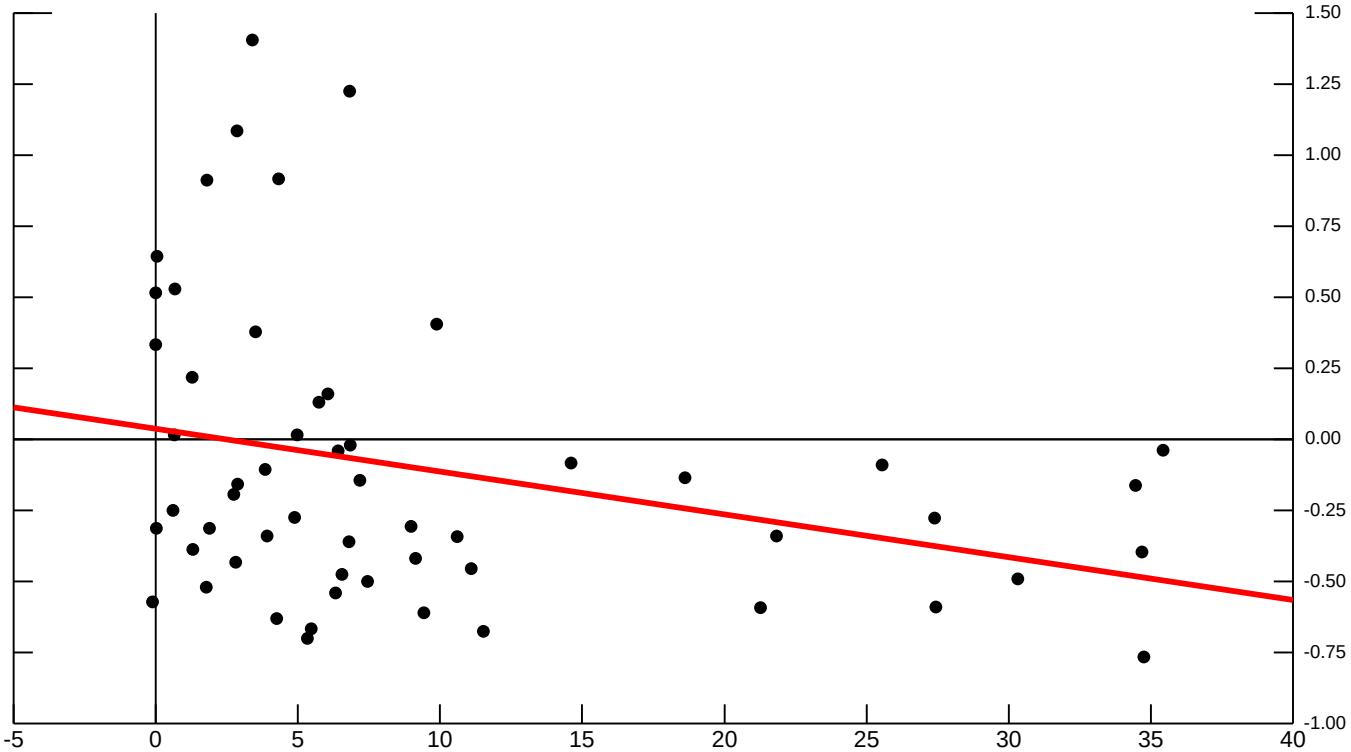
		Specification 1 (including commodity prices)		Specification 2 (excluding commodity prices)	
		Foreign CPI in U.S. Dollars (1)	Commodity Prices (2)	Foreign CPI in U.S. Dollars (3)	Commodity Prices (4)
1.	European Union	0.23***	0.11***	0.30***	---
2.	Japan	0.22***	0.10	0.22***	---
3.	Canada	0.02	0.40***	0.34***	---
4.	Asian NIEs+	0.22***	0.10	0.23***	---

Note: The exchange rate variable is the nominal bilateral rate against the U.S. dollar. Estimation Period: 1991:Q2 - 2004:Q4. *, **, and *** indicate significance at the 10, 5, and 1 percent levels, respectively.

+ Includes Hong Kong, Korea, Singapore, and Taiwan.

U.S. Non-oil Imports from China and Pass-through

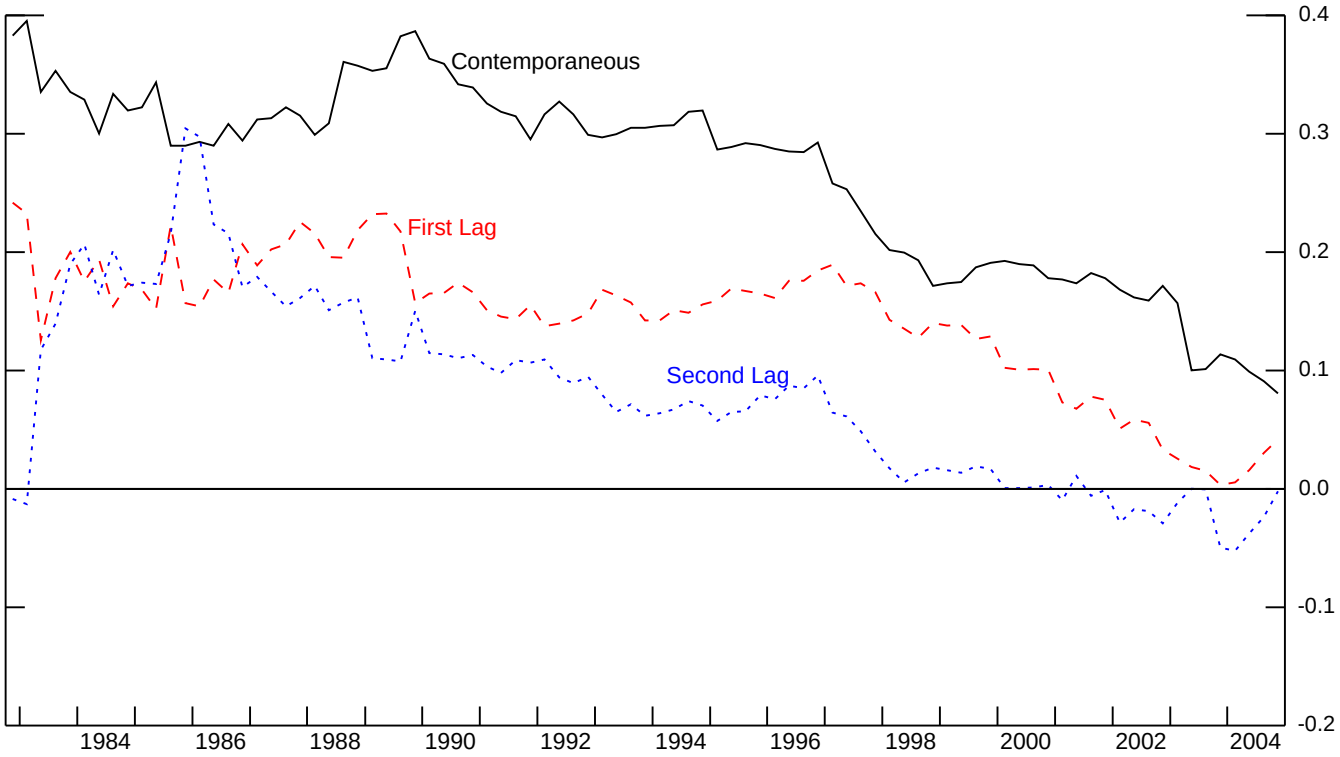
Change in Pass-through Coefficient (1985-1994 vs. 1995-2004)



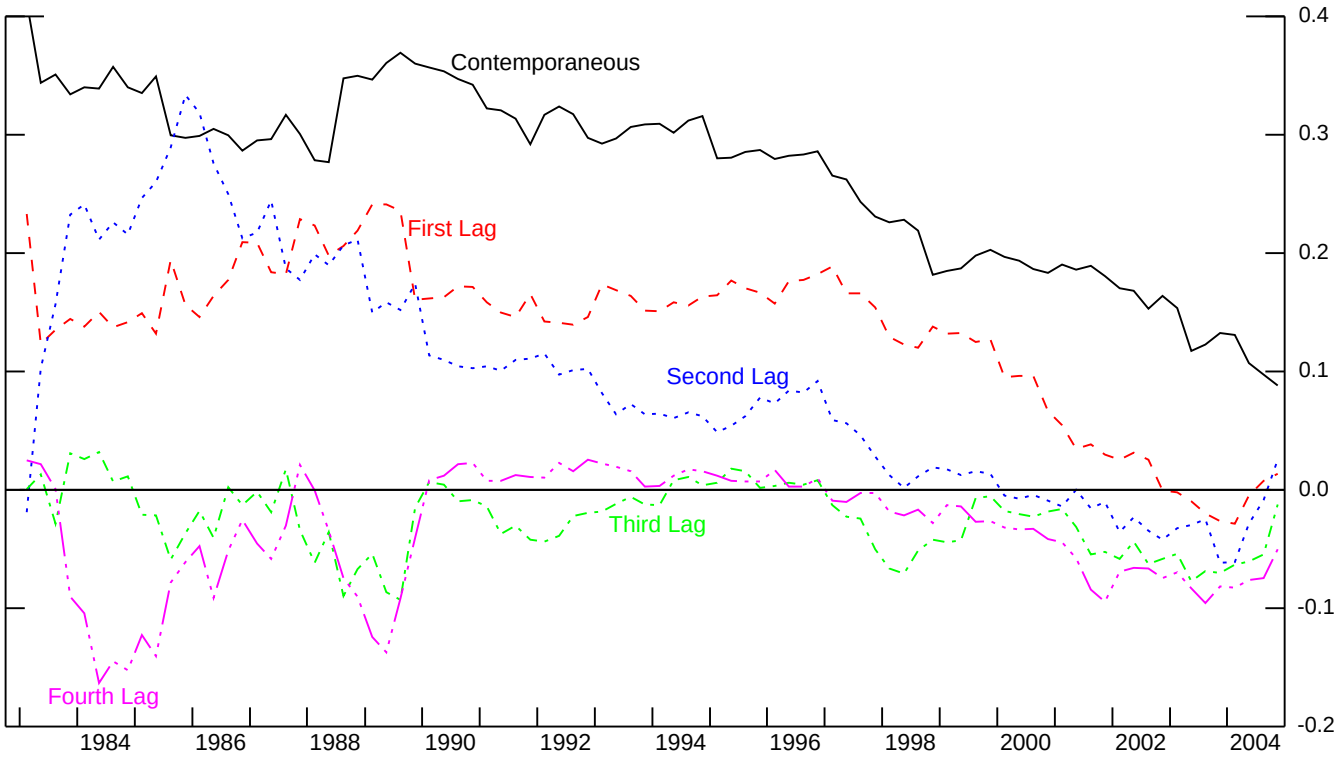
Percentage Point Change in China Share by Sector (1994-2004)

Evolution of Lag Structure in Exchange Rate Pass-through

With Two Lags (as in Exhibit 1)

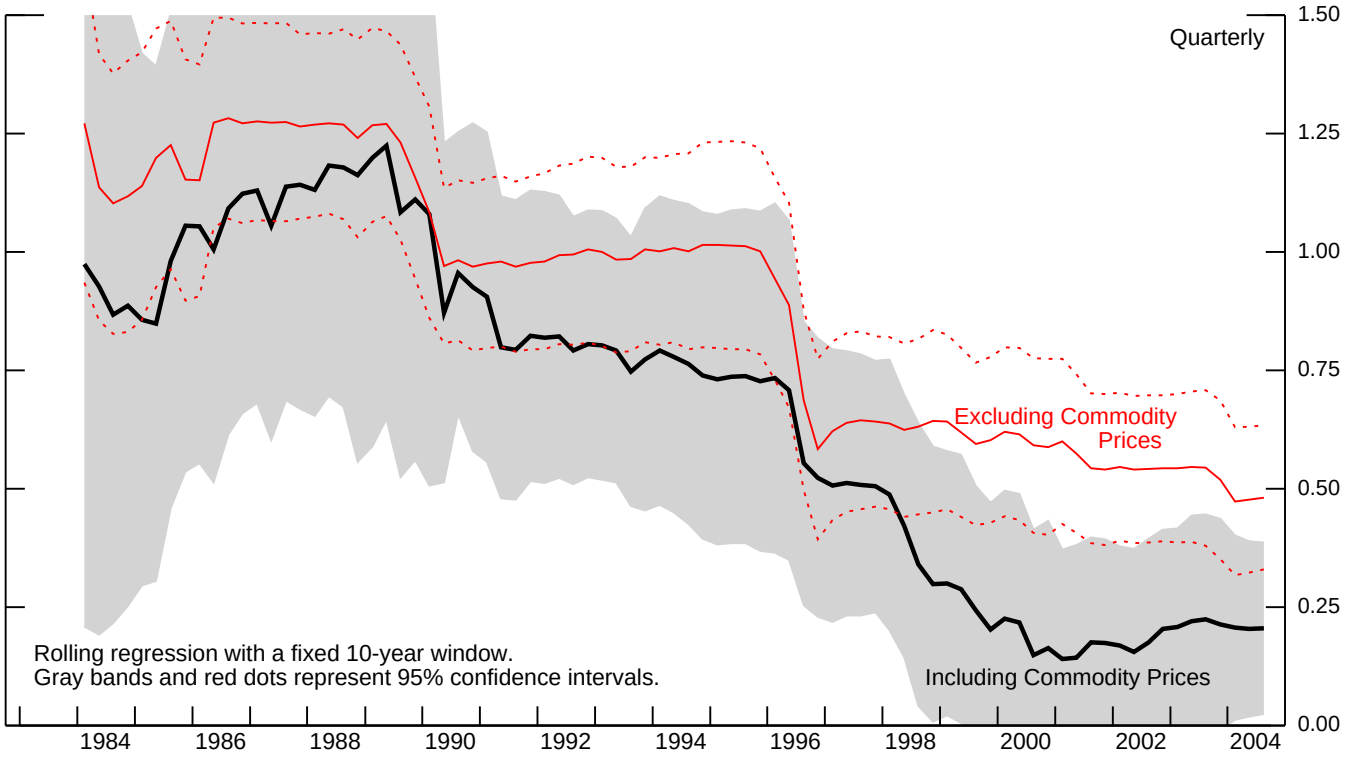


With Four Lags



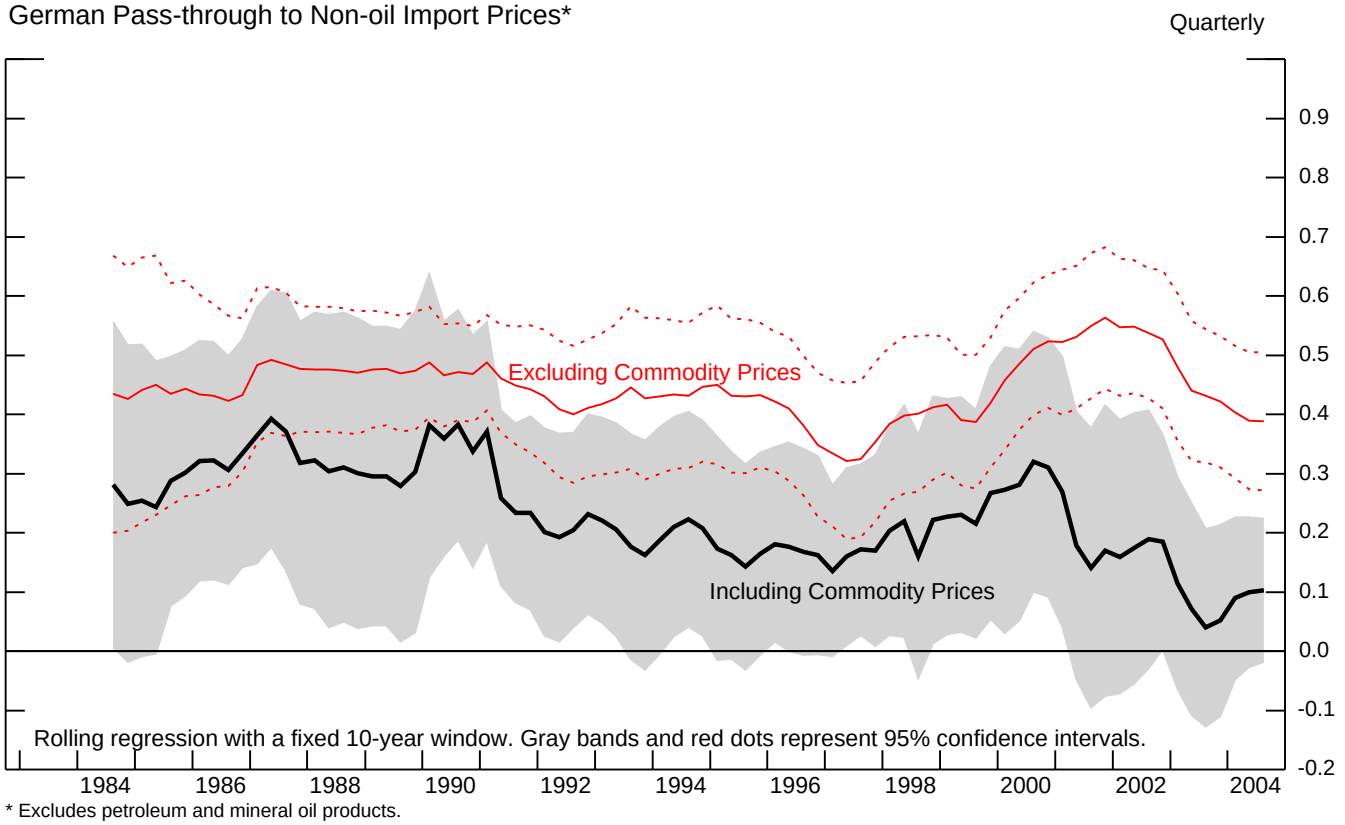
Exchange Rate Pass-through to German and Japanese Import Prices

Japanese Pass-through to Non-oil Import Prices*



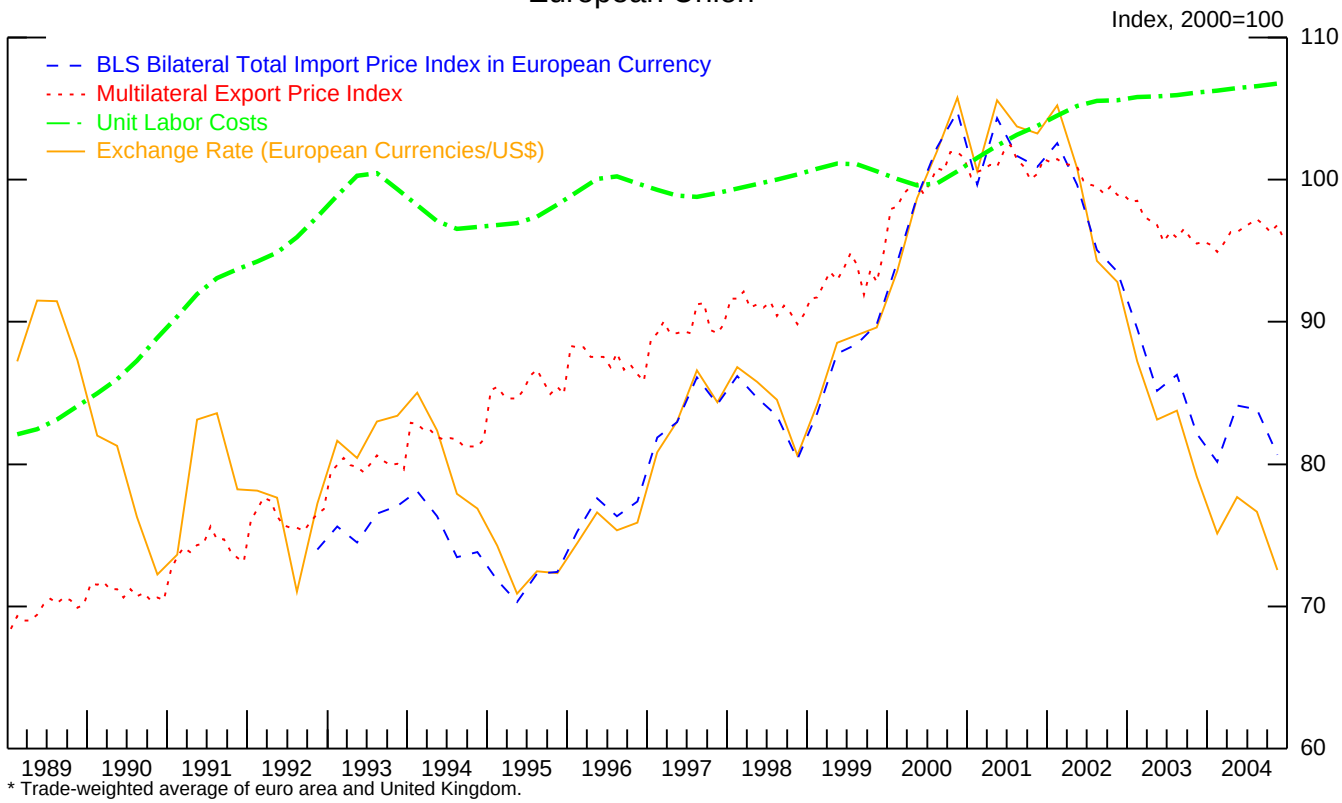
* Excludes petroleum, coal, and natural gas products.

German Pass-through to Non-oil Import Prices*



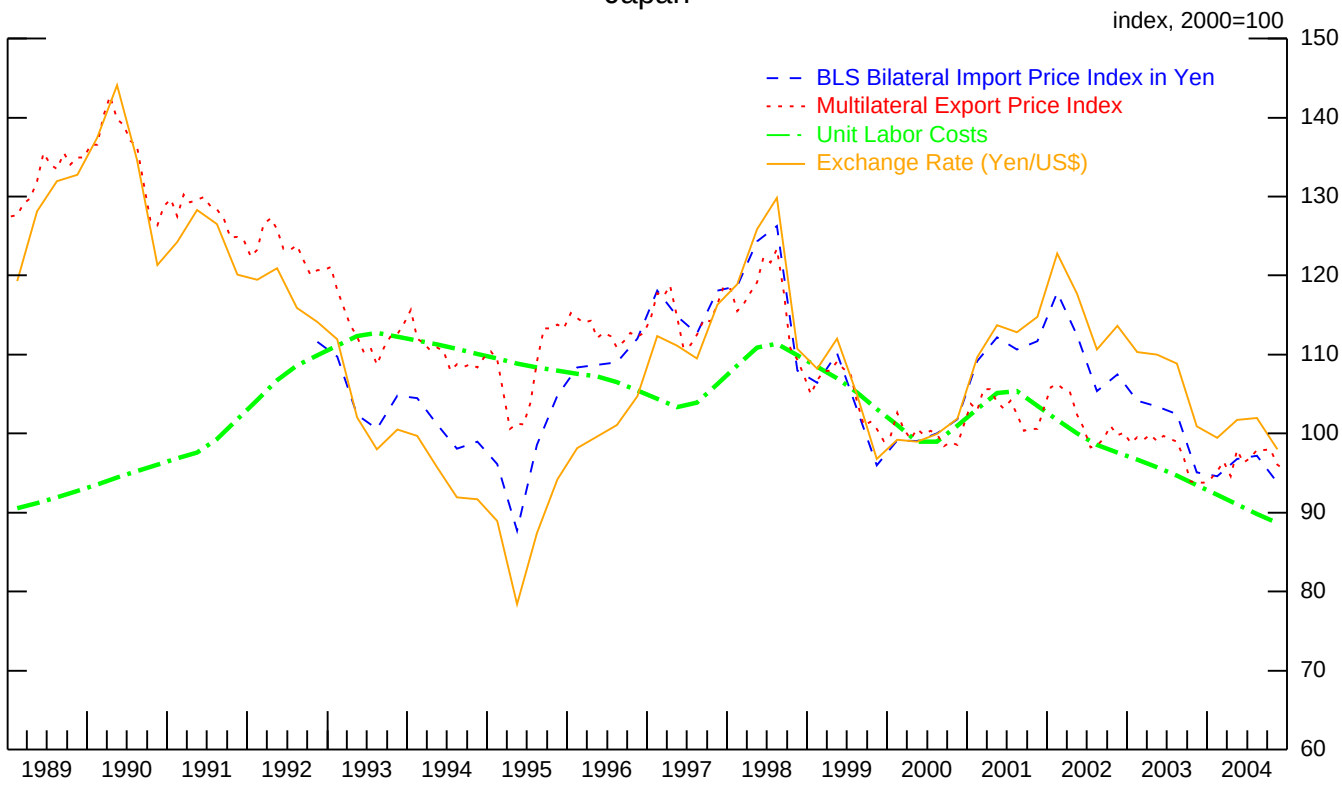
* Excludes petroleum and mineral oil products.

European Union*

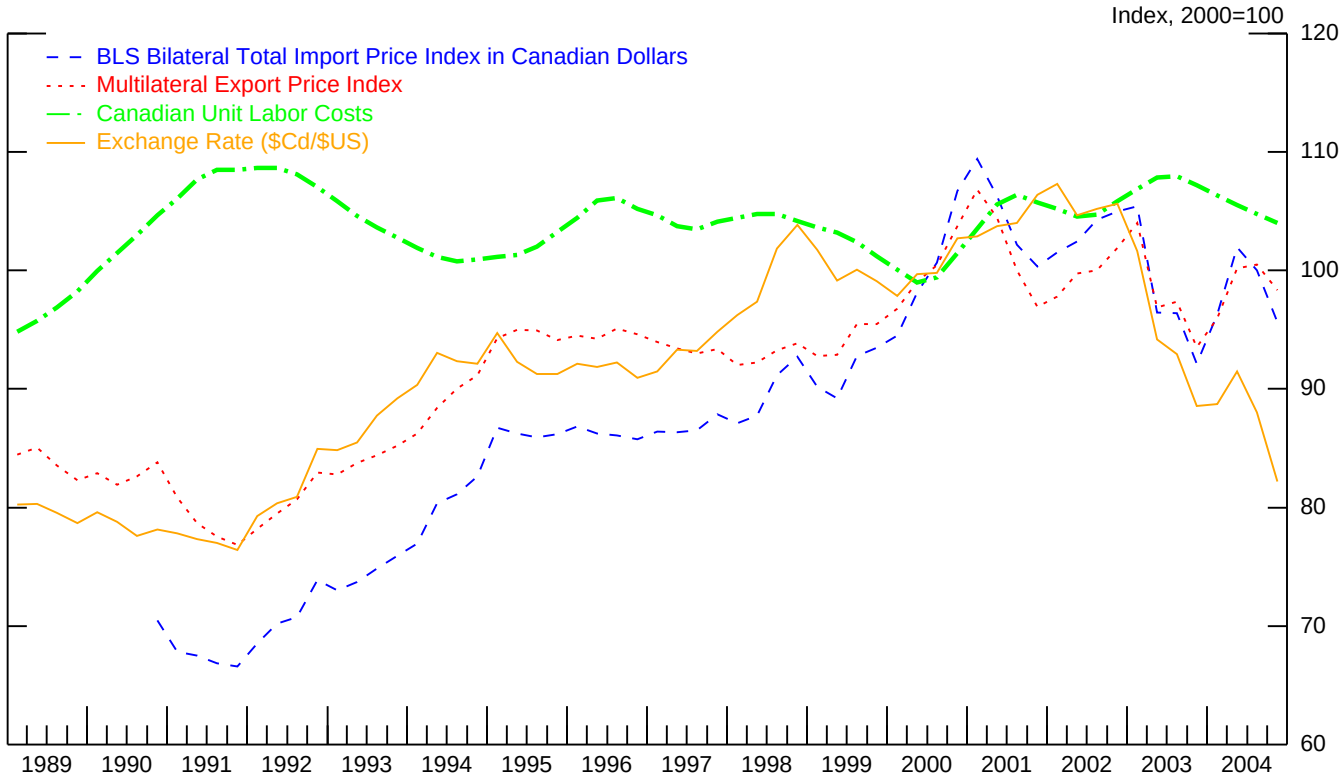


* Trade-weighted average of euro area and United Kingdom.

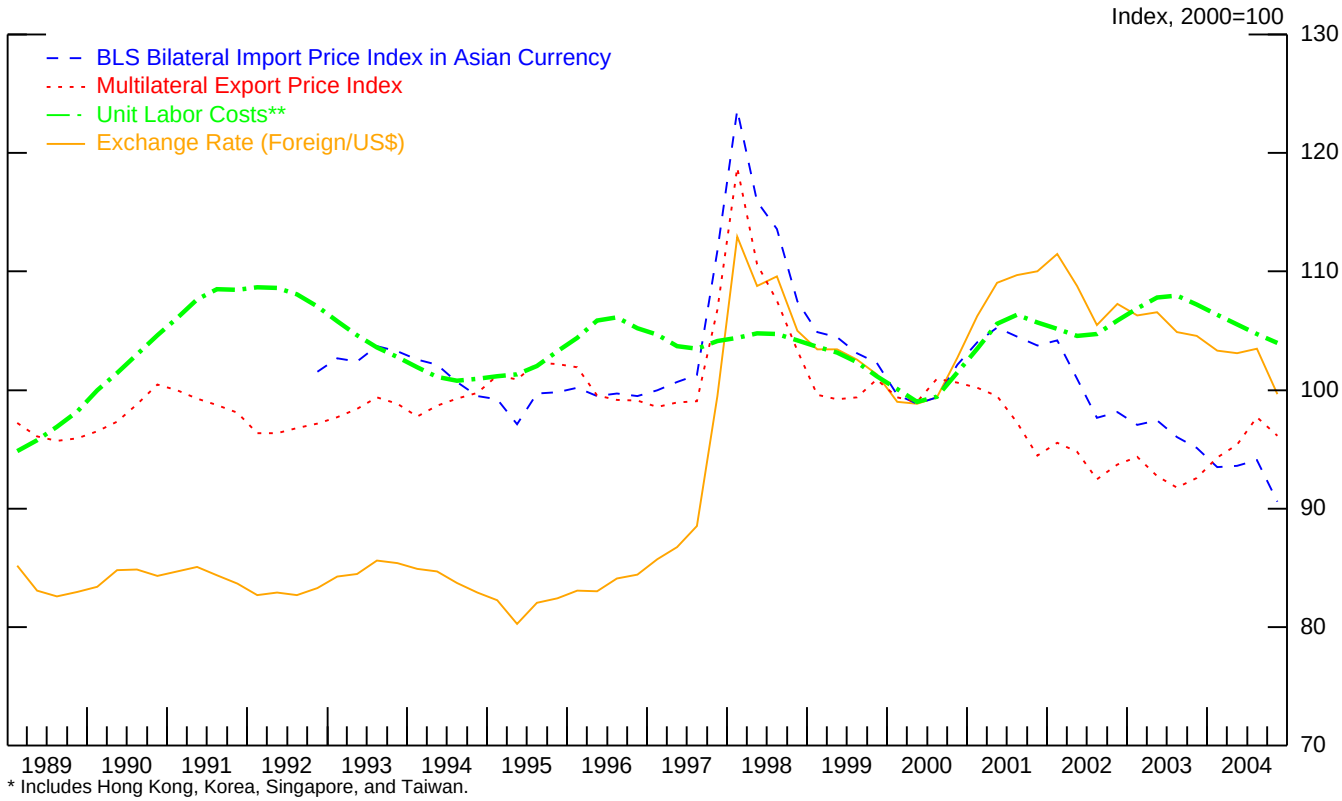
Japan



Canada



Asian NIEs*



* Includes Hong Kong, Korea, Singapore, and Taiwan.
** Unit labor costs are for Korea.

Foreign Export Prices and Unit Labor Costs

Percent Change

Source	1995:Q2 - 2002:Q1 Export Prices (1)	1995:Q2 - 2002:Q1 Unit Labor Costs (2)	1995:Q2 - 2002:Q1 Difference (3)=(1)-(2)	2002:Q1 - 2004:Q4 Export Prices (4)	2002:Q1 - 2004:Q4 Unit Labor Costs (5)	2002:Q1 - 2004:Q4 Difference (6)=(4)-(5)
European Union						
Bilateral U.S. Total	45.9	7.8	38.2	-21.4	2.1	-23.5
Bilateral U.S. Manuf.	45.7	7.8	37.9	-22.7	2.1	-24.8
Multilateral	19.4	7.8	11.6	-4.9	2.1	-7.0
Japan						
Bilateral U.S.	34.3	-6.5	40.8	-20.4	-12.9	-7.5
Multilateral	4.8	-6.5	11.3	-8.9	-12.9	4.0
Canada						
Bilateral U.S. Total	17.7	3.8	13.9	-5.8	-1.1	-4.7
Bilateral U.S. Manuf.	15.6	3.8	11.8	-14.2	-1.1	-13.1
Multilateral	2.9	3.8	-0.9	0.6	-1.1	1.7
Asian NIEs*						
Bilateral U.S.	7.3	-6.6	13.9	-13.0	-2.4	-10.6
Multilateral	-5.3	-6.6	1.3	2.3	-2.4	4.7

* Includes Hong Kong, Korea, Taiwan, and Singapore; unit labor costs are for Korea.

Source: Bilateral import prices are from the BLS (expressed in terms of exporter's currency); multilateral export prices are from country sources; unit labor costs are from OECD.

Response of Foreign Multilateral Export Prices to NEER

Country/Region	Exchange Rate		Exporting Country's Prices			
	Response	Confidence Band (95%)	Response	Confidence Band (95%)	R^2	Start Date
	(1)	(2)	(3)	(4)	(5)	(6)
European Union	0.26	(0.08, 0.44)	0.79	(0.18, 1.40)	0.31	1990
Of which:						
Germany	0.03	(0.00, 0.06)	1.08	(1.00, 1.17)	0.87	1975
United Kingdom	0.33	(0.21, 0.45)	0.19	(0.06, 0.32)	0.41	1980
Japan	0.47	(0.41, 0.54)	0.20	(-0.18, 0.58)	0.88	1980
Canada	0.36	(0.11, 0.61)	0.71	(0.24, 1.17)	0.24	1980
Asian NIEs*	0.28	(0.10, 0.45)	1.11	(0.76, 1.46)	0.55	1981
Memo:						
United States	0.12	(-0.02, 0.26)	0.71	(0.35, 1.07)	0.18	1980

* Includes Hong Kong, Korea, Singapore, and Taiwan.

Response of Foreign Multilateral Export Prices to U.S. Dollar

Country/Region	Exchange Rate Response (1)	Exchange Rate Confidence Band (95%) (2)	Exporting Country's Prices Response (3)	Exporting Country's Prices Confidence Band (95%) (4)	R^2 (5)	Start Date (6)
European Union	0.24	(0.13, 0.36)	0.76	(0.20, 1.31)	0.44	1990
Of which:						
Germany	0.02	(0.00, 0.04)	1.07	(0.99, 1.15)	0.88	1971
United Kingdom	0.23	(0.15, 0.32)	0.14	(0.00, 0.28)	0.43	1980
Japan	0.45	(0.41, 0.49)	0.32	(0.13, 0.52)	0.92	1980
Canada	0.34	(0.10, 0.59)	0.57	(0.11, 1.03)	0.23	1980
Asian NIEs*	0.29	(0.20, 0.39)	0.85	(0.62, 1.09)	0.81	1981

* Includes Hong Kong, Korea, Singapore, and Taiwan.

Country/Region	Exchange Rate Response (1)	Confidence Band (95%) (2)	R^2 (3)	Start Date (4)
European Union	0.28	(0.13, 0.40)	0.40	1990
Of which:				
Germany	0.08	(0.05, 0.11)	0.10	1971
United Kingdom	0.28	(0.21, 0.35)	0.40	1980
Japan	0.47	(0.43, 0.52)	0.90	1980
Canada	0.40	(0.13, 0.64)	0.19	1980
Asian NIEs*	0.31	(0.19, 0.46)	0.65	1981

* Includes Hong Kong, Korea, Singapore, and Taiwan.

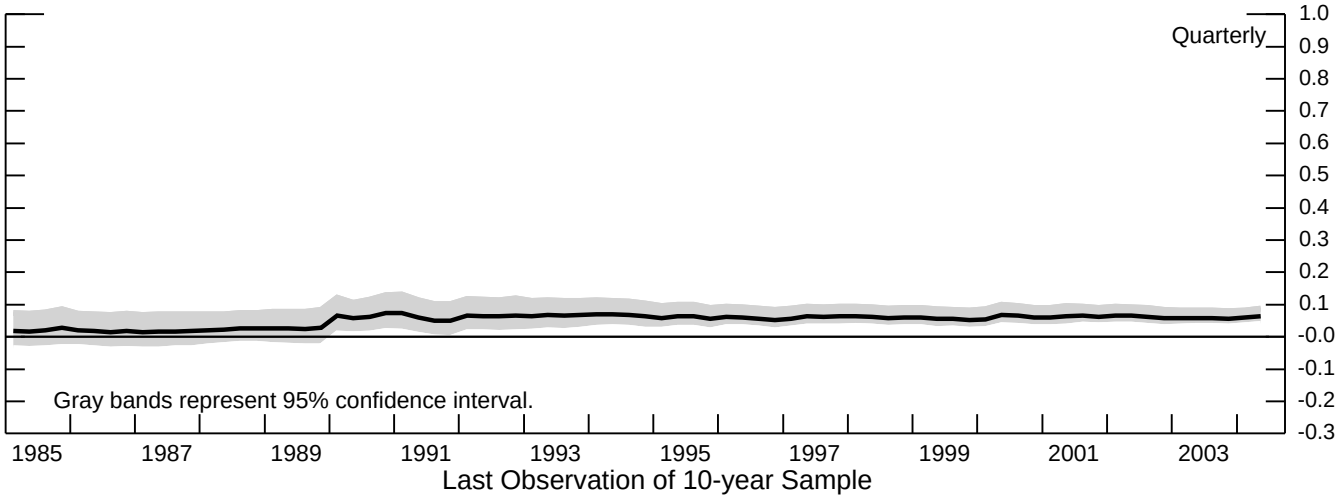
Response of BLS Bilateral Price Indexes to U.S. Dollar

Country/Region	Exchange Rate Response (1)	Exchange Rate Confidence Band (95%) (2)	Exporting Country's Prices Response (3)	Exporting Country's Prices Confidence Band (95%) (4)	R^2 (5)	Start Date (6)
European Union						
Total	0.70	(0.63,0.77)	0.28	(-0.01, 0.57)	0.95	1991
Manufacturing	0.70	(0.65, 0.76)	0.12	(-0.14, 0.37)	0.96	1991
Japan	0.77	(0.72,0.82)	-0.25	(-0.83, 0.33)	0.98	1990
Canada						
Total	0.72	(0.41, 1.03)	0.22	(-1.05, 1.49)	0.52	1991
Manufacturing	0.77	(0.63, 0.91)	0.27	(-0.29, 0.84)	0.86	1991
Asian NIEs*	0.74	(0.66, 0.81)	0.08	(-0.10, 0.28)	0.96	1991

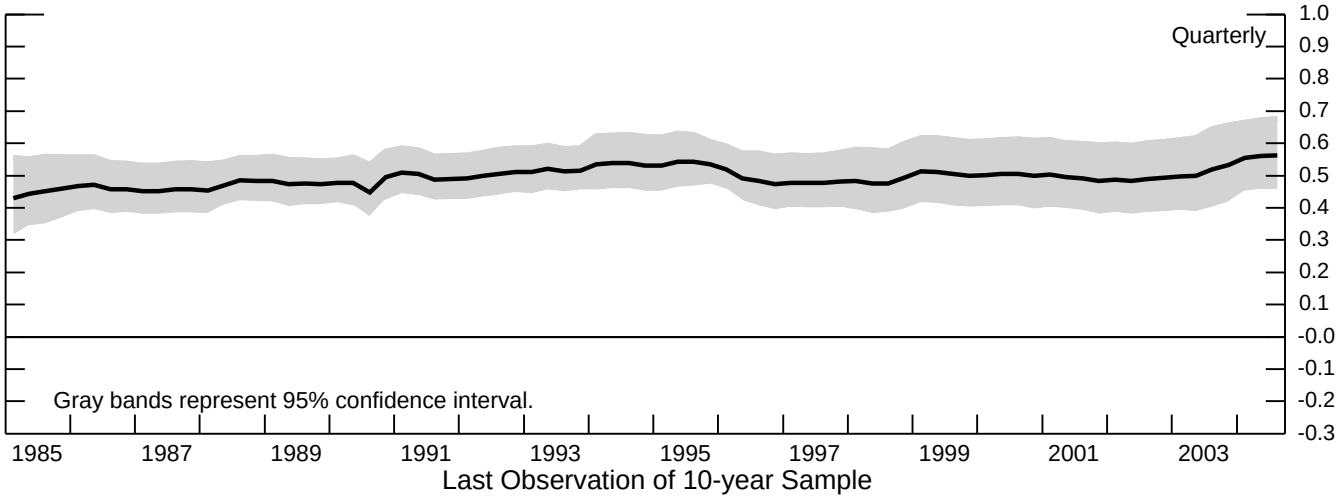
* Includes Hong Kong, Korea, Singapore, and Taiwan.

Rolling Regression: Response of Export Prices to NEER

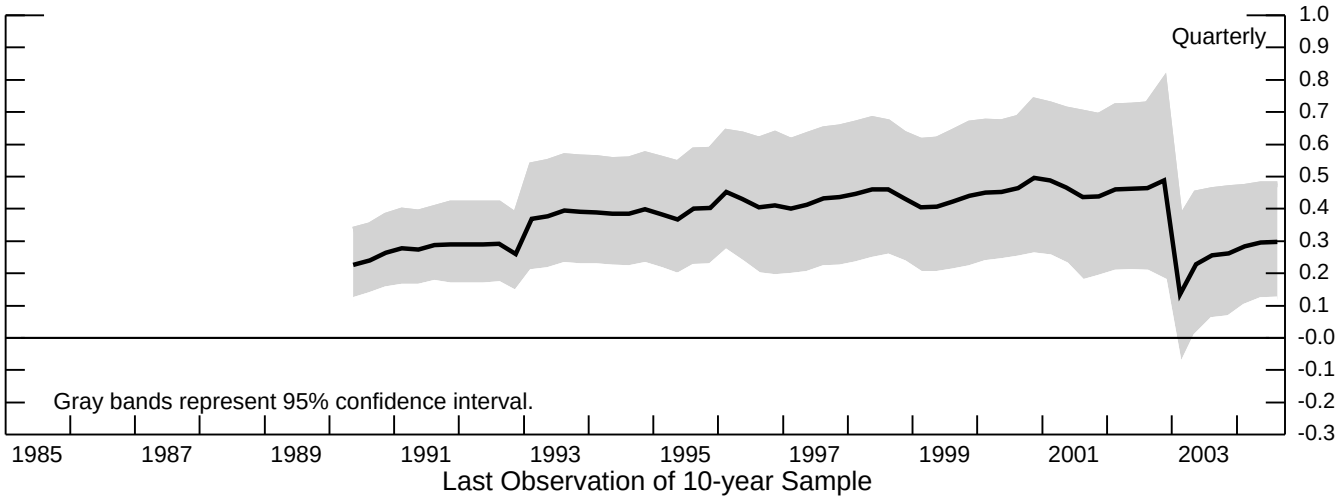
Germany



Japan

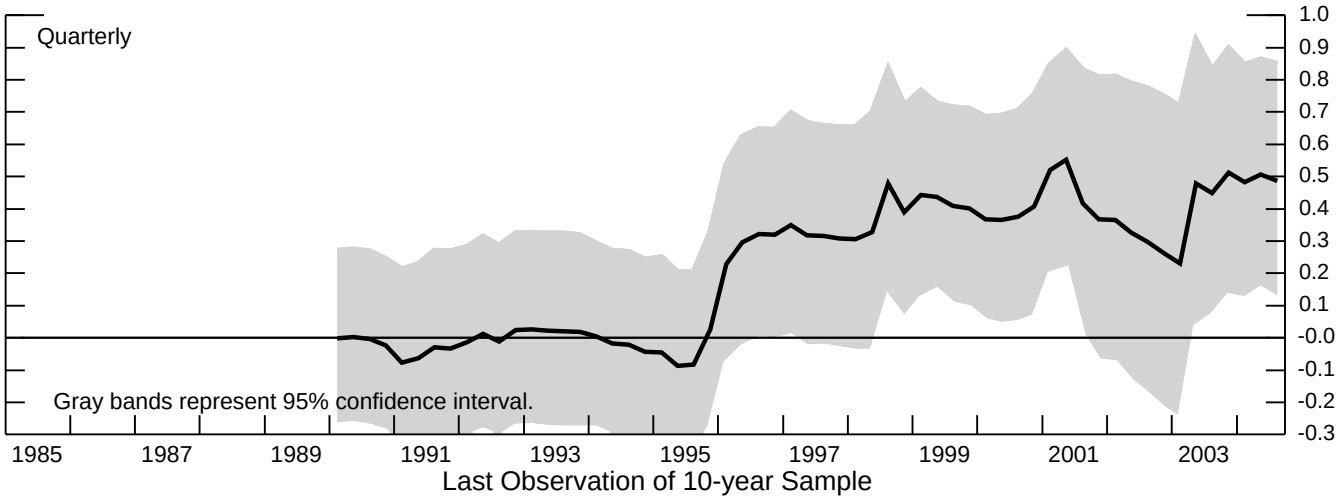


United Kingdom



Rolling Regressions: Response of Export Prices to NEER (continued)

Canada



Asian NIEs