Exchange Rates and the Prices of Manufacturing Products Imported into the United States

Giovanni P. Olivei

Economist, Federal Reserve Bank of Boston. Jennifer Young provided outstanding research assistance.
giovanni.olivei@bos.frb.org

Exchange rate fluctuations remain remarkably large, despite the steady decline in the volatility of the trade-weighted dollar since the late 1980s. Yet large fluctuations in the value of the dollar do not translate into similarly large swings in the domestic production of traded goods relative to foreign. The reason lies mainly in the fact that the prices of imported goods do not usually respond one-for-one to changes in the exchange rate. The extent and pervasiveness of such a phenomenon, often labeled as incomplete "pass-through" of exchange rates to import prices, has long been debated in academic and policy circles.

From a macroeconomic standpoint, knowing how much of a change in the exchange rate is passed through to import prices is important for assessing the effects of changes in currency value on both the balance of payments and domestic inflation. Of particular interest is whether the devaluation of a nation's currency would improve its external balance. From an imports perspective, this amounts to asking what portion of the devaluation would be passed through to local-currency import prices. Other things equal, the lower the degree of pass-through, the larger the currency depreciation needed to achieve a given reduction in the quantity of imports.

A related question concerns the effect of exchange rate changes on overall domestic inflation. Some have argued that low import prices were the main reason behind the low inflation rates that characterized the U.S. expansion through the late 1990s.[1] According to this view, import prices helped to keep inflation low not only via their direct effect on overall inflation, but also indirectly by putting pressure on domestic firms to maintain stable prices. While contentious, this argument highlights the

importance of knowing how the prices of imported goods are set and specifically how these prices are affected by fluctuations in the exchange rate.

A few studies have conveyed the notion that pass-through to import prices has been declining in the recent past, across both industrialized and developing countries. Most of this work relies on event studies and examines the impact of exchange rate changes on overall inflation.[2] The finding that the response of domestic inflation to exchange rate changes was more muted in recent episodes than in earlier periods is consistent with declines in pass-through into import prices. Yet, despite the abundance of empirical research on the relationship between exchange rates and import prices,[3] there is little systematic evidence on the time-series dimension of pass-through that encompasses the most recent years.

This study provides some updated estimates of the responsiveness of U.S. import prices to changes in the exchange rate over the period 1981 to 1999.

In this article, we provide some updated estimates of exchange rate pass-through to U.S. import prices that span the period 1981 to 1999. We use a cross-section of manufacturing industries at the 2-, 3-, and 4-digit Standard Industry Classification (SIC) level. These cover almost 75 percent of non-energy commodities imported into the United States. As in previous studies, we find a considerable degree of variation in pass-through across different industries. In addition, we document a decline in pass-through for the majority of industries in the most recent decade. For the industries in our sample, pass-through was 0.50 on average in the 1980s and dropped to an average of about 0.25 in the 1990s. This means that, other things equal, while in the 1980s a 1 percent dollar depreciation would translate into a 0.50 percent increase in import prices, in the 1990s the increase was only 0.25 percent. As with other studies, we find that it is difficult to relate the change in pass-through to macroeconomic outcomes such as the lower inflation rates achieved in many countries.

The rest of the article proceeds as follows. Section I provides a review of the microeconomic underpinnings of exchange rate pass-through. Section II describes the empirical framework used to estimate pass-through, while Section III describes the data used in this study. Section IV discusses the empirical results, and Section V provides some comments about the empirical findings. Section VI offers some concluding remarks.

I. Exchange Rate Pass-Through

Exchange rate pass-through denotes the impact of a change in the exchange rate between exporting and importing countries on local-currency prices of imports. Pass-through is "complete" when the response of import prices to exchange rate movements is one-for-one. Taking the United States as the importing country, this means that a *k*-percent appreciation (depreciation) of the dollar vis-à-vis the currency of a country exporting to the United States translates into a *k*-percent decrease (increase) in the U.S. dollar price of the goods the United States is importing from that country.

In the standard Mundell-Fleming setup, the assumption of complete pass-through informs the adjustment process of the current account to exchange rate movements. Yet, it is well-known that two factors determine the extent of pass-through: the responsiveness of markups to competitive conditions and the degree of returns to scale in the production of the imported good.

If the typical foreign firm sets the price of a good exported to the United States as a constant markup over marginal costs (with price and marginal costs measured in the same currency), then complete pass-through occurs when returns to scale are constant. In this scenario, a *k*-percent dollar appreciation lowers the foreign firm's marginal costs measured in dollars by the same amount. With a constant markup, the dollar price of the imported good must then decline by *k* percent. Pass-through will be less than full when returns to scale are decreasing. The increase in U.S. demand for the imported good brought by a dollar appreciation now puts upward pressure on the foreign firm's marginal costs. Thus, when measured in dollars, marginal costs decline by less than *k* percent in response to a *k*-percent dollar appreciation. Since the

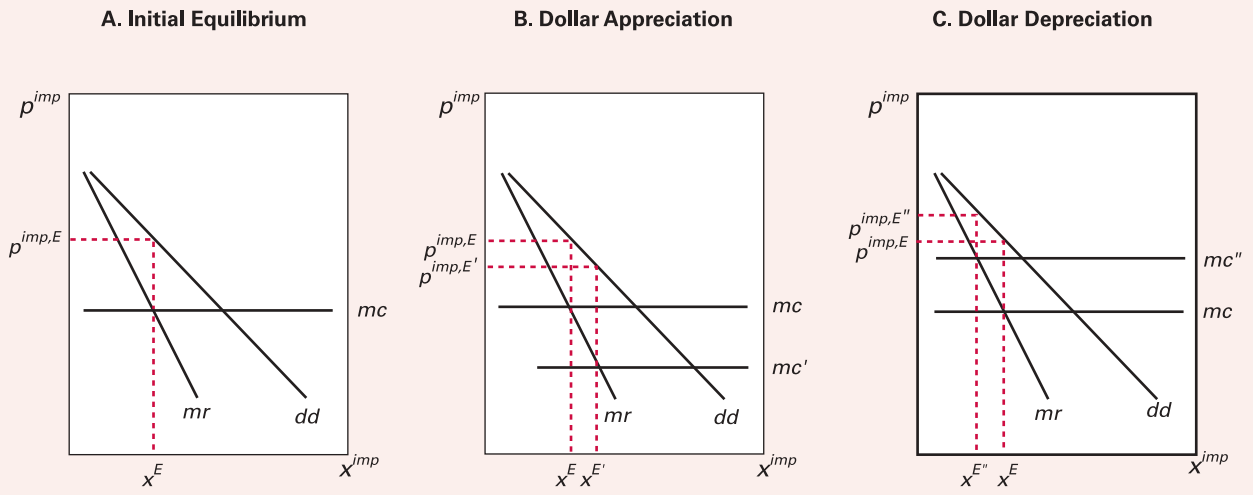
[1] See, for example, Rich and Rissmiller (2000).

[2] See, for example, Cunningham and Haldane (1999).

[3] A comprehensive and thoughtful review of the literature on exchange rates and prices can be found in Goldberg and Knetter (1997).

Figure 1

Exchange Rate Pass-Through with a Monopolistic Foreign Firm



markup is constant, this leads to incomplete pass-through (that is, a decline in the dollar price of the imported good of less than k percent).[4]

A constant markup of price over costs is typical of industries with a very large number of firms, where the impact of any individual firm's price changes on the industry price is negligible.[5] In an oligopoly setting, instead, the markup will usually depend on the good's dollar price and the dollar price of competing goods, and the strength of demand for both the imported and the competing goods.

To illustrate how the markup may respond to changes in the dollar price of the imported good, consider a simple example in which a monopolist foreign firm sells all its output to the United States. We assume that the linear demand curve *dd* depicted in panel A of Figure 1 represents the demand for the imported good as a function of p^{imp}, the dollar price of the imported good. Profit maximization requires equalization of marginal revenue and marginal costs (both expressed in dollars), which occurs at the intersection of the schedules *mr* and *mc*. Note that the marginal cost schedule *mc* is flat, implying constant returns to scale. The firm sets the profit-maximizing price $p^{imp,E}$ as a markup over marginal costs, with x^E denoting the quantity of the imported good demanded at $p^{imp,E}$.

Panel B of Figure 1 illustrates how a dollar appreciation affects the dollar price of the imported good. The appreciation lowers the dollar cost of producing the good, and thus the marginal cost schedule shifts down by the same proportion of the appreciation.[6] The graph shows that at the new equilibrium the difference between the dollar price of the imported good, $p^{imp,E'}$, and marginal cost, mc', is larger than at the old equilibrium. This signals that the foreign firm charges a higher markup over production costs in dollars. The graph also shows that as a consequence of the higher markup, the decline in the dollar price of the imported good is smaller than the dollar appreciation.

[4] The opposite result occurs in the presence of increasing returns to scale, where a change in the exchange rate is more than fully passed through in the import price.

[5] In the limiting case of a perfectly competitive industry, the markup will be constant at zero. In a setting with monopolistic competition à la Dixit and Stiglitz (1977), the markup will be positive but constant, since a firm's market share is infinitely small.

[6] The assumption that the foreign firm's costs in dollars decline by the same percentage of the dollar appreciation implies that the change in the exchange rate has no impact on the foreign price of inputs used in the production of the good. This is a reasonable approximation for labor inputs, but it is an unrealistic assumption when the firm heavily relies on imported raw materials and energy. In this case, a dollar appreciation would raise the foreign price of imported raw materials and energy. It is easy to show that allowing for this effect would lower the extent of exchange rate pass-through, other things equal.

Panel C of Figure 1 illustrates the opposite case of a dollar depreciation. The depreciation raises the dollar cost of producing the good, and thus the marginal cost curve shifts up. At the new equilibrium the dollar price of the imported good increases by less than the increase in marginal cost brought by the depreciation. This implies that the foreign firm charges a lower markup over production costs in dollars.

The simple example in Figure 1 shows that exchange rate pass-through can be less than complete even in the presence of constant returns to scale. The linear demand curve depicted in the figure generates the inverse relationship between p^{imp} and the markup that results in a less than complete pass-through.[7] This inverse relationship is present whenever the demand curve is less convex than a constant-elasticity curve. As the reader can easily verify, increasing marginal costs (that is, decreasing returns to scale) would lower the extent of exchange rate pass-through. Vice versa, decreasing marginal costs (increasing returns to scale) would increase the extent of pass-through. In principle, the case where a change in the exchange rate is more than fully passed through cannot be ruled out when returns to scale are sufficiently large to more than compensate for the opposite effect of a variable markup.[8] Appendix 1 provides an analytical derivation of the pass-through elasticity in the context of a stylized setup that forms the basis for our empirical investigation.

To summarize, the two determinants of exchange rate pass-through, the responsiveness of markups to competitive conditions and the degree of return to scale in production, can interact in different ways to produce different outcomes. The extent of exchange rate pass-through then becomes an inherently empirical issue, to which we turn next.

II. The Empirical Framework

As shown in Appendix 2, the starting point for empirically assessing the extent of exchange rate pass-through is a relationship of the following form:

$$\ln p^{imp} = b_0 + b_1(\ln w^* + \ln e) + b_2 \ln q + b_3 \ln I + \varepsilon, \quad (1)$$

where w^* is an aggregate of foreign factor prices used in the production of the good, e is the exchange rate that converts foreign costs into dollars (a dollar appreciation corresponds to a fall in e), q is an index of prices of competing varieties, I is the consumers' expenditure on the imported good and the competing varieties, and ε is an error term. The price of the imported good is set as a markup over costs in dollars. The markup generally depends on p^{imp}, q, and I, and so does the quantity produced of the imported good. As a result, the price of the imported good can be written as a function of (w^*e,q,I), of which equation (1) is an approximation. The parameter b_1 denotes the extent of exchange rate pass-through (the pass-through elasticity), with $b_1 = 1$ indicating complete pass-through and $b_1<1$ incomplete pass-through.

We estimate a first-difference version of equation (1) of the following form:

$$\Delta\ln\left(\frac{p^{imp}}{P}\right)_t = b_t + b_1\Delta\ln\left(\frac{eP^*}{P}\right)_t +$$

$$b_2\Delta\ln\left(\frac{q}{P}\right)_t + b_3\Delta\ln\left(\frac{I}{P}\right)_t + \rho\Delta\ln\left(\frac{p^{imp}}{P}\right)_{t-1} + \varepsilon_t, \quad (2)$$

where P and P^* denote the U.S. and foreign wholesale price indices, respectively, and, for any variable x, $\Delta\ln x = \ln x - \ln x_{-1}$. The derivation of this equation is left to Appendix 2. Here, we note that the intercept term, b_t, is time-varying and is meant to capture changes in the rate of growth of real foreign factor prices, w^*/P^*. A lag of the dependent variable was added as a regressor to allow for the possibility that foreign firms take time to adjust p^{imp} in response to a change in the exchange rate. Moreover, in deflating the variables by the U.S. wholesale price index P, we made use of the fact that p^{imp} is homogeneous of degree 1 in (w^*e,q,I), which implies the restriction $b_1 + b_2 + b_3 = 1$. Such a restriction will be tested in the data as a way to gauge the validity of the specification.

---

[7] With a linear demand curve, the decline (rise) in p^{imp} is associated with a decline (rise) in the demand elasticity of the imported good. It is well known that marginal revenues can be written as follows:

$$mr = p^{imp}\left(1 - \frac{1}{|\varepsilon|}\right),$$

where $|\varepsilon|>1$ denotes the absolute value of the demand elasticity of the imported good. Since the demand elasticity and p^{imp} are positively related, p^{imp} needs to change by a smaller proportion than marginal costs to restore equality between marginal costs and marginal revenues. Note also that the expression in brackets on the right-hand side of the equation is the inverse of the markup, so that p^{imp} and the markup are negatively related.

[8] While the example refers to a monopolist firm, it is possible to show that in a more realistic setup where domestic and foreign firms produce differentiated products and engage in Bertrand competition, it is still the case that pass-through will be less than complete whenever the demand curve for the imported good is less convex than a constant-elasticity curve (see Feenstra 1989). Even when such a condition on the shape of the demand curve is satisfied, the proviso that marginal costs need to be constant or decreasing continues to apply.

Table 1
Imported Goods by Product Groupings

SITC	Category	Imputed SIC
5	Chemicals and related products, n.e.s.	28
51	Organic chemicals	286
54	Medicinal and pharmaceutical products	283
55	Essential oils; polishing and cleansing preps	2842
59	Chemical materials and products, n.e.s.	2899
62	Rubber manufactures, n.e.s.	30
67	Iron and steel	332
68	Nonferrous metals	333
684	Aluminum	3334
694	Nails, screws, nuts, bolts, rivets, of iron, steel, copper, or aluminum	3452
72	Machinery specialized for particular industries	355
724	Textile and leather machinery, and parts thereof, n.e.s.	3552
73	Metalworking machinery	354
74	General industrial machinery, equipment, and machine parts, n.e.s.	356
743	Pumps, compressors, fans, centrifuges, and filtering apparatus	3561
75	Computer equipment and office machines	357
762	Radio-broadcast receivers	3662
763	Sound recorders or reproducers; television image and sound recorders	3651
764	Telecommunications equipment and parts, n.e.s.	366
77	Electrical machinery and equipment	36
771	Electric power machinery (except rotating power machinery) and parts thereof	3621
772	Electrical circuitry equipment	3613
775	Household-type electrical and nonelectrical equipment, n.e.s.	363
776	Electronic valves and tubes, diodes, transistors, and integrated circuits	367
78	Road vehicles	371
84	Articles of apparel and clothing accessories	23
85	Footwear	314
87	Professional, scientific, and controlling instruments and apparatus, n.e.s.	38
881	Photographic apparatus and equipment, n.e.s.	386
884	Optical goods, n.e.s.	383
89	Miscellaneous manufactured articles, n.e.s.	39
894	Baby carriages, toys, games, and sporting goods.	394
897	Jewelry and other articles of precious materials, n.e.s.	391
898	Musical instruments, CDs, tapes, other sound recordings	3931

Note: n.e.s. = not elsewhere specified.

From (2), it is possible to estimate a short-run exchange rate pass-through elasticity, b_1, and a long-run elasticity, $b_1/(1-\rho)$. An alternative specification would include lags of the exchange rate, instead of one lag of the dependent variable, as regressors. The pass-through estimates are generally quite similar under the two specifications, and we will note when this is not the case. Before turning to the estimation results, in the next section we provide a brief summary of the most important features of the data used in this study.

III. The Data

The U.S. Bureau of Labor Statistics (BLS) constructs U.S. import price indices at different levels of aggregation for product groupings that are mainly in the manufacturing sector. In this study, we consider quarterly import price data that the BLS produces using the Standard International Trade Classification (SITC) structure.[9] Table 1 provides a description of the product groupings we consider, together with the SITC mnemonics. The table lists 34 series (1 1-digit, 17 2-digit, and 16 3-digit SITC product grouping series), which represent approximately 75 percent of the value of non-energy goods imported into the United States. Note that there are 2-digit SITC series that overlap with one or more constituent 3-digit

[9] The use of SITC import price indices over SIC indices is rendered necessary by the fact that the BLS discontinued the publication of SIC import price indices in the early 1990s.

SITC series, and a 1-digit SITC series that overlaps with some constituent 2-digit SITC series. However, since the overlap is partial, we still consider in our analysis the 1-digit and 2-digit overlapping series.

The SITC groupings differ from the SIC industry groupings. Since other U.S. data used in this analysis are classified according to SIC, it becomes necessary to reconcile the SITC series with the SIC classification. This is done in the third column of Table 1. The reconciliation is imperfect in some cases and involves judgment, but we have limited the analysis to the groupings for which the attribution was not too problematic.

We construct a trade-weighted measure of the real exchange rate specific to each series in Table 1. For each of the groupings, we use as weights the import shares for the five countries from which the United States imports most. The information for constructing the weights is taken from U.S. import flows data by 4-digit SIC category assembled by Robert Feenstra for the period 1972 to 1994.[10] Wholesale price indices are used for constructing the real exchange rate. When the wholesale price index is not available for a particular country, we use the consumer price index.

Table 2
Exchange Rate Pass-Through Elasticities in the Short and Long Run, 1981 to 1999

SIC Category	Short-Run Elasticity	Long-Run Elasticity	Homogeneity Test [a]
28	.2023 *	.2127 *	Yes
286	.1348	.1463	No
283	.2414 *	.3605 *	Yes
2842	.4594 *	.4144 *	Yes
2899	.3387 *	.5075 *	No
30	.0696	.0968	Yes
332	.2813 *	.5321 *	Yes
333	.7716 * +	.9163 * +	Yes
3334	.9469 * +	.8891 * +	No
3452	.2949 *	.5280 *	Yes
355	.5344 *	.6026 *	Yes
3552	.4862 *	.5906 *	Yes
354	.4834 *	.5421 *	Yes
356	.4982 *	.6525 *	No
3561	.4350 *	.4957 *	Yes
357	.2552 *	.3371 *	[b]
3662	.0858 *	.0829 *	Yes
3651	.1777 *	.2127 *	Yes
366	.1180 *	.1511 *	Yes
36	.2781 *	.3269 *	Yes
3621	.4263 *	.4900 *	Yes
3613	.6773 *	.8706 * +	Yes
363	.1999 *	.1768 *	Yes
367	.3439 *	.3760 *	Yes
371	.2462 *	.3851 *	Yes
23	.1717 *	.1673 *	Yes
314	.0636	.0961	No
38	.5780 *	.6211 *	Yes
386	.3117 *	.4550 *	Yes
383	.4791 *	.5404 *	Yes
39	.3314 *	.4038 *	Yes
394	.1586 *	.2095 *	Yes
391	.3233 *	.3406 *	Yes
3931	.1956 *	.3848 *	Yes

[a] The column reports whether the hypothesis that the homogeneity restriction embedded in equation (5) is not rejected at the 95 percent confidence level. See main text for details.

[b] In this product category the PPI index has been proxied by a trend, since the index is available for the most recent years only. As a result, it is not possible to test for the homogeneity restriction.

Note: * indicates that the estimated coefficient is significantly different from zero at the 95 percent confidence level, and + indicates that the estimated coefficient is not significantly different from one at the 95 percent confidence level.

As a measure for q, the price of competing goods, we use the domestic price index from the corresponding SIC industry for each of the groupings in Table 1. When this is not available, we use the domestic price index from the corresponding 2-digit SIC industry. As a measure for I, the total U.S. expenditure on each product grouping, usually no data are available at quarterly frequencies. Thus, we proxy I with U.S. industrial production for the corresponding 2-digit (when available, 3-digit) SIC industry. The price index P that deflates all variables in equation (2) is the U.S. wholesale price index.

[10] The data can be retrieved from the Center for International Data at UC Davis (*http://data.econ.ucdavis.edu/international/*). We let the weights vary every six years. Specifically, we use import shares for the year 1994 to construct fixed weights over the period 1994 to 1999, import shares for the year 1988 to construct fixed weights for the period 1988 to 1993, and so on.

IV. Estimation Results

Most of the import price indices in Table 1 start in the early 1980s. We therefore estimate equation (2) for each of the product groupings in Table 1 over the period 1981 to 1999. Our interest is in the estimated value of the short-run and long-run exchange rate pass-through elasticities, b_1 and $b_1/(1-\rho)$, respectively. There are potential issues of simultaneity in the estimation of (2). The discussion in Section I about exchange rate pass-through was partial equilibrium in nature, in that any change in the exchange rate was assumed exogenous and the import sector small enough to impart negligible changes to aggregate variables. It is debatable whether the level of disaggregation in the data is enough to warrant the assumption of an exogenous exchange rate. Still, we opted not to instrument for exchange-rate changes because of the well-known difficulty in finding adequate instruments.[11]

Table 2 provides estimates of the short-run and long-run pass-through elasticities in the second and third columns, respectively, for each of the product groupings. As a check for the overall pricing specification adopted, we test the homogeneity of degree 1 restriction in the long run.[12] The fourth column of the table indicates whether one fails to reject the homogeneity hypothesis at the 95 percent confidence level.

Pass-through estimates are usually less than full, and the hypothesis that pass-through is full in the long-run is rejected in all but three industries.

The table shows that pass-through estimates are usually less than full, and the hypothesis that pass-through is full in the long run is rejected at standard confidence levels in all but three instances (product groupings SIC 333, SIC 3334, and SIC 3613). For the vast majority of the product groupings, the homogeneity of degree 1 restriction stemming from our price specification is not rejected.

There is a considerable degree of variation in pass-through across product groupings. Generally, industries belonging to SIC 33 (primary metals), SIC 35 (nonelectrical machinery), and SIC 38 (instruments and related products) have relatively higher pass-through elasticities than other industries. For the nonoverlapping sample of industries that we consider, the average short-run pass-through elasticity is 0.30. In accordance with the hypothesis that firms may be reluctant to change prices quickly following an exchange rate change, long-run estimates of the pass-through elasticity tend to be higher than their short-run counterparts. The average pass-through in the long run is 0.39. This is lower than estimates found in some previous studies, which are centered around 60 percent pass-through (see Goldberg and Knetter 1997). Using a variant of equation (2) that adds lags of the exchange rate in lieu of a lag in the dependent variable yields results similar to those reported in Table 2, although pass-through estimates for the groupings SIC 30 (rubber), SIC 357 (office and computing machines), and SIC 36 (electrical machinery) are somewhat higher.[13]

The difference from the estimates reported in some of the previous studies could be the result of the different specification and/or the different sample period used in this study. As concerns the specification, it is interesting to note that the results reported here are close to those in Yang (1997), which adopts a first-difference specification similar to the one in equation (2).[14] To the extent that the original series are stationary, differencing introduces a downward bias in the estimates. Given the low power of unit root tests over the short sample period we consider, the risk of over-differencing the data should be kept in mind.

As concerns the sample period, we now ask whether the pass-through estimates are stable over time. A few studies have documented a decline in the impact of exchange rate changes on *overall* inflation across industrialized as well as developing countries. This is consistent, among other things, with a decline in exchange rate pass-through into import prices. Cunningham and Haldane (1999), for example, document a very small exchange rate pass-through stemming from the 1992 and 1996 large swings in the value of the British pound (a 20 percent devaluation in 1992

[11] Issues of simultaneity, easier to resolve, involve the variables q/P and I/P, also. Point estimates do not change substantially when instrumenting $\Delta(q/P)_t$ and $\Delta(I/P)_t$ with their own lagged values, although standard errors become large. As a result, in the text we report regression results using no instruments.

[12] Thus, we test whether $(b_1 + b_2 + b_3)/(1-\rho)=1$.

[13] Specifically, long-run pass-through elasticities are estimated at 0.20, 0.45, and 0.50 respectively, versus the values 0.10, 0.34, and 0.33 reported in Table 2.

[14] The most important differences are that Yang (1997) does not allow for a time-varying intercept and does not use the homogeneity of degree 1 assumption to deflate right- and left-hand-side variables by a common price index.

and a similar appreciation in 1996). It has also been noted that the depreciation of the Brazilian real in early 1999 led to a much smaller pass-through to retail prices than in earlier episodes (Taylor 2000). McCarthy (2000) and Gagnon and Ihrig (2001) provide evidence that exchange-rate fluctuations during the 1990s exerted a smaller role on consumer price inflation in several industrialized countries.

Table 3 reports pass-through estimates when equation (2) is estimated over the periods 1981 to 1989 and 1990 to 1999. The table shows that for most product groupings there has been a decline in exchange rate pass-through to import prices. For example, in the road vehicles grouping (SIC 371) the long-run estimate of pass-through declined from about 0.50 to about 0.15.[15] During the 1980s, the average pass-though in the long run was 0.50, a value similar to estimates found in previous studies. It is possible to show that the decline in pass-through during the 1990s, to an average of 0.22, is statistically significant at standard confidence levels for several product groupings. The homogeneity assumption is usually not rejected in the 1980s subsample, but it is in about 30 percent of the cases in the 1990s subsample.

Table 3
Exchange Rate Pass-Through Elasticities in the Short and Long Run, 1981 to 1989 and 1990 to 1999

	1981–1989		1990–1999	
SIC Category	Short-Run Elasticity	Long-Run Elasticity	Short-Run Elasticity	Long-Run Elasticity
28	.2767 *	.2545 *	.1309 *	.1612 *
286	.2973 **	.2697 *	.0858	.0997
283	.2626 *	.4090 *	.2655 *	.2352 *
2842	.8499 *	.6550 *	.0317	.0230
2899	.4667 *	.5707 **	.1441	.2219
30	.2187 *	.2476 *	.0096	.0185
332	.2463 *	.6189 **	.2135 **	.2934 **
333	.8023 * +	1.1198 * +	.8781 * +	.9037 * +
3334	n.a.	n.a.	.6475 *	.5616 *
3452	.3171 *	.6528 *	.3094 *	.6718 *
355	.6150 *	.6970 *	.3755 *	.3388 *
3552	.4977 *	.6438 *	.4563 *	.3785 *
354	.6052 *	.6379 *	.3244 *	.3156 *
356	.6260 *	.7697 *	.3583 *	.3910 *
3561	.6144 *	.5812 *	.2589 *	.2086 *
357	.4293 *	.4589 *	-.040	-.032
3662	.1179	.1281	.0212	.0205
3651	.1058	.0896	.0180	.0176
366	.3302 *	.2882 *	.0665 **	.0789 **
36	.3686 *	.5155 *	.2736 *	.3039 *
3621	.5529 *	.6327 *	.2676 *	.2054 *
3613	.8367 *	1.0220 * +	.2089 *	.1689 **
363	.3352 *	.3178 *	.0201	.0164
367	.2291	.2138	.4269 *	.5606 *
371	.3782 *	.5247 *	.0852	.1244
23	.1975	.1641 **	.0936	.0411
314	.1170	.1494	.0190	.0185
38	.7067 *	.7469 *	.2135 *	.1738 *
386	.4851 *	.6211 *	.1739 *	.1865 *
383	.6400 *	.6565 *	.2686 *	.2774 *
39	.4849 *	.5353 *	.1793 *	.1502 **
394	.3284 *	.4893 *	.0432	.0567
391	.9034 * +	1.2275 * +	.0579	.0454
3931	.3106 *	.4932 *	.0926 **	.0684 **

Note: * indicates that the estimated coefficient is significantly different from zero at the 95 percent confidence level, and ** indicates that the estimated coefficient is significantly different from zero at the 90 percent confidence level. + indicates that the estimated coefficient is not significantly different from one at the 95 percent confidence level.

It is interesting to note that estimating a level version of equation (2) of the following form:

$$\ln\left(\frac{p^{imp}}{P}\right)_t = b_t + b_1\ln\left(\frac{eP^*}{P}\right)_t + b_2\ln\left(\frac{q}{P}\right)_t + b_3\ln\left(\frac{I}{P}\right)_t + \varepsilon_t,$$

where the time-varying intercept now follows a random walk, yields the same pattern of results.[16] For example, pass-through in the road vehicles industry is estimated at 0.54 in the 1980s and at 0.16 in the 1990s. These estimates are very similar to the long-run pass-through elasticities reported in Table 3. The instability of pass-through is illustrated in Figure 2, which depicts

[15] A similar picture emerges when one uses a variant of equation (2) that adds lags of the exchange rate instead of a lag in the dependent variable, although the decline in pass-through is in some instances less pronounced. In particular, under the alternative specification pass-through estimates for the road vehicles industry drop from 0.57 in the 1980s to 0.37 in the 1990s, while estimates for the computer industry drop from 0.54 to 0.30.

[16] This is true also when exchange rate movements are allowed to have a delayed impact on import prices by introducing lags of the exchange rate as additional regressors. Results are available upon request.

Table 4
Short-Run Exchange Rate Pass-Through Elasticities: Dollar Appreciations versus Dollar Depreciations, 1981 to 1999

SIC Category	Elasticity with respect to a dollar appreciation	Elasticity with respect to a dollar depreciation	Test of whether the elasticities differ [a]
28	.2379 *	.1651 *	No
286	.1624 *	.0493	No
283	.1750 *	.3039 *	No
2842	.3311 *	.5033 *	No
2899	.3821 *	.3128 *	No
30	.0069	.1172 *	No
332	.3490 *	.2530 *	No
333	.7471 *	.6394 *	No
3334	.9670 *	1.1677 *	No
3452	.3169 *	.2785 *	No
355	.5133 *	.5547 *	No
3552	.4767 *	.4917 *	No
354	.4473 *	.4953 *	No
356	.5135 *	.4859 *	No
3561	.5158 *	.3750 *	No
357	.1491 *	.2409 *	No
3662	.0466	.1127 *	No
3651	-.1532	.3466 *	Yes
366	.1612 *	.1121 *	No
36	.2359 *	.3102 *	No
3621	.4657 *	.3875 *	No
3613	.6507 *	.6659 *	No
363	.2508 *	.2340 *	No
367	.2390	.4129 *	No
371	.1593 *	.2907 *	No
23	.1529	.1931 **	No
314	.007	.1575 *	No
38	.5555 *	.5658 *	No
386	.3309 *	.3172 *	No
383	.4047 *	.5243 *	No
39	.3970 *	.3641 *	No
394	.1043	.1837 *	No
391	.3414 *	.3382 **	No
3931	.2810 *	.1154 *	Yes

[a] The column reports whether the hypothesis that the two estimated elasticities differ is not rejected at the 95 percent confidence level.

Note: * indicates that the estimated coefficient is significantly different from zero at the 95 percent confidence level, and ** indicates that the estimated coefficient is significantly different from zero at the 90 percent confidence level.

actual values of the relative import price in the road vehicles industry and predicted values using the above equation, estimated through the end of 1989. The figure shows that in the out-of-sample period the estimated relationship underpredicts import prices in the second half of the 1990s. In other words, the 0.54 pass-through estimate of the 1980s would have implied lower import prices than those actually experienced during the dollar appreciation of the second half of the 1990s.

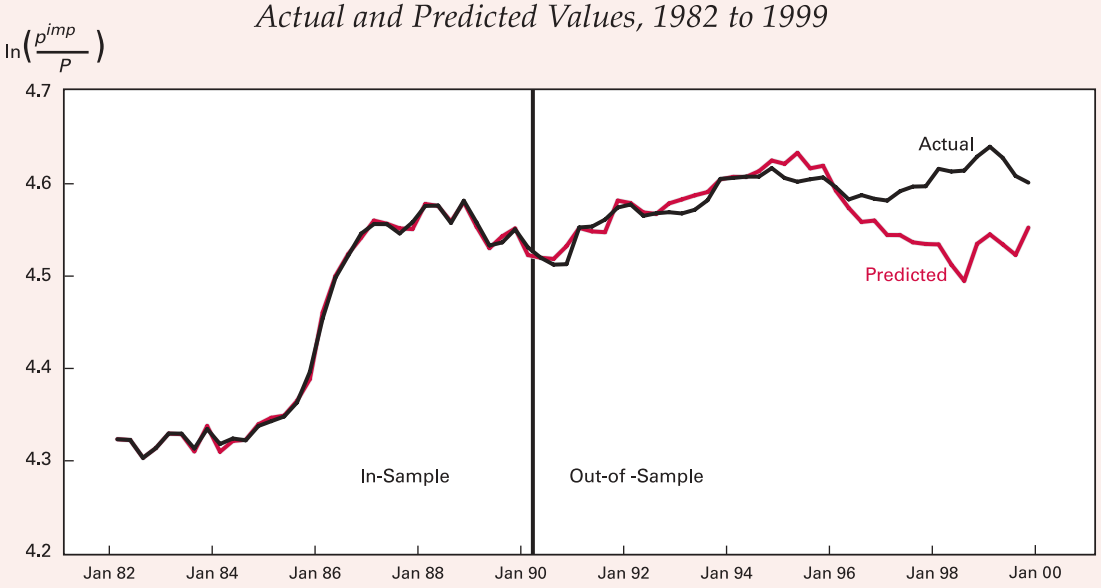
Misspecification of the estimating equation (2) could be at the root of the shift in pass-through. It is well known that when the behavior of some exogenous variables changes but the structural model is unchanged, apparent structural breaks could emerge if the estimated relationship is misspecified.

It is sometimes argued that pass-through is asymmetric, in that the dollar price of the imported good is more responsive to a dollar depreciation than to an appreciation. If this were the case, then pass-through estimates obtained from equation (2) for the 1990s would be downward biased when compared to estimates for the 1980s. This is because while during the 1980s there was a large dollar appreciation followed by an equally large dollar depreciation, during the 1990s there was a sizable appreciation only. Specifically, for most product groupings the trade-weighted value of the dollar did not change noticeably in the first half of the 1990s, while it appreciated considerably in the second half of the decade.

The hypothesis of asymmetric pass-through receives little support in our sample, when in equation (2) we allow for different pass-through elasticities for a dollar appreciation and for a dollar depreciation. As Table 4 shows, while one can find instances in which the change in U.S. import prices is somewhat larger in response to a depreciation (although significantly so in two industries only), in the vast majority of cases the estimated elasticities are close. Results not reported here for brevity also show that this is especially true for the 1980s subsample. As concerns the 1990s, there are a few product groupings for which pass-through with respect to a dollar depreciation is estimated imprecisely because of the paucity of depreciation episodes. However, even when the comparison is confined to the pass-through elasticity of a dollar appreciation, it is still the case that estimates are larger in the 1980s than in the 1990s.[17]

Figure 2

Relative U.S. Import Price in the Road Vehicles Industry: Actual and Predicted Values, 1982 to 1999



Source: Author's calculations. See Section III of the text.

Another potential source of misspecification comes from the failure to distinguish in equation (2) between temporary and permanent exchange rate changes. Froot and Klemperer (1989) estimate that permanent exchange rate changes lead to full pass-through, while temporary changes lead to very small (and sometimes negative) pass-through. They argue that such a behavior is rational when firms' future demands depend on current market shares. Specifically, when the value of the dollar is temporarily high, foreign firms will find investments in their U.S. market share less attractive, and they will prefer instead to let their current profit margins grow. A permanent appreciation, instead, does not create incentives to shift profits from today and will lead foreign firms to compete more vigorously, driving the current dollar price of imports down.

It is difficult in practice to distinguish between temporary and permanent exchange rate changes. Exchange rate movements tend to be very persistent and, thus, most changes should be interpreted as permanent. Here, we estimate the permanent component of the real exchange rate as a short, two-sided, weighted moving average of the actual real exchange rate.[18] Figure 3 plots the real exchange rate and the estimated permanent component, both in logarithms, for the road vehicles industry. The difference between the actual and the permanent component is the estimated temporary component.

Table 5 provides estimates of the short-run pass-through elasticity in equation (2) when permanent changes in the exchange rate are allowed to exert a different impact from temporary changes on import prices. While for some important product groupings (most notably electrical machinery and equipment and computer equipment and office machines) the response of U.S. import prices to permanent changes in the exchange rate is significantly larger than the response to temporary changes, this is by no means a uniform pattern. Indeed, the pass-through elasticity of temporary changes is usually significantly different from zero, and for most product groupings the hypothesis that the responses to temporary and permanent shocks are equal is not rejected at standard confidence levels.[19]

[17] Results are available upon request.

[18] Specifically, the permanent component is estimated by passing the real exchange rate through a two-sided high-pass filter with a maximum length of three quarters.

[19] Moreover, the pass-through elasticity of temporary exchange rate changes is usually estimated more precisely than the elasticity of permanent changes. Not surprisingly, then, the estimated short-run elasticities in Table 2 tend to be closer to the estimated elasticities of temporary changes in Table 4.

Therefore, while it is generally the case that a greater fraction of the volatility in exchange rate changes during the 1990s can be attributed to temporary movements, the results in Table 5 indicate that this is unlikely to explain the decline in pass-through over the past decade. In fact, it is possible to show that in the vast majority of product groupings the response of U.S. import prices to both temporary and permanent changes in the exchange rate declined during the 1990s.[20] Of course, these results hinge on the method used for distinguishing between temporary and permanent changes and should be interpreted with caution.[21]

Table 5
Short-Run Exchange Rate Pass-Through Elasticities: Permanent versus Temporary Changes in the Exchange Rate, 1981 to 1999

SIC Category	Elasticity with respect to a permanent change	Elasticity with respect to a temporary change	Test of whether the elasticities differ [a]
28	.1037	.1638	No
286	-.2310	.0701	No
283	.2565 **	.2287 *	No
2842	.7052 *	.3384 *	No
2899	.7361 **	.2385 *	No
30	.1458 **	.0115	No
332	.2626 **	.3002 *	No
333	.3185	1.0110 *	No
3334	-.772	1.1471 *	Yes
3452	.2516 *	.3124 *	No
355	.5037 *	.5553 *	No
3552	.4615 *	.4959 *	No
354	.3767 *	.5137 *	No
356	.4330 *	.5201 *	No
3561	.2559 **	.4949 *	No
357	.4703 *	.1864 *	Yes
3662	.0656	.0857 *	No
3651	.2273	.1526	No
366	.2737 **	.1200 *	No
36	.6759 *	.1955 *	Yes
3621	.4845 *	.4173 *	No
3613	.6395 *	.6931 *	No
363	.4682 *	.1551 *	Yes
367	.6095 **	.2480 **	No
371	.2248 *	.2532 *	No
23	.2766 **	.1360	No
314	.2396 **	.0316	No
38	.7707 *	.5181 *	No
386	.5085 *	.2401 *	Yes
383	.5730 *	.4503 *	No
39	.4161 *	.2909 *	No
394	.4680 *	.0340	Yes
391	.6758 **	.2360	No
3931	.1227	.2327 *	No

[a] The column reports whether the hypothesis that the two estimated elasticities differ is not rejected at the 95 percent confidence level.

Note: * indicates that the estimated coefficient is significantly different from zero at the 95 percent confidence level, and ** indicates that the estimated coefficient is significantly different from zero at the 90 percent confidence level.

V. Discussion

Aside from misspecification issues, there are several potential explanations for the decline in exchange rate pass-through. Taylor (2000) argues that the decline in pass-through (and more generally in the pricing power of firms) is due to the low inflation environment achieved in many countries during the 1990s. Recent attempts at testing empirically whether the decline in pass-through is linked to inflation performance, however, find little evidence in this respect. In a cross-section of OECD countries, Campa and Goldberg (2001) show that changes in inflation account for only a small fraction of the observed changes in pass-through elasticities.

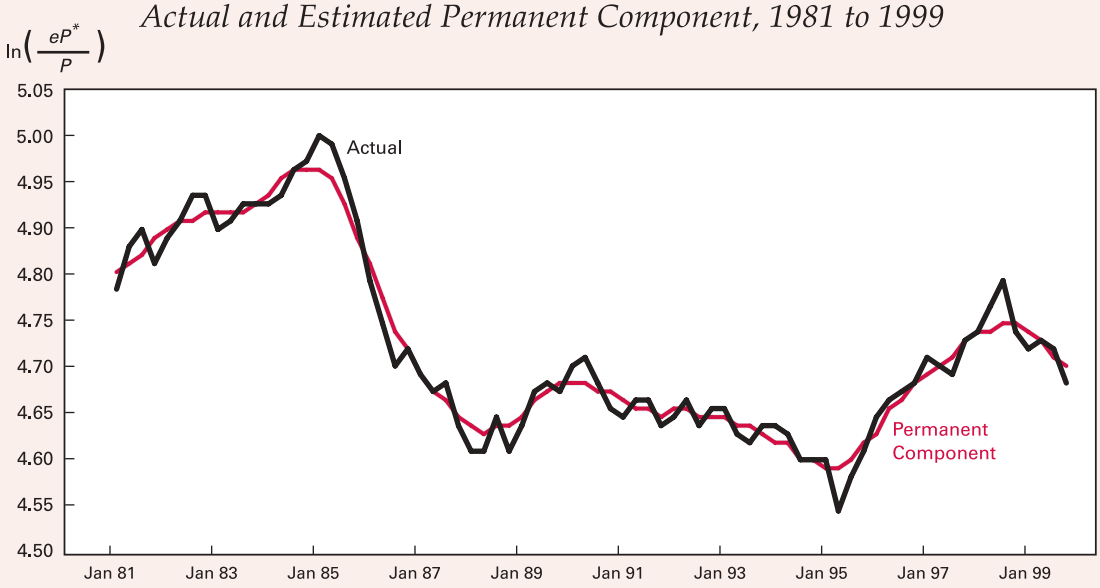
The view that changes in pass-through are linked to changes in inflation performance does not receive support in our sample, either. For each product grouping we computed weighted averages of inflation and inflation volatility in the countries the United States is importing from, in the same way the exchange rate measure is constructed. We then regressed the change in exchange rate pass-through over the past two decades on the change in foreign inflation and inflation volatility for our cross-section of industries. Neither variable exerted a statistically significant and economically relevant impact on the change in pass-through. Similarly, changes in exchange rate volatility did not

[20] Results are available upon request.

[21] It is interesting to note that changes in the length of the two-sided weighted moving average of the actual real exchange rate used for constructing the permanent component yield a similar outcome.

Figure 3

Real Exchange Rate in the Road Vehicles Industry: Actual and Estimated Permanent Component, 1981 to 1999



Source: Author's calculations. See Section III of the text.

show any significant correlation with changes in exchange rate pass-through.

While there is little prima facie evidence that changes in exchange rate pass-through are related to macroeconomic factors such as the conduct of monetary policy, most of the literature has focused on the microeconomic determinants of pass-through. For example, the market share of foreign firms should be inversely related to pass-through. Firms with larger market share have higher markups because they face a smaller demand elasticity and are thus more able to absorb cost shocks by varying their profit margins (see Yang 1997). There is some evidence in our cross-section of industries that changes in market share are inversely related to changes in exchange rate pass-through, approximately on a one-for-one basis.[22] This result contradicts the view that the decline in pass-through over the 1990s is the consequence of a decrease in firms' pricing power (Taylor 2000). Rather, the increase in foreign firms' pricing power that comes with a higher penetration in U.S. markets would have yielded the decline in pass-through. Still, it is important to note that the change in import share explains barely 20 percent of the variability of changes in pass-through in our cross-section of industries.

Other potential determinants of the change in pass-through are related to changes in intra-firm versus arm's length trade. In some industries (for example automotive, computer, and apparel) U.S. multinational firms have increasingly relied on foreign affiliates as platforms to serve the U.S. market, or as platforms for production sharing. To the extent that intra-company transfer prices are less responsive to exchange rate movements than prices based on arm's length trade, an increase in the share of imports based on intra-firm trade would translate into a decline in exchange rate pass-through. While this line of inquiry is left for future research, it is worthwhile to mention that the issue of whether the responsiveness of U.S. multinational enterprises' intra-firm trade to changes in economic conditions is different than the responsiveness of U.S. arm's length trade is highly contentious. There is, indeed, a view that intra-firm trade is less responsive than arm's length trade to shifts in relative prices because intra-firm trade is potentially "managed" trade that reflects hierarchical or com-

[22] Specifically, regressing the change in exchange rate pass-through over the past two decades on the change in import share in our cross-section of industries yields an estimated coefficient of −0.938, with a standard error of 0.357.

mand behavior.[23] Others, however, argue that intra-firm trade is no different than arm's length trade (Caves 1996), while work by Rangan and Lawrence (1999) conveys the opposite view that because of information advantages arising out of multinational operations, U.S. multinationals respond faster and more vigorously to changes in the exchange rate.

While more work is needed to assess the relative importance of different explanations for the observed change in pass-through, an issue that should be kept in mind when discussing import prices is that the data may be questionable. Cooper (1993), for example, argues that import prices do not take into account substantial advertising and other allowances that foreign firms in certain industries periodically provide to their major U.S. customers. Changes in the amount of these allowances could then result in changes in the estimate of exchange rate pass-through, even when on an economic basis the responsiveness of prices to exchange rate movements is unchanged.

VI. Conclusions

This article reexamines the responsiveness of U.S. import prices to changes in the exchange rate in a sample of manufacturing industries over the past two decades. We document a decline in the estimated pass-through elasticity for most industries in the 1990s. For the industries in our sample, pass-through was 0.50 on average in the 1980s and dropped to an average of about 0.25 in the 1990s. This finding suggests that larger changes in the exchange rate are now needed to move the dollar price of imported goods relative to the price of domestic goods. Thus, reducing the quantity of goods imported into the United States by a given amount would now entail a larger dollar depreciation than in the past, other things equal. Another implication is that while the dollar appreciation in the second half of the 1990s helped to keep import prices low and likely put pressure on domestic firms to maintain stable prices, foreign firms were not pursuing aggressive pricing strategies. Rather, the low estimates of exchange rate pass-through during the 1990s indicate that a relatively small fraction of the dollar appreciation translated into lower import prices, while the bulk of the appreciation translated into higher markups for the foreign firms.

As already mentioned, the empirical findings of the paper come with the caveat that recorded import prices are sometimes suspect, because they may not necessarily reflect advertising and other allowances that should be included in the true unit price of the imported good. Moreover, before speculating about the magnitude of the dollar depreciation that these pass-through estimates imply for redressing the U.S. external position, it would be useful to have a firmer grasp on the determinants of the decline in pass-through. Taylor (2000) notes that if the decline in pass-through is due to the low inflation environment achieved in many countries, then it could disappear quickly if expectations and monetary policy change. However, if the decline is not related to monetary policy but to microeconomic factors such as market structure, the degree of product differentiation, and the way multinational firms operate, the decline in pass-through could be more persistent. While we note that Taylor's arguments do not find much support in the present work, this still remains a largely unexplored issue.

[23] See, for example, Cho (1990). The BLS, which collects import prices data, seems aware of this possibility when in its *Handbook of Methods* it states that in constructing import price indices, it uses "intra-company transfer prices that are market-based or market-influenced." (See *http://www.bls.gov/opub/hom/homch15_e.htm*.)

Appendix 1

Derivation of Pass-Through Elasticity

The effect of a change in the price of an imported good with respect to a change in the exchange rate, the pass-through elasticity, is computed starting from a pricing relation of the following form (see Feenstra 1995):

$$p^{imp} = \mu^*\phi^*(x^*,w^*)e. \tag{1.1}$$

The typical foreign firm sets p^{imp}, the import price in U.S. dollars, as a markup μ^* over marginal costs ϕ^*, where e denotes the exchange rate that converts foreign costs into dollars. Marginal costs are a function of the firm's output x^* and of an aggregate of foreign factor prices w^*. We write marginal costs in dollar terms as $v^*(x^*)w^*e$, with a positive (negative) slope of v^* indicating increasing (decreasing) marginal costs. Equation (1.1) allows for different forms of industry pricing. The markup μ^* is unity under perfect competition, and it is strictly greater than unity under imperfect competition. In the latter case, the markup will depend on the price elasticity for the imported good and the specific mode of market conduct.[a]

If the foreign firm's output is equal to import demand, $x^* = C$, we can rewrite the previous relation as follows:

$$p^{imp} = \mu^*v^*(C)w^*e. \tag{2.1}$$

Under certain simplifying assumptions, it is possible to show that the demand for the imported good and the markup μ^* depend on the price p^{imp} of the imported good, the price q of a domestic good competing with the imported good, and the consumer expenditure I on both the imported and the domestic goods.[b] As a result, the price of the imported good will be a function of the following variables:

$$p^{imp} = f(w^*e,q,I). \tag{3.1}$$

In general, the function f is homogenous of degree 1 in $[w^*e,q,I]$, which means that increasing w^*e,q, and I by the same amount leads to an increase of equal amount in p^{imp}.

Totally differentiating equation (2.1) with the help of (3.1) and solving for the pass-through elasticity yields:

$$\frac{\partial \ln p^{imp}}{\partial \ln e} = \left[1 - \frac{\partial \ln \mu^*}{\partial \ln p^{imp}} + \eta^* \frac{Cv^{*\prime}}{v^*}\right]^{-1}, \tag{4.1}$$

where η^* is the absolute value of the price elasticity of the imported good. For plausible shapes of the demand curve of the imported good, the markup will decline with price, $\partial \ln \mu^* / \partial \ln p^{imp} < 0$. This means that the foreign firm will lower (raise) its markup when the dollar depreciates (appreciates). As a result, the pass-through elasticity will be less than unity. Equation (4.1) also shows that even in a perfectly competitive setting where the markup is not responsive to changes in the price of the imported good, it is still possible to have a pass-through elasticity below unity as long as marginal costs are increasing, $v^{*\prime} > 0$. In sum, incomplete pass-through can be the result of imperfect competition or increasing marginal costs under perfect competition.

---

[a] The markup can be written in general form as $\eta^*/(\eta^* - \theta^*)$, where η^* denotes the (absolute value of the) price elasticity of the demand for the imported good, and θ^* is an indicator of the firm's pricing mode: $\theta^* = 0$ under perfect competition, and $\theta^* > 0$ under imperfect competition. Under imperfect competition, the value of θ^* will be a function of the firm's market share (see Feenstra 1995 and Yang 1997).

[b] Specifically, the imported good and the domestic good competing with the imported good must be (weakly) separable from other goods in the expenditure function. The discussion here assumes that the import is provided by a single foreign firm, and that there is a single competing domestic good. However, the argument can be generalized to the case of many imported and domestic varieties. (See Feenstra 1989; 1995.)

Appendix 2

Derivation of Empirical Specification[a]

A log-linear version of (3.1) in Appendix 1 provides the basis for the empirical assessment of exchange rate pass-through:

$$\ln p^{imp} = b_0 + b_1\ln(w^*e) + b_2\ln q + b_3\ln I + \varepsilon, \qquad (1.2)$$

where ε is an error term, and the homogeneity of degree one of the function f in (3.1) implies that $b_1 + b_2 + b_3 = 1$. Because of homogeneity, the variables appearing on the right- and left-hand sides of (1.2) can be deflated by a common price.

Equation (1.2) shows that estimation of the degree of exchange rate pass-though requires controlling for foreign costs and for import demand shifters, such as competing prices and income. Deflating both sides of the equation by the U.S. wholesale price index, P, we rewrite (1.2) as follows:

$$\ln\left(\frac{p^{imp}}{P}\right) = b_0 + b_1\ln\left(\frac{w^*}{P^*}\right) + b_1\ln\left(\frac{eP^*}{P}\right) + b_2\ln\left(\frac{q}{P}\right) + b_3\ln\left(\frac{I}{P}\right) + \varepsilon, \qquad (2.2)$$

where P^* is the foreign wholesale price index. The term eP^*/P is a real exchange rate measure.

Several issues are associated with the estimation of equation (2.2). The sample we are using generally fails to reject the hypothesis of nonstationarity of the data. Also, the hypothesis that a linear combination of the variables is nonstationary is not always rejected. Thus, while theory suggests a levels relationship among variables in the form of equation (2.2), for estimation purposes we start with a first-difference version of (2.2):

$$\Delta\ln\left(\frac{p^{imp}}{P}\right) = b_0 + b_1\Delta\ln\left(\frac{w^*}{P^*}\right) + b_1\Delta\ln\left(\frac{eP^*}{P}\right) + b_2\Delta\ln\left(\frac{q}{P}\right) + b_3\Delta\ln\left(\frac{I}{P}\right) + \varepsilon, \qquad (3.2)$$

where, for any variable x, $\Delta\ln x = \ln x - \ln x_{-1}$.

Another important issue concerns the measurement of foreign factor prices, w^*. It is generally hard to obtain an adequate measure of w^*, and especially so in the context of the disaggregated data sample we are using. Mismeasurement of w^* will lead to a downward bias in the estimate of the pass-through elasticity, b_1. Some of the most important contributions to the research on exchange rate pass-through have dealt with ways to alleviate the cost measurement problem. This requires, however, knowing not only the price charged by the foreign firm in the United States, p^{imp}, but also the prices the firm charges in export markets other than the United States (see Knetter 1993).

Since this information is not available in our data sample, we follow a different approach. Note that, to the extent that the change in the foreign cost index w^* differs from the change in the foreign wholesale price index P^*, one can think of the first two terms on the right-hand side of equation (3.2), $b_0 + b_1\Delta\ln(w^*/P^*)$, as a time-varying intercept. This leads to the following modification of (3.2):

$$\Delta\ln\left(\frac{p^{imp}}{P}\right)_t = b_t + b_1\Delta\ln\left(\frac{eP^*}{P}\right)_t + b_2\Delta\ln\left(\frac{q}{P}\right)_t + b_3\Delta\ln\left(\frac{I}{P}\right)_t + \varepsilon_t, \qquad (4.2)$$

where for clarity we have now added time subscripts and b_t denotes an intercept term that varies over time. If the slope coefficients are stable, any intercept drift in this equation arises from a departure of the rate of growth in w^* from the rate of growth in P^*. In order to estimate the drift, we adopt an unobserved component model for the intercept, in which the intercept follows a first-order autoregressive process:

$$b_t = \varphi b_{t-1} + \eta_t, \text{ where } \eta_t \text{ is i.i.d.N}(0,\sigma_\eta^2),$$

where $|\varphi| < 1$ is a parameter to be estimated.

As written, equation (4.2) implies an instantaneous adjustment to exchange rate changes. It is plausible, however, that a firm may be reluctant to change p^{imp} quickly following a change in the exchange rate. Therefore, we estimate a modified version of (2.4) that introduces a lag of the dependent variable as a regressor:

$$\Delta\ln\left(\frac{p^{imp}}{P}\right)_t = b_t + b_1\Delta\ln\left(\frac{eP^*}{P}\right)_t + b_2\Delta\ln\left(\frac{q}{P}\right)_t + b_3\Delta\ln\left(\frac{I}{P}\right)_t + \rho\Delta\ln\left(\frac{p^{imp}}{P}\right)_{t-1} + \varepsilon_t,$$

which is equation (2) in the text.

[a] Equation (2) in the main text.

References

Campa, Jose and Linda S. Goldberg. 2001. "Exchange Rate Pass-Through into Import Prices: A Macro or Micro Phenomenon?" Working Paper, Federal Reserve Bank of New York, July.

Caves, Richard E. 1996. *Multinational Enterprise and Economic Analysis: Second Edition.* Cambridge: Cambridge University Press.

Cho, Kang Rae. 1990. "The Role of Product-Specific Factors in Intra-Firm Trade of U.S Manufacturing Multinational Corporations." *Journal of International Business Studies*, 21 (2), pp. 319–30.

Cooper, Richard N. 1993. "Comment on 'The Responses of U.S. Firms to Exchange Rate Fluctuations: Piercing the Corporate Veil,' by S. Rangan and R. Lawrence." *Brookings Papers on Economic Activity* 2, pp. 370–75.

Cunningham, Alastair and Andrew E. Haldane. 1999. "The Monetary Transmission Mechanism in the United Kingdom: Pass-Through and Policy Rules." Prepared for the 3rd Annual Conference of the Central Bank of Chile, September 21–22.

Dixit, Avinash and Joseph Stiglitz. 1977. "Monopolistic Competition and Optimum Product Diversity." *The American Economic Review*, 67, June, pp. 297–308.

Feenstra, Robert C. 1989. "Symmetric Pass-Through of Tariffs and Exchange Rates Under Imperfect Competition: An Empirical Test." *Journal of International Economics*, 27, pp. 25–45.

_____. 1995. "Estimating the Effects of Trade Policy." In Gene M. Grossman and Kenneth Rogoff, eds., *Handbook of International Economics,* vol. 3, pp. 1553–96. Amsterdam: North Holland.

Froot, Kenneth A. and Paul D. Klemperer. 1989. "Exchange Rate Pass-Through When Market Share Matters." *The American Economic Review*, 79, September, pp. 637–54.

Gagnon, Joseph E. and Jane Ihrig. 2001. "Monetary Policy and Exchange Rate Pass-Through." International Finance Discussion Paper, Board of Governors of the Federal Reserve System, no. 704, July.

Goldberg, Pinelopi K. and Michael M. Knetter. 1997. "Goods Prices and Exchange Rates: What Have We Learned?" *Journal of Economic Literature*, 35, September, pp. 1243–72.

Knetter, Michael M. 1993. "International Comparisons of Pricing-to-Market Behavior." *The American Economic Review*, 83, June, pp. 473–86.

McCarthy, Jonathan. 2000. "Pass-Through of Exchange Rates and Import Prices to Domestic Inflation in Some Industrialized Economies." Working Paper, Federal Reserve Bank of New York, September.

Rangan, Subramanian and Robert Z. Lawrence. 1999. "Search and Deliberation in International Exchange: Learning from Multinational Trade about Lags, Distance Effects, and Home Bias." National Bureau of Economic Research, Working Paper No. 7012, March.

Rich, Robert W. and Donald Rissmiller. 2000. "Understanding the Recent Behavior of U.S. Inflation." Federal Reserve Bank of New York *Current Issues in Economics and Finance*, July.

Taylor, John B. 2000. "Low Inflation, Pass-Through, and the Pricing Power of Firms." *European Economic Review*, 44, pp. 1389–1408.

Yang, Jiawen. 1997. "Exchange Rate Pass-Through in U.S. Manufacturing Industries." *The Review of Economics and Statistics*, 79, (1), February, pp. 95–104.