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Abstract

This paper examines the current thinking on exchange-rate pass-through to both import prices and consumer prices and estimates the extent to which they have fallen in the G-7 countries since the late 1970s and 1980s. For import-price pass-through we find that all countries experience a numerical decline in the responsiveness of import prices to exchange-rate movements; for nearly half of these countries the decline between 1975-1989 and 1990-2004 is statistically significant. We estimate that while a 10 percent depreciation in the local currency would have increased import prices by nearly 7 percent on average across these countries in the late 1970s and 1980s, it would have only increased import prices by 4 percent in the last 15 years. The responsiveness of consumer prices to exchange-rate movements declines for nearly every country, with the decline being statistically significant for two countries. Specifically, while a 10 percent depreciation in the local currency would have increased consumer prices by almost 2 percent on average in the late 1970s and 1980s, it would have had a neutral effect on consumer prices in the last 15 years.

Keywords: Pass-through; Inflation; Consumer Prices; Import prices; Exchange rates.

JEL Classification: E31, F3, F41.

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I. Introduction

The transmission of movements in a currency's foreign exchange value into inflation, broadly known as exchange-rate pass-through, has been a hot topic of research for many decades. Initially, the fact that movements in exchange rates did not one-for-one pass through to changes in prices as predicted by the law of one price led researchers to explore several reasons for pass-through's incompleteness. More recently, the literature has turned to the issue of the relatively widespread and on-going decline in exchange-rate pass-through. Understanding the factors that lead to this decline is critical for determining the appropriate monetary policy response to an appreciation or depreciation of a currency's foreign exchange value. This paper examines the current thinking on exchange-rate pass-through to both import prices and consumer prices and estimates the extent to which they have fallen in the G-7 countries since the late 1970s and 1980s.

Because the term "pass-through" is used to mean very different things in the literature, it is important to be specific regarding what we call import-price and consumer-price pass-through. We define import-price pass-through as the sensitivity of movements in a country's merchandise import prices to changes in its currency's foreign exchange value, after properly controlling for other factors that may influence the evolution of import prices. This is typically known as "first-stage pass-through" in the literature, so as to distinguish it from so-called "second-stage pass-through" or the sensitivity of a country's rate of consumer price inflation to changes in its import prices. This paper does not explicitly consider second-stage pass-through. Instead, we define consumer-price pass-through as the sensitivity of a country's rate of consumer-price inflation to changes in its currency's foreign exchange value, also after properly controlling for other factors that may affect the evolution of consumer prices. In other words, by consumer-price pass-

through, we mean both first and second-stage pass-through at once. As a result, this last estimate includes the effect of exchange-rate movements on both import prices and on other prices in the consumer basket, such as those of domestically-produced goods, services and other non-tradeable prices.

With few exceptions,[1] much of the macro literature on exchange-rate pass-through has focused on analyzing the decline in the exchange-rate pass-through into either consumer or import prices, not both. We estimate both consumer-price and import-price pass-through for the G-7 countries in two 15-year samples, 1975-1989 and 1990-2004. Then we test for a significant decline in pass-through, as frequently reported in the literature.[2] Unlike previous studies, we employ an econometric methodology for choosing the appropriate control variables that customizes our empirical model for each country, allowing for heterogeneity in the inflation process across countries.

For import-price pass-through, we find that all countries experienced a numerical decline in the responsiveness of import prices to exchange-rate movements; for nearly half of the countries the decline is statistically significant. Across the G-7 countries, import-price pass-through fell from near 0.7 in the first sample period to about 0.4 in the second sample. This means that a 10 percent depreciation in the local currency would have increased import prices by nearly 7 percent in the late 1970s and 1980s, but only by 4 percent in the last 15 years.

The responsiveness of consumer prices to exchange-rate movements declined in 6 of the 7 countries in our sample, and the decline is statistically significant for two countries, Italy and

[1] See McCarthy (2000), Sekine (2005) and Frankel, Parsley, and Wei (2005).

[2] We do not consider non-linear pass-through. That is, the possibility that currency depreciations may pass-through to prices to a different degree than currency appreciations (asymmetries) or the possibility that large currency movements (vis-a-vis small ones) may be passed through more than implied by a linear relationship (threshold effects). We note however that the literature has had a hard time finding statistically significant non-linear effects. Olivei (2002) finds that pass-through is symmetric for appreciations and depreciations in all but two of 34 U.S. industry groupings. Pollard and Coughlin (2004) produce results providing little support for the existence of asymmetries or threshold effects using quarterly U.S. data for 20 industries.

France. Across the G-7 countries, consumer-price pass-through fell from nearly 0.13 on average to zero across the two sample periods, implying exchange-rate movements have had no noticeable impact on consumer prices in recent years.

We now turn to Section II, which overviews key papers in the pass-through literature. We cover both theoretical explanations for incomplete and declining pass-through, and we review the key empirical papers on this topic. Section III describes the model we use to estimate pass-through, while section IV discusses the methodology and data. Section V provides the pass-through estimates and compares our findings with the literature. Section VI concludes with an open question that remains in the field.

II. Review of the Literature

One can argue that interest in pass-through began in the 1960s and early 1970s, when open economy monetary models assumed absolute (or in some cases relative) Purchasing Power Parity, the macroeconomic cousin of the single-good Law of One Price, in their frameworks to pin down the behavior of exchange rates. The natural question arising from these models was "Does Purchasing Power Parity and/or the Law of One Price hold in the data?" Numerous tests on a variety of goods and across countries yielded very little evidence in support of this assumption.[3] As a result, researchers began to develop models to explain the lack of purchasing-power-parity, and many of these models had implications for the nature of pass-through. By 1997, Goldberg and Knetter note that a search of the EconLit database of the words "Law of One Price," "Purchasing Power Parity," "Exchange-Rate Pass-Through", and "Pricing-to-Market" yielded nearly 700 entries. Acknowledging this massive literature, here we only survey some important papers that focus either on proposed theoretical hypotheses to explain incomplete pass-through or empirical demonstrations of the fall in pass-through.

[3] See Rogoff (1996) for a survey of the literature that tests purchasing power parity and the law of one price.

One motivation for deviations from the law of one price is pricing-to-market, as proposed by Krugman (1987) and Dornbusch (1987). To generate incomplete pass-through in this framework, one typically thinks of an oligopolistic market where a firm can adjust its markup to an exchange rate shock. In particular, if the firm's markup decreases as the price of the good it sells increases, then pass-through is less than complete. This action might be a defensive response to perceived temporary currency misalignments (e.g., Marston (1991)) or it might result from market share considerations (e.g., Hooper and Mann (1989), Kasa (1992) or Froot and Klemperer (1989)). Of course, a firm can only dampen the impact of exchange rate movements on its prices while its markup is positive.

A related but slightly different framework is local currency pricing. Here one thinks of an exporting firm setting the price of its good, which may or may not be sticky, in the currency of the country to which it exports. Two papers cited frequently are Devereux and Engel (2001) and Bacchetta and vanWincoop (2003). The novelty of their papers is that they endogenize a firm's choice of invoicing currency and argue that countries with low relative exchange rate variability or stable monetary policies are more likely to have their currencies chosen for transaction invoicing, and hence more likely to have low import-price pass-through. A problem with the local currency pricing hypothesis is that while in the medium-term a firm may choose to invoice in the currency of the destination market to shield the price paid by its clients from exchange-rate movements, over the long run, in the face of a protracted appreciation of the exporter's currency, it will have to adjust its local currency price to keep its margins from turning negative.

Another reason for less-than-complete pass-through is cross-border production. If production takes place in several stages across many countries, then the costs of producing the

final good are incurred in several currencies. This can explain incomplete pass-through as long as all of these currencies do not experience a common appreciation against the export destination's currency. For instance, Aksoy and Riyanto (2000) and Hegji (2003) build theoretical models where the increased use of cross-border production within the same firm may have lead to lower pass-through. Also, along this vein, Bodnar, Dumas, and Marston (2002) show pass-through can be less than one if part of the costs of production are incurred in a different currency (i.e. if cross-border production arrangements take place), if goods are highly substitutable, or if the market share of the exporting firm in the foreign market is large.

Another argument for incomplete pass-through is articulated by Mann (1986). She suggested that the increased usage of exchange-rate hedges may shield a firm from exchange-rate shocks allowing them to avoid passing such shocks to consumers. Of course, hedging can allow firms to postpone passing through an exchange rate shock, but in the long-run a sufficiently large and permanent exchange rate shock will have to be passed through to importers. The general consensus among researchers in the pass-through literature is that exchange rate hedges may slow the pass-through for at most one year.

We finally note a recent paper by Gust, Leduc, & Vigfusson (2005) that proposes the process of international globalization itself may induce a fall in pass-through. In their model, lower trade costs (interpreted broadly as increased globalization) increase exporting firm's relative markups which in turn allow their prices to be less sensitive to exchange rates yielding lower pass-through.

Turning to the empirical literature on declining import-price pass-through, Campa and Goldberg (2002 and 2004) are cited frequently. They estimate pass-through of several import categories across many countries and conclude that a shift in the composition of the typical

import basket away from goods with relatively high degrees of exchange-rate sensitivity (particularly energy-related goods) explains observed declines in pass-through. Importantly, their data set ends in 1999 and hence does not cover the last few years in which very little import-price pass-through has been registered, at least in the United States.

Marazzi, Sheets, Vigfusson et al. (2005) estimate exchange-rate pass-through to U.S. import prices of core goods using a rolling regression framework and carry out a large number of robustness tests to conclude that U.S. import-price pass-through has indeed fallen, as suggested by sector-specific pass-through tests of Olivei (2002). They find that the Campa-Goldberg compositional-change hypothesis can only explain about one-third of the decline in pass-through to U.S. import prices. In addition they note that in all of their robustness tests, the year 1997 stands out as a moment in time after which pass-through's decline gained momentum. Given that a substantial portion of U.S. imports come from Asia, the authors speculate that the Asian financial crisis of 1997 may have begun a process of unraveling import-price pass-through in the U.S. They also provide evidence suggesting that China's surging exports to the U.S. may also be partly responsible for the low levels of observed pass-through in recent years.

Fewer hypotheses have been proposed for the fall in exchange-rate pass-through to consumer prices. Gagnon and Ihrig (2004) provide a model that links pass-through to monetary policy conditions; empirically they find that countries with credible and anti-inflationary monetary policies tend to experience lower consumer-price pass-through. This study is consistent with Taylor (2000) who provides a model where lower pass-through is caused by lower perceived persistence of inflation. Given that countries' fall in pass-through has coincided with the global low inflation environment of the 1990s (see figure 1), this explanation has many supporters.

III. Model

The model we use to analyze exchange rate pass-through stems from an analytical framework whose foundation dates back to the law of one price:[4] under perfect competition in domestic and international goods markets and with no barriers to trade, the exchange rate equates the domestic currency price of similarly traded goods produced at home and abroad. This means that for a well-defined tradable good, it must be the case that:

$$P^h = ER^{h,f} \times P^f \tag{1}$$

where P^h is the price of the good in country h (for home country) expressed in country-h currency, P^f is the price of the good in country f (for foreign country) expressed in country-f currency and $ER^{h,f}$ is the nominal exchange rate between country-h and country-f currencies. The law of one price, in principle, should hold for either consumer or import prices, as long as the good is well-defined and there are no barriers to trade. Taking the first difference of the log of equation (1) yields:

$$\Delta p^h = \Delta er^{h,f} + \Delta p^f \tag{2}$$

where lower case letters indicate the logarithm of a variable.

We augment this equation before taking it to the data. First, we include an intercept term to allow for changes in trade barriers. Second, we include three additional lags of the independent variables so as to allow exchange rate and foreign price movements to affect domestic prices with a lag.[5] Third, we include lagged dependent variables to wash away

[4] See Mann (1986). More recently, several authors have refined this framework to account for potentially relevant departures from perfect competition, such as price discrimination across exporting destinations (see Knetter (1989, 1993, 1995), and Gagnon and Knetter (1995)).

[5] Exchange-rate hedging activity typically lasts no more than one year. As a result, the contemporaneous term of exchange rates and three additional lags should be enough to cover the full lag structure.

potential unit root problems in the dependent variable. Fourth, we include a few additional controls, including certain dummy variables (more details below), output gaps, and commodity prices (and their lags) to control for business cycle fluctuations and commodity price volatility. These additions yield our benchmark model:

$$\Delta p_t^h = \alpha + \sum_{j=1}^{3} \phi_j \Delta p_{t-j}^h + \sum_{j=0}^{3} \beta_j \Delta er_{t-j}^{h,f} + \sum_{j=0}^{3} \gamma_j \Delta p_{t-j}^f + \sum_j \sigma_j X_{t-j} + \varepsilon_t \qquad (3)$$

where X stands for a vector of control variables and where the superscript f (for foreign) can be interpreted to be the rest of the world from the perspective of the home country. If the law of one price held and pass-through were complete, then $\beta_0 = 1$, $\gamma_0 = 1$ and all other coefficients would be zero.

For the remainder of the paper we focus on what is typically known as the long-run pass-through coefficient:

$$\beta = \frac{\sum_{j=0}^{3} \beta_j}{1 - \sum_{j=1}^{3} \phi_j} \qquad (4)$$

Since β implicitly incorporates structural factors (such as demand preferences, industrial market structure, monetary policy regimes, etc.), a change in any of these factors should also change β. We now turn to the data and econometric techniques used in estimating β.

IV. Methodology and Data

We estimate exchange-rate pass-through with quarterly data from 1975Q1 to 2004Q4 on the G-7 countries: the United States, the United Kingdom, Japan, Italy, Germany, France, and Canada. For each country we consider two versions of equation (3), one for estimating import-price pass-through and the other for estimating consumer-price pass-through.

We customize the control variables in equation (3) for each country, recognizing differences across the countries' economies. Specifically, for each country, whether examining import prices or consumer prices, we begin by using an algorithm developed by Hendry and Krolzing (2001) on the first 15 years of data (i.e. 1975Q1-1989Q4) to select the appropriate specification for the control variables and the lagged dependent variables.[6] This algorithm proceeds as follows: first, it estimates the general unrestricted model and tests it for congruence (i.e., white-noise residuals, constant parameters). Second, it implements multiple reduction paths simultaneously. Third, it tests whether each resulting specification is congruent and, if so, continues implementing reductions and testing for congruence until an incongruent specification is found. At this time, the immediately preceding specification is designated as a final model. Finally, it assembles all of the final models from the different reduction paths and selects the one that encompasses all others.[7] The independent variables chosen by the Hendry and Krolzig algorithm for each country's import-price pass-through and consumer-price pass-through are found in Appendix 1. As shown here, the selected control variables vary substantially across the countries in our sample, which suggests that fitting one version of equation (3) to all countries might not be appropriate. Most other cross-country studies examining pass-through invoke a one-model-fits-all approach and, therefore, may neglect important cross-country differences.

After choosing the import-price pass-through model and the consumer-price pass-through model for each country, we estimate them over two 15-year sub-samples, 1975Q1-1989Q4 and 1990Q1-2004Q4. Then we use Wald tests to see if there are statistically-significant changes to the pass-through process over these two sample periods. However, to more precisely gauge

[6] We also tried applying the Hendry and Krolzig algorithm to the full sample and found roughly similar results.
[7] For a more detailed discussion of the algorithm and its properties, see Hendry and Krolzig (2005) or Granger and Hendry (2004).

when the pass-through processes might have changed we also employ 15-year sample regression windows that are rolled forward one quarter at a time.

Table 1 provides summary statistics for import-price inflation, consumer-price inflation and the exchange rate for each country in our sample.[8] Over our sample, average quarterly import-price and consumer-price inflation were both the largest in Italy, while Japan and Germany had the lowest average rates of import-price and consumer-price inflation, respectively. Inflation volatility tended to be much higher for import prices than for consumer prices. Note that for the price series reported here and used in our regressions we try to choose indexes that excluded primary raw commodities because of their marked volatility.[9] Because this type of series was not available for Japan, we construct our own index by subtracting off the import price of petroleum, coal, and natural gas from the total merchandise import price index. For Italy, France, and Canada, we splice together import price data from different databases, because of data constraints.

Our exchange rate indexes are constructed by aggregating the rates of change of a country's nominal exchange rate with each of 35 countries, using bilateral import weights. The indexes are quoted in local currency units per unit of foreign currency, meaning that increases (decreases) in this index correspond to depreciations (appreciations).[10] A similar construction is followed in building our foreign price indexes, which use headline consumer-price indices from 35 countries.[11] As shown in Table 1, on average, all countries experienced quarterly

[8] See Appendix 2 for sources of the import and consumer price data.
[9] When it was not possible to find a price index that excluded all primary raw commodities, our inclusion of commodity price indexes as independent variables should mitigate some of the noise generated by these sectors.
[10] This is the methodology described in Loretan (2005).
[11] For import-price pass-through, we would have preferred using export price indices, but we instead chose CPIs because they are available for many more countries and in longer time series.

appreciations over the entire sample period, with exchange-rate volatility being the highest for Japan and lowest for Canada.

The additional independent variables are those commonly used in the literature. The output gaps are based on potential GDP measures that are constructed from a Hodrick-Prescott (1997) filter. Commodity prices are the IMF's index of non-fuel primary commodity prices, and oil prices are West Texas Intermediate crude oil prices. Both of these series are expressed in U.S. dollars, allowing the exchange rate coefficient in equation (3) to pick up changing pass-through from these commodity prices to the dependent variable.[12] And, we include tax dummies for Canada, Japan, and the U.K. to control for changes in indirect tax policies that affect consumer prices, as well as a German reunification dummy.

V. Results

This section is divided into two parts. First, we report the estimates of import-price pass-through; then we present the estimates of consumer-price pass-through. Our analysis suggests that pass-through has declined, whether measured at the import or consumer price level.

V.1 Pass-through to Import Prices

Table 2 summarizes our results for exchange-rate pass-through to import prices in the G-7 countries. Between the 1975-1989 period and the 1990-2004 period, the sensitivity of import prices to movements in exchange rates decreased numerically in all of the countries we survey. Canada is the only country with almost complete pass-through; however, we believe this largely reflects problems with Canadian import price data. Specifically, Canadian import prices are constructed as the weighted average of the producer prices of several of its large trading partners converted into Canadian dollars. The use of exchange rates to create the Canadian import price

[12] Estimates for the average G-7 pass-through coefficients across the two samples are roughly unchanged if one uses local currency prices for these commodities.

biases upwards the estimate of Canadian import-price pass-through, allowing it to exhibit almost complete pass-through in both 15-year samples.

Excluding Canada, the exchange-rate sensitivity of import prices fell about 0.27 on average across our sample of countries, from 0.67 in the 1975-1989 period to 0.41 in the 1990-2004 period. This means that while a 10 percent depreciation of a given country's currency translated into almost 7 percent higher import prices in the late 1970s and throughout the 1980s, more recently this depreciation would mean less than 4 percent higher import prices.

The fall in import-price pass-through shown in Table 2 is statistically significant for 3 out of the 7 countries in our sample, as noted by the asterisk in column 3. Specifically, the United States (10 percent significance level), Japan (1 percent), and France (1 percent) experience statistically-significant reductions in import-price pass-through between the two 15-year samples. These are also the countries with the largest declines in the time-varying estimates of first-stage pass-through reported in Sekine (2005).

Figure 2 illustrates our pass-through estimates for the G-7 countries as the sample period is rolled forward in time. The rolling estimates of import-price pass-through for the United States are shown in the top-left panel. The shaded areas around the estimate indicate the 95 percent confidence interval. The first observation which lies above 1989 (on the horizontal axis) corresponds to our earliest 15-year sample (i.e. the 1975-1989 period as reported in Table 2). For this period exchange-rate pass-through to U.S. import prices was about 0.66, slightly above previous estimates (see Goldberg and Knetter (1997)).[13] However, in the latest 15-year sample, which is reported as 2004:Q4 on the horizontal axis (i.e. the 1990-2004 period reported in Table 2), the exchange-rate sensitivity of U.S. import prices has fallen to 0.32, close to those obtained

[13] Goldberg and Knetter (1997) state 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."

by Olivei (2002) and Marazzi, Sheets, Vigfusson et al (2005). The pass-through estimate appears to trend down throughout the sample. However, interestingly, it appears to fall sharply during the 1996-98 period, after which the estimate trends down even faster than before. These results are similar to those obtained by Marazzi, Sheets, Vigfusson et al. (2005) and hint at a hypothesis suggested first by these authors. That is, the 1997 Asian financial crisis may have played a role in the reduction of import-price pass-through. In their paper, the authors take care to run several robustness tests. One is to consider different sample windows of 5 and 10 years, in addition to a 15-year window. These robustness tests also suggest that the pass-through process changed at about the time the 1997 Asian financial crisis rolls into the sample window. These robustness tests are important, because without them it is not clear whether a change in the pass-through estimate reflects the new quarters of data entering the sample or the old quarters of data dropping out of the sample. As a result, the fact that around 1997, no matter the size of the sample window, the decline in U.S. import-price pass-through sped up suggests that it is the former.

Looking at rolling estimates of import-price pass-through in other industrialized countries we find more evidence that the Asian crisis may be a watershed event in the decline in import-price pass-through. The United Kingdom's import-price pass-through is featured in the top-right panel. In the late 1970s and 1980s, the exchange-rate sensitivity of U.K. import prices was near 0.8. It remained stable until about the 1996-98 period, after which it began trending down to under 0.6 in the most recent 15-year sample. France's import-price pass-through (top-right panel of the continuation of figure 3) exhibits this feature even more clearly. French import-price pass-through was about 0.5 and stable through 1996; in 1997, the estimate takes a dive to below 0.2 by the 15-year sample ending in 2000, after which it remains fairly stable. This

similar pattern across the United States, the United Kingdom, and France suggests that the fall in import-price pass-through is not a relic of changes to the data construction methodology of import prices, as some observers believe. That said, that import-price pass-through began to fall markedly around 1997 does not preclude the possibility that this is due to increased local currency pricing or increased cross-border production arrangements or any other of the theoretical possibilities suggested in the literature review. It simply points out an event around which the fall in pass-through may have begun to coalesce. By signaling the beginning of a change in the underlying industrial structure of several key manufactured goods industries, it is possible that this defining event has had lasting effects on price-setting behavior which we can observe in estimates of import-price pass-through.

Of note, nevertheless, is that Japan, a country that has very close economic ties to those countries directly involved in the Asian financial crisis, did not exhibit the same decrease in import-price pass-through around 1996-98. Still, while the timing may not coincide with those of the U.S., the U.K, and France, Japan's import-price pass-through has shown the largest fall among our sample of countries. Specifically, we estimate that Japanese import-price pass-through fell about 0.53 between the earliest and latest 15-year sample. This roughly coincides with the change in the estimate for import-price pass-through reported in both Campa and Goldberg (2004) and Otani, Shiratsuka, and Shirota (2005). The latter paper does several robustness tests and also estimates import-price pass-through for 8 Japanese import sectors. Importantly, when primary commodities are excluded from the dependent variable, the fall in import-price pass-through is much smaller, but still statistically significant. The authors then decompose this decline in overall import-price pass-through into contributions from compositional changes to the Japanese import basket (as in the Campa-Goldberg hypothesis) and

into contributions from declines in the pass-through to sectoral import prices. They find that only about 15 percent of the decline in import-price pass-through can be attributed to changes in the composition of the Japanese import basket.[14] Instead, the majority of the decline is due to lower pass-through to sectoral import prices themselves, particularly the metals, chemicals, and machinery sectors.

Finally, although German and Italian import-price pass-through decreased numerically between our earliest and latest 15-year samples, the reduction is neither statistically nor economically significant. German import-price pass-through is remarkably low and stable at about 0.35. In fact, it registered the lowest level of pass-through in the early 1970s and 1980s among our sample of countries. In the last 15 years, France now records the lowest level of import-price pass-through. Nevertheless, with an already low level of pass-through, it is not too surprising that German import-price pass-through did not fall very much, specifically about 0.09. This estimate for the change in pass-through is about in line with the estimated decrease reported in Campa and Goldberg of about 0.04.

V.2 Pass-through to Consumer Prices

Just as we saw with import-price pass-through, there is a general downward trend in the estimate of consumer-price pass-through in industrialized countries. A cursory look at Figure 3 shows that consumer-price pass-through declined in 6 of the 7 countries in our sample. The 95 percent confidence bands, the shaded areas, are much larger than those found for our import-price pass-through estimates, but we still find significant declines in consumer-price pass-through for two countries: Italy and France.

[14] This is similar to the one-third contribution from compositional changes that Marazzi, Sheets, Vigfusson et al (2005) attribute to the fall in U.S. import-price pass-through.

The explicit estimates of consumer-price pass-through for the first and second sample periods are reported in Table 3, along with the change in the pass-through between the two periods. Italy has the largest decline, at nearly 0.4, while we estimate the French decline near 0.3. Wald tests for these two countries indicate these reductions in pass-through are statistically significant. For most other countries we find smaller declines in consumer-price passthrough. In Germany, pass-through remained roughly flat. Overall, the average pass-through declines from 0.14 to zero.

These estimates of pass-through to consumer prices are consistent with other empirical studies. Just as in Gagnon and Ihrig (2004) we find pass-through falls for all G-7 countries except Germany. They find more significant falls than in this analysis, potentially reflecting the fact that they divide their sample periods at monetary policy break points for each country. That is, the literature attributes a credible, anti-inflationary monetary policy regime with low pass-through and Gagnon and Ihrig's first sample period is solely prior to the establishment of credible, anti-inflationary regimes; whereas, our decision to break the samples equally into 15 year periods causes our first sample period to be a mixture of monetary policy regimes.

An interesting country in our sample is the United Kingdom. The sterling depreciated by roughly 20 percent (a.r.) between 1992 and 1993. Looking at Figure 3 one sees that our estimate of pass-through fell from over 0.1 to near zero prior to this episode and, hence, the impact of this depreciation on consumer prices was minimal. However, if pass-through had not fallen consumer prices would have jumped up by over 2 percent. In 1996-97 there was a 15 percent appreciation in the sterling; with low pass-through, consumer-price inflation again did not react. For more analysis of these two large swings in the pound and the minimal impact on consumer prices one can turn to Cunningham and Haldane (1999).

Our near zero estimate of Canadian consumer-price pass-through in both sample periods is consistent with numerous Bank of Canada studies.[15] These studies, which are typically based on Phillips curve models, suggest that the pass-through essentially fell to zero around 1983. We have an estimate of 0.05 in the first sample period and -0.09 in the second sample period, neither of which is statistically different from zero. As an aside, a more recent study by Leung (2003) examines the impact of exchange-rate movements on total Canadian consumer prices as well as several components of the index. He finds it is possible that offsetting changes in the sub-indexes lead to little impact at the aggregate level.

IV. Conclusion

Our analysis finds a decline in import-price and consumer-price pass-through for almost all of the G-7 countries. For about half of these countries the decline in each type of pass-through is significant. The fact that exchange-rate pass-through to both consumer and import prices has fallen within the same time frame and the fact that part of the consumption basket is imported begs the following question: *How much of the fall in consumer-price pass-through is explained by the decline in import-price pass-through?*

Existing work on this question is mixed. Some argue that imports are too small of a share of the consumer price basket to have a significant impact on the decline in consumer-price pass-through. But, given that imports are over 40 percent of consumption for the majority of the G-7 countries we believe a more thorough analysis is necessary. Looking at our results, we find some countries, such as France and the United Kingdom, where the declines in import-price and consumer-price pass-through are similar in magnitude, suggesting that reductions in import-price pass-through might explain most of the change in consumer-price pass-through.

[15] Many of the Bank of Canada studies are summarized in Longworth (2002).

For other countries the declines in import-price and consumer-price pass-through are not so closely related. For example, the fall in Italian import-price pass-through of about 0.15 is much too small to explain the 0.4 decline in consumer-price pass-through. But, noting that consumer-price pass-through is also influenced by second stage pass-through one should consider how this changed over the sample periods as well. Table 4 displays the correlation between import price inflation and consumer price inflation in the two samples; these correlations serve as rough proxies for second-stage pass-through. As shown, the correlation is smaller in the second sample period for all G-7 countries and, Italy experienced one of the larger reductions in its correlation. Indeed, the BIS (2005) and Sekine (2005) present evidence suggesting second-stage pass-through has declined over time for the G-7 countries. This suggests that for Italy, the decline in import-price pass-through along with the decline in second-stage pass-through might be able to explain its estimated decline in consumer-price pass-through.

It should be noted that a cross-country study by McCarthy (2000), using a vector autoregressive model, finds that exchange rate shocks have modest effects on consumer-price inflation (including effects through import prices). So, in general, explaining the decline in consumer-price pass-through cannot rely solely on changes in first and second stage pass-through. A perfect example of this point is Germany. German consumer-price pass-through increased slightly between our two sample periods, even in the face of a decline in the responsiveness of import prices to exchange rate movements. Worse, table 4 suggests that second-stage pass-through fell sharply in Germany. This suggests that something else must be at work keeping consumer-price pass-through from falling. One answer might be that pass-through of exchange rates to the consumer prices of domestically-produced goods (i.e. tradables and non-tradables), as opposed to the consumer prices of imported goods, rose.

As illustrated by the different countries in our sample, there is not a simple answer to what drives changes in consumer-price pass-through. More research is needed on this issue to fully understand first-stage, second-stage and consumer-price pass-through.

VII. References

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Figure 1

Decline in Headline Inflation for the G-7 Countries

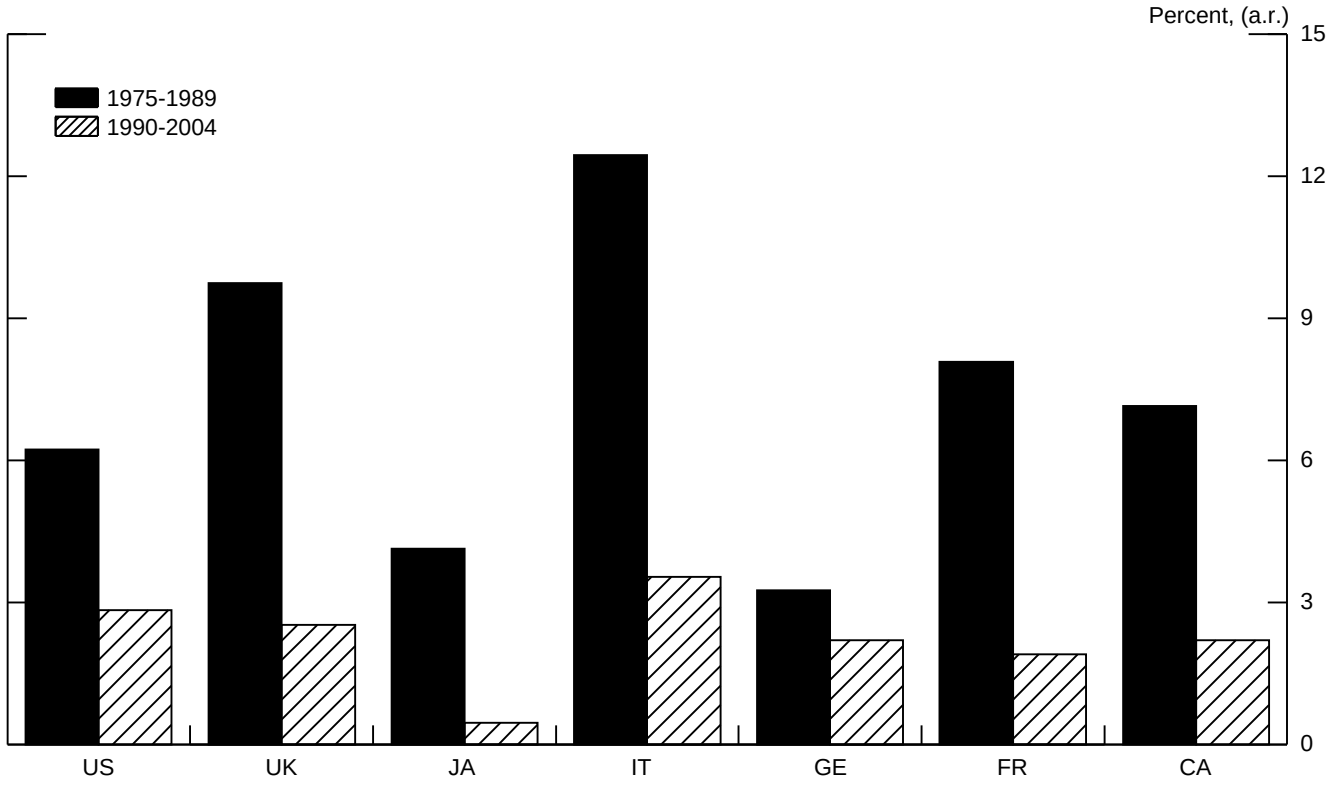
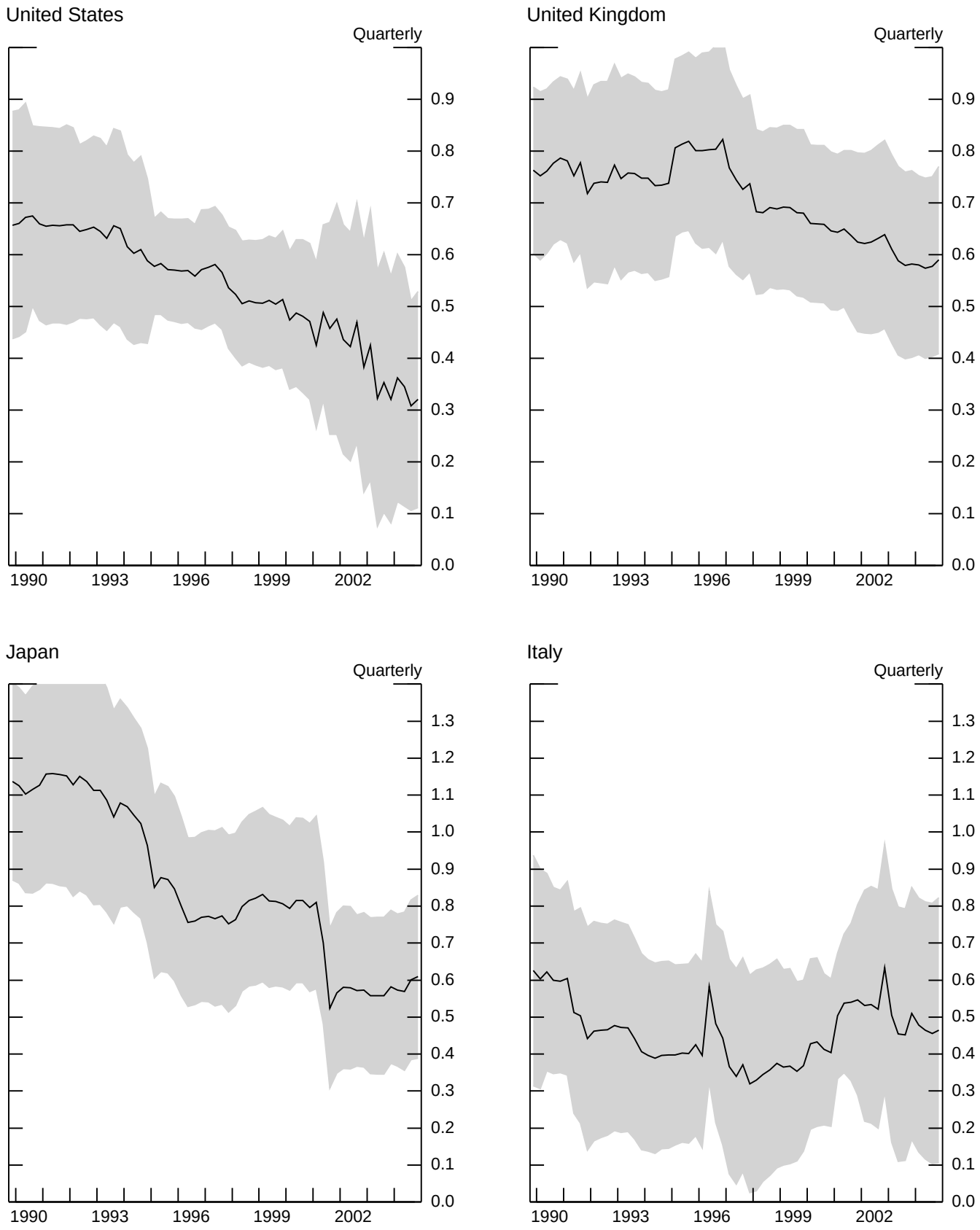


Figure 2

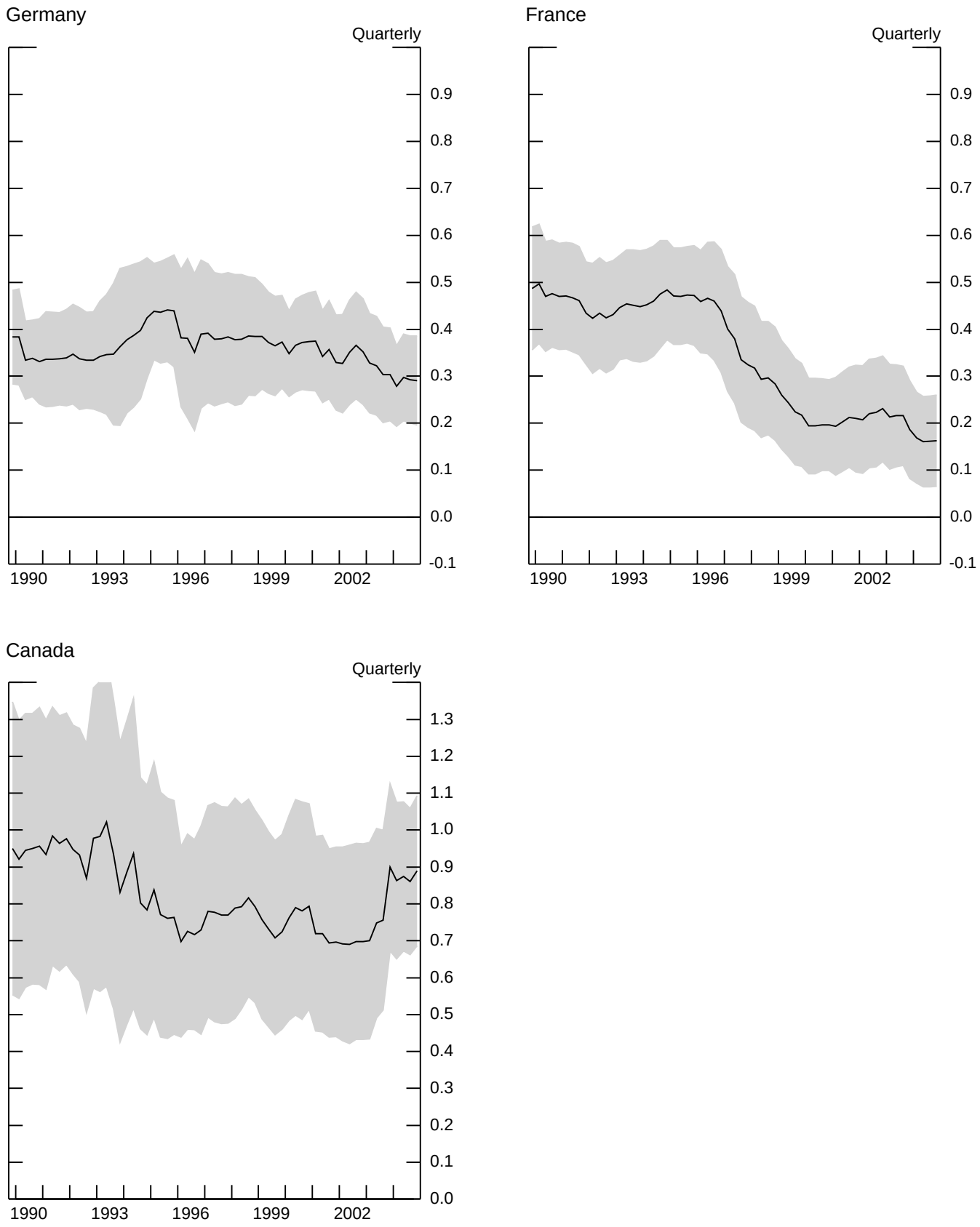
Long Run Pass-through to Prices of Imported Core Goods*



* Rolling regressions with a fixed 15-year window. Gray bands represent 95% confidence interval.

Figure 2

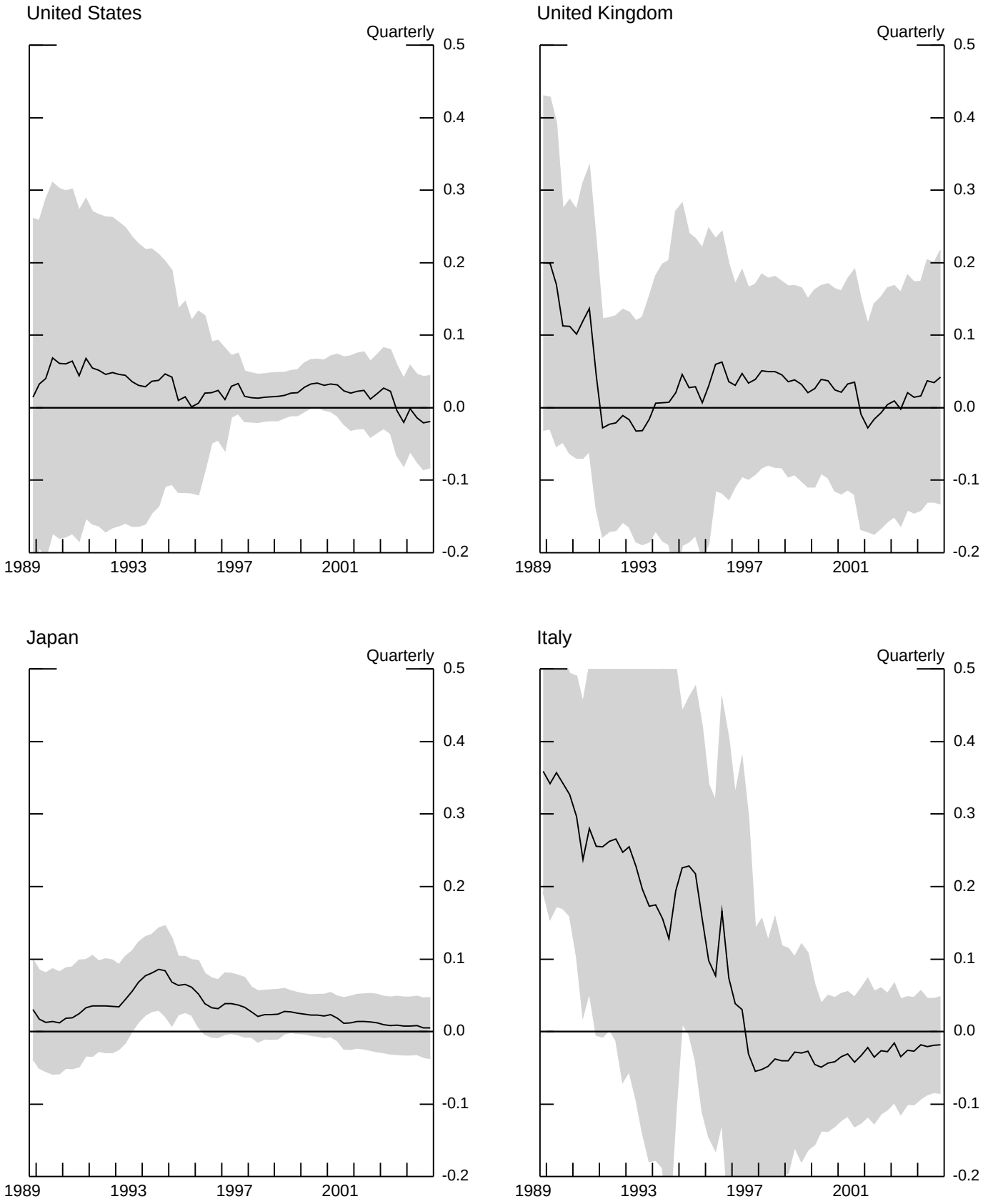
Long Run Pass-through to Prices of Imported Core Goods*



* Rolling regression with a fixed 15-year window. Gray bands represent 95% confidence interval.

Figure 3

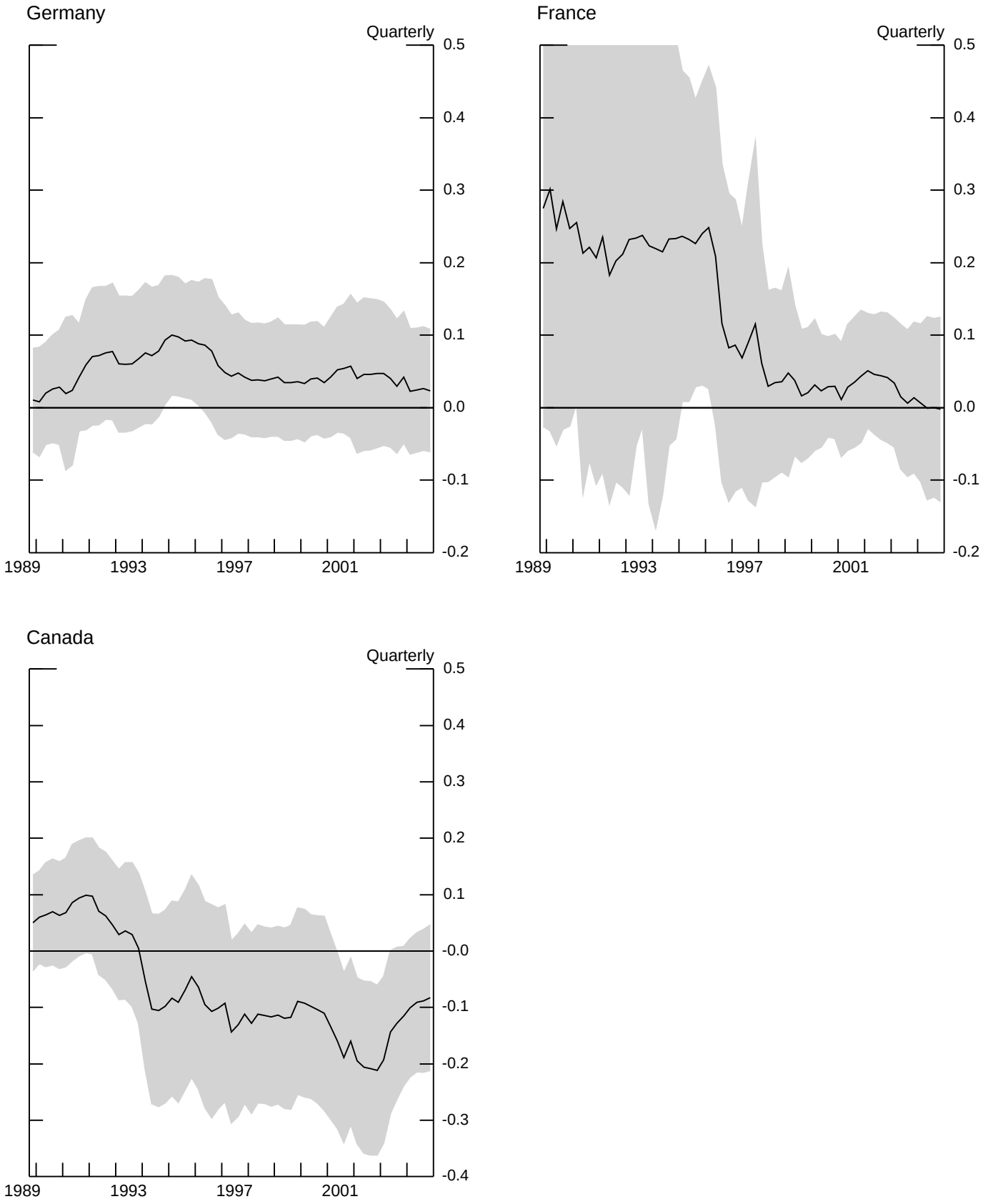
Long Run Pass-through to Prices of Consumer Goods*



* Rolling regressions with a fixed 15-year window. Gray bands represent 95% confidence interval.

Figure 3

Long Run Pass-through to Prices of Imported Consumer Goods*



* Rolling regression with a fixed 15-year window. Gray bands represent 95% confidence interval.

Table 1: Summary Statistics*

	Δp^M		Δp^{CPI}		Δer	
	μ	σ	μ	σ	μ	σ
United States	1.043	1.861	1.148	0.798	-0.869	2.580
United Kingdom	1.291	2.658	1.560	1.543	-0.046	3.232
Japan	0.154	5.305	0.820	1.195	-1.608	4.961
Italy	1.573	3.320	2.016	1.594	-0.848	4.309
Germany	0.343	1.774	0.734	0.560	-1.373	3.744
France	0.740	1.666	1.294	1.111	-0.635	3.696
Canada	0.676	1.940	1.106	0.822	-0.007	2.211

* We report 100 times the means and standard deviations of the variables used in the regressions.

Table 2: Estimates of Long-Run Import Price Pass-Through[†]

	1975-1989 (1)	1990-2004 (2)	Change (3) = (2) - (1)
United States	0.657 (0.109)	0.320 (0.104)	-0.337*
United Kingdom	0.763 (0.080)	0.590 (0.090)	-0.173
Japan	1.137 (0.133)	0.609 (0.109)	-0.528**
Italy	0.626 (0.155)	0.465 (0.179)	-0.161
Germany	0.384 (0.050)	0.291 (0.047)	-0.093
France	0.487 (0.065)	0.163 (0.048)	-0.324**
Canada	0.951 (0.197)	0.890 (0.101)	-0.061
Average	0.715	0.475	-0.239
Average (ex Canada)	0.676	0.406	-0.269

[†] Standard errors in parentheses.
*, ** indicate that the decline in pass-through is statistically different from zero at the 10 percent level and the 5 percent level, respectively.

Table 3: Estimates of Long-Run Consumer Price Pass-Through†

	1975-1989 (1)	1990-2004 (2)	Change (3) = (2) - (1)
United States	0.014 (0.123)	-0.019 (0.031)	-0.033
United Kingdom	0.200 (0.115)	0.042 (0.087)	-0.157
Japan	0.031 (0.034)	0.005 (0.021)	-0.026
Italy	0.359 (0.083)	-0.018 (0.033)	-0.377**
Germany	0.010 (0.035)	0.023 (0.042)	0.013
France	0.275 (0.150)	-0.002 (0.063)	-0.277*
Canada	0.050 (0.042)	-0.083 (0.064)	-0.133
Average	0.134	-0.007	-0.142

† Standard errors in parentheses.
*, ** indicate that the decline in pass-through is statistically different from zero at the 10 percent level and the 5 percent level, respectively.

Table 4: Correlations Between Import-Price Inflation and Consumer-Price Inflation

	1975-1989	1990-2004
United States	0.211	0.146
United Kingdom*	0.232	0.102
Japan	0.327	-0.081
Italy*	0.381	0.071
Germany	0.242	-0.152
France*	0.516	0.165
Canada	0.272	-0.045
Average	0.312	0.029
Average (ex Core)**	0.377	0.112

* We report headline CPI inflation for these countries; for other countries, we report core CPI inflation.
** This average excludes the countries whose CPI data is core CPI.

Appendix 1: Models Selected by the Hendry and Krolzig (2001) Algorithm

Import Price Pass-Through Regressions

Numbers Indicate Lags in Chosen Specification

	Intercept?	lagged Mprice	Own Output Gap	World Output Gap	IMF Commodity Prices	WTI Spot Prices	Broad Nominal ER	Foreign CPI	Dummies
United States		1			2	1	0,1,2,3	0,1,2,3	
United Kingdom					1,3	1	0,1,2,3	0,1,2,3	tax
France					1		0,1,2,3	0,1,2,3	
Germany	yes	1,2	0		0,2		0,1,2,3	0,1,2,3	unification
Italy	yes		2				0,1,2,3	0,1,2,3	
Canada		3			2,3		0,1,2,3	0,1,2,3	tax
Japan			0,1		0	1	0,1,2,3	0,1,2,3	tax

Consumer Pass-Through Regressions

Numbers Indicate Lags in Chosen Specification

	Intercept?	lagged CPI	Own Output Gap	World Output Gap	IMF Commodity Prices	WTI Spot Prices	Broad Nominal ER	Foreign CPI	Dummies
United States	yes	3		0		1	0,1,2,3	0,1,2,3	
United Kingdom	yes	1	1				0,1,2,3	0,1,2,3	tax
France		1,2					0,1,2,3	0,1,2,3	
Germany		2		1,3			0,1,2,3	0,1,2,3	unification
Italy		1	0		3		0,1,2,3	0,1,2,3	
Canada				0,3	1	1	0,1,2,3	0,1,2,3	tax
Japan		3	0,1		3	0	0,1,2,3	0,1,2,3	tax

Appendix 2: Data Sources

Import Prices

	Source	Description
United States	BEA and Grimm(1998)	Goods excluding petroleum, computers, and semiconductors
United Kingdom	Office for National Statistics	Goods excluding oil and erratics
Japan	Ministry of Internal Affairs and Communications	Goods excluding petroleum, coal, and natural gas
Italy	Constructed by authors	Goods excluding energy from OECD ITCI Database (1975Q1-1997Q2) and Haver Analytics (1997Q3-2004Q4)
Germany	Deutsche Bundesbank	Goods excluding petroleum and mineral oil products
France	Constructed by authors	Goods excluding energy from OECD ITCI Database (1975Q1-1977Q4) and INSEE (1978Q1-2004Q4)
Canada	Constructed by authors	Goods excluding energy from OECD ITCI Database (1975Q1-1980Q4) and Statistics Canada (1981Q1-2004Q4)

Consumer Prices

	Source	Description
United States	Bureau of Labor Statistics	CPI: All items excluding food and energy
United Kingdom	Office for National Statistics	Headline CPI: All items
Japan	Ministry of Internal Affairs and Communications	CPI: All items excluding fresh food (SA, 2000=100). Seasonally adjusted by Haver.
Italy	Istituto Nazionale di Statistica	Headline CPI: All items
Germany	Deutsche Bundesbank	Consumer Price Index: Total excluding energy
France	INSEE	Headline CPI: All items
Canada	Statistics Canada	CPI: All items excluding food and energy