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THE SEGMENTATION OF INTERNATIONAL MARKETS: EVIDENCE FROM *THE ECONOMIST*

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ABSTRACT

This paper studies the behavior of newsstand prices for *The Economist* magazine in eight markets. Substantial variations in markups across markets are related to exchange rate fluctuations. Some of this variation can be traced to menu costs. However, much of the variation appears to result from intentional price discrimination across three regions: the U.S., the U.K., and Continental Europe and Scandinavia. Differences in demand elasticities can plausibly be attributed to differences in preferences and the set of competing products across markets. Segmentation of the markets is facilitated by the time-sensitive nature of the product which makes arbitrage very costly.

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The Segmentation of International Markets: Evidence from *The Economist*

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Globalization–the process of integration of national economies–is among the most widely discussed economic phenomena of the late 20th century. One important aspect of globalization is the integration of product markets. Multilateral and bilateral agreements to reduce tariffs and sometimes other barriers through the GATT, WTO, and other regional arrangements have been widely hailed as steps toward a truly global marketplace. Perhaps this helps explain the rebirth of interest in studies that examine the behavior of prices and exchange rates across countries.[1] Rather than validating the integration of product markets, however, this work has detected systematic departures from price equalization across markets for a variety of goods.[2] Debate in this area of research is no longer about the facts, but rather about how to interpret them.

While the data reveal statistically significant deviations from price equalization, the economic interpretation of those deviations has been controversial for at least two reasons. First, there are concerns about the homogeneity of the products used to test the integration of markets. Prices may refer to transactions involving products that are physically different, have different terms of sale (e.g., flexibility on delivery dates), or are sold in different locations, and thus may include different amounts of value added that are non-tradable (e.g., distribution and retail services). Second, even if the identical goods assumption holds to a close approximation, questions remain about the economic

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[1] See the review articles by Rogoff (1996) of Goldberg and Knetter (1996) for the macroeconomic and microeconomic evidence on prices and exchange rates.

[2] See for example, Isard (1977), Kravis and Lipsey (1978), Richardson (1978), Giovannini (1988), Knetter (1989, 1993), and Marston (1990).

significance of departures from price equalization across markets. It is possible that prices and exchange rates are correlated, but that the implied deviations from the law of one price are small or short-lived. In that case, the law of one price might remain a useful building block in modeling linkages between economies. On the other hand, correlation between common-currency relative prices for a good and exchange rates may imply a complete disconnection between national markets for goods.

This paper will assess the economic significance of departures from the law of one price in newsstand prices for *The Economist* magazine in eight markets. The objectives of the paper are to understand first the pricing behavior of *The Economist* itself and then the lessons this pricing behavior offers for other product markets. Of particular interest is whether statistical evidence against the law of one price represents price changes that are unintentional, as suggested by Ghosh and Wolf (1994), or intentional, and consequently whether national markets should be viewed as integrated or segmented for modeling purposes.

There are several main findings. First, standard empirical tests reveal a substantial amount of destination-specific markup adjustment in response to exchange rate changes for nearly all country pairs. About 75-80% of an exchange rate change is offset by markup adjustment for the typical pair of markets in the sample. Second, infrequent price adjustment in the local currency appears to explain a substantial amount of measured markup adjustment, as found by Ghosh and Wolf (1994). However, even after accounting for infrequent adjustment, markup adjustment of about 40-50% of any exchange rate change remains to be explained by other factors. Third, the magnitude of departures from the law of one price and their persistence varies widely across markets. Deviations are small within Continental Europe, but are large between Continental Europe, the U.K., and the U.S. For a number of bilateral pairs of markets within Europe and Scandinavia, it is possible to reject a unit root in the common currency relative prices. For the U.S. and U.K., countries with relatively large deviations from the average price across all markets,

deviations are more persistent. Fourth, the largest deviations from the law of one price in our sample are not always good predictors of future changes in relative cover prices, especially for the U.S.

Weighing all of the evidence, it appears that price differentials within continental Europe and Scandinavia are small, short-lived, and perhaps unintended consequences of unanticipated exchange rate changes. This suggests these nations form an integrated market for *The Economist*. The U.K. and the U.S. markets exhibit large and persistent price differences with each and with the rest of the markets. Across these three groupings of nations, price discrimination appears to be an intentional policy aimed at maximizing profits across segmented markets. Market segmentation appears to be a consequence of structural characteristics of the newsstand magazine industry, rather than barriers to trade between countries.

The next section presents theory and prior evidence on the law of one price. Section III discusses the data on cover prices for *The Economist* and its distinguishing characteristics relative to other international trade data used to the law of one price and related topics. Section IV presents the evidence against the law of one price and the sensitivity of that evidence to the frequency of price adjustment. Section V studies the magnitude and persistence of deviations from the law of one price using a variety of techniques in order to better understand the relationships between different national markets for *The Economist*. Section VI concludes the paper.

II. Theory and Evidence on the Law of One Price

The linkages between national economies depend in large part on whether product markets are integrated or segmented. For purposes of this paper an integrated market is one in which geography and/or nationality do not have systematic effects on transaction prices for otherwise identical products. Gold is a good example. Similarly, a product

market is geographically segmented if the location of the buyers and sellers influences the terms of the transaction in a systematic way. The market for automobiles, for example, is segmented for a variety of reasons. Automobiles purchased in a foreign market may be subject to tariffs and may not comply with safety and environmental regulations in the home market. Furthermore, warranties and service are often linked to the location of purchase. By making resale across nations costly, these factors permit nearly identical automobiles to sell for different prices in two markets without inducing profitable third-party arbitrage.[3]

The law of one price (henceforth, LOP) provides an empirical definition of market integration: identical products sell for the same common-currency price in different countries. The assumptions required for the LOP to hold are profit maximization and costless transportation, distribution, and resale. Let p denote the home currency price in country H, p^* the home currency price in country F, and E the exchange rate of H's currency per unit of F's. If the LOP holds for some good i, then:

$$(1) p_i = Ep_i^*$$

Since the assumptions of costless transportation, distribution, and resale are unlikely to hold in practice, the absolute version of the LOP is modified. Suppose costs of transportation or resale (such as trade barriers) preclude price equalization, but that the frictions give rise to a stable price differential across two markets. In this case, we have:

$$(1') p_i = \alpha Ep_i^* ,$$

where α is the real product exchange rate or, alternatively, (α x 100) is the home currency price as a percentage of the foreign. If α remains constant over time, then common

[3] See Verboven's (1996) article on price discrimination in the European market for automobiles for a discussion of the factors that make resale costly in those markets.

currency prices for a particular product change in the same way over time in two countries, and the *relative* LOP holds.

Since most international comparisons involve price indices, tests have focused on the relative LOP. The standard approach to testing the LOP involves regressing the ratio of prices in two markets, expressed in units of a common currency, on the (nominal or real) exchange rate between the markets or other market-specific variables that might influence relative prices. Research has repeatedly found that relative prices depend on exchange rates, a violation of both the absolute and relative LOP. Early controversies in interpretation centered in large part on whether the tests represented goods which were in fact identical.[4] True skeptics viewed rejection of the LOP as evidence against the identical goods assumption, as opposed to evidence against the integration of markets.[5] More recently, products used to test the LOP have become increasingly detailed, which has mitigated this criticism.[6] Studies using a variety of data sources (price indices and unit values) at different frequencies (monthly and annual) in different empirical frameworks have consistently rejected the LOP.

One recent line of research in this area admits at the outset that price discrimination may be a central feature of product markets. Pricing-to-market (henceforth, PTM) is a branch of research that analyzes prices of goods shipped to multiple markets by a group of firms from a single source country that may be capable of price discrimination.[7] In theory, profit maximizing prices depend upon a number of destination-specific variables, including the exchange rate, when the exporter is capable of price discriminating across markets. Thus, a significant correlation between relative prices and exchange rates (or any other cost or demand shifters) is consistent with PTM but not with LOP.

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[4] Price comparisons in many investigations of the LOP refer to products produced in different source countries, e.g., Isard (1977) and Richardson (1978).
[5] See McCloskey and Zecher (1984) and the comment by Lipsey (1984) for an interesting debate about the interpretation and economic significance of deviations from PPP and LOP.
[6] Giovannini (1985) examines export prices of nuts and bolts from Japan; Knetter (1989, 1993) uses exports of 7-digit industries which in some cases represent fairly homogenous bulk commodities.
[7] See, for example, Knetter (1989, 1993) or Marston (1990).

A reasonable estimate of the magnitude of PTM, at least for German and Japanese exports, is that nearly half of the effect of an exchange rate change on the buyer's price is offset by destination-specific adjustment of markups, although there is substantial industry variation.[8] Estimates obtained with monthly data (e.g., Marston) do appear to be slightly higher than those obtained with annual data (e.g., Knetter), a fact which suggests that simple static models of price discrimination may not be the only explanation for the empirical evidence.

Several papers have explicitly allowed for dynamic aspects of price adjustment in studying PTM. Early work by Giovannini (1988) and Marston (1990), for example, allowed for pre-set prices and delays in reacting to changes in exchange rates. Marston finds that most prices are adjusted within a few months for the 4-digit Japanese exports he studied. Kasa (1992) and Gagnon and Knetter (1995) estimate error-correction models that allow for short-run deviations from equilibrium pricing. Gagnon and Knetter find that the dynamic response of markups on German and Japanese automobile exports varies across export destinations with invoicing patterns in manufacturing. For shipments to markets where invoicing tends to be in the exporter's currency, markups adjust more in the long run than they do in the short run. For shipments to markets where invoicing tends to be in the buyer's currency, exporters' markups adjust too much in the short run. This suggests that invoice prices may be rigid in the short run, something that has been noted going back to the literature on the J-Curve.

The precise microeconomic behavior underlying price adjustment to exchange rates is difficult to discern from most of these studies. Trade data tend to be aggregated over units of time, product characteristics, and/or destination markets, and information on the currency of invoice for any particular shipment is typically unavailable. Ghosh and Wolf (1994) try to remedy this problem by studying the adjustment of cover prices of *The Economist*. In doing so, they reach the alarming conclusion that standard econometric

[8] See Goldberg and Knetter (1996) and references therein.

methods provide very misleading results in this context. In particular, while standard methods show very strong evidence of PTM (i.e., common currency relative prices move nearly one-for-one with exchange rates), they argue that this is primarily a consequence of short-run price rigidity in the buyer's currency and that restricting attention to the adjustment of cover prices reveals evidence that is consistent with the LOP. They caution that price rigidity and invoicing in the buyer's currency, rather than strategic price discrimination, may thus be responsible for the existing evidence on PTM using conventional data sources.

Although empirical research on Purchasing Power Parity (PPP) is structurally equivalent to the LOP, it is much more advanced in characterizing the time series behavior of deviations from parity. Since tests of PPP require only aggregate price indices and exchange rates, the data are available for many countries over long periods of time. Consequently, there is broad agreement emerging in the literature that deviations from PPP are mean-reverting with a half-life of 3 to 5 years.[9] The literature on the LOP has arrived at no such consensus, even for individual products. The gathering of large data samples is inhibited by two factors. First, product classification codes change frequently on data collected within individual countries which places limits on the length of individual price series. Second, price data suffer from a lack of comparability across countries.[10] It is usually the case that increasing the breadth of a panel would decrease its length or require moving to higher levels of aggregation at which the identical goods assumption becomes questionable. The typical study of the LOP or PTM does not have nearly enough data for unit root tests to have sufficient power against economically distinct alternatives; thus, the

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[9] Such half-lives are exhibited in the work of Frankel and Rose (1995) and Wei and Parsley (1995) with panel data or Edison (1987) with long time series data. New work may yet undermine this view. See recent papers by Engel (1996) and O'Connell (1996).

[10] An exception is Froot, Kim and Rogoff (1995). However, their research on commodity prices has such long time series that exchange rate data are not available for much of the period. They adopt the creative solution of converting all prices into silver equivalents (on the assumption the law of one price holds for silver) and proceed to study deviations from the law of one price in this manner.

persistence and interpretation of deviations from the LOP remains a matter of some controversy.

The resolution of this controversy is important, since the decision about whether to model markets as integrated or segmented has first-order ramifications for the welfare effects of many economic policies. This paper will try to add resolution to this controversy in two ways: (1) by reevaluating the evidence on pricing behavior of *The Economist*, and (2) by assessing the relevance of that evidence for behavior in other markets.

III. The Data

The data used in this paper are local currency cover prices from the North American version of *The Economist* for eight countries: Denmark, France, Italy, the Netherlands, Sweden, the United Kingdom, the United States, and West Germany. These data are available in principle from May 1966 (when many prices began to appear on the cover) until the present. Due to changes in the countries whose prices are reported, the data sample for most of the empirical work done here ends in December 1990, although price behavior in certain markets is discussed up to the present. Furthermore, the analysis will concentrate on data from the post-Bretton Woods period, beginning in 1973. Although the data are available weekly, we use a monthly frequency and record the price prevailing at the end of each month. Monthly average market exchange rates and consumer price indices for each country are taken from the *International Financial Statistics* published by the International Monetary Fund.

Before proceeding to analyze the data, it is worth emphasizing some of its unique features. These data are well-suited to this inquiry in four respects: the product is quite homogeneous across markets, the price adjustments to particular markets are observed at high frequencies, the data are available on a consistent basis for a reasonably long time

span, and prices are quoted in the local (buyer's) currency.[11] The first three features imply that there is a relatively large amount of very clean data, which should make it easy to characterize price behavior in this market. This is in contrast to the more highly aggregated (both in terms of product coverage and time) price index and unit value data normally used to study pricing in international markets, where measurement error and short sample periods often make it difficult to obtain precise parameter estimates and characterize long run behavior. The fourth feature, prices quoted in the buyer's currency, introduces the interesting dynamic issues to tests of PTM or the LOP.

The empirical work will use the British Pound or Pound-equivalent prices for *The Economist* in the sample of eight markets. Monthly local currency prices are converted into pound-equivalents using the average monthly (pound per local currency) exchange rate. Figure 1 shows the pound prices of *The Economist* in four markets: France, Germany, the United Kingdom, and the United States. It is evident from the figure that common currency prices are not identical. In particular, U.K. prices tend to be lower than prices to other markets. French and German prices appear to be much higher on average, at least in recent years. However, these differentials could in principle be explained by differences in the retail and distribution costs across countries, rather than differences in the price of the tradable good itself. Instead, evidence against the LOP must come in the form of violations in the relative version of the LOP: the common currency relative prices must change in way that is not easily explained by changes in retail and distribution costs. A typical approach is to assume these retail and distribution costs can be reduced to a country-fixed effect–i.e., they give rise to a constant (percentage) differential in common currency prices across markets. Changes in the relative price are interpreted as evidence against the LOP. PTM goes a step further in testing whether relative price changes are correlated with nominal or real exchange rate changes across markets.

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[11] The main difference in content across regions is in the ordering of articles and the advertising content. Since readers may not have strong preferences over either of these features, the magazines are in principle substitutable across regions.

The evidence for such correlations as well as the complications that arise due to menu costs and infrequent price adjustment are illustrated in Figure 2. The figure plots the percentage difference in pound-equivalent prices between France and Germany and the log ratio of the Ff./DM exchange rate (normalized at its mean). Overall, the figure reads like an advertisement for Franco-German economic integration. Exchange rates and relative prices have stabilized over time. However, the basic problem for econometric analysis is clear: in most months, the movement in the common-currency relative price is exactly equal to the exchange rate change. Tables 1 and 2 document the two main features of price adjustment of *The Economist*. Table 1 shows that prices are adjusted infrequently in all markets, ranging from only seven adjustments in 18 years in the U.S. and Germany, up to 18 adjustments in Italy, and that certain months are more likely to greet readers with a new price. Table 2 shows that changes are correlated across markets.[12] Can standard methods distinguish between short-run and long-run behavior in this kind of setting? We now turn to econometric techniques in an attempt to characterize pricing behavior in this market.

IV. Empirical Evidence on Pricing to Market

The absolute version of the LOP in equation (1) states that common-currency prices are equal across markets. Due to non-stationarity of the nominal prices, it is common to form the common currency price ratio (p/Ep^*) before testing the LOP. The absolute LOP implies this ratio equals one, while the relative LOP implies the ratio is constant. Econometric tests then regress the common-currency price ratio on a constant and other variables (denoted here by X), often including the nominal or real exchange rate between the home and foreign market:

[12] See Ghosh and Wolf (1994) for greater detail on the nature of price stickiness for this market. This paper is not concerned with the determinants of the timing of price adjustment, but rather with the extent to which price differences are intended or unintended.

(2) $\ln(p / Ep^*) = \alpha + \beta \ln X + \varepsilon$

where ε is a random error and time subscripts have been suppressed on all variables. Hence, the test of the absolute LOP is a test of whether $\alpha = 0$ and $\beta = 0$. The relative version of the LOP allows the constant to be arbitrary, and tests only $\beta = 0$. Since cover prices of *The Economist* are inclusive of distribution and retailing costs which may vary across markets but are relatively stable over time, the focus will be on testing the relative version. Equation (2) is very similar to Marston's (1990) PTM equation, except he motivates the inclusion of some additional cost and demand shift variables which may help to explain variation in the margin of price discrimination. In practice, most of the action is in the exchange rates, so other factors will be ignored in what follows here.

Equation (2) is estimated for all bilateral country pairs in our sample using the real exchange rate as our RHS variable. Table 3A reports the estimated values of β for each of the country pairs using monthly data, where the asterisks denote significance at the 1% (**) and 5% (*) level, respectively. Of the 28 bilateral pairs in the table, 24 coefficients are negative and significant. A negative coefficient implies the standard pattern of PTM–common-currency relative prices rise for countries whose currencies appreciate. The median value of the coefficients reported in Table 1A is -.73, meaning that 73% of any exchange rate change is offset by adjustment of the pound-equivalent price. Alternatively, local currency prices change by only 27% of any exchange rate change.

Ghosh and Wolf (1994) point out that the statistical relationship between common-currency relative prices and exchange rates for *The Economist* may be dominated by cover price rigidity rather than long-run strategic pricing behavior. They argue that the best way to measure the "intended" price discrimination is to measure the data at frequencies at which cover prices are actually adjusted. They suggest a simple procedure used here. For each bilateral pair of countries, a new data set on cover prices and exchange rates is constructed by choosing observations only in those periods in which at least one of the two cover

prices is adjusted. This reduces, but does not quite eliminate, the contribution of menu costs to correlations between common-currency prices and exchange rates.[13] Since this data set reports information on a time scale that corresponds to economic decisions, it is labeled "Economic Time."

The results of bilateral PTM regressions using Economic Time are reported in Table 3B, which is analogous to 3A. There is a reduction in the number of coefficients that are statistically significant at the 1% level–only 13 of 28 coefficients are negative and significant, while one is positive and significant. Five more coefficients are negative and significant at the 5% level. The median value of coefficients in Table 3B is -.58, somewhat lower than in Table 3A. This indicates that some, but not all, of the statistical evidence of PTM found in the monthly data is a consequence of local currency price rigidity.

Since most studies of PTM use data at annual or quarterly frequencies, rather than monthly frequencies, it is of interest to see how time aggregation affects the answers. The monthly data are converted to an annual frequency and estimation of bilateral PTM coefficients is repeated. The results, shown in Table 3C, lie in between those in Tables 3A and 3B, although it appears the answers are closer to what is obtained with monthly data. Time aggregation up to the annual frequency does not come close to eliminating the contribution of price rigidity in the buyer's currency to statistical evidence of PTM.

In addition to estimating (2) the panel data version of this PTM test is also estimated:

$$(3)\quad \ln p_{it} = \theta_t + \lambda_i + \beta_i \ln X_{it} + \varepsilon_{it}$$

[13] If the timing of price changes were perfectly correlated, this contamination would be eliminated all together. The correlation of price changes is not perfect, but high enough that these problems are likely to be small. For the typical country pair, a price change in one country this month means there is about a 50% chance of a price change in the other country in that same month. The pattern of price changes has become increasingly correlated across markets. In fact, over the last five years of the sample, 86% of all cover price changes occurred in April, with at least four of the eight markets experiencing a price increase in that month in each of the last five years. Furthermore, remaining bias due to the deviation from optimal pricing when one market's price has not been changed is less than the amount of bias that has been corrected by this process. Countries whose cover prices change almost certainly had to have prices further from the optimum than countries whose prices did not change.

The panel of (the logs of) common-currency prices to all destinations is regressed on a set of dummies for each time period, the θ_t, and each country, the λ_i (one country effect is dropped to avoid singularity), and X denotes the price level adjusted exchange rate between the destination country and the exporter (in this case, the U.K. whose prices are not included in the model due to the lack of exchange rate variability).[14] The time dummy in each period will measure the common component of prices across all markets, presumably due to changes in the underlying common cost. The country effects measure the average price differential relative to the country whose fixed effect was omitted to identify the model. Conditional correlations between prices and exchange rates is evidence against the LOP and in favor of PTM.

Results of the panel model are reported for all three frequencies of the data in Table 4. Each column in the table reports the estimated value of β for each country and its standard error, along with an estimate of β when it is constrained to be equal across all destinations. The coefficient estimates range from about -.7 to -1.0, indicating between 70% and 100% of the effect of an exchange rate change on local currency prices is offset by adjustment of export margins (or retail margins). The constrained estimates are clustered around -.8. The results are virtually identical across the three units of time, with the exception that standard errors tend to be greater for the data sets with fewer observations. One reason that the differences in results are not as great as they were in the bilateral comparisons is that the Economic Time data set now includes a much higher incidence of cover price rigidity. For the bilateral comparisons, requiring that a cover price change for each data point ensures that 50% (one out of two) markets experience a price

[14] The nominal exchange rates are deflated by the price level in the destination market in order to impose homogeneity in prices and exchange rates. If an exchange rate change merely offsets inflation in the destination market, then no export price adjustment is called for. The same condition could be imposed by using real exchange rates, but there is no reason to think the home country price level has any relevance for the pricing in a foreign market.

change. For the panel case, it only ensures that 12.5% (one out of eight) markets experience a price change. That allows for a large amount of price rigidity to remain.

The evidence in Tables 3 and 4 confirms Ghosh and Wolf's (1994) claim that standard tests for PTM capture unintended correlation between relative prices and exchange rates resulting from invoicing in the buyer's currency. However, even when the data are modified to eliminate the bulk of price rigidity, it appears that a substantial amount of PTM remains. If we regress the bilateral coefficients found in Table 3B on those in Table 3A to obtain a rough measure of how moving to Economic Time changes the estimates, we get a coefficient of 0.7, suggesting that moving to Economic Time reduces estimated PTM by 30%. The true impact of menu costs may be slightly higher since price changes are not perfectly synchronized. However, it is unlikely that a full accounting of menu costs could reduce measured PTM by more than about 40-45%. That still leaves evidence of substantial destination-specific markup adjustment–about 40-50% of any exchange rate change–even after correcting for price rigidity. We now turn to the question of whether PTM of this magnitude is associated with economically significant deviations from the LOP.

V. The Character of Deviations from the LOP

A. How Big Are the Deviations?

The magnitude of deviations from the absolute LOP can be constructed from a panel regression similar to equation (3):

$$(3') \ln p_{it} = \theta_t + \varepsilon_{it}$$

where prices are pound-equivalent prices and the country effects and exchange rate covariate have been dropped from (3). The period-specific dummies will equal the average

pound price prevailing across all markets in each period. The residuals for this regression are then the deviations between the actual price in country *i* in period *t*, and this average price, which will be designated as the "nominal anchor" (following the terminology of O'Connell (1996)) toward which prices should converge for the LOP to hold.

Analysis of the residuals for each country from the regression (3') is in Table 5. The first column reports the average value of the residuals for each country. These range from a low of -.37 for the U.K. to a high of .10 for Sweden and the U.S. This implies that on average, there is a 47% difference between prices in the U.K. and these two markets over our sample. These differences do not necessarily represent price discrimination by the publisher, since distribution and retailing costs might vary across destinations and thus account for some of the gap.

Provided the distribution and retailing costs are fairly stable within markets over time, which seems like a reasonable assumption, fluctuations in relative prices across markets might provide indirect evidence on the behavior of publishers margins to different markets. To get a sense of the magnitude of violations in the relative LOP, it is necessary to look at the standard deviations of the residuals from (3'). They vary across countries from a low of .05 for Denmark and the Netherlands to a high of .15 for the U.S. Under the assumption of normality of the errors (which is a good approximation based on visual inspection of histograms of the residuals for each country) prices in the U.S. are more than 15% from their mean (which equals the nominal anchor plus an average U.S. differential) about 32% of the time. This suggests potentially wide variation in publishers margins in this market.

The residuals from (3') are measured relative to an average price, so they understate the magnitude of price discrimination that exists across particular markets at various points in time. Deviations between certain pairs of markets can be very large and change dramatically over time. For example, from May 1983 to July 1985, the dollar price of *The Economist* in the U.S. ($2.50) exceeded the dollar-equivalent price in Germany by $0.60

or more each month. However, since May of 1994, the dollar-equivalent price in Germany has exceeded the dollar price in the U.S. ($3.50) by at least $1, and sometimes by more than $2! Individually, these periods represent large deviations from the absolute LOP. Together they constitute a serious violation of the relative LOP–relative prices change by over 50% between these markets.

B. Bilateral Unit Root Tests

The persistence of deviations from the LOP can be studied in a more systematic way. The standard technique from the PPP literature is to test for a unit root in the real exchange rate. In this case, the relative common-currency price represents a real "product" exchange rate. If the LOP exerts some influence on relative prices in this market, then common-currency relative prices should be stationary, i.e., it should be possible to reject a unit root in the data.

Table 6 reports the results of unit root tests for the bilateral country pairs using monthly data. The table gives the estimated root (alpha) for an augmented Weighted Symmetric test and the p-value associated with a test of the hypothesis that the common-currency relative price has a unit root. Turning to Table 6, seven of the 28 cases provide evidence against a unit root at a level of significance below 10%, perhaps a surprisingly high amount of rejections in only 18 years of data. These cases all involve combinations of Continental European or Scandinavian markets. There is never evidence against a unit root in bilateral comparisons involving the U.S. and the U.K. The estimated roots for the seven cases with p-values below .10 lie around 0.9, with an implied half-life of deviations of about 6.6 months, which seems like fairly rapid reversion to the mean.

In general, the problem with these tests is that they have low power against local alternatives. Relative to the evidence on PPP, a deviation with a half-life of 6.6 months is rather short and would be viewed as rapid convergence. Even a root of 0.95 would imply a half-life just over one year. Unfortunately, the data series is too short to offer enough

power to reject a unit root for estimated values of alpha as low as 0.87 (France-Italy). Given that our time series cannot be expanded without eliminating countries or using six years of data from the fixed exchange rate period, one approach to increasing the power of these tests would be to pool information across pairs of markets. The standard approach to pooling (e.g., Frankel and Rose (1995)) involves selecting a base country which is used to form all bilateral comparisons. However, this approach introduces cross-sectional dependence in the error structure, as shown by O'Connell (1996). In the presence of such errors, a unit root may be rejected too easily in standard tests.

C. Multilateral Unit Root Tests

As noted by O'Connell (1996), one approach to dealing with the cross-sectional dependence of errors is to construct deviations from the LOP in manner that weights all countries equally in forming the nominal anchor, as opposed to selecting a single base country for bilateral comparisons. A natural method for doing this is to retrieve the residuals from a fixed effects panel model that includes both time and country effects:

$$(3'') \ln p_{it} = \theta_t + \lambda_i + \varepsilon_{it}$$

Including the country effects amounts to making this a test of the relative LOP.

Table 7 reports the estimated root, alpha, and the p-value for the augmented Weighted Symmetric unit root test. Interestingly, a unit root can be rejected at the 1% level for Italy and at the 7% level for Sweden–i.e., there is some fairly strong evidence that deviations are mean-reverting for those countries. The estimated roots of .87 and .89, respectively, imply half-lives of 5.2 and 6.2 months for deviations from the LOP. Italy and Sweden are the highest and third-highest inflation countries in our sample over this period. High inflation presumably requires more frequent cover price adjustments and thus a better opportunity to detect mean reversion in the deviations.

The other six countries show far less evidence of mean reversion in the residuals. The U.S. is the extreme case, with an estimated root of 0.98 and a p-value of .90. There is virtually no evidence for mean reversion. France has the smallest root of the remaining six countries and the lowest p-value. The results of Tables 6 and 7 reveal that Italy, Sweden, and France show the most evidence of integration if the criteria is evidence against a unit root in bilateral or multilateral relative price behavior. The results in Table 6 suggest that a Continental European/Scandinavian grouping of France, Italy, Netherlands, Sweden, and Germany, and to a lesser extent, Denmark, have tendencies toward the LOOP vis-a-vis each other. The U.S. and U.K. markets appear to be completely divorced from the rest and from each other.

D. How Are Large Deviations Eliminated?

As a final exercise, cases of unusually large deviations are studied to examine the extent to and process by which particularly large deviations are eliminated. These are arguably the most informative observations in the data set. When large deviations occur for any reason, two mechanisms can eliminate them: exchange rates can change or cover prices can be adjusted. Which, if either, of these happens may tell us something useful about the market for *The Economist* magazine. In particular, if arbitrage–or the threat of it–imposes some discipline on the pricing of this product, then the very largest deviations ought to be eliminated quickly by cover price adjustments. If not, the large deviations may persist for longer periods until, perhaps because of arbitrage pressures arising in other product markets, exchange rates change in a way that moves relative prices of many products, including *The Economist*, back toward LOP.

Column 1 of Table 8 reports the magnitude of the largest positive and largest negative residual for each country from estimation of (3").[15] When we have a large deviation, what combination of relative cover price adjustment (i.e., the difference in cover

[15] Actually, it is the largest residual through December of 1988, since two years of data are left to analyze subsequent price and exchange rate behavior.

price inflation in the home market and cover price inflation in all other markets) and exchange rate changes are observed in the ensuing months? I choose two different intervals to be the "ensuing months"–one year and two years. This is arbitrary, but easily replicated for other horizons. For each interval, Table 8 reports the relative cover price adjustment that occurred and the exchange-rate-induced change in relative price structure (calculated as the change in the residual over the interval not accounted for by cover price changes). As a matter of accounting, if the initial deviation is to be completely eliminated, the sum of the relative cover price change and the exchange-rate-induced change should equal the residual in magnitude, but have the opposite sign.

There are several interesting cases. Looking first at the largest deviations, the United States has deviations of 32% above the relative LOP and 25% below. In each case, over a one or two year horizon, these very large deviations elicit almost no change in relative cover prices. In fact, over the 2-year horizon, relative cover prices move in the wrong direction in both cases. When U.S. prices were extremely high in the spring of 1985, U.S. cover prices rose 4% more rapidly over the next two years than cover prices in our other markets. During this period, however, the sharp depreciation of the dollar did bring the U.S. relative price back toward its LOP level. When U.S. prices were extremely low in early 1988, U.S. cover prices rose 5% more slowly than other prices over the next two years. During this interval, changes in the value of the dollar only reduced 2% of the initial gap. Further confirmation of this situation is presented in Figure 3. The figure is the U.S.-German analog to Figure 2 which showed how cover price adjustments eliminated differences in prices between the French and German markets. There are no discernible cover price adjustments to restore the LOP between the U.S. and Germany, even when differences are over 30% in either direction. This evidence is quite damaging to the LOP as applied to *The Economist* price in the U.S. vis-a-vis other markets in the sample.

For the other countries, the large deviations are somewhat better predictors of future relative cover price changes. When Italy's relative price was 23% below its relative LOP

price in early 1975, during the next two years the Italian cover price rose 38% more than other cover prices in our sample. The Lira continued to depreciate, which offset part of the impact of the cover price adjustment over this period. Large deviations foreshadow cover price changes of this nature for at least one case (the positive deviation) for Germany and the U.K. as well. Nonetheless, it comes as a surprise that the largest deviations from the LOP do not yield better predictions of relative cover price adjustment over the next year or two. This raises questions about the underlying mechanism generating convergence to the LOP in certain cases. It does not appear that arbitrage activity in this product market exerts much direct influence on cover price adjustments.

E. What Explains the Behavior of Cover Prices in Different Markets?

The evidence presented thus far on price behavior is largely inconsistent with the competitive integrated markets model for a homogeneous product. This section will consider the how modifications to the simple model might help explain the observed behavior. The normal considerations in pricing a newsstand magazine in a single market are production costs, the costs of distribution and retailing in the market, the potential for growth in sales, competitors' prices, and the relationship between advertising revenue and circulation.

There appears to be limited scope for cost-based explanations of the violations of the LOP observed here. Differences in printing costs could explain some differences in average price (*The Economist* is printed in several locations) across markets, but probably not much of the change in relative prices. Similarly, distribution and retailing costs may vary across markets, but are probably relatively stable within markets over time. Thus, they might explain deviations from absolute LOP in cover prices, but not from relative LOP.

The revenue-based factors that underlie optimal pricing will potentially lead publishers to want to price discriminate across markets. In markets distinguished by

upside growth potential, newsstand prices may be lower to encourage potential customers to sample the product. Markets with many close substitutes will have higher demand elasticities and presumably lower prices. Finally, the relationship between circulation and advertising rates might dictate differences in the optimal price across markets. Any desire to price discriminate will be tempered by the threat of gray markets or third-party arbitrage. Readers will care little about where their copy of the magazine is produced and what advertising it contains, hence they should view magazines sold in different locations as close substitutes. Presumably, there is some level of price discrimination that could not be sustained between any given pair of markets for a product that can be transported, such as *The Economist.* The fundamental questions that need to be addressed are: (1) Are demand conditions sufficiently different across countries that firms would like to discriminate? and (2) Are costs of resale high enough between markets that discrimination is sustainable?

What are the data on cover prices of *The Economist* trying to tell us? I think the answer is roughly the following. There are at least three distinct markets in our sample: the U.S., the U.K., and Continental Europe and Scandinavia (henceforth CES). Across these three markets, demand conditions are sufficiently different and resale costs are sufficiently high that large deviations from both the absolute and relative LOP are observed. In the home market, the U.K., *The Economist* is priced much lower, in part because it faces stiff local competition. It is a higher-priced specialty item in CES markets, with a smaller number of close substitutes due to language differences. Distribution and retail costs are also likely to be higher in CES, adding to the gap in cover prices. The U.S. market lies somewhere in between the other two in terms of the niche filled by *The Economist.* There is competition from locally-produced English language magazines, but the substitutability may not be as close as it is with U.K.-based competitors. Circulation has grown rapidly in the U.S. in the last ten years, which may be part of the reason–in addition to changes in the value of the dollar–the U.S. price has fallen relative to the other markets in recent years.

One way to approach the issue of whether markets are integrated or segmented in this context is to ask which products are closer substitutes for *The Economist* sold in North America: *The Economist* sold in, say, the U.K. or Germany, or *Business Week* or *U.S. News* sold in the U.S. Lacking data on quantities in these markets, it is not possible to estimate the cross-price elasticities of demand. Intuitively, it seems that local magazines are the relevant substitutes. But the arbitrage arguments underlying the LOP imply that foreign issues of *The Economist* are an effective substitute as well. If that were true, then the U.S. price should be pulled in the direction of the price for *The Economist* in other markets.

Figure 4 shows the dollar prices of *The Economist* in the U.S., the U.K., and Germany, plus the dollar prices of *Business Week* and *U.S. News* in the U.S. market. *The Economist* is priced somewhat above the two U.S. competitors, and the price differential is quite stable. It is hard to make a case that prices of *The Economist* in other markets have exerted any influence on the U.S. price. If such influence were present, we would expect it to take the following form: When foreign market prices of *The Economist* are substantially lower (higher) than the U.S. price, the differential between *The Economist* and *Business Week* should be smaller (larger) in the U.S. market. The differential between *The Economist* and *Business Week* changes very little between the early to mid-1980s, when foreign market prices are very low and should be exerting downward pressure on the U.S. price of *The Economist*, and the mid-1990s when foreign prices are very high.

There are thus reasons to think that the optimal price may differ across the three market regions and indications that prices in other markets have little effect on each other. What are the factors that make resale costly between these three markets? The segmentation is likely a consequence of the time sensitive content of the magazine and the fact that air freight costs between markets are high relative to the price of the product. Furthermore, surface distribution schedules within markets are often coordinated among many different weekly magazines, and delays of even one day might be extremely costly. Thus, third-party arbitrage is likely to be extremely costly. Furthermore, any attempt at such a scheme

could be easily detected in a market where items are provided to retailers on a sale/return basis by distribution agents. The potential profits would be short-lived if they exist at all.

The more difficult issue is how to interpret behavior within the "CES market." There are two possible explanations: (1) demand elasticities, and thus prices, are similar across markets or (2) the costs of resale are sufficiently low across these markets that price discrimination cannot persist even if demand elasticities did differ across markets. It is possible to argue in favor of both of these interpretations. The preferences of readers for an English language publication and the set of substitutes are probably very similar across the CES countries, making the demand elasticities for *The Economist* about the same in all of them. On the other hand, shipping across certain markets may well be cheaper within Europe, since it may not require air freight, so it is at least conceivable that these markets are truly integrated in the sense that price discrimination between them is not sustainable.

F. Lessons for Other Product Markets

As noted in the discussion of the data, there are many features of the newsstand magazine market that make it desirable for the study of price adjustment, and many others that make it a very unique market. Thus, it is important to consider which lessons emerge from our analysis that might be extended to other product markets.

The paper confirmed the finding by Ghosh and Wolf (1994) that a combination of menu costs and invoicing in the buyer's currency can lead to unintended deviations from the LOP. Interpreting statistical evidence of PTM as arising purely from strategic considerations is inappropriate in these circumstances. How typical are these circumstances? It seems evident that menu costs are pervasive. Most differentiated products are not sold in auction markets. However, invoicing in the buyer's currency is not common for exports of manufactures by the major industrialized countries studied in most research on PTM. Page (1981) reports that 98% of all U.S. exports are invoiced in dollars, while over 80% of Germany and British exports are invoiced in the home

currency. Thus, a menu cost, taken literally, will lead to unintended price relative price *stability* across markets in the short run in the typical case. The potential bias flagged by Ghosh and Wolf is likely to be important for Japanese exports, which Page estimates are more often invoiced in other currencies than in Yen, and the exports of small or developing economies whose currencies are seldom used in international transactions.[16] The bulk of existing work on PTM is probably not affected by this problem, however.

A second lesson that emerges from the paper is that PTM, while it may provide a useful empirical characterization of the effect of exchange rates on relative prices across export destinations, is not a reliable guide to the economic significance of deviations from the LOP. There are many countries pairs within Europe which exhibit statistically significant evidence of PTM even when studying only those periods in which cover prices change, yet the deviations from the LOP appear to be small and short-lived. The time series methods used here to assess the persistence of deviations from the LOP will not be useful in most work with standard trade data due to the relatively short sample periods. But simple descriptive approaches to the data that examine the magnitude and persistence of deviations from the LOP can reveal more about the economic significance of the deviations than a single regression coefficient.

Third, it appears that industry characteristics may be very important in understanding the magnitude of price differences in any particular market. In the case of *The Economist*, the time sensitivity of its content makes it a perishable good. Perishability, in turn, probably makes the costs of resale by third parties across markets very high. The fact that standard distribution systems are coordinated across many weekly magazines enables publishers to print on a just-in-time basis for magazines to enter the network. Transshipment from other markets would be extremely costly, if not impossible. These natural barriers to trade appear to permit markup differences of as much as 30% or more between regions. If many other industries were to share these characteristics, natural

[16] Much existing work on pricing of Japanese exports does allow for some form of dynamic adjustment, partly as a result of this pattern of invoicing (e.g., Giovannini (1988), Marston (1990)).

barriers might explain a significant amount of the observed deviations from PPP. This underscores the fact that further work using detailed data, such as Engel and Rogers (1996), Wei and Parsley (1995), or Verboven (1996), will be helpful in learning more about the nature of market segmentation and deviations from PPP.

Finally, researchers should be cautious about pooling data and imposing a common response across markets in order to increase the power of tests. In the case of the newsstand market for *The Economist*, the economically interesting findings are associated with the heterogeneity of behavior across markets. Similarly, it may be less interesting to know whether a unit root can be rejected in the real exchange rate when enough countries are pooled in a single model than it is to know who is integrated with whom.

VI. Conclusion

This paper has studied the pricing behavior of *The Economist* in order to address issues concerning the interpretation of pricing-to-market research in this and other settings and to relate that research to the more general issue of the integration of national product markets. With regard to *The Economist* in particular, bilateral and multilateral PTM tests suggest that exchange rate changes predict deviations in the law of one price very well: 75-80% of an exchange rate change is translated into a deviation from the LOP. Infrequent price adjustment and pricing in the buyer's currency appear to be responsible for about 40% of the magnitude of this response, leaving a large amount to be explained by factors other than menu costs.

Deviations from both absolute and relative LOP in this market are large and quite persistent, although these features vary a great deal across markets. Descriptive and time series methods indicate that markets within Continental Europe and Scandinavia are integrated in the sense that LOP holds quite well. The U.S. and U.K. markets seem completely divorced from each other and from the rest–there is no significant evidence of

mean reversion in relative prices with other markets in the sample. Furthermore, for the case of the U.S., even the largest deviations from the LOP over the entire sample are poor predictors of changes in relative cover prices.

It is likely the case that North America, Europe/Scandinavia, and the U.K. are segmented markets for this product. Demand elasticities are likely to be different across these groups because of underlying differences in the native language (which will affect readers' preferences) and the set of competitors across . Publishers appear able to exploit differences in demand elasticities because of the time-sensitive nature of the product. It would be virtually impossible to transship the product across regions on a timely basis for newsstand distribution. Thus, natural barriers to trade appear to permit violations of the law of one price for newsstand magazines in the neighborhood of 30%. If this were true for most industries, it would go far toward explaining the behavior of deviations from PPP, although that seems unlikely. Further research will apply similar techniques to standard trade data with the hope that a clear picture concerning market integration will emerge.

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Table 1. Number of Price Changes by Country and Month

(1973-1990)

	Denmark	France	Italy	Netherlands	Sweden	U.K.	US	Germany
Jan	1	3	3	1	2	1	0	1
Feb	2	0	1	0	2	0	0	0
Mar	1	1	1	1	1	1	1	0
Apr	5	5	3	5	5	3	1	0
May	1	1	1	1	1	1	1	2
June	0	0	3	0	0	0	0	0
July	4	3	4	3	2	2	2	1
Aug	1	2	1	1	2	6	0	2
Sept	0	0	0	0	0	0	1	0
Oct	0	0	0	0	0	0	1	0
Nov	1	0	1	0	0	1	0	0
Dec	0	0	0	0	0	0	0	0

Table 2. Conditional Probability of Price Changes

Table entry gives probability a price change occurred in the row country given that one occurred in the column country.

	Denmark	France	Italy	Netherlands	Sweden	UK	US	Germany
Denmark	1	.80	.50	1	.73	.40	.57	.67
France	.75	1	.50	1	.80	.40	.57	.83
Italy	.56	.60	1	.67	.47	.33	.57	.50
Netherlands	.75	.80	.44	1	.67	.40	.57	.67
Sweden	.69	.80	.39	.83	1	.27	.29	.83
UK	.38	.40	.28	.50	.27	1	.43	.33
US	.25	.27	.22	.33	.13	.20	1	.33
Germany	.25	.33	.17	.33	.33	.13	.29	1

Note: Table entry gives the probability a price change occurred in the row country given that one occurred in the column country.

Table 3. Bilateral Pricing to Market

Table entries are estimated values of ß for equation (2) for each country pair.

A. Monthly

	Denmark	France	Italy	Netherlands	Sweden	UK	US
France	-.07						
Italy	-.69**	-1.07**					
Netherlands	-.46**	-.74**	-.85**				
Sweden	.24**	-.18	-.65**	.03			
UK	-.61**	-.99**	-.59**	-.82**	-.38**		
US	-.82**	-.89**	-1.24**	-.72**	-.54**	-.81**	
Germany	-1.33**	-1.57**	-1.42**	-1.19**	-.30	-1.20**	-.92**

B. Economic Time

	Denmark	France	Italy	Netherlands	Sweden	UK	US
France	.03						
Italy	-.57*	-.95**					
Netherlands	-.16**	-.36	-.72**				
Sweden	.23**	-.34	-.54**	.07			
UK	-.39*	-.72**	-.25	-.45*	-.24		
US	-.76**	-.87**	-.95**	-.85**	-.63**	-.66**	
Germany	-.90	-.72*	1.15**	-1.08	-.13	-.74**	-.58**

* significant at the 5% level

** significant at the 1% level

Table 3. Bilateral Pricing to Market (cont'd)

C. Annual

	Denmark	France	Italy	Netherlands	Sweden	U.K.	US
France	.16						
Italy	-.67*	-1.06**					
Netherlands	-.42	-.60*	-.83**				
Sweden	.43	.67	-.64**	-.32			
U.K.	-.58**	.99**	-.56	.81**	-.33		
US	-.81**	-.87**	-1.28**	-.69**	-.52*	-.77**	
Germany	-1.28**	-1.59**	-1.43**	-1.15**	.08	-1.22**	-.91**

* significant at the 5% level

** significant at the 1% level

Table 4. Panel Data Pricing to Market

Estimates of ß from equation (3) with data measured at different frequencies.

	Monthly	Economic Time	Annual
Denmark	-.84 (.03)	-.84 (.07)	-.83 (.11)
France	-.86 (.04)	-.85 (.08)	-.84 (.12)
Italy	-1.0 (.03)	-.99 (.07)	-.97 (.10)
Netherlands	-.88 (.04)	-.86 (.08)	-.86 (.12)
Sweden	-1.03 (.04)	-1.03 (.08)	-1.01 (.12)
US	-.74 (.03)	-.76 (.06)	-.72 (.10)
Germany	-.77 (.04)	-.78 (.08)	-.75 (.13)
Constrained	-.80 (.03)	-.78 (.06)	-.78 (.09)

Note: Standard errors in parentheses.

Table 5. Magnitude of Departures from the Absolute LOP
(monthly data)

	Mean of Residuals	Standard Deviation of Residuals		Mean of Residuals	Standard Deviation of Residuals
Denmark	.02	.05	Sweden	.10	.07
France	-.02	.06	UK	.37	.11
Italy	.05	.12	US	.10	.15
Netherlands	.04	.05	Germany	.08	.11

Table 6. Bilateral Unit Root tests (monthly data)

Table entries give estimated values of alpha in Augmented Weighted-Symmetric tests and p-values for the null hypothesis of a unit root.

	Denmark alpha/p	France alpha/p	Italy alpha/p	Netherlands alpha/p	Sweden alpha/p	UK alpha/p	US alpha/p
France	.92/.12						
Italy	.92/.14	.87/.30					
Netherlands	.94/.32	.92/.06	.88/.03				
Sweden	.88/.08	.89/.11	.89/.06	.90/.05			
UK	.95/.43	.94/.23	.93/.16	.96/.66	.93/.26		
US	.98/.91	.98/.90	.97/.83	.97/.88	.95/.58	.95/.43	
Germany	.94/.31	.90/.02	.79/.00	.94/.22	.93/.16	.96/.53	.98/.87

Table 7. Persistence of Deviations from the LOP (monthly data)

	alpha / p-value[1]		alpha / p-value[1]
Denmark	.96 / .64	Sweden	.89 / .07
France	.93 / .18	UK	.94 / .37
Italy	.88 / .01	US	.98 / .90
Netherlands	.95 / .52	Germany	.95 / .34

[1] Estimated value of alpha in Augmented Weighted-Symmetric unit root test. The p-value gives the marginal significance level of a test of the unit root hypothesis.

Table 8. Analysis of Large Deviations

	Residual	1-year % change Relative Cover Price	1 year % change Exchange Rate	2-year % change Relative Cover Price	2-year % change Exchange Rate
Denmark	.12	.02	-.07	.00	-.09
	-.13	.05	.01	.01	.05
France	.11	-.03	-.04	-.04	-.06
	-.17	.10	-.02	.17	-.04
Italy	.19	.04	-.03	.01	-.04
	-.23	.31	-.20	.38	-.21
Netherlands	.13	-.13	.05	-.17	.05
	-.15	-.02	.09	-.01	.17
Sweden	.28	-.14	-.01	-.26	-.00
	-.13	.10	.04	.09	.06
UK	.19	-.20	-.12	-.22	-.19
	-.27	-.01	.10	.01	.07
US	.32	-.07	-.29	.04	-.43
	-.25	-.03	.09	-.05	.02
Germany	.24	-.20	.05	-.31	.08
	-.16	.02	.09	.04	.16

Figure 1. Pound Prices for The Economist

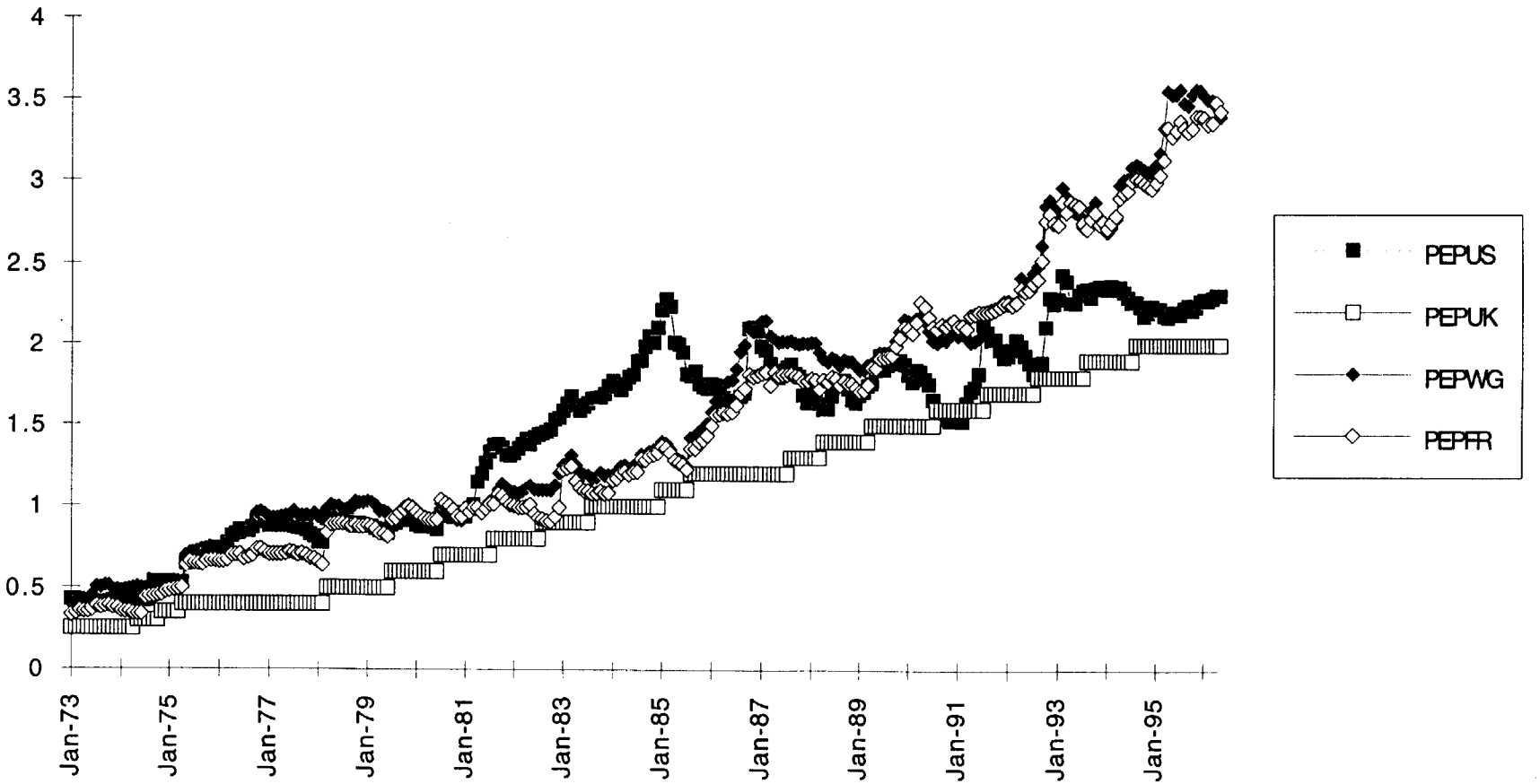

Figure 2. French-German Price Differentials and the Exchange Rate

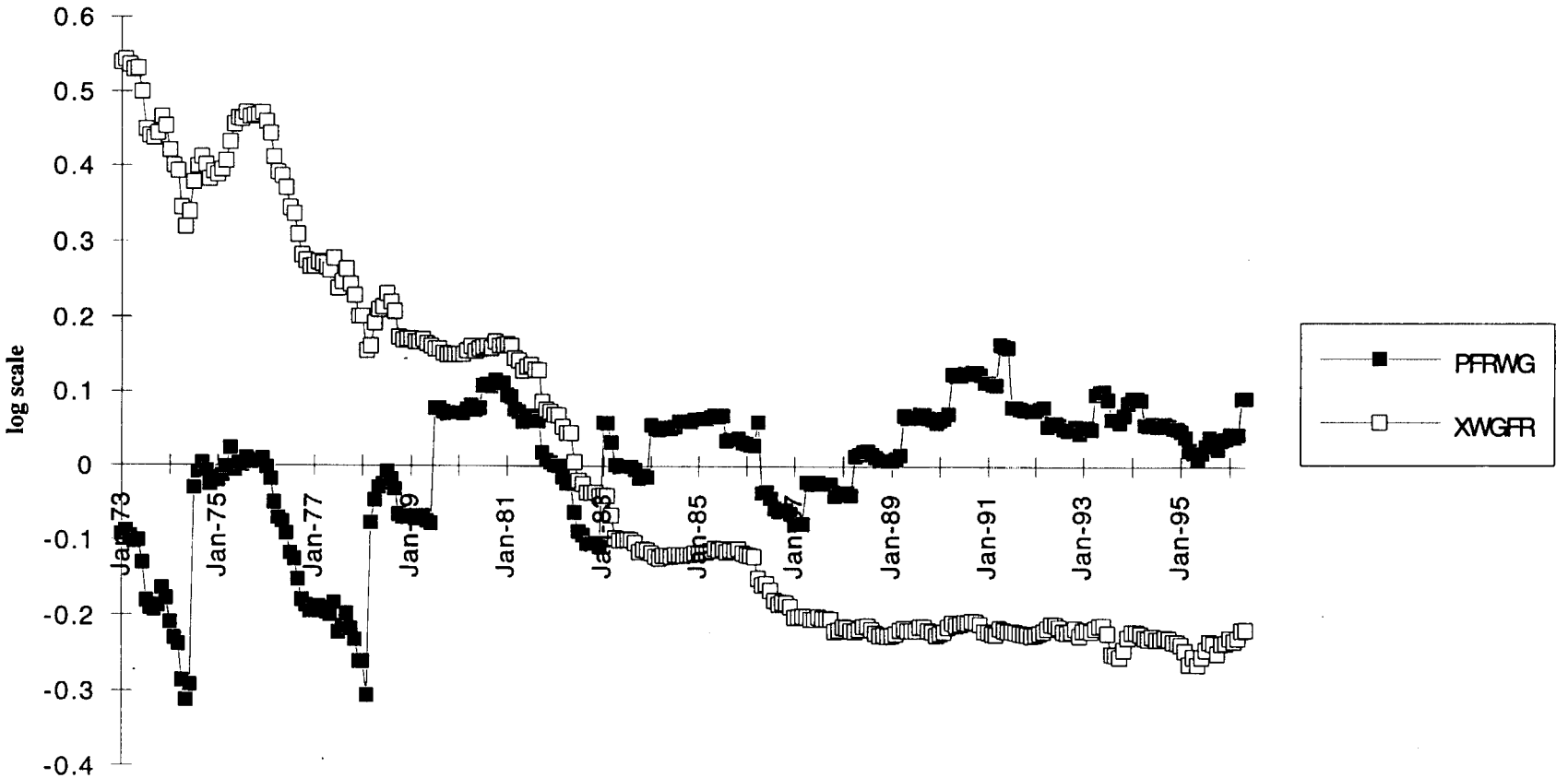

Figure 3. US-German Price Differentials and the Exchange Rate

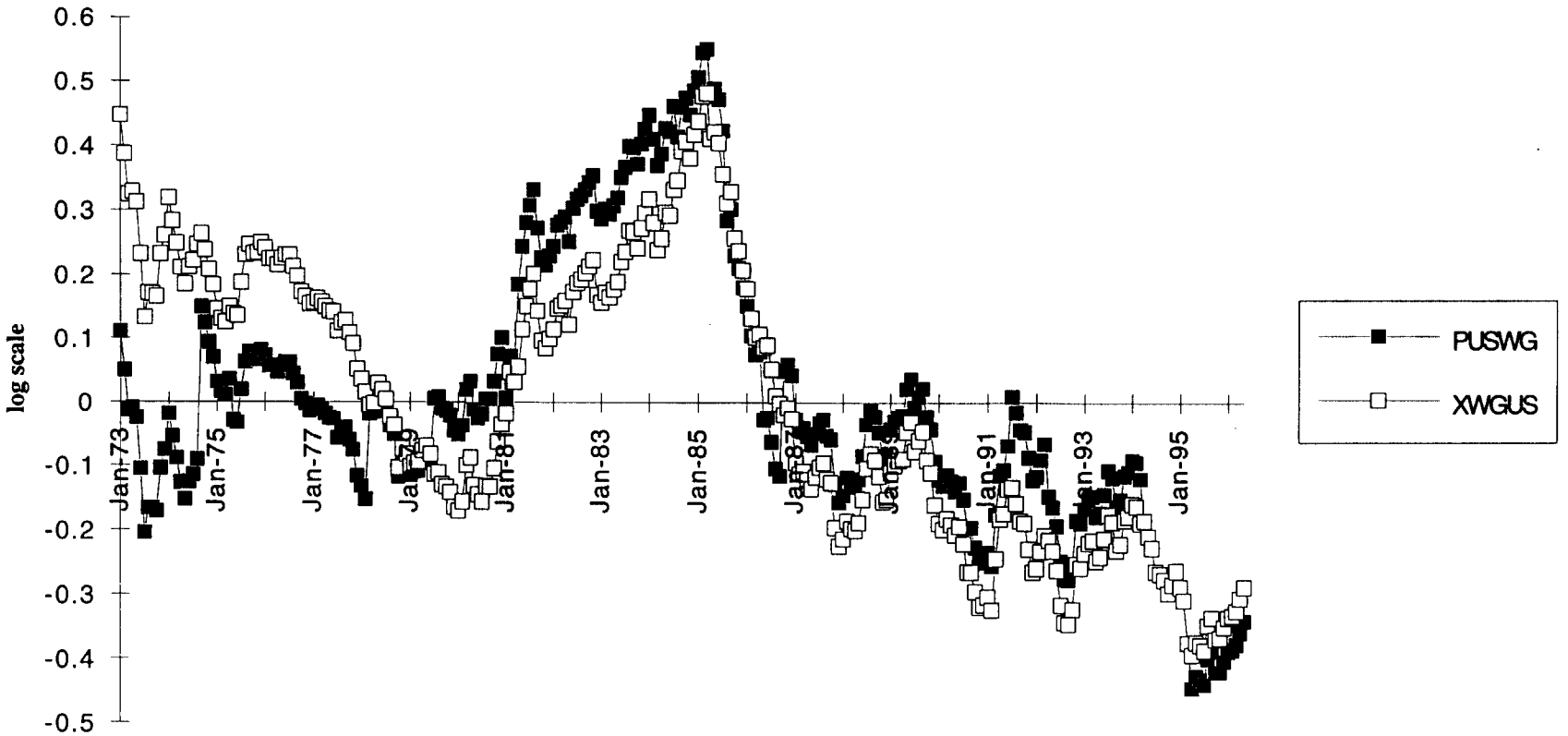

Figure 4. Dollar Prices of The Economist in Three Markets and U.S. News and Business Week in the U.S.