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The Law of One Price and Its Limits

The law of one price (LOP) states that prices in different parts of the world for a given product should be the same when expressed in a common currency. The LOP closely approximates reality at the wholesale level for a few globally traded goods (such as crude oil and rubber) and financial products (such as foreign exchange, corporate shares, and interbank loans).

However, empirical studies uniformly show that the LOP does not describe most markets—even as a rough approximation. Detailed comparisons of levels and changes in prices quoted by sellers from different countries indicate that only homogenous primary commodities are equated internationally by arbitrage.[1] Williamson and Milner (1991, 238) write: "[T]he hypothesis that arbitrage quickly equates goods prices internationally has probably been rejected more decisively by empirical evidence than any other hypothesis in the history of economics."

Literature Survey

In response to Williamson and Milner (1991), the immediate question is: why does arbitrage fail? Scholars who have examined the data usually start by attributing price dispersion to distance and borders. Then they bring other factors into play. Our study focuses on a different question—

1. For early examples of this research, see Isard (1977) and the special issue of the *Journal of International Economics* (August 1978), particularly Kravis and Lipsey (1978). See also Mussa (1986), Parsely and Wei (1995), and Engel and Rogers (1999).

sizing up the potential benefits of price convergence rather than examining the reasons for price divergence. Nevertheless, it is useful to start by surveying the literature on the causes of price divergence.

That the law of one price fails to hold across international borders does not surprise most people. Countries differ dramatically in terms of the costs of production and distribution on the one hand, and the patterns of demand on the other. Tariff and nontariff barriers as well as transportation and cultural barriers limit the scope for arbitrage to operate across borders. Monopoly and oligopoly firms practice price discrimination, both within and among countries. A familiar example is the cost of air travel: the price of an economy-class ticket between Los Angeles and London, on the same flight, can easily vary between $200 and $1,500.

In examining price divergence, Kravis and Lipsey (1983) usefully distinguished between short-term and long-term influences of national price levels. Short-term influences are primarily associated with money market conditions. These forces are most apparent when comparing changes in national price levels translated at market exchange rates. Much of the year-to-year relative change in national price levels can be explained by exchange rate fluctuations (more on this below, in the discussion of exchange rate pass-through). However, sustained national differences in PPP rates are also evident. We now turn to what Kravis and Lipsey call longer-term or structural factors to explain sustained differences in PPP price levels.

Longer-term factors that result in sustained differences in price levels between countries can be grouped into two broad categories: factors that affect the costs of production and consumption within a country and factors that prevent arbitrage from equalizing prices. Among the factors that affect the costs of production within a country, differences in taxation and government restrictions have an obvious impact (Balassa 1964). Of greater importance are differences in factor costs. Two major models have been proposed to explain why factor costs differ across countries. The productivity-differential model focuses on differences in labor productivity to explain factor cost differentials (Kravis, Heston, and Summers 1978). The factor-proportions explanation, on the other hand, focuses on the relative abundance of factors to explain price differences (Ohlin [1933] 1967; Bhagwati 1984). Retail prices, for example, are comparatively high in Tokyo and Hong Kong because the scarcity of urban land leads to very high rents per square meter, both for retail space and apartments where retail workers live.

Supply side theories, however, do not fully explain price differences across countries. Differences in demand must be taken into account. Consumer preferences can vary markedly across countries, dramatically affecting prices. For instance, Australian wine was exceedingly cheap for many decades when consumers did not value quality Australian vintages, either domestically or internationally. A dramatic change in consumer preferences, aided by clever marketing, has resulted in significant price increases for quality Australian wine despite a massive expansion in output.

Table 2.1 Average tariffs and estimated tariff equivalents by countries/regions

Countries/regions	Average tariff on merchandise[a]	Estimated tariff equivalent barriers: Business/financial services	Estimated tariff equivalent barriers: Construction
North America[b]	6.0	8.2	9.8
Western Europe	6.0	8.5	18.3
Australia and New Zealand	5.0	6.9	24.4
Japan	6.0	19.7	29.7
China	18.0	18.8	40.9
Taiwan	n.a.	2.6	5.3
Other NICs	n.a.	2.1	10.3
Indonesia	13.0	6.8	9.6
Other Southeast Asia	10.0	5.0	17.7
India	30.0	13.1	61.6
Other South Asia[c]	25.0	20.4	46.3
Brazil	15.0	35.7	57.2
Other Latin America	12.0	4.7	26.0
Turkey[c]	13.0	20.4	46.3
Middle East and North Africa	20.0	4.0	9.5
CECs and Russia	10.0	18.4	51.9
South Africa	6.0	15.7	42.1
Other sub-Saharan Africa	n.a.	0.3	11.1
Rest of world	n.a.	20.4	46.3

CECs = Central European countries
n.a. = not available
NICs = newly industrialized countries

a. Tariff averages are unweighted across all commodities and for the latest available year, in many cases 1997 or 1998. Country coverage of regions is not comprehensive. Reported figures should be regarded as indicative of the prevailing order of magnitude.
b. North America values were calculated by assigning Canada/Mexico numbers to the United States.
c. Estimated tariff equivalent barriers, business/financial services and construction for other South Asia and Turkey were assigned estimated rest-of-world values.

Source: Francois and Hoekman (1999).

Differences in production costs and the structure of demand are a necessary but not sufficient explanation for why price levels differ across countries. Why does international arbitrage not operate to equalize prices? Among the forces identified in the literature are transport costs (Usher 1968), tariff and nontariff barriers to trade and investment, and market organization. We do not dwell on transport costs beyond the obvious observation that high transport costs separate the markets of cities such as Delhi and Frankfurt. As for tariff and nontariff barriers, these are pervasive, even after the accomplishments of the General Agreement on Tariffs and Trade (GATT), the World Trade Organization (WTO), and regional trade agreements. For example, Francois and Hoekman (1999) used a gravity model to indirectly estimate implied nontariff barriers for business/financial services and construction work, and then compared their findings to tariff levels on merchandise imports (table 2.1). They found

that barriers for business and financial services are about the same height as for merchandise trade, even though explicit border barriers are seldom imposed on business and financial services. Moreover, they estimated even higher implicit barriers for construction services. Trade barriers interfere with arbitrage in a major way. However, the implied extent of price variation that can be accounted for by tariff and nontariff barriers is much smaller than the actual variation exhibited in prices between countries. Rarely, for example, do tariff and nontariff barriers exceed 100 percent; still, it is common for prices to diverge by a factor of two or more.

Another reason for price variation is the wide prevalence of noncompetitive market structures, ranging from monopolies (common for public utilities) to soft cartels. Producers with market power often find that their interests are served by discouraging foreign firms from making inroads into the local market. In an empirical study of high Japanese prices, Noland (1995) found evidence that oligopoly behavior and *keiretsu* practices were part of the explanation. A dramatic example of price discrimination was recently reported in the pharmaceutical industry. Responding to public pressure, major drug companies have drastically cut the price of their "cocktail" ingredients for AIDS treatment in Africa. Bristol-Myers Squibb, for example, will market Zerit at $54 per patient per year in Africa, compared to a cost of $3,589 in the United States and Europe (*Wall Street Journal*, 15 March 2001, B1). Pharmaceutical price discrimination can be justified by the economic necessity of charging high prices in rich countries to fund research and development costs, and the moral imperative of charging low prices in poor countries to save lives. The same social justification does not apply with equal force to most other industries. Yet, as Evenett, Levenstein, and Suslow (forthcoming) show, private cartels are alive and well in many segments of the world economy.

Another manifestation of market power is the common phenomenon of less than one-for-one exchange rate pass-through, when firms set their local prices. Goldberg and Knetter (1997) surveyed the extensive empirical literature on exchange rate pass-through and concluded that in many cases half or more of the effect of exchange rate changes is offset by destination-specific markups over cost. This implies that half or less of the change in exchange rates is transmitted into price changes in the destination market. Varian (1989) argues that price discrimination (which is the main cause of incomplete exchange rate pass-through) reflects three underlying market forces: (1) sorting of customers, (2) prevention of resale, and (3) the presence of market power.

Impediments to arbitrage operate within countries as well as among countries. Engel and Rogers (1999) examined monthly price index data for 43 different goods in 29 US cities between 1986 and 1996. They found that nominal price stickiness and distance were the major reasons for the dispersion of month-to-month price index changes within the United

States.[2] Parsely (1996) found a similar pattern for price level differentials within the United States. Our own data, summarized in box 2 (chapter 1), reveals enormous impediments to arbitrage within China. Goods and services are substantially more expensive in the major cities than elsewhere in China.

Even when tariffs are zero and there are no explicit nontariff barriers, an international border dramatically augments the extent of price divergence between cities. Engel and Rogers (1998) examined the border effect between Canada and the United States and calculated that it added 75,000 miles to the cross-country volatility of relative prices.[3] Using the same regression results but a different computation method, Parsely and Wei (1999) calculated that the Canada-US border added 101 million miles to cross-country price volatility! In a later paper, Rogers and Smith found that the US-Mexico border effect on price divergence between 1980 and 1997 was nearly 10 times the magnitude of the US-Canada border effect. However, during the 1988-94 period, when the peso was stable in nominal terms, the US-Mexico border effect was substantially smaller than for the period as a whole.

These empirical findings underscore the failings of the law of one price, but they do not mean that separated markets have zero influence on each other. Parsely and Wei (1996) found that the rate of price convergence is at least three times as fast for tradable products as for nontradable products. Their analysis was based on an examination of actual prices (not price indexes) for 51 goods and services in 48 US cities. Parsely and Wei also found that price convergence occurs much faster among US cities than across national borders. Finally, they confirmed that price convergence is faster when initial price differences are larger, and convergence is slower when distance between cities is greater.[4]

In an earlier study, Parsely and Wei (1995) examined deviations from purchasing power parity (PPP) for 12 tradable sectors in 14 Organization for Economic Cooperation and Development (OECD) countries using OECD sectoral data. They found that greater levels of exchange rate volatility and higher transportation costs increased the deviations from PPP. They also found that the rate of price convergence is faster

2. Sticky nominal prices can persist only because arbitrage functions poorly. In that sense, they are a result as much as a cause of price dispersion.

3. Engel and Rogers (2000) found similar but less extreme results for European borders. In their European study, Engel and Rogers distinguished between a "real border effect" (trade barriers of various kinds) and a "sticky consumer price effect" (prices expressed in local currency units do not respond one-for-one to exchange rate changes). Leonard (1999) has confirmed that relative prices for goods separated by an international border exhibit much greater price divergence than between cities within a country.

4. A subsequent study by O'Connell and Wei (1997) confirmed that large price disparities between US cities decay faster than small disparities.

when initial deviations are larger, and that changes in prices—not changes in nominal exchange rates—carry out most of the observed convergence.

Parsely and Wei (1995) found that customs unions and free trade agreements did not significantly reduce price differences between country pairs. More recent empirical analysis by Frankel and Rose (2000) strongly suggests, however, that a free trade area, like a common currency, sharply increases the magnitude of bilateral trade flows (by a factor of two or more). Their econometric observation corresponds to the observed trade boom within NAFTA and Mercosur.[5] Future analysis might show—contrary to Parsely and Wei (1995)—that these arrangements also reduce the very strong border effect on prices.[6]

Examining actual prices over 88 quarters for 27 products among 48 cities each in the United States and Japan, Parsely and Wei (1999) reached a number of new and interesting conclusions. They explained retail price differences between city pairs by distance, shipping costs, the stickiness of prices expressed in local currencies coupled with exchange rate variability,[7] and the all-important border. The authors calculated that the US-Japan border is equivalent to adding 43,000 trillion miles to the within-country volatility of relative prices! The importance of this astronomical number is that borders can create enormous price divergence, vastly larger than the estimated effects of distance and shipping costs. Parsely and Wei (1999) also calculated that the border effect diminished over the 88 quarters at a rate of about 0.4 percent per year.

To lay the groundwork for our benefit calculations, we emphasize that exchange rate variability, border barriers, and shipping costs all reflect policy choices. Distance is defined by geography, but shipping costs are determined by both technology and policy choice, such as how much competition is permitted in sea freight and air cargo, and to what extent ports are operated privately rather than publicly. Likewise, exchange rate variability and border barriers are subject to policy choices. All these policy choices in turn affect the extent of price divergence between countries.

5. See, for example, Mutti (2001) and Weintraub (2000).

6. A recent study by Moodley, Kerr, and Gordon (2000) found somewhat stronger cointegration of US and Canadian producer prices after the Canada-US Free Trade Agreement (CUSTA) entered into force in 1990. The authors, however, interpret their finding as the outcome of long-term forces, not a CUSTA effect.

7. Retail price stickiness reflects, of course, the failure of arbitrage between markets. It is interesting that Rogers and Smith (2001) conclude that price stickiness in local currency, coupled with exchange rate variability, has a greater impact than border barriers on price divergence between US and Mexican cities.

Trade, Direct Foreign Investment, and Price Convergence

Lower barriers in a global economy should bring more price convergence, even at the retail level, where local markups are an important cause of price divergence. For example, if halogen floor lamps are produced in China more cheaply than in the United States, Chinese firms will sell more of their lamps in the US market, rather than in China. If transport costs are modest and no trade barriers impede commerce, the enlarged supply of halogen floor lamps in the US market will cause the US unit price to fall. Meanwhile, the diminished supply of halogen floor lamps in the Chinese market will cause the Chinese unit price to rise. In an ideal economic world with zero friction, no product taxes, and equivalent markups in all wholesale retail distribution, the price of halogen floor lamps in the US and Chinese markets would become identical.

Free investment also promotes market integration, but in less obvious ways than trade. Multinational enterprises (MNEs) will enter markets where they can cheaply produce goods and services, using their proprietary know-how and superior access to world capital markets. Producing in lower-cost locations, MNEs tend to bid up local wages. The typical US MNE operating abroad, for example, pays about 50 percent higher wages to its workers than the national average wage level in its host country (Graham 2000). MNEs will use their internal supply channels to move tradable products from countries where they can be made cheaply to countries where they can be sold dearly. Hence, working both in the factor markets (bidding down the price of capital and bidding up the price of labor) and in product markets, direct investment also brings about price convergence for tradable products.

However, for nontradable products, MNE activity may improve the technology of local production without necessarily promoting price convergence. As our earlier example of Société Lyonnaise d'Eau illustrated, price divergence could in fact widen if better MNE technology improves production of nontradable products in countries where they are already cheap because of low input costs. We think this example is atypical. In most cases, we believe, MNE activity in nontradable products will promote price convergence because the biggest reasons for sharp price differences are differences in production and distribution technology and the extent of monopoly power in purely local markets, not input cost differences.

McDonald's illustrates MNE activity in a nontraded product. The famous "Big Mac Index" published in *The Economist* essentially captures price divergence for this well-known hamburger. By contrast, the prices of the main ingredients of a Big Mac—bread, cheese, lettuce, and ground beef—represent locally produced goods. If McDonald's operations worldwide serve to narrow price divergence, then price variations of the Big Mac (measured by the coefficient of variation, i.e., the standard deviation

Table 2.2 Price variation of multinational brands versus local products (coefficients of variation)

Multinational brand		Local products	
Big Mac	0.32	Ingredients of Big Mac (average)	0.50
		Bread	0.43
		Cheese	0.50
		Lettuce	0.53
		Ground beef	0.54
Kodak color film	0.30	Cost of developing film	0.45
International daily newspaper	0.46	Daily local newspaper	0.60
Time magazine	0.37		
Coca-Cola	0.37	White sugar	0.54
IKEA furnishings	0.41	Household items	0.37

Notes: Except for IKEA furnishings, the coefficients of variation were calculated using price data in the following countries: United States, Israel, United Kingdom, Japan, Euro area countries, Argentina, United Arab Emirates, Saudi Arabia, Chile, Taiwan, Colombia, Mexico, Indonesia, Greece, Singapore, Egypt, South Korea, Brazil, Czech Republic, Thailand, South Africa, Philippines, Poland, Hong Kong, Russia, Turkey, China, Hungary, and Malaysia.

For IKEA furnishings and household items, the coefficients of variation were calculated using price data in the following countries: Austria, Belgium, Hong Kong, Denmark, Finland, France, Germany, Italy, Netherlands, Norway, Singapore, Spain, Sweden, Switzerland, United Kingdom, United Arab Emirates, United States, Czech Republic, Hungary, Malaysia, Poland, Indonesia, Australia, Canada, and Kuwait.

Sources: The Economist, 8 January 2000, 100; Haskel and Wolf (1999); and authors' calculations.

divided by the mean) should be smaller than the price variations of its ingredients.

Table 2.2 provides the coefficients of variation for Big Mac prices versus similar coefficients for local goods (bread, cheese, etc.). Similar paired comparisons are made for four other MNE-branded products and locally produced goods. The pairs include Kodak color film versus the cost of developing color pictures, an international foreign daily newspaper and *Time* versus a daily local newspaper, Coca-Cola versus sugar, and IKEA furnishings versus household items. Among this limited set of products, the coefficients of variation for locally produced goods are moderately larger than the coefficients for the multinational brand prices (except for IKEA furnishings versus household items). This limited comparison provides only weak evidence that MNE activity may on balance promote price convergence even among nontradable and difficult-to-trade items.

Lower Barriers, Better Technology, More Convergence

If all barriers to trade and investment were removed, and if free competition prevailed in all markets, prices of individual products would converge among cities around the world. But they would not become identical. Prices for individual products are determined by forces and frictions

besides the play of open and competitive markets. Different distribution markups, transportation and communication costs, and different product taxes are all at work. These forces and frictions are city-specific or country-specific. Land costs differ enormously from city to city, depending on income levels and population pressure. Hence the costs of retail, wholesale, office, and living space differ enormously. Differences will persist even if all trade and investment barriers vanish, and markets become perfectly competitive.

In the halogen floor lamp example, trade enables US consumers to purchase Chinese lamps, but US consumers may still pay a much higher price for the identical lamp than Chinese consumers. This higher price may reflect a higher sales tax in the United States, the higher cost of operating US retail stores, and transportation and storage costs between China and the United States.

For all these reasons, our working hypothesis holds that open and competitive markets—fostered by eliminating trade and investment barriers, by the Internet and e-commerce, by falling transportation and communication costs, and by rapid delivery services—will improve price convergence but will not achieve the law of one price.