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PRODUCT PRICE DIFFERENCES ACROSS COUNTRIES

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Preliminary

Product Price Differences Across Countries

Robert E. Lipsey and Birgitta Swedenborg

Introduction

National price levels differ greatly across countries, even among countries that are close trading partners. The traditional explanation of these differences is based on the dichotomy between services, assumed to be nontradable, and goods, assumed to be tradable and therefore subject to the international equalization of prices through trade. International price level differences were assumed to be concentrated in the nontradable service sector, with high per capita income associated with high service prices. Service prices were assumed to be high in high-income countries because exchange rates, and prices of labor, were determined in the tradable, or goods sector, where high-income countries enjoyed large productivity advantages over low-income countries. In the service sector, productivity differences between rich and poor countries were assumed to be smaller than in the goods sector, causing services to be expensive in rich countries.. That explanation in terms of difference in productivity relationships is often referred to as the Balassa- Samuelson effect, although it has a long history, going back to Ricardo (1817), explained more fully by Harrod (1939), and Balassa (1964). Some of the history is described in Kravis and Lipsey (1983). A somewhat different explanation of the role of service industries is given by Kravis and Lipsey (1983) and Bhagwati (1984), who ascribe the higher prices of services in rich countries to the higher labor intensity of services than of goods, combined with the higher prices of labor in the rich countries, determined in the goods sector.

The continuing series of international price and income comparisons stemming from the United Nations International Comparison Program has made it clear that the goods-services dichotomy is an oversimplification. Goods prices differ substantially across countries for many reasons, including the fact that all final goods prices incorporate some service element. At the aggregate level, several studies by Kravis and Lipsey suggested a role for the openness of an economy to trade in the determination of price levels. Two earlier studies by the present authors examined food price differences across countries and price differences in general at a fairly disaggregated level. Agricultural protection played an important role in explaining large differences in food prices (Lipsey and Swedenborg, 1996). More generally, wage compression, or low wage dispersion in a country's labor market, was associated with high price levels (Lipsey and Swedenborg, 1999). We hypothesized that wage compression reflected the effects of high minimum wages, whether legislated or negotiated by unions, particularly on prices in the service sector. The reason for that hypothesis was that the service sector was more labor-intensive, and particularly more unskilled labor intensive, than the goods sector and because it was less subject to the price convergence effects of international trade.

In this paper, we examine how country characteristics interact with product characteristics to determine the prices for individual goods and service categories. The country characteristics include exchange rates, tax levels, per capita income, and wage compression. The product characteristics include the tradability of individual products at the producer level, protection and subsidies on agricultural products, labor intensity, and skill intensity. The labor and skill intensity measures combine the factor intensities at the producer level with the factor intensities in the transportation, wholesale, and retail trade industries that intervene between the producer and the consumer of each product. We use a relatively consistent series of price level

observations for close to 200 final products (including services) from the OECD, covering the period from1985 to 1999. Input-Output tables for the United States are used to derive estimates of tradability and trade and transportation margins.

Our earlier studies pointed to per capita real income, exchange rates, agricultural protection, and wage dispersion as significant influences on product price levels. High real income, high currency values relative to moving averages of values, high agricultural protection , and high degrees of wage compression (or low wage dispersion below the median wage), all tended to raise product price levels. One problem with interpreting the effects of variables such as per capita income and wage dispersion is that they are fairly permanent features of an economy and might be standing in for other permanent characteristics not included in the analysis. To reduce this danger, we take advantage of the likelihood that the effects would differ according to the characteristics of individual products, and a finding that they did so in a predictable way would add to the plausibility of the findings.

One characteristic that differs widely across products, and should interact with country characteristics is tradability. The products differ widely in their tradability, ranging from close to zero in some services to a median level of over 60 per cent in clothing and footwear, as can be seen in Appendix Table 1.We would expect that higher tradability for a product would weaken the effect of per capita income by moving country price levels toward international averages. Higher tradability should also weaken any effects of wage dispersion in the same way.

We expect that wage compression, or low wage dispersion in the lower parts of the wage distribution, raises prices, and that the effect is larger, the more labor-intensive a product is. It should be smaller, the higher the skill intensity of the product. To a large extent, the labor intensity of a product at the consumer level depends on the size of the transportation, and

wholesale and retail trade margins for it, and the factor intensity in transportation, wholesale, and retail trade. These margins differ widely across product groups, from under 17 per cent on average in Machinery and equipment, to more than three quarters in clothing and footwear, as is shown in Appendix Table 2.

The expectations about determinants of price levels and interactions between country and product characteristics are tested by running a series of equations in which the price of a product in a country, relative to the OECD average, is explained by various combinations of country and product variables. One of the country characteristics is real per capita output Another is wage dispersion, as measured by the ratio of the median wage to the wage at the 10^{th} percentile. Another variable is the exchange rate deviation, measured by the deviation of the price of the currency in a given year relative to a moving average of prices, all taken as ratios to similar ratios for all countries. Other variables were food VATs, food protection levels, and the ratio of indirect taxes to GDP.

Among product characteristics are labor intensities, skill intensities, tradability, and transportation and trade margins, which were used in the calculation of labor and skill intensities.

Equations have been run for the combination of 1985, 1990, 1993, 1996, and 1999 data, without dummy variables and with various combinations of year dummies, commodity dummies, and country dummies.

Definitions of variables

The dependent variable we study is the price of an individual product in each country, measured in national currency and converted into U.S. dollars by the average exchange rate against the U.S. dollar, as reported in OECD (2001). The individual product prices are for almost 200 categories of goods and services covered in OECD price comparisons. After

conversion to $U.S., each product price was taken as a relative to the average price in the 14 countries for which prices were available in all the years. These were Austria, Belgium, Canada, Denmark, France, Germany, Italy Japan, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom, and the United States.

Among the independent variables, Gross Domestic Product per Capita in current year international prices was as reported in OECD (2003). Each country's real per capita output was taken relative to the average for the same 14 countries as for prices.

Wage dispersion is the ratio of the median wage to the wage at the lowest decile. Data for years before 1996 are from OECD (1996). Later data were obtained directly from the OECD. 1996 data for Austria, Finland, France, Italy, Japan, New Zealand, Sweden Switzerland, the United Kingdom, and the United States are for men only. For Australia, Belgium, Germany, the Netherlands, and Spain, 1995 data, for Canada and Ireland, 1994 data, and for Portugal, 1993 for men were used. For Norway (1991) and Denmark (1990), data covered both men and women. The same wage dispersion measures were used for 1999. We would prefer to have wage dispersion data for more years, but fortunately for the estimation, the levels are fairly constant over time.

Tradability is measured by the extent of international trade (exports plus imports) in a product or service, relative to the cost of production. For goods, the ratios are based on UNIDO (2000), which provides export, import, and production data for ISIC Revision 2 industries. Tradability is assumed to be a fixed characteristic of a product and data for a single year are used for the calculation, 1991 for 41 countries, 1992 data for three, 1990 for one, and 1986 for one.

We could not find corresponding international data for services. The most detailed breakdown was for the United States, for which we used the 1992 Input-Output table of the

Bureau of Economic Analysis, which provided exports, imports, and domestic production for a large number of services.

Labor intensity is measured as the ratio of the number of employees to the value added in an industry. Since the prices are at the final product level, we wish to include the labor intensity of the margin between the producer price and the final price, which we take to be the sum of costs incurred in three broad industry groups, transportation, wholesale trade, and retail trade to deliver the final product. Unfortunately, there is no subdivision of these costs according to the product involved, so that labor intensities in these three industry groups are assumed to be identical across all products that are transported, all that are wholesaled, and all that are retailed. Thus, the labor intensity for a product (i) is measured as:

$$\frac{EMP_i + EMP_{TR} * \frac{TC_i}{\sum TC} + EMP_{WT} * \frac{WT_i}{\sum WT} + EMP_{RT} * \frac{RT_i}{\sum RT}}{(VA-T)_i + (VA-T)_{TR} * \frac{TC_i}{\sum TC} + (VA-T)_{WT} * \frac{WT_i}{\sum WT} + (VA-T)_{RT} * \frac{RT_i}{\sum RT}}$$

where
EMP_i: Employment in industry i;
EMP_{TR}: Total employment in Transportation industries;
EMP_{WT}: Total employment in Wholesale Trade industry;
EMP_{RT}: Total employment in Retail Trade industry;
$(VA-T)_i$: Valueadded excluding indirect taxes in industry i;
$(VA-T)_{TR}$: Valueadded excluding indirect taxes in Transportation industries;
$(VA-T)_{WT}$: Valueadded excluding indirect taxes in Wholesale Trade industry;
$(VA-T)_{RT}$: Valueadded excluding indirect taxes in Retail Trade industry;
TC_i: Transportation costs in industry i;
WT_i: Wholesale margin in industry i;
RT_i: Retail margin in industry i;
$\sum TC$: Total transportation costs in all industries;
$\sum WT$: Total wholesale margin in all industries;

∑RT: Total retail margin in all industries.

All data come from U.S. 1992 Input-Output tables, BEA.

Skill intensity for a product is approximated by compensation per worker in the industry the product belongs to plus compensation per worker in the value added in transportation and in wholesale and retail trade between the producer and the final consumer. The estimated total compensation per worker for a product (i) is:

$$\frac{CMP_i + CMP_{TR} * \frac{TC_i}{\sum TC} + CMP_{WT} * \frac{WT_i}{\sum WT} + CMP_{RT} * \frac{RT_i}{\sum RT}}{EMP_i + EMP_{TR} * \frac{TC_i}{\sum TC} + EMP_{WT} * \frac{WT_i}{\sum WT} + EMP_{RT} * \frac{RT_i}{\sum RT}}$$

where
CMP_i: Compensation in industry i;
CMP_{TR}: Total compensation in Transportation industries;
CMP_{WT}: Total compensation in Wholesale Trade industry;
CMP_{RT}: Total compensation in Retail Trade industry;
Definitions of all other variables are the same as described in the formula of LI1.

All the data for the calculation of labor intensity and skill intensity are from the 1992 U.S. Input-Output tables, published by the Bureau of Economic Analysis. Our use of U.S. data to represent the world implies an assumption that these product characteristics do not vary greatly from country to country to country.

The exchange rate deviation for each year is calculated from nominal exchange rates relative to the dollar, in terms of dollars per unit of other currency, from International Monetary Fund (2002). A trend was fitted to each country's rate from 1970 to 2002, the series were put in terms of relatives, with the period average = 100. These relatives were averaged across 20 countries, and all recalculated with the average of all countries as the base (=100). A three-year

moving average was fitted to each country's series of relatives, and deviations from this three-year index form our exchange rate deviation measure.

The Tax variable is the ratio of Net indirect tax (indirect tax minus subsidies) as a per cent of GDP, from OECD National Accounts (OECD, 1999 and 2003).

The VAT on food, as of 1990, is from Lipsey and Swedenborg (1993), Appendix Table 4. The variable is used only for five grain products, the only ones for which it was significant in 1996.

Consumer subsidy equivalent is a measure of agricultural protection, calculated by the OECD from data on price differences for agricultural products between individual country and international markets. Data are from OECD (1991 and later issues).

Regression results

Equations pooling all products, countries, and years, without dummy variables, are shown in Table 1. The explanatory power of the equations is limited by the pooling, in the sense that idiosyncratic features of price setting for individual products in individual countries cannot

Table 1

Pooled Regressions for Individual Product Prices Without Product Dummies
1985, 1990, 1993, 1996, and 1999
14 to 20 Countries

GDPC (GDP per capita)	0.5572 (27.60)	0.5572 (27.60)	0.5572 (27.60)	0.5572 (27.60)
GDP x TDB (tradability)	-0.0042 (10.06)	-0.0042 (10.06)	-0.0042 (10.06)	-0.0042 (10.06)
WD (Wage dispersion)	-0.428 (37.09)	-0.4251 (35.48)	-0.4296 (36.12)	-0.4261 (32.92)
WD x TDB	0.0026 (10.21)	0.0026 (10.18)	0.0026 (10.21)	0.0026 (10.18)
WD x LI (Labor intensity)		-0.0027 (0.87)		-0.0024 (0.69)
WD x SI (Skill intensity)			0.0017 (0.57)	0.0006 (0.19)
Tax	-0.0096 (9.11)	-0.0096 (9.11)	-0.0096 (9.11)	-0.0096 (9.11)
XR (Exchange rate deviation)	0.265 (10.29)	0.2649 (10.29)	0.265 (10.29)	0.2649 (10.29)
FVAT (Food VAT)	0.0007 (0.53)	0.0007 (0.52)	0.0007 (0.55)	0.0007 (0.52)
$\overline{R}$ -squared	0.153	0.153	0.153	0.153
No. Obs.	15,587	15,587	15,587	15,587

Note: Figures in parentheses are T-statistics.

be taken into account. The one exception is that protection levels for some individual food products are included, and the VAT level for foods is included in the explanation of all food prices. The familiar positive influence of per capita income levels on prices is evident, but it is significantly modified by international trade. The more tradable a product, the weaker the effect of per capita income on its price. Wage dispersion, as in our earlier study, is negatively related to price. Higher dispersion, or less wage compression, is associated with lower prices. This influence also is weakened by trade. The more tradable the product, the smaller the effect of a given difference in wage dispersion.

The expectation that the impact of wage dispersion would be larger in more labor-intensive products and smaller in skill-intensive products was not met. The coefficients for labor intensity were negative and those for skill intensity positive, as expected, but none of them was statistically significant.

The tax variable produced a paradoxical result, indicating that countries with high ratios of indirect taxes to GDP had lower price levels than countries with lower indirect tax levels. High values of a country's currency, relative to a moving average of its currency values, were associated with high prices. VATs on foods had no discernable effect on food prices.

The results of including product dummies in the equations are shown in Table 2. Most of the coefficients are similar to those in the equations without product dummies. They are a little larger for per capita income and the cross-product of income and tradability, and smaller for wage dispersion and the cross-product of wage dispersion and tradability. The tax coefficient remains negative and significant and is little changed, and the exchange rate coefficient is also unchanged. There are two substantial differences. The effect of wage dispersion now appears to be greater on prices of products of higher labor intensity and smaller on prices of skill-intensive

Table 2

Pooled Regressions for Individual Product Prices With Product Dummies
1985, 1990, 1993, 1996, and 1999
14 to 20 Countries

GDPC (GDP per capita)	0.6212	0.6206	0.6214	0.6206
	(27.47)	(27.46)	(27.48)	(27.46)
GDP x TDB (tradability)	-0.0067	-0.0067	-0.0067	-0.0067
	(11.82)	(11.81)	(11.83)	(11.81)
WD (Wage dispersion)	-0.3752	-0.2676	-0.4303	-0.288
	(28.99)	(11.14)	(19.18)	(7.35)
WD x TDB	0.0011	0.0009	0.0011	0.0009
	(3.42)	(2.75)	(3.44)	(2.79)
WD x LI (Labor intensity)		-0.1025		-0.096
		(5.32)		(4.43)
WD x SI (Skill intensity)			0.0553	0.0136
			(3.01)	(0.66)
Tax	-0.0094	-0.0095	-0.0094	-0.0095
	(8.96)	(8.98)	(8.96)	(8.97)
XR (Exchange rate deviation)	0.2693	0.2691	0.2695	0.2691
	(10.47)	(10.47)	(10.48)	(10.47)
FVAT (Food VAT)	0.0082	0.0084	0.0081	0.0084
	(4.45)	(4.57)	(4.38)	(4.54)
$\overline{R}$ -squared	0.1668	0.1684	0.1673	0.1684
No. Obs.	15,587	15,587	15,587	15,587

Note: Figures in parentheses are T-statistics.

products. Both of these are in accord with our explanation of the way wage dispersion has its influence on prices. The other effect of adding the product dummy terms is that higher food VATs are associated with higher food prices, also as might be expected.

The negative coefficient for the tax variable remains a puzzle. It was not removed by substituting other tax measures or adding a variable for average agricultural protection as a possible proxy for protection in general. The anatomy of the negative coefficient is revealed by a scatter diagram of tax against average price, shown as Chart 1 in the Appendix. It appears from that diagram that there are two extreme outliers in this relationship, Japan and Switzerland, which have low indirect tax shares of GDP, but high price levels. Among the other 18 countries, the simple relationship was clearly positive. That fact does not necessarily mean that these two countries are responsible for the negative tax coefficient in the multiple regression, since other country characteristics could account for the high price levels, but it led us to experiment with adding dummy variables for these two countries to the equations, as shown in Table 3.

A comparison of the last column of Table 3 with that of Table 2 reveals the role of these two countries. All the coefficients are almost the same except two: the one for the exchange rate deviation index, which becomes much larger, and the one for the tax variable, which becomes positive, as we expected, and highly significant. There is some aspect of the Japanese and Swiss economies that we have not identified in these equations that causes their price levels to be substantially higher than those of the other countries. Aside from those two countries, high ratios of indirect taxes to GDP raise the prices of goods and services.

Table 3

Pooled Regressions for Individual Product Prices With Product Dummies and Dummies for Japan and Switzerland 1985, 1990, 1993, 1996, and 1999

14 to 20 Countries

	With Product Dummies			
GDPC (GDP per capita)	0.6267	0.6261	0.6269	0.6262
	(28.99)	(28.99)	(29.01)	(28.99)
GDP x TDB (tradability)	-0.0067	-0.0067	-0.0067	-0.0067
	(12.39)	(12.39)	(12.40)	(12.39)
WD (Wage dispersion)	-0.3304	-0.2253	-0.3884	-0.2531
	(26.47)	(9.81)	(18.10)	(6.77)
WD x TDB	0.0011	0.0009	0.0011	0.0009
	(3.51)	(2.83)	(3.54)	(2.89)
WD x LI (Labor intensity)		-0.1002		-0.0913
		(5.45)		(4.42)
WD x SI (Skill intensity)			0.0583	0.0186
			(3.32)	(0.94)
Tax	0.2479	0.2476	0.248	0.2477
	(10.10)	(10.10)	(10.11)	(10.10)
XR (Exchange rate deviation)	0.0166	0.0165	0.0166	0.0165
	(13.07)	(13.07)	(13.09)	(13.07)
FVAT (Food VAT)	0.0083	0.0085	0.0082	0.0085
	(4.73)	(4.86)	(4.66)	(4.82)
Japan	0.4364	0.4362	0.4366	0.4363
	(39.10)	(39.12)	(39.13)	(39.12)
Switzerland	0.2356	0.2354	0.2359	0.2355
	(13.74)	(13.74)	(13.76)	(13.74)
$\overline{R}$ -squared	0.2426	0.244	0.2431	0.2441
No. Obs.	15587	15587	15587	15587

Note: Figures in parentheses are T-statistics.

Conclusions

On the whole, these tests encourage us to believe that we understand more about what explains price differences across countries for individual products, including services, than we did before. In particular, the role we hypothesized for wage compression, or wage dispersion, is reinforced by the finding that its effect is accentuated in labor-intensive products, but weaker in skill-intensive products. Wage compression raises the prices of labor-intensive products more than those of capital-intensive ones. And it raises the prices of products produced by unskilled labor more than those of skill-intensive products. The role of product tradability is also confirmed by its effect on the impact of higher per capita income; more tradable products being less affected by a country's income level. The role of short-term exchange rate fluctuations is also confirmed in our data, showing, not surprisingly, that nominal exchange rate changes are not offset by price changes, but represent changes in real exchange rates. .High VATs on foods raise their prices, as we might expect.

The most mysterious relationship was that of commodity prices to the level of indirect taxes. We could only reverse this result by adding country dummies for Japan and Switzerland, two countries with relatively low ratios of indirect taxes to GDP but exceptionally high price levels, especially in Japan. The need for these dummy variables for the two countries tells us that there are some very important influences on price levels still missing from our equations

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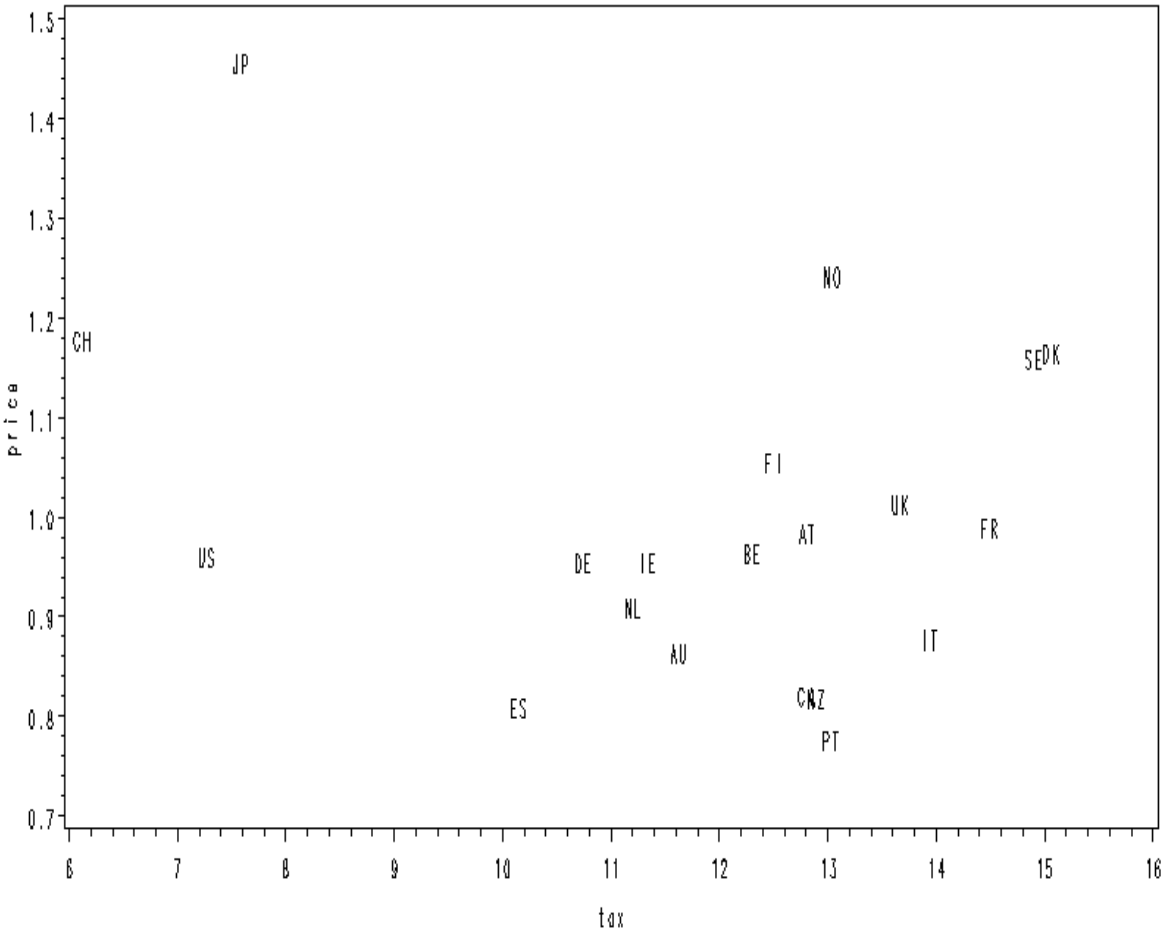
Appendix Chart 1

Price Level Related to Tax, 1999 (20 Countries)



Appendix Table 1

Median Levels of Tradability in Various Product Groups

OECD Code	Commodity Group	Median
111	Food, beverages and tabacco	20.83
112	Clothing and footwear	61.95
113	Cross Rent, fuel and power	0.49
114	Household equipment and operation	20.75
115	Medical and health care	0.02
116	Transport and communication	7.78
117	Education, recreation and culture	10.00
118	Miscellaneous goods and services	1.22
131	Collective consumption by government	0.00
132	Education	0.00
133	Medical Supplies and Services	0.01
134	Social security and welfare services / Recreation, cultural, religious affairs	0.01
141	Machinery and equipment	54.56
142	Construction	0.00

Appendix Table 2

Average Combined Transportation, Wholesale, and Retail Trade Margins

OECD Code	Commodity Group	Average Margin
111	Food, beverages and tabacco	34.20
112	Clothing and footwear	78.74
114	Household equipment and operation	39.11
115	Medical and health care	50.43
116	Transport and communication	24.48
117	Education, recreation and culture	41.79
118	Miscellaneous goods and services	56.83
141	Machinery and equipment	16.57