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ABSTRACT

Why Does the 'Law of One Price' Fail? A Case Study*

We use retail transaction prices for a multinational retailer to examine the extent and permanence of violations of the law of one price (LOOP) for identical products sold in a variety of countries. We find median deviations of 20–50%. The differences are not systematic across very similar goods within a product group (e.g. two types of mirrors), nor across product groups, ruling out differences in local distribution costs as an explanation of violations of the LOOP and pointing instead to differences in mark-ups. While divergences are large at a point in time, both their extent and their duration is limited, suggesting the presence of significant indirect competitive pressures.

JEL Classification: D40, E30, F41, L81
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NON-TECHNICAL SUMMARY

A key assumption in international macroeconomics is the law of one price (LOOP): an identical traded good should sell at the same (common currency) price in all locations. Put differently, the world is assumed to be an integrated market and the extent to which the LOOP holds or fails provides information about whether markets are global or are locally segmented.

Most available price information comes in index form. As base years and base prices vary, the LOOP can only be tested in a very indirect way using these data, specifically, index number-based studies can only examine whether price differences increase or decrease over time, but cannot make statements about the level of these actual price differences. In consequence, attention has turned to studies of the actual prices of individual products. Ideally these should have two properties, being identical and being widely traded.

In this Paper we examine the prices of a range of goods that fulfil these requirements, specifically, the catalogue prices in 25 countries of 119 goods sold by IKEA, the Swedish household furniture retailer. The goods are identical in terms of both design and country of origin and the catalogue prices are the actual transaction prices.

For these data, the simple law of one price is convincingly rejected. Converting prices into a common currency, we find median deviations of relative prices of between 20% and 50%.

Conceptually, the final retail selling price of a product may be decomposed into the import price of the product, the local distribution cost and the profit mark-up. A difference in prices can thus reflect differences in mark-ups (an indication that markets are less than perfectly integrated), however, they may also simply reflect differences in local distribution costs, VAT etc. The data allow a number of indirect tests of this hypothesis. Thus one might suspect that local distribution costs are similar for similar goods. To take one example, if local costs are at the root of the rejection of the LOOP, one would expect that if one mirror is more expensive in Denmark compared to other European countries, then all mirrors should be more expensive in Denmark. This is not the case, for instance, small round wooden mirrors are most expensive in Denmark, while small square wooden mirrors are cheapest in Denmark, a finding that is difficult to reconcile with differences in local distribution costs between square and round mirrors. The same finding applies to virtually all of the 119 products: there are no uniformly more expensive or cheaper countries, rather, the ordering of prices differ for each product.

This finding does not rule out important differences in local distribution costs, but suggests that such differences are not the sole reason for the violation of the LOOP, pointing instead to differences in mark-ups. Such differences in mark-up raise the issue of potential arbitrage: if price differences between countries are sufficiently large relative to transaction costs, buying products in cheaper and reselling them in more expensive markets may be profitable. Indeed, it is precisely this arbitrage possibility which underlies the theory of the LOOP. For IKEA products, it is relatively unlikely that consumer arbitrage takes place on a substantial scale. Price differences could however be exploited by competing retailers to influence their competitive position. One would expect such arbitrage or competitive pressures to be particularly acute for countries which are highly integrated, sharing common borders, common languages, being a member of the same trade block. If so, price differences should be smaller across such subsets of countries. We find that indeed to be the case: typical price divergences increase in distance and decrease in market size. We also find, consistent with arbitrage and competitive pressures, that price differences tend to narrow over time, a tendency which is most pronounced for the goods displaying the largest initial price differences.

In conclusion, the data establish the presence of substantial price differences at a point in time: defined narrowly, the LOOP fails, but the data also suggest that the size of deviations from the LOOP is limited.

1 Introduction

The law of one price (LOOP), and purchasing power parity for tradables, continues to be a bedrock assumption of international economics. While there is by now significant evidence that neither holds at a point in time[1], a lively recent literature suggests that deviations from PPP may be bounded, and that, once thresholds are taken into account, mean reversion is fairly fast.[2] One popular interpretation of threshold mean reversion is costly arbitrage ensuring that relative prices remain within corridors determined by arbitrage costs [O'Connell and Wei (1997), Obstfeld and Taylor (1997)].

The finding of fast mean reversion might be taken to imply that real exchange rate "misalignments" are of relatively little concern, being automatically undone over a fairly short period by arbitrage. Several caveats attach to this interpretation, however. First, virtually all studies in this literature have been based on price indices. Mean reversion thus does not imply reversion to absolute PPP, nor does it map naturally into any arbitrage cost argument. Second, a number of ancillary findings are troubling for the arbitrage explanation. For one, there does not seem to be a significant trade response to misalignments, nor do trade flows display any discontinuity around points of pronounced mean reversion [Campa and Wolf (1998)]. In addition, the mean reversion in relative prices appears to primarily reflect a reversion in the nominal exchange rate, not in prices. While neither of these two points is sufficient to reject arbitrage[3] they indicate the need for further study of the causes of mean reversion to distinguish between the arbitrage interpretation and alternative explanations consistent with the above stylized facts, most notably changes in monetary and fiscal policies motivated by exchange rate objectives.

One avenue of progress in disentangling views on the causes of mean reversion has been a shift from studying price indices to examining the pattern of actual prices. Recent studies in this literature have looked at the price of hamburgers [Cumby (1996)], magazines [Ghosh

[1] A very partial list of recent work, with different conclusions, includes Cumby (1996), Engel, Hendrickson and Rogers (1996), Frankel and Rose (1996), O'Connell (1997), Papell (1996), O'Connell and Wei (1997), Obstfeld and Taylor (1997), Parsley and Wei (1995,96), Weber (1997). Froot and Rogoff (1995) and Rogoff (1996) provide an overview of the literature.

[2] Benninga and Protopapadakis (1988), Coleman (1995), Dumas (1992), Obstfeld and Taylor (1997), O'Connell and Wei (1997), Williams and Wright (1991).

[3] The threat of potential arbitrage might be enough to trigger price adjustments, without actual arbitrage taken place, while broadly shared relative price misalignments may be reflected in exchange rate movements.

and Wolf (1997), Knetter (1998)] and a broad group of consumer items [Crucini, Telmer and Zachariadis (1998)], inter alia. In general, these studies find substantial violations of the law of one price at a point in time, though Cumby (1997) and Ghosh and Wolf (1997) also find some evidence for mean reversion over time.

The present paper follows in this tradition, examining absolute prices for more than 100 identical goods (in design and country of origin) sold in twenty-five countries by IKEA, a Swedish furniture retailer. The data-set has a number of properties providing value added to the existing literature. First, the price data are the actual local currency transaction prices for identical goods, allowing a direct computation of absolute and proportional violations of the law of one price. We thus avoid two of the major problems facing studies comparing international index numbers, the lack of an absolute baseline, and the likelihood of differences in the composition of the basket underlying the index.

Second, unlike hamburgers and magazines, household furnishings are both highly traded and highly tradable: IKEA sources from fifty countries and sells in almost thirty countries.[4] Third, the dataset is three-dimensional, with a country, a product and a time dimension, allowing us to study not only the presence of violations of the law of one price, but also changes in these violations over time and determinants of differences in these violations across county-pairs.

Abandoning price indices for actual transaction prices comes at a cost: by necessity, any group of products selected has some "special" characteristics which may limit the extent to which findings for that group can be assumed to hold for broader price indices. Arguably, however, lamps, kitchen utensils, chairs and other relatively cheap household items are in fact quite "typical" of the generic "traded good" analyzed in the theoretical literature. Product designs are unique to IKEA, thus the goods are differentiated. Yet IKEA has a number of similarly-sized competitors producing fairly close substitutes, including Great Universal Stores (with 4.6bn sales and 26,779 employees, versus IKEA's 5.86bn sales and 36,400 employees) and Pinault-Printemps-Redoute (16.3bn, 62,842 employees) in Europe; Heilig-Meyers (2.1 bn, 23.100 employees) , Ethan Allan, Pier 1 Imports and others in the United States. It thus seems reasonable to classify the products examined here as being

[4] About eighty percent of products are sourced from Europe, primarily from the Nordic countries (thirty percent) and eastern Europe, notably Poland. Most of the remaining products are sourced in east Asia. (Die Zeit, 27.8.98:23)

differentiated products with reasonably close substitutes sold in an imperfect competition environment, and thus being representative for much of intra-OECD trade.

We begin the exploration of the data by documenting common currency price divergences both across products and across country pairs. We find that substantial divergences, of the order of twenty to fifty percent, are typical. These may indicate pricing power, yet they may also simply reflect differences in the local "nontraded" component of the transaction price, composed of local distribution costs, tariff, taxes etcetera, with the law of one price holding for the "traded" component. An innovation in this paper is to use very similar products in the sample (for example a round versus an oval wooden mirror, both made in the same source country) to provide an approximate way around this problem. To the degree that local nontraded costs can be thought of as a multiplicative markup, they can be eliminated by computing the relative price of these two similar goods within a country. A comparison of this relative price across countries (that is, of the *double* relative price) then allows an indirect look at divergences controlling for differences in local costs. We find that price differences persist even for these double relative prices. In sum, the data thus reveal both significant differences in common currency prices, and significant difference in relative price structures.

Exploring the country and product dimension of the dataset, we next ask whether *differences* in the degree to which the law of one price holds across country-pairs can be systematically related to country-pair characteristics (such as their distance, similarity of language, and market size). We find moderate evidence for larger divergences between markets located further apart and markets of smaller size. To the extent that market size and distance proxy for the "ease of arbitrage", both directly for IKEA products, and indirectly through competing stores selling comparable products, there thus is some evidence that conditions in other markets influence local price setting.

Finally, we ask whether such differences persist over time or are undone, as would be the case if arbitrage pressures are significant. We find the latter to be the case: the relative price of a good at time t is strongly negatively associated with its change from t to t+1. With costly arbitrage, mean reversion would commence only once the relative price divergence exceeded the cost of arbitrage. We also find evidence for such threshold effects: mean reversion is significantly faster once relative prices exceed 2.5.

In summary, this particular micro dataset suggests four characteristics of relative prices.

First, at a time, divergences from the law of one price are large for individual products. Second, divergences are also quite large for double relative prices, ruling out at least simple proportional local distribution costs as explaining for the first finding. Third, divergences are smaller between countries located close by, and between larger economies. Fourth, divergences tend to be undone over time, in particular once relative prices breach the threshold of 2.5. The latter two findings are consistent with (though not proof of) arbitrage pressures, either directly, or through competing stores.

The remainder of the paper is structured as follows. We begin with a brief description of the dataset. We then turn to a discussion of the price setting process followed by IKEA, based on communications with store managers. Next, we present stylized facts on common currency prices before examining causes of cross-sectional differences in relative price divergences.

2 Data

The study is based on the local currency catalogue prices of IKEA stores. IKEA sells in a total of 140 stores in twenty-nine countries, we were able to obtain catalogs for twenty-five of these, located in western and eastern Europe, the Americas, Asia and Australia.[5] The dataset spans the catalogue years 1995 to 1998, with a small number of catalogues for the first two years and a near complete set for the last two years.

IKEA sells a total of about 12,000 products. We selected a subset of 119 products, drawn from six categories: mirrors, lamps, rugs, chairs, chests of drawers, and kitchen utensils, as well as a single high price item, a leather sofa. The subgroups were selected to cover a range of transportability, average prices and design intensity. For each subgroup, we selected those items which were available in the greatest number of countries. The sample is thus fairly diverse, ranging from low price items such as forks, typically selling at the equivalent of about 2US$, to the leather sofa, selling at the equivalent of more than 500US$. The prices are valid for one year starting from the publication of the catalogue

[5]The countries are Austria, Australia, Belgium, Canada, Czech, Denmark, Finland, France, Germany, Italy, Hong Kong, Hungary, Kuwait, Malaysia, Netherlands, Norway, Poland, Singapore, Slovakia, Spain, Sweden, Switzerland, UAE, UK, and the USA. We were unable to obtain catalogs for the four remaining locations: China,Iceland, Saudi Arabia and Taiwan.

and are actual transaction prices. Coverage differs across countries and years. The sample contains 220 transaction prices for 1995, 268 for 1996, 1,421 for 1997 and 1,200 for 1998.[6] Relative price observations number 392 for 1995, followed by 408 in 1996, 10,175 in 1997 and 10,175 in 1998. Common currency translations (into the Swedish Krona, except where stated otherwise) were undertaken using the June bilateral exchange rate, reflecting the mailing date of the catalogs.

3 How Does IKEA Set Prices?

A sizable literature relates the optimal price setting behavior of multinational enterprises such as IKEA to the strategic behavior of competitors [Dornbusch (1987), Aw (1993), Knetter (1993, 1994), Gron and Swenson (1996)]; the importance of menu and adjustment costs [Delgado (1991), Kasa (1992)]; the expected permanence of cost, demand and exchange rate shocks, the presence of fixed entry and exit costs [Dixit (1989)], the importance of distribution networks, market share considerations [Froot and Klemperer (1989), Feenstra, Gagnon and Knetter (1993)]; arbitrage pressures and other factors.[7] To learn about the relative importance of these factors, we requested information about pricing strategy, and specifically the effect of exchange rate movements, from several IKEA store managers.

According to the answers received, prices are determined by country-managers, subject to a shared low price business strategy. The IKEA head office provides *"a guide where a product sits in the price ladder. This is only used as a guide. (...) On a few products, normally to create a particular volume in sales, IKEA headquarters may recommend a price."*[8] The low price strategy aims at creating a consumer expectation that IKEA prices will be below those of local competitors for virtually all products. One store manager stated that: *"We have a price difference of 15% or more to (the) nearest competitor on similar, or what a customer experience(s) as similar product(s)."* A second store manager responded that *"for comparable products in the eyes of a visitor we set a price which is a minimum of 20% lower than our nearest competitor".*

[6] We used the 1997 catalogs to select the products. The lower number of price observations for 1998 reflects the discontinuation of some products.

[7] Menon (1995), Rogoff (1996) and Goldberg and Knetter (1997) provide recent surveys.

[8] All quotes in italics are taken directly from written communications with IKEA store managers.

The low price strategy appears to dominate margin considerations: *"Basically our prices are set "before or without taking into consideration" the COGS"* (cost of goods sold). *Then we have to find better and better sourcing so that we can survive with lower prices than our competitors."* Prices are set and guaranteed for a year. Intra-year exchange rate passthrough is hence zero. Between years, the dominance of the low price strategy constrains exchange rate passthrough for depreciations: *"The exchange rate has a very big effect on our profitability, but very little on the pricing process, which is based on the market. [...] At times when exchange rates do put pressure on the profits we have to work harder to reduce our production costs. The price the customer pays is very rarely affected."*

In consequence, margins differ across countries depending on the competitiveness of local suppliers: *"In another country the competition could be less fierce, meaning that we can have higher prices, higher margins and still be essentially cheaper than the competition."* In response to a specific question regarding the price divergence between two rather similar mirrors, the correspondent hypothesized that *"probably the competition is different in UK compared with US on mentioned mirrors."*

In setting prices, IKEA managers thus appear to pay exclusive attention to the prices of domestic competitors. IKEA price setters thus apparently do not consider direct international retail arbitrage to constitute a serious constraint. Exchange rate movements (or cost shocks more generally) thus seem only to influence IKEA to the degree that domestic competitors are subject to the same shocks and are willing to assume the role of price leader. particularly for price reductions.

4 Static Deviations From The LOOP: An Example

The following sections assess two key properties of prices: the divergence of common currency prices of a given product across countries, and the divergence of relative prices across products for a given country pair. We begin with an illustrative example, the 1998 prices of three mirrors in the European IKEA stores, translated into US$, reported in Table 1.

The simple law of one price clearly fails. Prices for the Alg mirror, a two-pack of a very simple square mirror tile, run from the equivalent of 12US$ in Norway to 24US$ in Austria and 25US$ in the United Kingdom. Similarly, prices for the Guldros mirror, a fairly simple round mirror with beveled glass, run from the equivalent of 67US$ in Switzerland to

119US$ in Denmark. Both the Alg and the Guldros mirrors have no particularly distinctive features, in consequence, one might expect quite similar products to have been available in local competitor stores. In contrast, the Krabb mirror, a wavy mirror tile, is quite distinct. The range of prices is even wider for this mirror, ranging from the equivalent of 20$ in the Netherlands to 51$ in neighboring Germany.

It might be supposed that bilateral price differences have an important systematic component across products, reflecting differences in local distribution costs. While we return to this point in more detail below, column 4 of table 1, reporting the ratio of the Krabb mirror to a four-pack of the Alg mirror, does not support the presence of a systematic factor. Relative prices differ substantially. For example, while the Krabb mirror costs about fifty percent more than the Alg mirror in Germany and Denmark, it sells at a forty percent lower relative price in the Netherlands. These differences are furthermore sufficient to alter the ranking of international relative prices, for example, the Alg mirror is more expensive in Austria than in Denmark, while the Guldros mirror is more expensive in Denmark than in Austria.

4.1 Common Currency Price Differences: Products

We next turn to the overall distribution of relative common currency prices. For each product, we first construct the set of all independent relative prices. For each country pair, the relative price is constructed by dividing the larger by the smaller price, thus the relative price distribution is bounded below by one. To assure reasonable sample size, we drop all products for which fewer than fifty relative prices were available.

For the remaining products, we sort the relative prices by size and drop all observations in the top decile to eliminate outliers. For the remaining observations, Table 2 reports the maximum and median relative price as well as the coefficient of variation. Under the strict null of the law of one price *without* differences in local distribution costs, the maximum and median relative price should be equal to one, and the coefficient of variation should be equal to zero.

The table unambiguously rejects the null. The price difference (in common currency) between the cheapest and the most expensive store exceeds fifty percent for most goods, and ranges up to nine hundred percent for some goods. The median difference in the common

currency ranges between twenty and thirty percent for most goods.

The table also reveals substantial differences across product groups. Mirrors appear to be fairly similarly priced across countries: only for two mirrors does the maximum price deviation exceed one hundred percent, and the coefficient of variation is generally quite low. In sharp contrast, the maximum price differentials for lamps, rugs, chairs and kitchen utensils frequently exceed one hundred percent.

On first sight, the data thus clearly reject any simple notion of the law of one price. The divergences are consistent with two explanations. The retail price of an item k produced in country j and sold in country i reflects production costs, local distribution costs, tariffs etc. as well as differences in markups indicating violations of the law of one price. Denoting the source country currency cost of product k by C^j and the exchange rate between the source country and the destination country as S_{ij}, the local price of the product can be written as:

$$P_i^k = [S_{ij}C^j(1+\pi_i^k)(1+\gamma_i^k)](1+\mu_i^k) \tag{1}$$

where μ denotes the profit margin, π denotes the local distribution cost and γ denotes any other cost, such as tariffs. Deviations from the LOOP may thus either reflect differences in markups, and hence price discrimination and/or differences in distribution costs or tariffs.

To pursue this distinction further, we next turn to the distribution of relative common currency prices across products for a given country pair. Specifically, if differences in local distribution costs are of the same sign across all products for a given country pair, and if such differences are the driving force behind differences in retail prices, then relative prices for a given country pair should be bunched either above or below unity.

4.2 Common Currency Price Differences: Country Pairs

For each country pair, we construct the set of all independent relative prices (for all products for which prices for both countries are available), eliminating all country pairs for which less than fifty relative prices were available, leaving 132 country pairs. For each product, the relative price is constructed by dividing the price in the first country by the price of the second country, thus the relative price distribution is bounded below by zero. The data are then sorted by size and the top and bottom decile is dropped to eliminate outliers. For the

remaining data we extract, for each country pair, the maximum and the minimum relative common currency price across all products, and compute the coefficient of variation across all relative common currency prices.

Table 3 reports the distribution of these three statistics. Again, the simple law of one price finds little support. For 37 of the 132 country pairs, the maximum price divergence across all products sold in both countries exceeds fifty percent, for another 61 country pairs, the maximum price divergence exceeds twenty percent, with matching results for the minimum price. The coefficient of variation falls below unity for all but two country pairs, but nevertheless suggests substantial variability across products for given country pairs in most cases.

The same variability is suggested by the comparison of the maximum and minimum relative price across all products for a given country pair. For 128 out of the 132 cases, the minimum relative price is below unity while the maximum relative price is above unity. Simple differences in local costs common to all products thus do not suffice to explain relative price divergences, an attribution of differences in final transaction prices to differences in the local non traded cost component hence requires the latter to be larger for some goods in the first country, and larger for other goods in the second country.

The presence of very similar products in the sample permits a closer look at the likely importance of this possibility. Specifically, under the adjunct hypothesis that even if local costs differ *across* product groups, they are quite similar across products *within* a particular product group, double relative prices of similar products in two countries, should not be affected by local cost differences.

4.3 Double Relative Prices

We assume that two near-identical products $k1$ and $k2$ from an identical source country[9] (for instance a fork and a spoon from the same cutlery series, or a round and a square wooden mirror produced in the same country) have equal tariffs and other local distribution costs, as well as equal common currency source country costs. The double relative price of items $k1$ and $k2$ in countries $i1$ and $i2$ thus reduces to the double relative markup:

[9] A spot-check in the US and the UK revealed production origins to be the same.

$$Z_{i1,i2}^{k1,k2} = \frac{\frac{1+\mu_{i1}^{k1}}{1+\mu_{i1}^{k2}}}{\frac{1+\mu_{i2}^{k1}}{1+\mu_{i2}^{k2}}} \tag{2}$$

Under the assumptions, $Z_{i1,i2}^{k1,k2} = 1$ is hence a necessary, though not a sufficient condition for non-price discrimination. To implement the test, we define all goods within a given category (mirrors, chairs, chest of drawers, lamps, kitchen utensils, rugs) as "near identical". We then compute all independent relative relative prices within the category, always placing the larger relative price in the numerator. Table 4 reports the resulting percentile distribution.

The divergences reported earlier are replicated. For all product groups except chests of drawers and kitchen utensils, more than half of the double relative prices differ by more than twenty percent across country pairs, for the latter two groups, the share is above forty percent. For all product groups, a significant portion of double relative prices exceeds two, with rugs (almost sixteen percent of all relative prices) and lamps (almost twelve percent) having the highest fraction of large deviations.

In summary, the evidence presented up to this point casts doubt on the possibility that simple differences in transaction costs can account for the observed price differentials, pointing instead to quite large differences in profit margins, consistent with the informal statements provided by the IKEA store managers.

5 Cross-Country Differences In Price Divergences

Price-discrimination opens the door to potential arbitrage once price differences exceed the cost of arbitrage. [10] For the particular price data-set considered here, limitations on wholesale purchases and trans-national shipments of IKEA products suggest that, consistent with the statement by IKEA managers given above, direct arbitrage is not a major constraint on IKEA price setting. Competition from similar goods may, however, create pressure limiting price divergences. We next examine whether there is evidence suggesting that IKEA pricing is indeed constrained by actual or potential arbitrage. If so, relative price differentials should be smaller for countries between which arbitrage is less costly.

[10] Benninga and Protopapadakis (1988), Coleman (1995), Dumas (1992), Obstfeld and Taylor (1997), O'Connell and Wei (1997), Williams and Wright (1991).

Furthermore, relative prices might exhibit mean reversion. We take up these points in the next two sections.

A sizable empirical literature has established that bilateral trade flows are larger between closer, larger and richer countries, as well as between countries sharing a border or the same language.[11] We assume that these determinants of trade flows also provide reasonable proxies for the ease of arbitrage.

Sorting relative prices for each country pair by size, we use the difference between the 10th and the 90th percentile as the measure of bilateral divergence.[12] Regressing this measure on the gravity determinants[13] yields:

$(Max - Min)_{ab} =$	5.56	-0.248	$ln(Distance_{a,b})$	-0.740	$ln(Pop._a Pop_b)$
	(1.50)	(0.52)		(3.39)	
		-0.172	$ln(YPC_a YPC_b)$	-0.648	$Adjacent_{ab}$
		(0.42)		(1.21)	
		-0.129	*Language*	-0.223	*EU*
		(0.25)		(0.54)	

with an R^2 of 0.111 and 117 observations (t-statistics in brackets). *Distance* is the greater circle distance between capitals or central cities, *pop* and YPC denote population and income per capita in US dollars, *Adjacent* and *Language* are 0-1 dummies equal to one if the two countries share a common border and a common language, and EU denotes joint membership in the European Union. While the overall explanatory power is not very high, and only population is individually significant, the sign pattern of the regression coefficients is consistent with an "ease of arbitrage" explanation of limits to the deviations from the law of one price: divergences are smaller for countries that are closer together, share a common border, speak the same language, are joint members in the EU, and have larger markets.

[11] A sample of recent applications and surveys includes Bergstrand (1985,1989), Deardorff (1984), Frankel, Stein and Wei (1993), Helpman (1987), Hummels and Levinsohn (1995), Rauch (1996), Sanso et al. (1993), and Wei (1996) among others.

[12] The exclusion of the top and bottom ten percent aims to reduce outlier effects.

[13] The gravity variables are taken from Shang-Jin Wei's NBER webpage (under www.nber.org), updated from www.indo.com/distance)

6 Mean Reversion

To the degree that potential or actual direct or indirect arbitrage pressures are operative, specifically, to the degree that competing stores act, or are perceived as potentially acting as price leaders, one would also expect large relative price deviations to be undone over time. To explore this point, we estimate the standard mean reversion regression of the log change in relative prices between period t and t+1 on the log level in period t for the entire sample (a total of 3214 observations), yielding:

$$D[Log(R_t)] = \underset{(73.4)}{\text{-0.89}} \quad Log(R_{t-1})$$

with an R^2 of 0.627. There is thus evidence of highly significant, and very rapid, mean reversion. Recent research has however suggests that the linear specification is inappropriate in the presence of arbitrage costs. Specifically, if arbitrage is costly, mean reversion should increase once the initial relative price divergence exceeds a critical threshold. [14] Estimating a threshold mean reversion regression:

$$D[Log(R_t)] = b_1 Log(R_{t-1}) + b_2 * D_U * Log(R_{t-1}) + b_3 * D_L * Log(R_{t-1}) \qquad (3)$$

where D_L (D_U) are dummy variables set equal to one if the lagged relative price falls below (above) a specified lower (upper) threshold yields unexplained variance minimizing thresholds of -0.75 and 0.95 with:[15]

$$D[Log(R_t)] = \underset{(4.53)}{\text{-0.19}} \quad Log(R_{t-1}) \quad \underset{(16.63)}{\text{-0.78}} \quad D_U Log(R_{t-1}) \quad \underset{(16.45)}{\text{-0.74}} \quad D_L Log(R_{t-1})$$

and a R^2 of 0.659. For initial log relative prices between -0.75 and 0.95 mean reversion is thus present, but, with a half life of deviations of more than three years, quite slow. For for larger and smaller initial log relative prices, mean reversion in contrast is quite fast, with half lives of deviation of less than three months.[16] The results are thus consistent with

[14] Benninga and Protopapadakis (1988), Coleman (1995), Dumas (1992), Obstfeld and Taylor (1997), O'Connell and Wei (1997).

[15] $D_U = 1$ [$D_L = 1$] iff $Log(R_{t-1}) > 0.95$ [$Log(R_{t-1}) < -0.75$].

[16] Since transportation costs depend primarily on volume and distance shipped, it may however be inap-

arbitrage pressure manifesting itself once relative prices diverge by more than a critical threshold of about 2.5, perhaps because of an unanticipated exchange rate movement. The results are however not sufficient to establish this point. specifically, if differences in IKEA prices across particular country pairs are matched by differences in overall price levels, threshold mean reversion can also result from exchange rate policy based on PPP benchmarks [Campa and Wolf (1998)].

7 Conclusion

We examine a panel of local currency transaction prices of identical products sold by the same company in a large group of countries. We find significant common currency price divergences across countries for a given product and across products for a given country pair. The distribution properties of the price divergences suggests that they cannot be attributed to differences in local costs, tariffs, taxes etc.; pointing instead to sizable differences in markups.

The divergences suggest potential scope for arbitrage. While we found no evidence for direct arbitrage, a number of data features suggest that IKEA pricing may be influenced indirectly by competitor pricing. Specifically, we found divergences to be lower among highly integrated countries, and to be undone over time. In conjunction, the data clearly reject any strict form of the law of one price, but are consistent with a weaker specifications in which deviations from the law of one price are bounded and, at least for large deviations, temporary.

propriate to assume that the same threshold applies for all country-pairs and all products. To allow for this possibility, we estimated the threshold equations separately for three price ranges (below 50 SK, between 50 and 250 SK and above 250 SK) and for three distance ranges (below 500 KM, between 500 KM and 1000 KM, and above 1000 KM). No consistent pattern emerged from these regressions, arguing in favor of pooling across distance and price ranges.

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Table 1: **European Prices 1998 US$.**

	Mirrors			
	A	B	C	D
Austria	24	113	48	1.20
Belgium	22	111	28	0.78
Denmark	13	119	34	1.55
Finland	15	107	21	0.75
France	21	100	33	1.00
Germany	22	97	51	1.50
Italy	23	79	44	1.16
Netherlands	20	101	20	0.56
Norway	12	82	27	1.23
Spain	32	112	34	0.85
Sweden	15	94	24	1.14
Switzerland	19	67	27	0.79
United Kingdom	25	115	30	0.75

A: Alg: square mirror tiles

B: Guldros: round mirror

C: Krabb: wavy mirror

D: Krabb/Alg

Table 2: **Common Currency Relative Prices: Products**

Product	Max	Median	CoV	Product	Max	Median	CoV
Mirrors							
Alg 2Pack	2.04	1.25	0.20	Krabb	1.83	1.26	0.17
Alg 4Pack	1.82	1.19	0.17	Biscaya	1.38	1.11	0.09
Bjorn 75x118cm	1.19	1.06	0.04	Bjorn 75x75cm	1.47	1.15	0.11
Bonnett	1.68	1.20	0.13	Brok	1.41	1.15	0.09
Fiffig	1.60	1.19	0.14	Fjord	1.34	1.14	0.07
Flagg	1.26	1.07	0.06	Guldros	1.49	1.15	0.10
Kloster	1.23	1.11	0.05	Micky	1.49	1.17	0.10
Narvik	1.37	1.12	0.08	Octagon	1.59	1.20	0.13
Pejla	1.53	1.16	0.11	Piral	1.43	1.14	0.09
Ratt	1.64	1.16	0.13	Sill	1.90	1.21	0.17
Spatta	1.62	1.19	0.13	Stirr	1.50	1.19	0.11
Tunga	1.71	1.25	0.15	Uddebo	4.84	1.32	0.41
Ulk	1.51	1.10	0.12	Vimma	1.42	1.15	0.09
Lamps							
Antifoni	1.95	1.25	0.17	Bor	7.28	1.20	0.80
Glimt	9.83	2.98	0.68	Glittra	4.38	1.18	0.45
Gospel	1.41	1.15	0.09	Ilmenit	4.22	1.27	0.55
Kryolit	3.74	1.26	0.25	Kvartett	5.26	1.24	0.68
Kvinet	6.57	1.39	0.75	Kvintol	1.88	1.21	0.17
Mystik	5.48	1.27	0.53	Rimfrost	3.55	1.24	0.30
Skyfall	5.88	1.26	0.76	Smog	6.58	1.24	0.72
Rugs							
Bro	8.99	1.27	1.00	Karby	6.31	1.16	0.75
Klampen	3.38	1.32	0.28	Mjang	8.53	1.24	0.85
Ollerup	6.13	1.16	0.71	Saltnes	7.07	1.22	0.84
Stuby	3.29	1.32	0.30	Vasby	9.71	1.25	0.94
Chairs							
Abo	1.85	1.16	0.14	Albert	9.58	1.22	0.91
Bobbi	4.90	1.25	0.59	Dora	7.62	1.25	0.88
Hogmo	2.42	1.28	0.20	Hornsby	5.19	1.30	0.51
Ivar	2.14	1.25	0.18	Jussi	1.87	1.24	0.16
Kronvik	1.86	1.21	0.15	Mans	7.31	1.26	0.86
Ogla	2.06	1.28	0.18	Oglett	1.50	1.14	0.10
Ringo	2.11	1.29	0.19	Terje	1.87	1.20	0.16
Ticho	5.71	1.22	0.56	Tomas	9.62	1.34	0.98
Tuna	8.52	1.37	0.87	Vebster	1.81	1.19	0.15
Drawers							
Fjord 80x80	1.93	1.21	0.15	Fjord 125x80	1.75	1.22	0.15
Fjord 58x80	1.79	1.14	0.14	Kurs-A	1.84	1.20	0.16
Kurs-D	2.49	1.22	0.25	Kurs-F	2.08	1.20	0.16
Kurs-G	1.72	1.16	0.13	Kurs-I	5.70	1.19	0.58
Narvik 2-dr.	4.92	1.18	0.49	Narvik 3-dr.	1.90	1.23	0.18
Narvik 5-dr.	1.79	1.09	0.13	Narvik 6-dr.	1.86	1.18	0.15
Kitchen Utensils							
Fanfar 7 Piece set	6.23	1.24	0.78	Fanfar 5l pasta pan	3.43	1.18	0.34
Grunka 34.5 Skimmer	5.90	1.28	0.60	Grunka 28.5 Ladle	7.51	1.25	0.71
Grunka 33cm Spoon	2.68	1.23	0.23	Grunka 31cm Soup Ladle	3.93	1.25	0.25
Grunka Spagehtti server	3.93	1.25	0.26	Grunka Carving Fork	5.00	1.24	0.50
Grunka 34cm Spatula	2.95	1.25	0.24	Heat Cork mats	7.65	1.34	0.67
Kontrol 1.6l Saucepan	9.32	1.30	0.96	Kontrol 6.3l casserole	5.07	1.20	0.72
Kontrol 2.0l saucepan	7.21	1.15	0.94				
Easy Chairs and Leather Sofa							
Arstad	5.71	1.25	0.47	Boana	5.74	1.31	0.70
Kimsta	2.04	1.18	0.18	Pixbo	2.03	1.22	0.17
Sofa Halland	1.57	1.13	0.10				

Table 3: **Common Currency Relative Prices: Country-Pairs**

Maximum		Minimum		Coeff. of Variation	
Range	Cases	Range	Cases	Range	Cases
Above 5.00	12	Below 0.149	15	Above 1.00	2
3.00 to 4.99	0	0.15 to 0.449	0	0.800 to 0.999	2
2.00 to 2.99	3	0.45 to 0.499	3	0.700 to 0.799	11
1.50 to 1.99	22	0.50 to 0.599	16	0.250 to 0.699	15
1.40 to 1.49	10	0.60 to 0.699	23	0.200 to 0.249	11
1.30 to 1.39	18	0.70 to 0.799	31	0.150 to 0.199	49
1.20 to 1.29	33	0.80 to 0.899	22	0.125 to 0.149	33
1.00 to 1.19	28	0.90 to 0.999	15	0.100 to 0.124	7
Below 1.00	2	Above 1.00	7	Below 0.100	2

Table 4: **Percentile Distribution Of Relative Relative Prices**

	Mirrors	Lamps	Rugs	Chairs	Chests of Drawers	Kitchen Utensils	Easy Chairs
1.0 to 1.1	24.4	24.8	19.5	25.5	36.0	39.0	18.2
1.1 to 1.2	19.6	19.2	18.3	21.1	23.9	13.1	18.6
1.2 to 1.3	15.0	14.4	12.8	15.4	13.9	12.5	13.4
1.3 to 1.4	10.8	9.8	10.6	10.5	8.1	7.8	12.0
1.4 to 1.5	7.8	7.2	6.8	7.3	4.9	5.3	8.4
1.5 to 1.6	5.9	4.4	5.0	5.0	3.1	3.8	5.8
1.6 to 1.7	3.9	3.2	3.7	3.5	1.8	3.3	5.2
1.7 to 1.8	2.8	2.2	2.8	2.4	1.3	1.5	3.0
1.8 to 1.9	1.9	1.6	2.1	1.6	0.9	2.0	2.2
1.9 to 2.0	1.5	1.1	2.0	1.1	0.6	1.5	1.8
2.0+	6.0	11.6	15.9	5.9	4.9	9.8	10.9
No. of Obs.	38568	9535	2851	25109	15105	11426	931

Table 5: Distribution Of Price Changes (Obs)

Price Change	Cases
Smaller than -20 Percent	186
Between -20 and -15 Percent	24
Between -15 and -10 Percent	37
Between -10 and - 5 Percent	31
Between -5 and 0 Percent	375
Between 0 and 5 Percent	416
Between 5 and 10 Percent	56
Between 10 and 15 Percent	28
Between 15 and 20 Percent	16
Above 20 Percent	183