One TV, One Price?*

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Abstract

We use a unique dataset on television prices across European countries and regions to investigate differences in price levels. With detailed price level data, we are able to account for most of the usual arguments invoked to explain price differences. Thanks to the dimensionality of our data, we have (partial) information on the costs involved in production, cross-country differences in firm perception, and ultimately the international prices of the actual same good. We use these data to answer classic questions in the literature. We first focus on price differences, and show that: (i) Quality accounts for the lion's share of international price dispersion. Rich economies tend to consume higher quality goods. (ii) Even for the exact same television set, sizeable international price differentials subsist, of 8% on average. This may reflect the fact that the perception of a given firm does vary sizeably across countries, something we estimate directly. (iii) EMU countries display lower price dispersion than non-EMU countries. (iv) A border effect subsist. Absolute price differentials and relative price volatility are positively correlated with exchange rate volatility, but not with conventional measures of transport costs. (v) In terms of price dynamics, exchange rate passthrough is low in the short run, but high in the long run.

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1 Introduction

A large literature on Purchasing Power Parity (PPP) has documented that aggregate price levels expressed in common currency differ persistently across national borders [1]. The sources and extent of good price differences across markets is a topic of great importance. Significant price differentials across countries may entail large social costs due to the distortions introduced by price discriminating producers or retailers and may be of concern to regulators and policy makers alike. Understanding the determinants of deviations form PPP is also important for the modelling of the open economy as the international transmission of shocks and welfare results hinge crucially on the extent of exchange rate pass-through[2]. A number of recent contributions have studied datasets on disaggregated prices featuring (close) to identical products in an attempt to correct for differences in the composition of the basket of goods across locations. Haskel and Wolf (2001), Goldberg and Verboven (2001, 2005), Crucini, Telmer and Zachariadis (2005), Crucini and Shintani (2008), Broda and Weinstein (2007), Burstein and Jaimovich (2008) and Gopinath et al (2009) document that prices of goods that are similar - or identical - differ substantially across borders[3]. This literature has highlighted differences in wholesale costs such as local distribution costs as a contributing factor for explaining cross-country differences in retail prices (see e.g. Goldberg and Verboven (2001), or Gopinath et al. (2009)). Nominal rigidities preventing instantaneous adjustment of prices to changes in marginal costs may also be responsible for deviations from PPP. Much less attention, however, has been paid to the extent to which firms are able to price discriminate across borders due to branding. The present paper contributes to this burgeoning literature on the law of one price that uses high quality micro data on price levels to investigate price convergence and the importance of exchange rate pass-through. We also study the role of market segmentation, proxied by distance, border and exchange rate volatility, and of brands in explaining price differences.

We investigate these issues using a panel database on the prices of television sets across European countries and within regions of some of these countries. Our sample contains the key members of the euro area as well as non-euro area countries; it has three large new EU members (the Czech Republic, Hungary and Poland). The television market is of particular interest since TVs have been present in the shopping basket of European consumers for many years, and almost every household in Europe owns at least one TV set. Furthermore, the good's price is substantial enough to warrant some reflection (and,

[1] Surveys can be found in Rogoff (1996) and Taylor and Taylor (2004).

[2] See Carvalho and Nechio (2009) for a recent model of the open economy with heterogeneous price adjustments.

[3] Other contributions include Asplund and Friberg (2001), Ghosh and Wolf (1994), Parsley and Wei (2004), Imbs et al (2005). Other studies such as Engel and Rogers (1996) and Gorodnichenko and Tesar (2009) have used volatility of relative price indices across locations to identify a border effect.

possibly, some international comparisons) before making the actual purchase decision. Finally, the production and distribution of TV sets across European countries are actually subject to very little regulation. These features of the good that we study stand in stark contrast with existing work, which either focused on low unit costs goods, or on expensive yet heavily regulated durable goods.[4] Thus, our data single out a good where large price differences would be particularly intriguing as arbitrage is likely both intense and relatively unfettered - whether is it done by individual consumers, or trading firms set up with that purpose.

We supplement actual retail transactions price data with detailed information on the characteristics of the TV sets sold and on brands. Those characteristics are refined enough to allow us to actually control for variations in quality both across regions and over time.[5] Thus, we bring the focus on any residual explanations for differences in prices, over and beyond the usual argument that standard data unduly compare apples with oranges. In particular, we consider market segmentation, differences in distribution costs. Finally, we consider heterogeneous preferences and potential differences in the national perception of a given brand. In addition, using a subsample of our data, we can also compare the prices of the exact same TV set across countries. The corollary question of whether price differences are larger within or between countries can be addressed as well, thanks to a regional dimension in (some of) our data. We are also able to estimate good specific exchange rate pass-through equations. Both exercises are important, for recent contributions have argued the border effect and imperfect pass through are artefacts of aggregation (see Broda and Weinstein, 2007). The availability of actual prices makes it possible to investigate whether price differentials are related in any systematic manner with goods' unit prices, as would be the case if arbitragers needed to pay a setup cost to take advantage of price differences. These costs could help explain some of the remaining cross-sectional variation in prices, once differences in quality and in costs are controlled for.

We stress that we exploit our data in two different ways. First, we perform hedonic pricing using the entire dataset, controlling for quality differences (vertical or horizontal differentiation). We seek to explain remaining price differences by market segmentation and other factors, such as firm perception. We also investigate the extent of pass-through into export prices. Second, we focus on a subsample of our dataset, which includes only the exact same TV sets across countries. Our results are as follows:

(i) A large part of international price differences can be explained by differences in the quality of the goods purchased. Going further, price differences for the same

[4]See Haskel and Wolf (2001) or Goldberg and Verboven (2001), respectively, for studies on Ikea mirrors and automobile sales. Nevo (2001) focuses on ready-to-eat cereals.

[5]This corresponds to another desirable feature of the good we are investigating. Most of the production costs of TV sets appear to depend on the tube used in the device, whose type is included in our dataset and whose production location can be traced.

television sets are sizeable and comparable to those uncovered with hedonic price regressions. The ranking of countries in terms of expensiveness, however, differs between the two methods. We interpret such residual price differences as the possibility that brand perception differ across countries. We identify brand valuations across countries, proxied by a firm fixed effect. We show they are also an important source of price variation. They do not correlate with any conventional measures of cultural proximity, nor with exchange rate volatility.

(ii) Absolute price differentials and relative price volatility for the same television sets are positively correlated with exchange rate volatility. This suggests the "border effect" documented first by Engel and Rogers (1996) using price index data is important also to explain differences in very disaggregated price levels.

(iii) EMU countries display considerably smaller price dispersion than countries external to the monetary union. In fact, EMU price differences are comparable to within country regional price dispersion, but, since our sample starts in 1999 we are unable to disentangle whether this is due to the birth of the euro, to unobserved country characteristics or to common market policies predating 1999.

(iv) Exchange rate pass-through is high in the long run but incomplete in the short run.

In our regressions, we attempt to capture not only international differences in production costs, but also the different "subjective" valuations attached to firms by countries. Thanks to the dimensionality of our data, we are able to introduce a firm specific fixed effect allowed to vary country by country. We call this fixed effect "brand". We find these brand effects to be an important source of international price variation. Brand perceptions vary across countries, which may be a reflection of heterogeneous preferences (design for example may be highly valued in some countries and less so in others), unobserved marketing activity, different brand awareness, after-sales services, or of country-specific habit formation. Our data unfortunately do not allow us to distinguish between those different types of explanations. While structural studies have paid attention to the fact that prices seem to be relatively stable over time and affected little by changes in marginal costs (such as exchange rates for imported goods in Goldberg and Hellerstein (2008) for example) much less effort has gone into examining how firms can build up brand premia that allows them to charge a premium for their goods. We believe that the size of the brand premia that we find for TVs, if comparable for other goods, may be sufficiently large that their welfare implications dominate those that derive from sluggish adjustment of prices.

The rest of the paper proceeds as follows. We next describe our dataset in more details. In Section 3, we analyze international price differentials. We first compare raw and quality adjusted price differences. We document dramatic reversals in countries' expensiveness

rankings. We then go the whole way and study the dispersion of prices for the same television sets across countries, using a subsample of our dataset. We relate these absolute price differences to plausible determinants such as exchange rate volatility. We then show "brand effects" explain a large fraction of international price differences. Section 4 brings in the regional dimension in our dataset. We compare intranational to international price differentials, evaluate the existence of a border effect in these disaggregated data, and assess whether EMU countries can be considered as integrated as regions within the same country. Section 5 uses hedonic regressions to investigate the role of exchange rates in explaining price differentials and estimate the extent of pass-through. Section 6 concludes.

2 Data

Our data were obtained from GfK France. GfK is a private company selling market surveys based on high quality and very disaggregated data. The traditional focus of GfK has been on consumer electronics and especially the TV market. The data cover at least 80 percent of all TV sales in the countries considered, and up to 95 percent for some markets. Duty free shops as well as small outlets are excluded. We have data on countries which belong to the EU and the euro area (Austria, Belgium, France, Germany, Greece, Italy, the Netherlands, Portugal, Spain); on countries belonging to the EU but that have not adopted the euro (Sweden, the United Kingdom and the accession countries, Hungary, the Czech Republic and Poland); and finally on Switzerland. For the majority of these countries, the data are national averages (weighted by sale volumes), collected bimonthly (6 observations per year).[6] The period considered is 1999 till end of 2002. We also have regional information for Germany (4 regions), Italy (4 regions), Spain (4 regions) and Switzerland (2 regions).

The data are reported in national currency and we use market exchange rates to convert price levels into a common currency, which we choose to be the Euro. For each market we have information on the prices of TV sets, and on a variety of their characteristics. These include the TV screen size (smaller than 28 inches, 28 inches, 29 inches, or more than 29 inches), the tube dimension (4:3 or 16:9), the type of the tube (50 or 100 Hertz), and the brand, which is separated into 24 individual brands and an aggregate of all others. To maximize the number of characteristics available for each TV set, we restrict our sample to televisions whose screen size is at least 28 inches. Combining the country and good dimensions, our international cross-sectional dimension is as large as 4,500 goods. The coverage of these data is summarized in Table 1. In Table 2, we show the list of brands and their country of origin. The regional data do not have all the characteristics we study in the country sample. But they still allow us to perform some

[6]For Switzerland, the data are four-monthly, i.e. three observations per year.

hedonic regressions and to gain some insights in the degree of regional price convergence and the magnitude of national border effects.

3 International Differences in TV Prices

We start by investigating the extent of cross-market TV price differentials and how these relate to the characteristics of TVs, the producer and/or the market. Our data have 25,576 observations, the average TV costs 992 euros, with a minimum price of 69 euros and a maximum of 8,205 euros. We first focus on raw, uncorrected prices. We then perform hedonic regressions to investigate the importance of quality and other observed characteristics. We examine the international ranking of prices thus corrected, and their dispersion. We then analyze a restricted sample containing only identical TV sets. We continue to find price differences, which we ascribe to unobserved differences in goods (perceived?) quality. We begin to try and capture these effects, and include a country-specific firm fixed effect. This is meant to capture the importance of brands, which we show is sizeable even after observable characteristics are held constant.

3.1 Uncorrected Prices 1999-2002

In Figure 1 we illustrate the average 'raw' prices across countries for the sample period that we have data for. These data were computed by weighting prices with sales shares in each country. Table 3 report the averages of these prices for each of the 15 countries in the sample. Several observations stand out. First, average TV prices differ substantially across countries. The most expensive market, using this measure, is Switzerland and the cheapest is the Czech Republic. Average TV prices in Switzerland are almost 50 percent higher than the cross-country average while prices in the Czech Republic are 25 percent below the average. Prices vary significantly over the sample period as well but the cross-country ranking appears relatively stable. Prices in Switzerland, for example remain the highest throughout the sample and the two cheapest markets are consistently Hungary and the Czech republic. The data do not reveal any significant evidence of convergence of TV prices even though the country rankings of average TV prices change over time.

The average 'raw' TV prices seem to have some relationship to income. In Figure 2 we plot the average prices against GDP per capita, both in logarithms.[7] As expected given Table 3, there is a strong positive relationship and the slope indicates that the elasticity

[7]The measure of income is GDP per capita (in euro), averaged over the 1999-2002 sample.

of the raw price to income is non-negligible (around 1/3). Thus, TV sets are significantly more expensive in richer countries.

But these numbers cannot be taken as proof that firms set higher prices in richer countries. The price differences could simply reflect differences in the characteristics and quality of TV sets across Europe. For instance, it is entirely possible that the typical TV set sold in Switzerland is simply not available (or has a very thin market) in Poland or Hungary. Price differences could simply reflect differences in quality. It seems plausible that higher average income in, say, Switzerland than in, say, Poland, implies that the typical Swiss consumer demands better specifications and better quality TV set than the typical Polish consumer. In order to take this into account, we need either to correct for product characteristics or compare exactly the same TV sets across countries. We next investigate the first of these possibilities.

3.2 Hedonic Regressions: Corrected Prices 1999-2002

In this section we explore the extent to which quality-adjusted prices, denoted by θ_{mt}, differ across markets. We adopt an hedonic price adjustment approach expressing the prices of the products as

$$p_{imt}^{euro} = \omega_{imt}\ \gamma + \theta_{st} + \theta_{mf} + \theta_{mt} + \varepsilon_{imt} \tag{1}$$

where p_{imt}^{euro} is the logarithm of the price of product i in market m at date t expressed in euro, ω_{imt} is a vector of product characteristics that may be different across markets, θ_{st} is a source country-time dummy, and θ_{mt} is a market-country time dummy[8]. Importantly, θ_{mf} is a market/firm supplier dummy, or "brand" dummy, that allows for possible heterogeneity in brand perception across countries. A similar formulation was implemented by Goldberg and Verboven (2001), and Verboven (1996) among others, in their study of the European car market. Hedonic regressions model prices as a function of observable product characteristics that might affect the costs of supplying the good, and its quality. The market-country time dummies θ_{mt} capture the cross-country price differences that are unrelated to the observed variables meant to explain differences in good's quality or due to a brand premium. The θ_{mt} are therefore hedonic prices -quality adjusted prices-, whose properties we study.

Product characteristics are included in order to control for observable differences which may affect the consumer's evaluation of the TV set. Observable product characteristics include the size of the screen, the tube dimension, and the picture renewal rate. It seems

[8]There is very little variation in the TV tax rates in our sample. We therefore do not include a tax variable.

reasonable to assume that, all other things equal, larger and more sophisticated TV sets are more expensive. The screen sizes are divided into three categories, 28", 29" and larger than 29".[9] Tube dimension is defined as either the old 4:3 ratio, or the more recent wide screen format, 16:9. Given the versatility of wide screen formats, we would expect TV sets equipped with 16:9 tubes to be more expensive than those with 4:3 tubes. We also include information on picture quality, distinguishing between lower quality 50 Hz and more advanced 100 Hz TV sets. The higher renewal rate frequency reduces flicker normally observed on 50 Hz TV sets. Unfortunately, the data does not include other relevant variables such as the quality of the audio or the number of tuners. However, the variables that we include are those that the industry believes to be the most important observable product characteristics.

Television production is a highly globalized activity. Television sets are often produced by multinationals whose headquarters are usually located in their country of origin (source country), while key TV components, i.e. tubes, are purchased in another country and the final assemblage of the TV sets is performed in yet another one. The identification of the production country is therefore not straightforward. We scanned thoroughly the annual reports for each TV producer we have data on, as well as outsourcing announcements in the financial press. We choose as the source country the country of origin of the firm since a non negligible part of the activity of the company, such as marketing and advertising decisions and some stages of production most frequently take place in the firm's country of origin (see Table 2).

The inclusion of brand dummies is meant to reflect unobserved product characteristics or unobserved attributes that may be differently valued across countries, such as design or 'glamour'. For example, producers such as Bang and Olufsen (B&O) or Loewe are well-known for exquisite design which may increase consumers' willingness to pay. If certain producers are renowned for high (or low) quality TV sets, their reputation can also be expected to affect consumers' perception of the product. Other aspects such as the degree to which TV sets can be integrated with other audio-visual products may have similar consequences. Brands may also be related to after-sales service, reliability and durability of the product. Many of these aspects are hard to measure directly, but will be captured through the inclusion of market specific brand dummies.

Finally, the country-time effect θ_{mt} picks up cross-country price differentials common across goods, and that are uncorrelated with observed variables . It can reflect either local costs at the retail level, or price differentials due to general differences in the willingness to pay for TV sets across markets. In particular, differences in the costs of distribution at the retail level are likely to affect the choice of retail prices through their effect on

[9]We also have data on smaller TV sets but for these products information is missing on other key variables.

retailer margins. Similarly, countries with higher income may also be countries in which consumers have a higher demand for durable goods. That is, markets where producers may be able to set higher prices, holding quality constant.

Table 4 reports the results of our hedonic price regression. The validity of an hedonic regression is commensurate to the goodness of its fit. In the present case, we obtain R^2 statistics around 80 percent, a rather good fit given the somewhat limited set of observable product characteristics included. Observable product characteristics all enter the hedonic prices with significant coefficients and with signs consistent with our priors. The results imply that TV sets with larger than 29 inch screen command a premium of around 32 percent relative to 29 inch television sets and a premium of 53 percent relative to 28 inch television sets. Similarly, we find that TV sets with 16:9 tubes are sold with a premium of approximately 26 percent relative to TV sets with 4:3 tubes. The higher price for wide screen TV sets are in line with standard industry wisdom. Finally, TV sets with 100 Hz picture renewal rate carry a premium of approximately 38 percent relative to traditional 50 Hz TV sets.

We also find highly significant source country-time effects indicating that our modeling of the source country appears to have an effect on the prices of the TV sets. Likewise, the country-time dummies are highly significant indicating that there are important differences in the general level of prices across markets that are not explained by differences in the product and/or production characteristics.

Finally, the hedonic regressions include a measure of brands in order to control for unobserved product characteristics or attributes. The brand dummies are in fact highly significant and the hypothesis that brands do not affect prices is resoundingly rejected. In Figure 3 we illustrate the size of the estimated brand effects. The largest effect is estimated for Bang & Olufsen (B&O) TV sets, a brand that is known for high quality and attractive design. Once observable product characteristics are accounted for, the premium on B&O remains very large, with prices around 150 percent higher than comparable products. Loewe, Sony and Panasonic are also highly priced, but their brand premia are considerably lower than those of B&O. At the other extreme, Mivar, Orion and Daewoo do not appear to possess much brand value. Thus, product and market characteristics are important components of the prices of the TVs, but brand effects seem to be pertinent as well. Evidently, either brands control for unobserved product characteristics (such as the quality of the TV set not captured by the product characteristics, design, the sound system etc.) and/or firms are able to brand their goods in such a way that they can charge relatively large premia for their goods.[10] Either way, brands seem to be an

[10]Unobserved quality differences are without any doubt important. For example, although many producers buy tubes from the same supplier, it is well-known that high-end TV producers such as Sony and B&O test the quality of the tubes more rigorously than some lower-end TV producers. Therefore, the brand dummy is likely to pick up the higher cost and quality of the TV sets of the high-end producers.

important dimension of prices.

3.3 Rankings and Dispersion

We now use corrected prices, denoted by θ_{mt} in the previous section. We investigate the ranking and dispersion of prices across European countries, once differences in the TV sets' main characteristics are accounted for. Let $p = \ln(\frac{\theta_i}{\theta^{uk}})$ denote country i's hedonic price relative to the UK. Figure 4 illustrates graphically our estimates for quality adjusted prices, which display a clear downward trend. A variety of (unreported) tests confirm that the hypothesis of non-stationarity is hard to reject for quality adjusted prices. This suggests that an important part of the time-variation in TV prices comes from quality improvements, a finding that in itself appears important. We investigate the dynamic properties of quality adjusted relative prices, and we choose the United Kingdom as the numeraire. We compute the average of hedonic prices relative to the UK. Table 5 contains the results.

The ranking of corrected TV prices changes dramatically. The UK, true to its reputation, is the most expensive country. Then, surprisingly, come the Czech Republic, Hungary and Poland. Controlling for quality, TV sets in the Czech Republic (and apparently in accession countries) are found to actually be highly expensive, less than 5% below the UK. These countries were at the bottom of the ranking of uncorrected prices. This suggests that TV sets sold in accession Europe score low on most of the product characteristics we observe, to such an extent that they are actually overpriced relative to other countries. Switzerland remains an expensive country, 5% below the UK. This implies that the high uncorrected prices we observe there are - partly, but not completely - due to high quality TV sets. Quite strikingly, the countries with cheapest TV sets in our sample are now Germany, Austria and the Netherlands. Raw Dutch prices were amongst the highest in our sample: Table 5 means therefore that the TV sets sold in the Netherlands are of such good quality as to be actually cheap relative to an European average, 15 percent below a similar TV set sold in the UK, for instance. It is also striking that the three newcomers in the EU (the Czech Republic, Hungary and Poland), which were the three cheapest countries when our ranking was conducted using raw prices are now among the most expensive ones once quality of the TV sets is accounted for.

The fact that the ranking of quality adjusted TV prices is rather different from the ranking of the average raw TV prices reflects that there are large differences across countries in the quality of the typical TV set purchased. This finding underlines the usefulness of studying prices of individual goods rather than price indices when investigating cross-market price differences.

The cross-sectional dispersion in prices seems substantially lower once quality differences are accounted for. On average, TV sets are 10 percent cheaper than in the UK, and the maximal discrepancy occurs between Germany and the UK, with (quality adjusted) price differences equal to 19 percent. In contrast, Table 3 pointed to differences close to a ratio of one to two, between Switzerland and the Czech Republic. Thus, part of this huge discrepancy stems from particularly low quality TVs in the Czech Republic. Nevertheless, price differences are still sizeable having accounted for product characteristics.

From Figure 4 we note a one-time fall in prices can be observed in all countries around July 2000, and, to a lesser extent, toward the end of 1999. Our conversations with TV manufacturers unanimously suggest the former was largely due to massive discounts across Europe following immediately the European football Championship, and disappointing TV sales. The fall in November-December 1999 is ascribed to a re-positioning of the main European manufacturers (Thompson, Sony and Phillips) into the high-end TV market - indeed a price war.

σ-convergence is apparent on Figure 4, with some price convergence towards a low common level. We investigate the possibility in more details on Figure 5, borrowing from the literature on economic growth, and computing a time-varying measures of σ-convergence.[11] We compute the cross-sectional variance of the measure of quality-adjusted prices $\widetilde{\theta}_{it}$,

$$\sigma_t^2 = E_t \left(\widetilde{\theta}_{it} - \mu \left(\widetilde{\theta}_{it} \right) \right)^2$$

at each time t, where $\mu \left(\widetilde{\theta}_{it} \right)$ denotes the cross-country average of quality adjusted prices. We plot the corresponding series in Figure 5, distinguishing between EMU and non-EMU countries. We show two measures for the EMU area, one including Greece and the other that excludes Greece. There are two reasons for excluding Greece. First, we do not have data for Greece for the full sample period and, secondly, Greece stands out as having large variability. The results are surprising. First, there are no apparent trends in either of the two series. There is a mild downward trend amongst EMU countries (especially when Greece is omitted), but the slope is weakly significant at best. This suggests the cross-sectional dispersion in quality adjusted prices did not experience any marked change in our sample. It also implies the convergence that is casually apparent from Figure 4 is in fact happening between groups of countries, rather than within EMU or non EMU economies. Second, however, dispersion is systematically lower within the European Monetary Union, with the short-lived exception of February 2000. This does suggest economic integration is more prevalent between EMU economies, but not necessarily because of the Monetary Union. If dynamic price convergence has happened within the sample of countries we are considering, it was between EMU and non-EMU countries.

[11] See Sala-i-Martin (1996) for a discussion.

In fact the absence of a marked downward trend in dispersion since 1999 suggests that most of the price convergence between EMU countries was a reality before the introduction of the Euro[12]. EMU countries may be better integrated with each other to start with.[13] Deep integration on the goods market could actually explain why these countries chose to have a common currency in the first place. Or alternatively, preferences in EMU countries may be more similar than the preferences among non-EMU countries, a group that includes economies as different as Switzerland, the UK and poorer countries like Poland and Hungary. Given our finding that intra-EMU price dispersion is smaller than average price dispersion in our sample, it is worth investigating whether intra-EMU price dispersion is of the same order of magnitude as regional price dispersion, i.e. whether EMU countries can be considered as integrated as regions within the same country. We take up this question in Section 4. The evidence in this section does not strongly support the idea that monetary union has caused goods market integration but neither does it contradict this hypothesis.

Last, in Figure 6 we repeat the analysis of the relationship between income and prices that we examined for raw prices in Figure 2. There is an overall negative correlation between quality adjusted prices and income per capita. However, this relationship is mostly driven by the three accession countries and when these are eliminated from the sample, there is basically no relationship between quality adjusted prices and relative income. In other words, the prices of TV sets adjusted for quality (and the other aspects included in the hedonic regressions) appear high in the three accession countries but do not vary systematically with income throughout the richer parts of the EU. In the light of Figure 2, this evidence shows quite clearly that while average transactions prices are higher in richer countries, these price differences reflect to a large extent quality and local cost differences rather than producers setting higher prices in countries where the average consumer is better off.

3.4 One TV, One Price?

Given our detailed data on TV sets, an alternative to hedonic regressions is to actually track price differences of the exact same TV over time and across locations. We follow that route in this section, and construct a restricted sample formed by the prices of TV sets with identical characteristics, among those we observe. In other words, remaining differences have to originate in unobserved features, such as brand perception, habit persistence or distribution and after-sale services. We investigate whether remaining price differences

[12]In that sense our results are consistent with Engel and Rogers (2004).

[13]Switzerland, the UK and Sweden are part of a free trade zone with EMU countries but the Czech Republic, Poland and Hungary had to comply to the restriction of the "rule of origin" during the period considered.

across countries can be linked to standard economic variable such as proximity in trade or exchange rate volatility. This should allow an assessment of the importance of arbitrage as a price equalizing force across borders. Sizeable price differentials would hint at the existence of important non-traded local costs such as retailing, distribution or at country specific unobserved differences in preferences or brand awareness.

We first construct a measure of bilateral price dispersion computing the variance of the relative prices for the same television set across country pairs. More precisely, we use the time average of p_{ik} (resp. p_{jk}), price of television k in country i (resp. j) to calculate the ij specific volatility of relative television prices

$$var_{ij} = \frac{1}{K(K-1)} \sum_k \bar{s}_k \left(\frac{p_{ik}}{p_{jk}} - m_{ij} \right)^2$$

where m_{ij} is the mean of the relative prices for country i and j, and $\bar{s}_k$ denotes the average share of the TV set of type k in sales in countries i and j. Since our measure of dispersion could be biased by differences in the number of common television sets across country pairs, we truncate our sample to ensure that K is the same across pairs. We are left with around 90 different television sets for each country pair.

Our results are reported in Table 6. We confirm the well-known result in Engel and Rogers (1996). Relative price volatility mirrors to some extent the movements in the nominal exchange rate. In particular, we find high volatilities between pairs of countries where the exchange rate fluctuates, involving for instance Switzerland or the UK. The highest average volatility of relative prices can be found for the UK-France country pair, while in contrast the Austrian-German couple or the trio Spain, Portugal, France who all share the euro, seem much more in phase.

Since one of the major advantage of our data is to include the actual price of each TV sets, we can also compare average television price differences in levels across country pairs. We construct a simple bilateral price differential measure as

$$\Delta_{ij} = \frac{1}{K} \sum_k \bar{s}_k \left(p_{ik} - p_{jk} \right)$$

where the set of televisions is also restricted to include solely the ones common across all country pairs.

The results presented in Table 7 are striking. They confirm the existence of important average price differences between European countries, even between TV sets that are as similar as an econometrician can know. On average the absolute price difference between the average price of the same televisions across pair of countries is as high as 80 euros, or a bit less than 8 percent of the average price. The estimate is similar to the estimate of

the average quality adjusted cross-market price difference of 10 percent that we estimated using hedonic prices above. The highest differentials can be found between the UK and the Netherlands, the UK and France, the UK and Germany, or Switzerland and Germany. British customers pay an amount in excess of 257.9 euros on average when they purchase a television set compared to Dutch customers; they also put on the table 224.2 euros more on average than their friends from across the Channel. This amount is comparable to the 225.4 euro the Swiss customers disburse in excess of their German neighbors. The correlation between the absolute values of the price differences and the bilateral volatility measure is high, approximately 0.74. In particular, the highest average price differentials can be found across the same markets for which the variance of relative prices is the highest. This result is interesting for two reasons. First, the conventional evidence on a border effect is based on the observed volatility of relative prices, as in Engel and Rogers (1996). Our data confirm a border effect is also at play on price levels. Second, a border effect continues to prevail even in highly disaggregated data.

We next attempt to relate our measures of relative prices variances and mean differentials to traditional measures of economic and/or cultural integration. We simply regress $X_{ij} = var_{ij}$ or $|\Delta_{ij}|$ on variables traditionally used as indicators of cultural or economic affinities such as distance d_{ij}, a common language dummy L_i and exchange rate volatility $vole_{ij}$ (or, alternatively, an EMU dummy). We include country fixed effects to account for the possibility prices be systematically higher, for instance in rich economies. We estimate

$$X_{ij} = \alpha_i + \alpha_j + d_{ij} + L_i + vole_{ij} + \varepsilon_{ij}$$

The results are presented in Table 8. They suggest very little geographical pattern of relative price volatility and of average price differences. Coefficients are significant on the exchange rate volatility, or an EMU dummy variable, but not on the geographic proximity variables. Both the first and second moments of price differentials are increasing in absolute value with exchange rate volatility, or, alternatively, a variable capturing membership to EMU. We stress again that the fact that the EMU dummy is significant does not imply that Monetary Union caused price convergence.

Altogether these results constitute strong evidence in favor of market segmentation (lack of arbitrage, different local costs) and/or differences in consumer valuation across countries. These in turn could be due either to unobserved differences in product quality (differential customer service, advertising across countries) or to preference heterogeneity (including different brand perception or habit formation). These effects are jointly captured by our brand market dummy. In what follows we investigate its quantitative importance in product valuation.

3.5 Brands 1999-2002

Our hedonic equation

$$p_{imt}^{euro} = \omega_{imt}\gamma + \theta_{st} + \theta_{mf} + \theta_{mt} + \varepsilon_{imt}$$

allows for market specific brand dummies. In Table 4, we report the outcome of an F-test on the null hypothesis that $\theta_{mf} = \theta_f$ for all m, f. The hypothesis is strongly rejected. By contrast, the regression coefficients on physical characteristics are not significantly different across countries. While brands may reflect unobserved quality differences, which are good-specific, the variable appears to affect prices in a manner that varies across markets, and therefore cannot be explained just by unobserved goods characteristics. They could also reflect international differences in brand perception.

Figure 7 illustrates the dispersion of the brand effects across the 15 markets in our sample[14]. The figure shows the range (from minimum to maximum) of brand effects across markets. Contrary to what one would expect if brands reflected only unobserved quality, the dispersion of the brand effects is large. In particular, some brands carry a positive premium in some markets but negative premia in others and the range of values are in some cases quite wide.

Of course, prices differ across markets, but these differences, captured by our country-time fixed effects (i.e. local costs like rents, or retail margins) should not affect the ranking of prices of individual TV sets. Figure 8 plots the distribution of Spearman rank correlations of prices for identical products in each of the fifteen markets. We ranked the TV sets from cheapest to most expensive in each of the fifteen markets in our sample. We then computed Spearman rank correlations between the rank of product i in market m and its rank in the other markets.

If TV sets were priced similarly across markets we would expect the rank correlation distributions to be narrow and with a high positive mean. Instead we find that the distributions of the rank correlations are very wide, include positive as well as negative values, and with modes that often are close to zero. In other words, even when comparing identical products, we observe a large amount of dispersion across markets[15]. Since we cannot reject commonality in the valuation of tube size, frequency, and screen size across countries, these international differences in valuations have to be related to more subjective characteristics of the television set, most prominently its brand.[16]

[14] We excluded brands which were not present in all markets.

[15] These results are consistent with Crucini, Telmer and Zachariadis (2005) who study a panel of goods prices for European cities. These authors show that there is little tendency for individual cities being systematically more expensive in the sense that there are roughly as many overpriced and underpriced goods when comparing any two EU countries.

[16] A caveat is in order. Our result could be explained by an omitted variable bias in the hedonic equation. If the unobserved physical characteristic is differently distributed across countries, it could

Brands are perceived differently across countries and this difference in valuation does influence both the premium that a brand carries in different countries and the relative ranking of TV sets across countries. This is an important finding since it indicates that the brand premium cannot simply be controlling for unobserved brand characteristics that we erroneously left out of the hedonic price regressions. If it were the case, then brand premia should not vary so much across borders. Instead, the results appear to indicate that firms invest in brand values and that these investments (or their effectiveness) vary across borders. Evidently, firms use such brand values in order to charge higher prices of their goods in markets where their goods are perceived as superior.

4 Regional Differences in TV Prices

For four of the countries in our sample we have information on regional prices for the post 1999 period. This dimension is available for Germany, Spain, Italy and Switzerland.[17] The regional dimension makes it possible to investigate whether absolute price differences are smaller within regions of countries than across national borders. We stress again that this hypothesis can only be investigated because our data is denominated in absolute prices rather than indexed.

Engel and Rogers (1996) examine price differences across city pairs located in Canada and in the United States using CPIs for 14 categories of consumer goods. They find that distance between markets matters for cross-market price variation, but most importantly that the price variation between cities located in two different countries is much higher than the price variation between equidistant cities located in the same country. Since Engel and Rogers examine CPIs their data do not allow them directly to investigate the extent to which absolute price differ across markets. Our data allow us to shed some new light on these issues and in particular whether absolute price differences can be linked to exchange rate volatility and distance.

Furthermore, as we have discussed above, the goods characteristics matter very significantly for the evidence on the LOP. Engel and Rogers (1996) use CPI data from the BLS and Statistics Canada. While they attempt to control for differences in the goods definitions as rigorously as possible, their data -and most alternatives in this literature-

account for part of the residual variation in the brand effect. There is little we can do against this here, given the data limitations. Our conversations with GfK do however strongly suggest the characteristics we observe are the key determinants of TV prices.

[17]The regions in these countries are: Germany: North - NorthWest - Middle - South; Spain: North - NorthEast - Middle - South; Italy: North - NorthWest - Middle - South and Switzerland: French - German parts.

just do not lend themselves to this type of thorough and accurate correction. See Gorodnichenko and Tesar (2009) and Gopinath et al (2009) for a discussion of the identification of the border effect.[18]

In Figure 9, we plot both intra-regional and international price dispersion. International price dispersion is, as before, measured as $\sigma_t^2 = E_t\left(\widetilde{\theta}_{it} - \mu\left(\widetilde{\theta}_{it}\right)\right)^2$. To compute regional price dispersion, we calculate the cross-sectional variance of prices of the regions in each country and then average this variance across the four countries with regional data. Figure 9 corroborates the view that regions within a country are more integrated than countries within Europe. This suggests that at the national level, strong forces of integration are at work, whether they be common currency, common preferences, ease of trade, integrated labour markets or common distribution networks. Such forces do not seem to exist or to be as strong at the international level.

In Figure 10, we plot the evolution of price dispersion for the three countries of our sample belonging to EMU and for which we have regional data (Italy, Spain and Germany). We compare price dispersion within these three countries and between those same countries. Figure 10 shows quite clearly that there is a tendency for regional price differentials to be smaller than cross-country price differentials even if the differences are much smaller than those shown in Figure 5 for all countries in the sample. A formal test for equality of the cross-sectional variances shows that regional price dispersion and intra-EMU price dispersion are not significantly different. One interpretation on these results is that the historic process of convergence among EMU countries, which has culminated in the Common Market initiative of 1992 and the introduction of the Euro in 1999 has borne fruit, at least for the TV market. The absolute deviations of quality-adjusted prices are no bigger across EMU-nations than among Spanish regions say. These results have to be taken with grain of salt though, as we could not control for quality as precisely for regional prices than what we do for country-wide prices. This implies that we may be overestimating the true dispersion of regional prices.

It remains nevertheless clear that intra-EMU price dispersion for TV prices, adjusted for quality, is relatively small. But whether EMU should be credited for this or whether the explanation for this fact should rest on arbitrage arguments, greater similitude in distribution and pricing strategies, or more homogeneous preferences within EMU countries remains to be determined. In fact it is quite striking that the birth of the euro in 1999 does not seem to have led to a significant trend decrease in price dispersion in our data. In the next section we study in more details the role of the exchange rate in international price differences.

[18]The product characteristics that we can control for when studying the regional data do not include the tube size and the picture renewal rate. Therefore, the hedonic price regressions using these data are not as good as those we estimate for the data at country levels.

5 Exchange Rate Pass-Through

We next ask to what extent observed price differences may be due to pricing to market and incomplete exchange rate pass-through. The degree of exchange-rate pass-through is also interesting in its own right since it is informative about the impact of monetary policy on cross-market price differentials.

We run the following regression, similar to Goldberg and Verboven (2001):

$$p_{imt}^{source} = \omega_{imt}\ \gamma + \theta_{st} + \theta_{mf} + \alpha S_{smt} + \varepsilon_{imt} \tag{3}$$

where, unlike equation (1), the left-hand side is expressed in the currency of the source country. On the right hand side, the destination market time effects are dropped and replaced with the log of the exchange rate of each source country vis-a-vis the destination market, S_{smt}. This regression allows us to investigate how much of the time variation in TV prices can be attributed to changes in the exchange rate, once we control for observable characteristics, source market effects and brands. If there is pricing to market (or local currency pricing) then changes in the exchange rate should be reflected one for one in the TV price, expressed in the exporter's (source) currency. In this case, there is zero pass-through and $\alpha = 1$. All the currency risk is borne by the exporter. At the other extreme, if there is complete pass-through and prices are fixed in the currency of the exporter (producer currency pricing), $\alpha = 0$ and prices in the export market fully respond to exchange rate changes.

In Table 9, we impose α to be the same across all bilateral exchange rates and estimate an average pricing to market coefficient of 0.178 (with a standard error of 0.004). In other words, more than 80 percent of a given change in exchange rate are passed directly onto consumer prices within a 6 months horizon. This implies a high degree of exchange rate pass-through for television sets, higher than the classic estimates of Kreinin (1977) but consistent with the rather higher pass-through estimates produced by Feenstra (1989) and reproduced in a number of subsequent contributions to the literature.

At face value, our results indicate that changes in exchange rates do not provide a major source of cross-market price differentials as exporters tend to pass these exchange rate changes onto importer prices. However, this finding comes with a number of caveats. First, in our sample, many observations concern fixed exchange rates, for instance when both the source and destination countries are within the euro area. The main time varying exchange rates are yen/euro, sterling/euro or won/euro. It is of course entirely possible that for Japanese firms for instance, the relevant exchange rate for pricing decisions is not merely the yen euro/exchange rate but it includes third currencies, because of the geographical dispersion of production. Such would be the case if some sizable portion of marginal costs were incurred in third currencies.

Second, there is reason to expect that the extent of pass-through varies across markets and source countries. Indeed it is well-known that larger markets (or markets whose currency is more internationalized) tend to benefit from a higher degree of pricing to market. In turn, the source country can matter since different brands do not internationalize production to the same extent when they serve the European market, depending for example on their geographical location. Furthermore, firms having a larger market share in a given country may be able to adjust their prices when exchange rate fluctuates without losing their customers. Less established firms may have to absorb exchange rate movements to a larger extent in order to stabilize their market share. Therefore, we also allowed pass-through coefficient to vary across source countries. But the two source countries commanding the highest market shares (41 percent in Japan and 21 percent in South Korea) actually implied similar pass-through estimates. These estimates provide some evidence that pass-through is sizable in the TV market. One possible interpretation, is that there is producer pricing in the exporter's currency.

Third, it is possible that the pass-through coefficients may not be appropriately estimated if pass-through occurs gradually over time. The specification in equation (2) assumes a static relationship and α measures the extent of long-run pass-through. Many theories instead imply that firms pass marginal cost changes onto prices gradually over time in the face of, for example, nominal rigidities. In this case, while long-run pass-through may be substantial, it is entirely possible that it takes a considerable amount of time before prices adjust to marginal cost changes and the static relationship that we estimate is silent about this issue. Even though our dataset is rather short in the time-dimension, it seems pertinent to allow for such partial adjustment.

We now subject our results to a battery of robustness checks meant to address these - and other - concerns. We first consider an alternative specification in which we estimate the following equation

$$p_{imt}^{source} = \omega_{imt}\ \gamma + \theta_{ft} + \alpha S_{smt} + \varepsilon_{imt} \tag{3a}$$

We replaced the source country-time effect with a firm-time fixed effect. This allows us to control for a situation in which different firms headquartered in the same country have very different costs of productions. That would happen, for example because their supply chains are located in different economic areas. We have also dropped the market/firm fixed effect. When this fixed effect and the firm-time fixed effect are both allowed for at the same time as the nominal exchange rate, multicollinearity implies non-invertibility of the covariance matrix of the regressors.

The results are reported in the second column of Table 9. We find this specification gives rise to even higher pass-through, which according to these estimates is almost perfect. We are, however, somewhat skeptical about these results as they seem quite extreme. As

an additional robustness check, we therefore include the a country-time fixed effect in this alternative regression. This country time-effect can be thought of as controlling for the aggregate price level of the country where the TV is sold, P_{mt} as it would appear in theoretical models of monopolistic competition. Thus, we estimate the model:

$$p_{imt}^{source} = \omega_{imt}\ \gamma + \theta_{ft} + \theta_{mt} + \alpha S_{smt} + \varepsilon_{imt} \tag{3b}$$

The results are reported in the third column of Table 9. Introducing the fixed effect changes the pass-through coefficient α to 0.45 thus indicating a much more partial pass-through. Nonetheless, although the degree of pass-through is smaller than in the first two experiments, it is still substantial.

Following Gottfries (2002), we now investigate whether there is evidence of higher pass-through in the short run than in the long run, as would be the case if prices were preset in the currency of the exporter. In order to look at pass-through dynamics, we estimate several specifications of the following equation

$$p_{imt}^{source} = \omega_{imt}\ \gamma + \theta_{st} + \theta_{ft} + \alpha S_{smt-1} + \delta\left(S_{smt} - S_{smt-1}\right) + \varepsilon_{imt} \tag{3c}$$

The estimated pass-through coefficients from this specification can be interpreted as follows: δ is a measure of the degree of short-run exchange rate pass-through within a 6 months period; α is a measure of the degree of long-run pass-through. The results from this exercise are reported in the final column of Table 9. They are interesting. We find that pass-through is high in the long run and close to the estimate of the first experiment (above 80 percent). In the short-run, however, pass-through is much less complete. According to our estimates, only 10 percent of the marginal cost change due to a change in the nominal exchange rate are passed onto prices within a 6 months period. This dynamic specification brings our results much closer to the consensus view, and confirm separating out short from long run influences of the nominal exchange rate is of the essence when estimating pass through coefficients.

The existence of imperfect pass through in the short run is consistent with the argument that market power and price discrimination prevail in the data, as documented early on by Goldberg and Knetter (1997). It is also consistent with the brand effects we document, suggesting the same good can be sold at different prices across countries. The findings in Gopinath and Itshoki (2009), that pass through and variable markups are tightly intertwined, are also a confirmation that market power does prevail in the data. The magnitude of pass through we document is also in the same ballpark as the evidence in Gopinath and Rigobon (2008) obtained on disaggregated US import prices. They find pass through is on average equal to 22%, which is not drastically different from our short run estimates.

6 Conclusion

We use a unique dataset on the raw prices and characteristics of TV sets across European countries and regions to inform a broad range of empirical questions. We show a large fraction of international price gaps corresponds to quality differences. Adjusting for quality, expensive countries are not the usual suspects: while Switzerland and the UK sell expensive TV sets for their quality, so do the Czech Republic, Poland and Hungary. Controlling for quality matters for price differences, but prices do not become the same when one compares the price of the same good across countries. Sizeable differences persist, and they are positively linked to exchange rate volatility, but not with conventional geographic measures of transport costs. We also find that relative rankings of the exact same television sets differ greatly across countries, suggesting a significant role for subjective valuations. Thanks to the dimensionality of our data, we can estimate country-specific firm effects, labeled "brands", which we find explain a sizeable portion of international price differences.

We find absolute price differences within EMU and between regions that are comparable in magnitude. They are significantly smaller than differences outside of the Monetary Union. We cannot draw the conclusion however that Monetary Union boosted price integration as our sample starts in 1999 and shows no sign of a marked downward trend in price dispersion. We also find substantial evidence of a border effect in international TV prices, even though we focus on disaggregated price levels. The border effect exists both for the volatility of relative prices, and their levels.

Finally, we find evidence of non linear exchange rate pass through dynamics. Pass through is imperfect in the short run, but close to complete in the long run. This confirms price discrimination may be at play in the data, at least in the short run. And it is consistent with the importance we document for firm effects across countries. The same good often has different prices across countries, in a way that it is tempting to relate with heterogeneous preferences or unobserved brand perception.

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Table 1: Data Coverage

Country	Time Series	Regional Data	$\hat{NT}$ [NT]
Germany	1993-2002	N,NW,M,S	310 [399]
France	1999-2002		124 [147]
Spain	1995-2002	S,N,NE,M	151 [315]
Italy	1999-2002	NW,NE,M,S	146 [147]
Switzerland*	1993-2002	F,G	211 [399]
Austria	1999-2002		125 [147]
Belgium	1999-2002		119 [147]
UK	1999-2002		128 [147]
Netherlands	1999-2002		128 [147]
Portugal	1999-2002		121 [147]
Greece	1999-2002		83 [147]
Sweden	1999-2002		122 [147]
Hungary	1999-2002		108 [147]
Czech Rep.	1999-2002		109 [147]
Poland	1999-2002		118 [147]

Notes: * implies data is available every 4 months. N=north, NW=North West, M=Middle/Center, S=South, F=French Part, G=German Part. $\hat{NT}$ are total available observations, while the numbers in parenthesis report potential maximum observations.

Table 2: Brands and their Origin

Brand	Country of origin (source country)	Purchased by
Aristona	Netherlands	
Brandt	Germany	Thomson (France)
B&O	Denmark	
Ferguson	UK	
Grundig	Germany	
Loewe	Germany	
Mivar	Italy	
Philips	Netherlands	
Radiola	France	Philips (Netherl.)
Saba	Germany	Thomson (France)
Schneider	France	Philips (Netherl.)
Telefunken	Germany	Thomson (France)
Thomson	France	
Hitachi	Japan	
JVC	Japan	
Orion	Japan	
Panasonic	US	
Sanyo	Japan	
Sharp	Japan	
Sony	Japan	
Toshiba	Japan	
Daewoo	South Korea	
LG	South Korea	
Samsung	South Korea	

Notes: The information on country of origin and ownership have been obtained from various issues of the business newspaper "Les Echos" between 1993 and 2003 and from websites of the TV manufacturers.

Table 3: Average Prices	
Country	Average Raw Price
Switzerland	1136.80
Netherlands	986.10
United Kingdom	938.75
Belgium	863.11
Greece	858.24
Portugal	830.37
Austria	775.48
Germany	766.16
Sweden	762.77
Spain	753.86
Italy	720.12
France	712.79
Poland	678.28
Hungary	643.07
Czech. Rep.	609.37
Average	802.35

Notes: The average TV set price is computed from weights derived from sales.

Table 4: Hedonic Regression	
Variable	Coefficient
Constant	7.480 (0.009)
28 inches	−0.528 (0.003)
29 inches	−0.315 (0.005)
Tube	−0.257 (0.003)
Hertz	−0.384 (0.003)
Source(time) Dummies[a]	41.279 (0.000)
Brand (Country) Dummies[a]	21.820 (0.000)
Country (time) Dummies[a]	6.386 (0.000)
F-test*	4.224 (0.000)
$\overline{R}^2$	0.784
NT	27760

* *The F-test is for the equality of brand dummies across countries*
[a] *F-Tests*

Table 5: Corrected Long Run Coefficients	
Country	Average Price
Czech. Rep.	0.989
Greece	0.941
Switzerland	0.956
Hungary	0.969
Poland	0.962
Belgium	0.894
France	0.877
Portugal	0.901
Spain	0.887
Sweden	0.871
Italy	0.867
Netherlands	0.842
Austria	0.838
Germany	0.809
Average	0.900

Notes:Ranking using hedonic prices. The table lists the raw average price $p = \ln(\frac{p^*}{p^{uk}})$ relative to the UK.

Table 6: Bilateral Price Dispersion as Measured by Relative Price Variance

	DE	FR	IT	CH	PL	CZ	HU	SE	GR	PT	NL	UK	BE	AT
DE														
FR	0.038													
IT	0.033	0.051												
CH	0.072	0.089	0.076											
PL	0.062	0.043	0.051	0.032										
CZ	0.054	0.066	0.031	0.042	0.009									
HU	0.039	0.053	0.032	0.019	0.012	0.011								
SE	0.044	0.062	0.031	0.049	0.030	0.027	0.021							
GR	0.024	0.057	0.028	0.051	0.061	0.032	0.026	0.040						
PT	0.035	0.015	0.031	0.045	0.038	0.030	0.025	0.029	0.050					
NL	0.026	0.033	0.027	0.090	0.055	0.042	0.037	0.037	0.036	0.025				
UK	0.097	0.100	0.087	0.039	0.030	0.028	0.024	0.053	0.079	0.059	0.098			
BE	0.036	0.039	0.034	0.044	0.031	0.014	0.028	0.022	0.032	0.022	0.024	0.063		
AT	0.010	0.022	0.027	0.057	0.040	0.034	0.026	0.032	0.017	0.031	0.014	0.060	0.020	
ES	0.039	0.019	0.042	0.064	0.037	0.062	0.038	0.054	0.035	0.016	0.032	0.080	0.039	0.024

Table 7: Price Dispersion as Measured by Price Level Differences

	DE	FR	IT	CH	PL	CZ	HU	SE	GR	PT	NL	UK	BE	AT
DE														
FR	-50.3													
IT	-29.6	0.9												
CH	-225.4	-132.1	-161.4											
PL	-163.6	-98.7	-138.4	-16.0										
CZ	-102.4	-69.4	-79.5	1.77	2.7									
HU	-113.1	-59.7	-77.0	-15.4	47.4	21.4								
SE	-92.3	-54.8	-52.9	68.8	80.5	44.8	46.9							
GR	-64.7	-5.0	-22.4	173.8	167.5	116.3	119.6	-3.6						
PT	-84.4	-32.8	-22.7	138.4	118.3	55.9	72.7	23.5	-2.5					
NL	-16.5	18.3	30.1	258.5	151.4	97.3	95.5	81.3	96.5	83.1				
UK	-205.2	-224.2	-178.7	-54.6	-10.2	-41.8	-29.9	-122.2	-156.7	-201.3	-257.9			
BE	-103.9	-2.1	-46.6	140.0	88.0	29.3	54.7	12.4	-4.5	-8.2	-78.8	153.8		
AT	-35.2	8.5	-5.5	204.3	137.3	85.8	94.6	51.3	20.2	31.0	-36.4	173.4	64.9	
ES	-76.2	-32.9	-39.9	124.3	104.9	89.9	65.3	21.9	-28.5	-25.9	-90.8	152.7	-0.3	-34.8

Table 8: Brand Value Regressions

	$volij$	$volij$	$\|\Delta_{ij}\|$	$\|\Delta_{ij}\|$
	(1)	(2)	(1)	(2)
Distance	-0.004	-0.003	-0.32	-0.25
	(0.004)	(0.003)	(0.21)	(0.17)
Volatility	6.235**		334.43**	
	(1.60)		(63.43)	
EMU		-0.055**		-3.44**
		(0.009)		(0.52)
language	-0.006	-0.009	0.398	0.24
	(0.008)	(0.006)	(0.58)	(0.43)
R-squared	0.83	0.86	0.62	0.74
N	55	55	55	55

Notes: The table below gives the results of regressions of bilateral volatility of relative prices and of the log of absolute average price differences on log(distance), exchange rate volatility (standard deviation of the first difference of bilateral exchange rates), language and EMU dummies. * and ** denote significance at the 5%, and 1% levels respectively. Robust standard errors are shown within brackets. Fixed effects are not reported.

Table 9: Hedonic Regression. Pass-through				
	Specification			
Variable	Baseline (3)	Equation (3a)	Equation (3b)	Equation (3c)
Constant	10.07 (0.024)	10.50 (0.022)	9.06 (0.023)	10.02 (0.025)
Exchange rate	0.178 (0.004)	0.005 (0.001)	0.456 (0.005)	-
Lagged Exchange Rate	-	-	–	0.186 (0.004)
Change in Exchange Rate	-	-	–	0.965 (0.117)
28 inches	−0.532 (0.005)	−0.533 (0.005)	−0.532 (0.004)	−0.531 (0.006)
29 inches	−0.295 (0.007)	−0.309 (0.007)	−0.313 (0.006)	−0.286 (0.007)
Tube	−0.268 (0.005)	−0.264 (0.005)	−0.266 (0.004)	−0.272 (0.006)
Hertz	−0.371 (0.004)	−0.354 (0.004)	−0.363 (0.004)	−0.375 (0.005)
Source(time) Dummies	271.62 (0.000)	–	–	277.80 (0.000)
Brand (Country) Dummies	42.77 (0.000)	–	–	39.32 (0.000)
Brand(time) Dummies	-	811.79 (0.000)	77.26 (0.000)	–
Market(time) Dummies	-	-	39.25 (0.000)	-
$\bar{R}^2$	0.97	0.98	0.99	0.98
NT	25,576	25,576	25,576	22,620

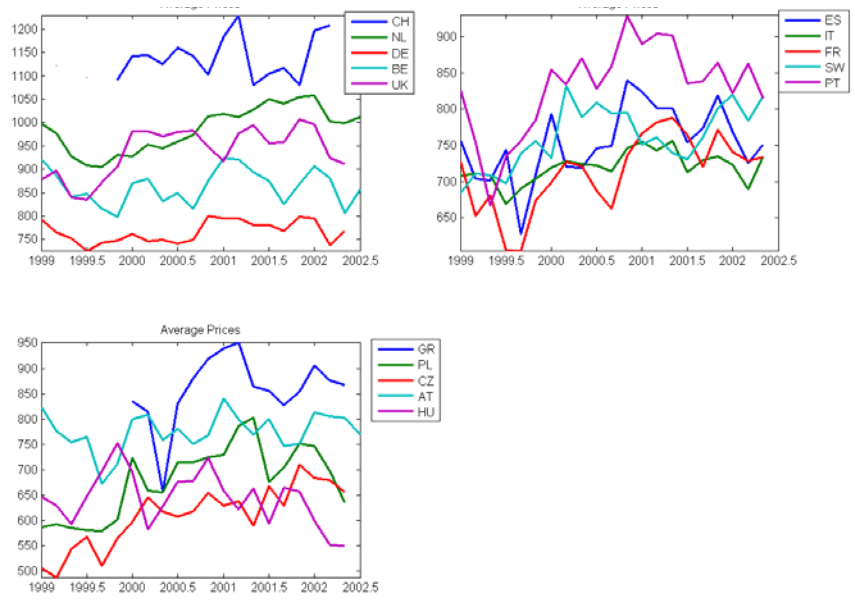

Figure 1: Average Raw TV Prices

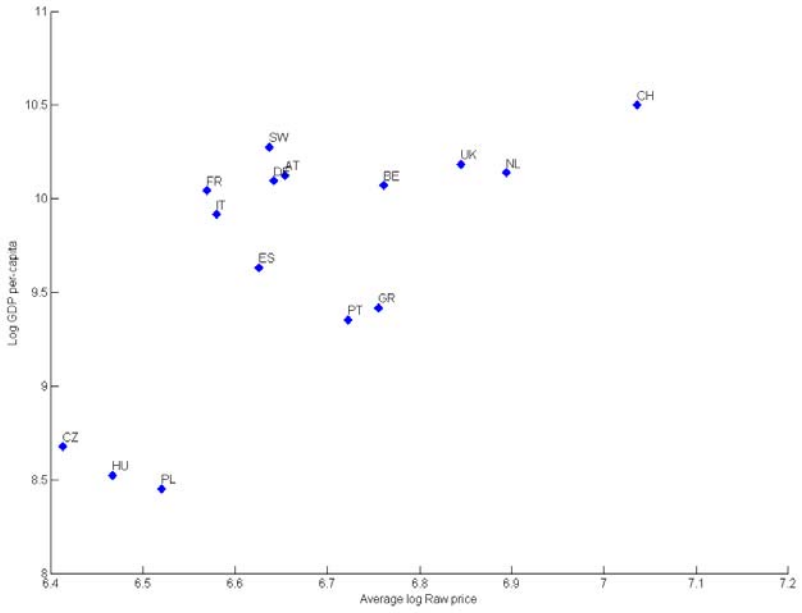

Figure 2: Average Raw Prices vs. Income

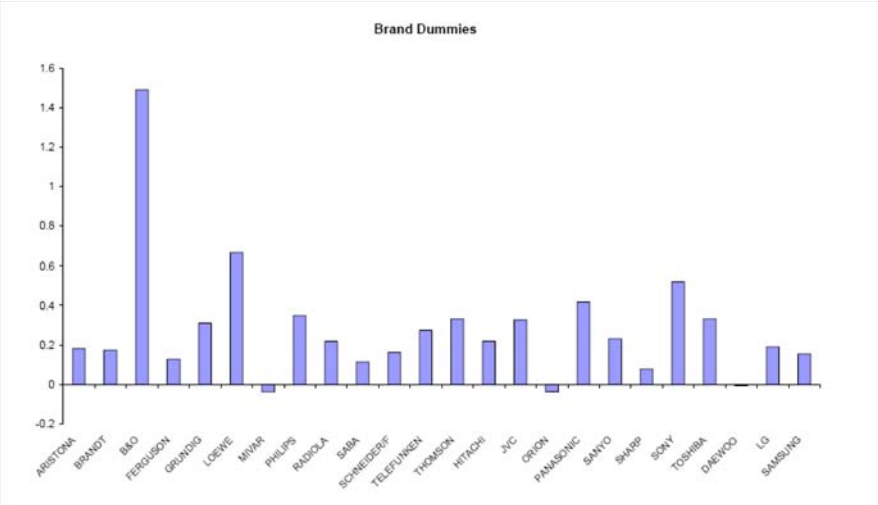

Figure 3: Estimated Brand Effects

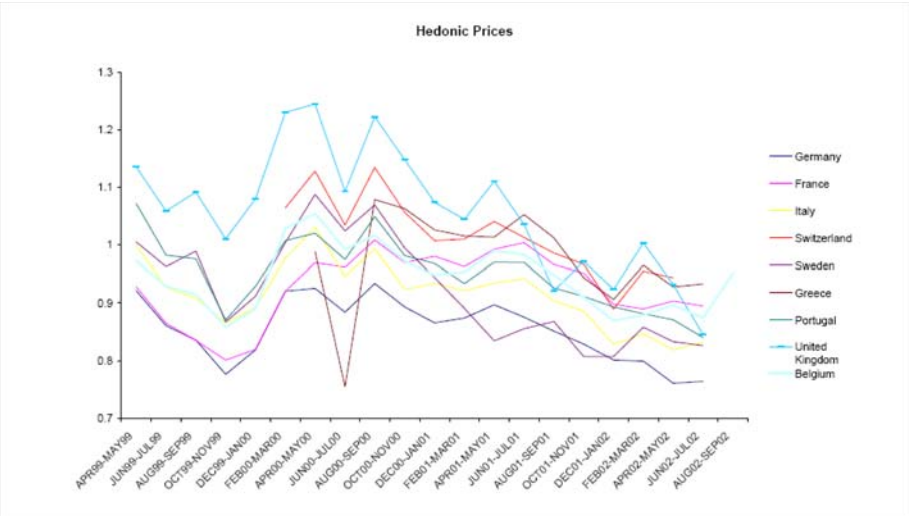

Figure 4: Evolution of Estimated Hedonic Prices

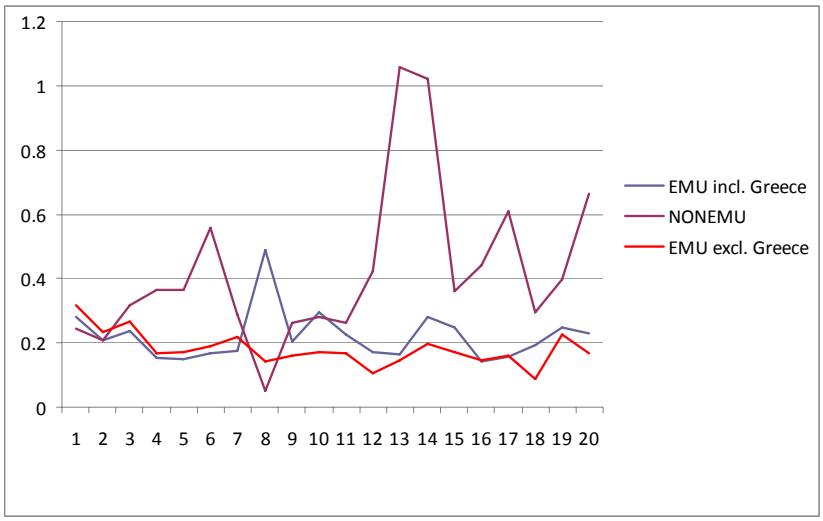

Figure 5: Cross-Sectional Variance of Hedonic Prices

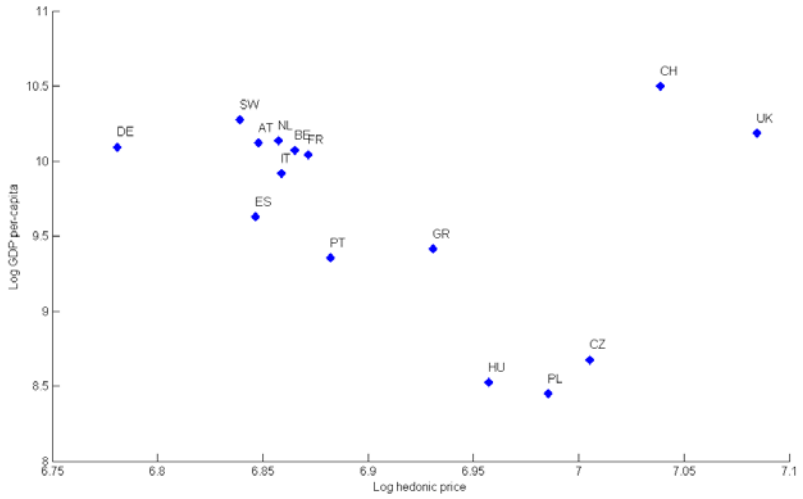

Figure 6: Average Hedonic Prices vs. Income

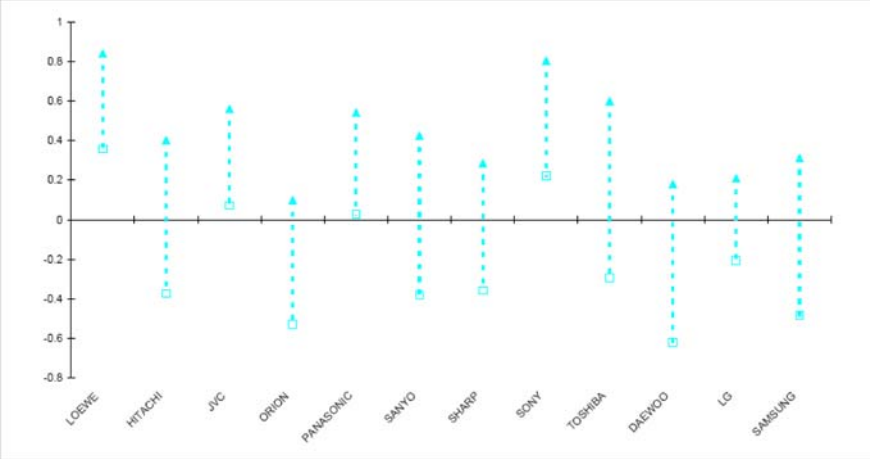

Figure 7: Estimated Ranges of Brand Effects Across Countries

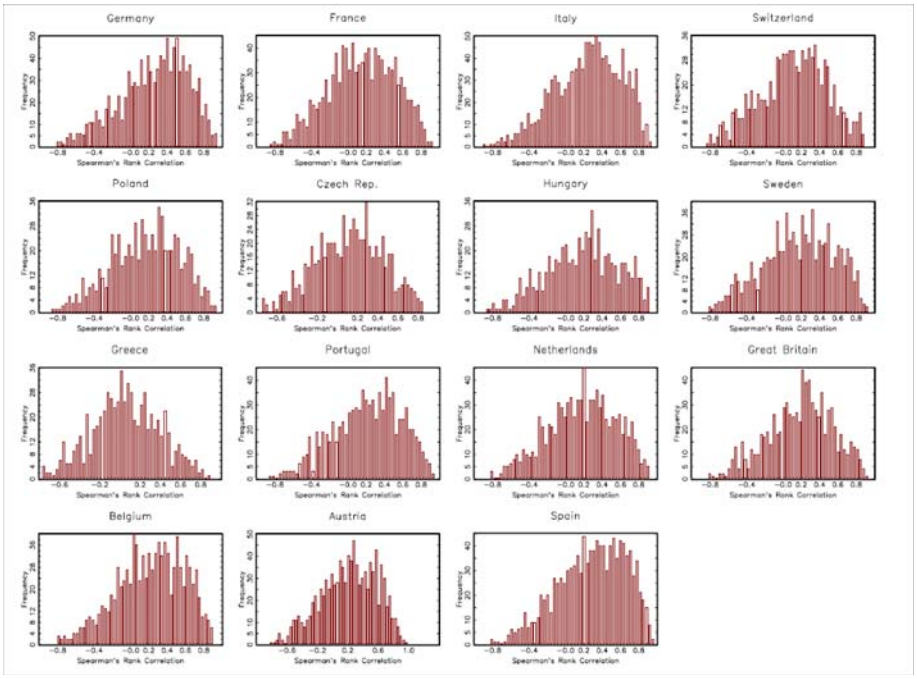

Figure 8: Distribution of Spearman Rank Correlations for Identical Producs

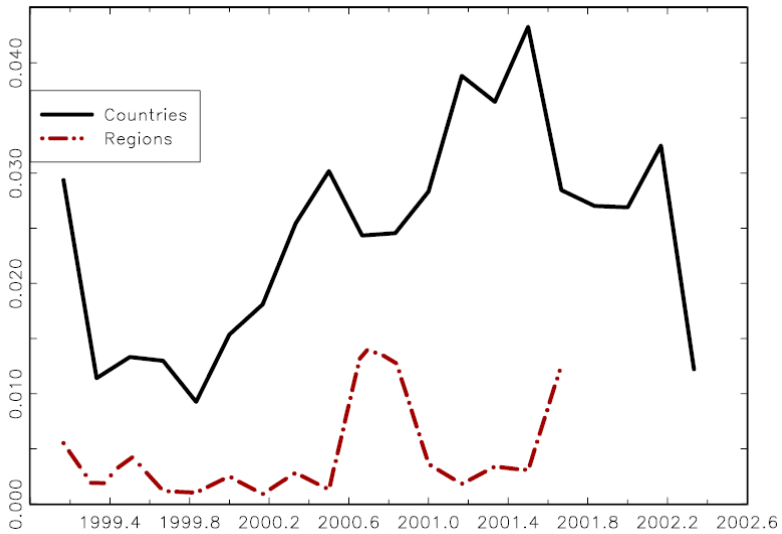

Figure 9: Cross-Sectional Hedonic Price Variation Within and Across Countries

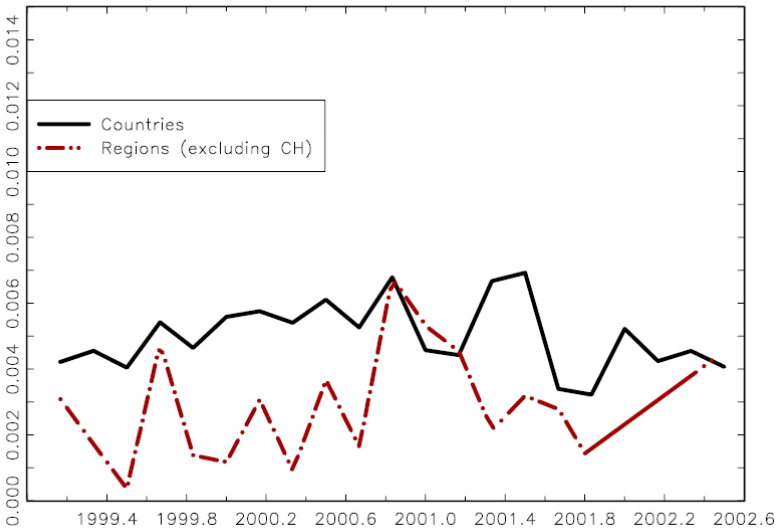

Figure 10: Cross-Sectional Hedonic Price Variance Within and Across Italy, Germany and Spain