Understanding post-Euro Law-of-One-Price Deviations*

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Abstract

We put together a unique panel of thousands of good-level prices before and after the euro in order to compare the determinants and understand the evolution of goods price dispersion across Europe over time. We find that tradeability and non-traded inputs play a significantly smaller role for cross-country price dispersion after the adoption of the euro, and for Eurozone (EZ) economies as compared to European Union (EU) ones. We then compare the distributions of law-of-one-price (LOP) deviations over time to understand how the degree of integration across European economies changed after the euro. Our tests reveal that the distributions after the euro are typically significantly different than those before, consistent with a greater degree of integration. Utilizing our unique panel dataset to trace the location of individual goods in the distribution of LOP deviations, we ask how the price advantage or disadvantage evident in these price distributions evolves over time, and whether goods characteristics play a role for the persistence of these LOP deviations. LOP deviations for these goods are highly correlated, on average, over five or ten year horizons, but much less so over twenty-year or longer horizons. These correlations are greater for homogeneous as compared to differentiated goods, and vary across countries. Finally, for most of these European economies and goods, price advantage is typically revealed to be more persistent than price disadvantage.

Keywords: micro prices, law-of-one-price, euro, integration, price advantage.

JEL Classification: F3, F4

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1 Introduction

What is the importance of different determinants of price differences within Europe after the process of European monetary unification? Are the distributions of LOP deviations similar before and after this process? How does the position of an individual good in the distribution of LOP deviations relate to its position in previous cross-sectional distributions? These are important questions as answering them can help us understand the determinants and degree of integration in the EU, as well as the pattern and evolution of price advantage within this group of countries.

In what follows, we attempt to offer some answers to the above questions. To this effect, we use a panel of good-level prices for the period 2005-2010 and a panel for 1985-1990, in order to understand and compare the determinants and the cross-sectional (over goods) distributions of LOP deviations in Europe before and after the completion of the process of European monetary unification that begun in the 1990's. In addition, we construct a panel that adds data from 1975 and 1980 to examine the persistence of LOP deviations over the period 1975-2010.

We find that trade costs and non-traded input costs play a smaller role for price dispersion after the adoption of the euro, and for EZ economies as compared to the broader group of EU economies. We proceed to compare the overall and country-level distributions of LOP deviations before and after the completion of the process of European monetary unification which in the case of the four new EZ members[1] involves a comparison of the distributions for 2005 versus 2010. Our tests reveal that the distributions of LOP deviations before and after the euro are significantly different. This is the case for the distributions that pool all countries together and is also typically the case for the individual EZ member countries distributions. As is evident, the density functions are characterized by a higher degree of integration with higher kurtosis and lower cross-country dispersion after euro adoption. In the case of the four new EU members that adopted the euro between 2005 and 2010, we can see that the density functions become more highly peaked at zero in 2010 as compared to 2005 with kurtosis values becoming greater in 2010, which is typically not the case for new EU members that did not adopt the euro during this period.

Importantly, the highly labour-intensive task of matching individual goods over time allows us to then use this unique panel dataset to trace the location of individual goods in the LOP distribution so as to understand how price advantage or disadvantage evolves or persists over time. It also allows us to examine whether goods characteristics play a role for the persistence of these LOP deviations. LOP deviations for these goods are highly correlated, on average, over five and ten year horizons, but much less so over twenty-year or longer horizons. These correlations are greater for

[1] Cyprus, Malta, the Slovak Republic and Slovenia.

homogeneous as compared to differentiated goods and also vary across countries. Furthermore, for most of these European countries and goods, price advantage appears to be more persistent than price disadvantage. In particular, countries like Germany, Luxembourg, the Netherlands, and the UK appear to have a persistent price advantage for tradeable goods consistent with a persistent productivity advantage.

Crucini, Telmer, and Zachariadis (2005) (CTZ) use four cross-sections of micro-level prices for 1975, 1980, 1985, and 1990 for as many as 13 EU countries and find that good-by-good measures of cross-sectional price dispersion are negatively related to the tradeability of the good, and positively related to the share of non-traded inputs required to produce the good. They go on to consider the distributions of LOP deviations for each of these cross-sections and document a tendency of the mean to center around zero. Our paper builds on this previous paper, extending it in several dimensions. First, we consider price level data after the European monetary unification for 2005 and for 2010. This allows us to assess the post-euro relevance of the basic retail price determination model proposed in CTZ and in Anderson and van Wincoop (2004), where retail goods are produced by combining a traded input with a non-traded input.[2] Similar models emphasizing the importance of traded and non-traded inputs have also been estimated by Parsley and Wei (2007), Faber and Stockman (2009) and Lee (2010). Second, we go beyond the cross-sectional approach of the earlier paper by matching the goods prices across all cross-sections in order to create a unique panel data set. The latter allows us to examine how the position of individual goods in the distribution of LOP deviations varies over time. That is, whether specific goods are systematically cheaper or more expensive in certain locations. This reveals how persistent the price advantage or price disadvantage of individual countries is over time.

Our paper also relates to the large body of papers focusing on the effects of the process of European unification. This literature has produced mixed results regarding the effect of this process on price dispersion. Some of these papers focus on specific markets e.g. autos (Goldberg and Verboven 2005), TV set prices (Imbs et al., 2010) or washing machine prices (Fischer, 2012) while others consider product-level prices for a broad range of tradeable goods. Part of our contribution is to investigate the impact of the process of European monetary unification on LOP deviations for a large number of individual consumer goods and services by comparing the distributions of LOP deviations before and after this process, and examining what determines these.

Allington et al. (2005) find that the euro led to greater integration evidenced by price convergence

[2] Our analysis is also relevant for the model of Lee and Shin (2010) that preserves the desirable empirical implications of the partial equilibrium retail model employed by CTZ in a general equilibrium setting, emphasizing the role of nontraded goods. The importance of non-traded inputs for the implications of general equilibrium open macroeconomy models was first illustrated in the seminal work of Stockman and Tesar (1995.)

for tradeables among EMU members between 1995 and 2002. Goldberg and Verboven (2005) provide evidence for price convergence in the European automobiles market attributable to the progress in European integration in this market over a period of three decades. Imbs et al. (2010) show that EMU countries display lower price dispersion but not necessarily because of the single currency. Similarly, Rogers (2007) finds that price dispersion for tradeables prices falls sharply across European cities from 1990 to 2004, but is unrelated to the launch of the euro. Our results are consistent with the latter papers since although we show that integration increases after the euro, we cannot attribute the increase in integration directly to the launch of the euro but rather to the overall process of monetary unification that begun in the 1990s. The findings of Fischer (2012) for highly comparable washing machine prices across 17 European countries during 1995-2005 are a bit stronger. More specifically, he does not find price convergence for EMU countries or that EMU membership is relevant for any small convergence clusters found in the data. On the other hand, the findings by Dreger et al. (2007) who use comparative price levels for the EU-25 during 1999-2004, are on the more positive side regarding the impact of the euro. They find price convergence that is more pronounced for the EU-10 and for homogeneous products and positively related to tradeability. Finally, Guerreiro and Mignon (2013) use comparative price levels for twelve EZ members at the monthly frequency between January 1970 and July 2011, and find high convergence speeds relative to Germany for core EZ countries (Austria, Belgium, France and the Netherlands) but also for Greece and Portugal albeit mainly due to their loss of price competitiveness over time. Our results for these peripheral countries provide lower-frequency and cross-sectional evidence in relation to the latter.

In the next section, we describe our elaborate data construction exercise. In section three, we present the results of our estimation exercise and compare the density functions of LOP deviations before and after the euro, before considering the persistence of price advantage over time and across countries. The final section briefly concludes.

2 Data

We now describe the data we have put together from a number of sources. This task involved matching individual goods over the different cross-sectional surveys, and the creation of a concordance allocating individual goods for which prices are available into industries for which the explanatory variables were available.

We define LOP deviations as

$$q_{ijt} = \frac{p_{ijt}}{\sum_{j'=1}^{N_{it}} p_{ij't}/N_{it}} - 1 \quad (1)$$

where p_{ij} is the common currency[3] price of good i in country j at time t, and N_{it} is the number of EZ countries where good i is available at time t. We regard LOP comparisons relative to the EZ-11 mean price to be more meaningful for the purposes of this paper. The EZ-11 are the eleven EZ economies as of January 1st 2001 that are also present in our 1985-1990 EU sample, which excludes Finland.[4] Tables and figures presented in our paper are based on LOP deviations relative to the EZ-11, unless otherwise noted.

The retail price data utilized here originate from Eurostat surveys conducted across European cities sampled in 1975, 1980, 1985, 1990, 2005 and 2010. The level of detail goes down to the level of the same brand sampled across locations, enabling highly accurate comparisons across space at a given point in time. The specificity of the goods is described in detail in CTZ. The price data for each cross-section is collected in a sequence of surveys where the same group of goods is collected within the same sub-period for all countries. Table 1 reports detailed information about data availability for the different cross-sections and for the panel we put together. Both CTZ and Inanc and Zachariadis (2012)[5] utilize the first four cross-sections of the Eurostat price data for 1975, 1980, 1985, and 1990. The Eurostat survey covers 9 countries for 658 goods in 1975, 12 countries for 1090 goods in 1980, 13 countries for 1805 goods in 1985, 13 countries for 1896 goods in 1990, 31 countries for 2505 goods in 2005, and 37 countries for 2414 goods in 2010. The nine EU countries in 1975 are Belgium, Denmark, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, and the UK. Greece, Portugal and Spain are added in 1980, and Austria in 1985. A number of additional EU and other European countries are added in 2005 and 2010.

The main novelty of our price levels dataset and the most demanding task in this regard, has been the construction of a panel dataset of individual goods across countries over time from the individual cross-sections available in 1975, 1980, 1985, 1990, 2005 and 2010. This was achieved by using a subset of more highly comparable goods that can be matched over time. In practice, some goods change over time and become non-comparable, especially over longer horizons. Moreover, the fact that there is a much lower number of goods available for 1975 and, to a lesser extent, for 1980, also reduces the number of goods that can be matched over longer periods of time. As a

[3] This is the euro for the 2005-2010 sample, and the Belgian Franc (as in CTZ) for the 1975-1990 sample.

[4] This also excludes the non-Eurozone EU members UK and Denmark. Including these in the calculation of the mean price does not change any of our qualitative results, even though Denmark is an outlier in terms of high prices.

[5] That paper focuses on identifying the probable source of products and shows that trade costs are important in determining international price differences and segmenting international markets, with physical distance relative to the origin having a precisely estimated positive impact on international deviations from the LOP and larger than estimates that do not account for product origin.

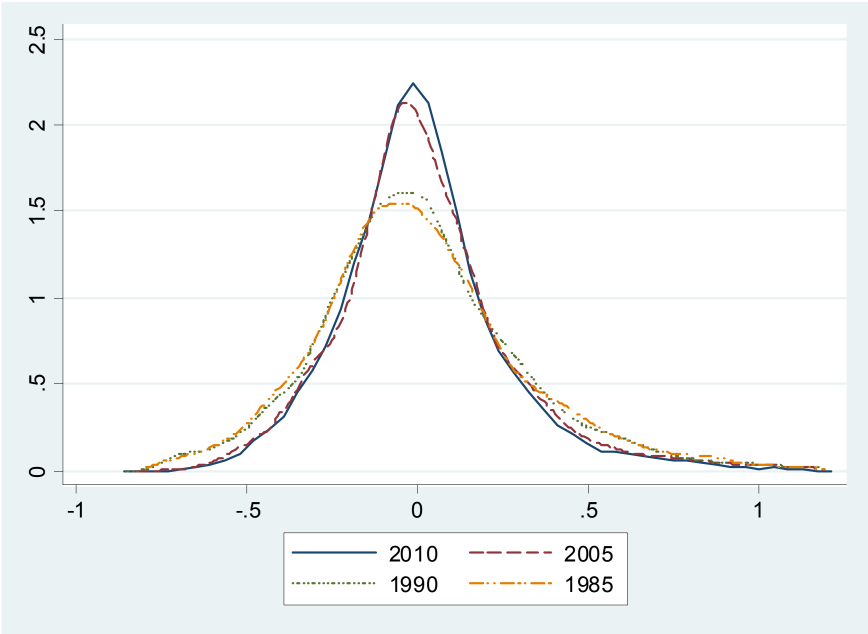

Figure 1: Empirical distributions of LOP deviations for the original 13-country sample

result of these two factors, only 339 goods could be matched, for example, between 1975 and 2010 as compared to 857 goods between 1985 and 2010. We thus deem it preferable to exclude the earlier cross-sections from our baseline results and emphasize results based on the remaining more highly comparable cross-sections between 1985 and 2010. To maintain a high degree of comparability, we use only goods that were also available in 1990, which is around the middle of our time sample and a year with a higher number of available goods as compared to earlier years.

We constructed our panel dataset from the separate cross-sections data by matching goods available at least in two different years. The matched goods prices were adjusted to have the same quantity units in different years, using an appropriate adjustment coefficient. This was deemed necessary since in some instances goods were sampled for different volumes in different years. For instance "Long grained rice, packed in carton" was sampled in 500g until 1990, and as 1 kg thereafter (see Table 2).[6] To explain LOP deviations across European countries we use only goods with sufficient cross-country variation. This is taken to be at least five observations in 1975, six in 1980, seven in 1985 and 1990, and thirteen for 2005 and 2010. Furthermore, to alleviate measurement error, we control for outliers by eliminating observations that are at least five times bigger or smaller than the cross-country mean price level.

[6] This might some times present us with a potential quantity discounts problem which we cannot address given the available information for this dataset.

Table 1: Data description

	1975	1980	1985	1990	2005	2010
Raw data						
Number of countries	9	12	13	13	31	37
Number of goods	658	1090	1805	1896	2505	2414
Number of matched goods*	587	1027	1629	1561	1993	1794
Number of matched goods between years						
1975		493	487	395	402	339
1980			945	688	640	562
1985				1227	993	857
1990					994	852
2005						1625
After adjustment**						
Number of matched goods*	376	494	865	972	651	608
Number of traded goods	335	433	745	817	574	534
Number of homogeneous goods	141	198	309	294	207	204

Notes: * Number of matched goods is the number of goods that can be matched to any one (even one) other year in the sample. **We adjust data in two steps: first, we use prices which satisfy sufficient country criteria (5 in 1975, 6 in 1980, 7 in 1985-1990, 13 in 2005-2010), and second, to maintain the highest degree of comparability, we consider only goods that were also available in 1990.

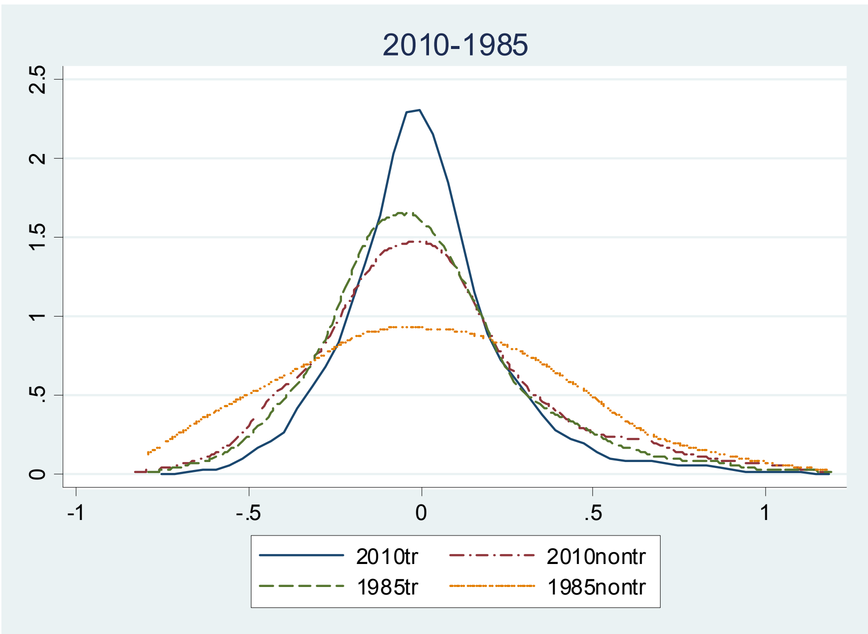

Figure 2: Empirical distributions of LOP deviations for the 13-country sample for tradeables (tr) and non-tradeables (nontr)

Table 2: A snapshot from the concordance of matching goods over time

description 1985	q85	description 1990	q90	description 2005	q05	description 2010	q10
Long grained rice- in carton	500g	Rice long-grained, packed in cartons	1kg	Rice, long-grain, Parboiled; cooking time $<$ 10min WKB	1kg	Long-grain rice, parboiled, WKB	1kg
Wheat flour - w/o vitamins	1kg	Wheat flour	1kg	Wheat flour, all-purpose flour, WKB	1kg	Wheat flour, WKB	1kg
Flaked oats - w/o vitamins	400g	Flaked oats, not vitamin enriched	1kg	Flaked oats, for cooking, WKB	500g	Flaked oats for cooking, WKB	1kg
Long thin french loaf - white not prewrapped, not sliced	250g	French white bread not wrapped nor sliced	1kg	Baguette, not industrially prepacked	500g	Baguette	200g
Man's pullover - wool	1	Men's pullover, pure new wool, lamb wool	1	Men's pullover / WKB-H	1	Men' s pullover, WKB-H	1
Refrigerator : 140 l, selected brand	1	Refrigerator, 140 I, SB	1	Refrigerator, BOSCH, KTL 15400 / SB	1	Refrigerator, undercounter with freezer, SB1	1
Motor car : diesel, SB	1 car	Motor car: diesel, 2500 cc, SB	1 car	Motor cars, Diesel engine NISSAN Terrano 2.7Tdi SB	1car	Motor car diesel SB1	1 car
Petrol : super, not self-service	1l	Petrol - super, no self service	1l	Petrol, Super Superplus, unleaded	10l	Petrol, 95 octane	10l
Services - plumber	1 hr	Services - plumber, without travel costs	1 hr	Plumber, hourly charge	1 hr	Plumber, hourly charge	1 hr
Domestic servant	1 hr	Domestic servant (housework)	1 hr	Domestic servant (housework) registered	1 hr	Domestic servant, (housework) registered	1 hr

Table 3: Mean and median LOP deviation

	Average LOP deviation											
	Traded goods						Nontraded goods					
country	1975	1980	1985	1990	2005	2010	1975	1980	1985	1990	2005	2010
Austria			.073	.062	.006	.012			.218	.247	.177	.191
Belgium	.005	.003	.045	.008	-.009	.029	.135	.277	.174	.09	.037	.016
France	.102	.072	.019	.046	.01	.011	.209	.182	.182	.116	.061	.079
Germany	.015	.061	-.035	-.012	-.025	-.013	.2	.226	.194	.277	.165	.125
Greece		-.001	-.019	-.026	-.055	-.002		-.37	-.353	-.385	-.233	-.18
Ireland	-.125	-.007	.059	.042	.146	.12	-.247	.061	.152	.059	.175	.115
Italy	.006	-.071	.028	.049	.054	.004	-.262	-.128	-.087	-.027	-.106	-.122
Luxembourg	-.007	.001	-.061	-.058	.008	-.004	-.144	.044	-.103	-.068	-.001	.09
Netherlands	-.011	-.001	-.059	-.018	-.003	-.029	.026	.215	.123	.083	.145	.074
Portugal		-.014	-.009	-.098	-.027	-.053		-.481	-.41	-.387	-.239	-.244
Spain		-.036	-.031	-.011	-.088	-.07		-.104	-.192	-.116	-.155	-.122
Denmark	.227	.349	.31	.3	.311	.28	.179	.314	.363	.512	.531	.542
UK	-.136	.047	-.026	-.053	.019	-.095	-.255	.161	.348	.4	.208	.052
	Median LOP deviation											
Austria			.054	.038	-.003	-.002			.233	.268	.136	.121
Belgium	-.003	.006	-.003	-.016	-.012	.018	.108	.265	.108	.041	-.003	-.011
France	.124	.051	-.005	.000	-.012	-.004	.183	.150	.155	.066	.048	.064
Germany	-.017	.023	-.069	-.045	-.035	-.019	.151	.210	.214	.246	.085	.069
Greece		-.1	-.073	-.089	-.058	-.006		-.428	-.445	-.391	-.302	-.219
Ireland	-.180	-.052	-.016	-.025	.108	.068	-.263	.025	.154	.013	.133	.058
Italy	-.010	-.092	-.007	.001	.028	-.021	-.349	-.163	-.116	-.018	-.166	-.126
Luxembourg	-.012	-.007	-.079	-.068	-.026	-.013	-.125	.032	-.126	-.044	-.02	.077
Netherlands	-.025	-.015	-.075	-.029	.003	-.025	.050	.28	.158	.114	.132	.063
Portugal		-.085	-.074	-.109	-.041	-.049		-.518	-.468	-.43	-.277	-.232
Spain		-.043	-.047	-.005	-.076	-.066		-.140	-.264	-.202	-.164	-.134
Denmark	.147	.276	.219	.230	.240	.201	.205	.298	.403	.377	.498	.556
UK	-.172	.01	-.088	-.075	-.012	-.107	-.238	.077	.227	.298	.024	-.077

Table 4: mean and median LOP deviation after correcting for income

	Average LOP deviation											
	Traded goods						Nontraded goods					
country	1975	1980	1985	1990	2005	2010	1975	1980	1985	1990	2005	2010
Austria			.045	.036	-.001	-.002			.189	.220	.170	.176
Belgium	-.041	-.042	.024	-.011	-.012	.020	.089	.232	.152	.070	.034	.008
France	.057	.030	-.016	.020	.016	.015	.164	.140	.146	.090	.067	.083
Germany	-.018	.027	-.064	-.040	-.018	-.012	.166	.192	.165	.249	.172	.126
Greece		.066	.047	.063	.012	.059		-.303	-.287	-.295	-.166	-.119
Ireland	-.059	.045	.090	.076	.102	.103	-.180	.113	.182	.093	.131	.097
Italy	.031	-.056	.022	.031	.074	.029	-.237	-.112	-.093	-.045	-.085	-.098
Luxembourg	-.089	-.079	-.132	-.145	-.106	-.133	-.226	-.036	-.174	-.155	-.115	-.039
Netherlands	-.061	-.047	-.089	-.033	-.017	-.049	-.024	.169	.093	.068	.131	.054
Portugal		.125	.130	.016	.064	.035		-.342	-.271	-.274	-.138	-.148
Spain		.021	.035	.027	-.047	-.029		-.047	-.126	-.078	-.113	-.081
Denmark	.158	.285	.244	.245	.270	.234	.110	.259	.297	.457	.490	.496
UK	-.119	.040	-.040	-.054	.009	-.080	-.239	.154	.334	.409	.198	.067
	Median LOP deviation											
Austria			.026	.011	-.010	-.017			.205	.241	.130	.106
Belgium	-.049	-.039	-.025	-.035	-.015	.010	.062	.220	.087	.022	-.006	-.019
France	.079	.008	-.040	-.025	-.006	.000	.138	.107	.119	.040	.054	.068
Germany	-.050	-.011	-.098	-.072	-.028	-.018	.118	.176	.185	.218	.092	.070
Greece		-.033	-.008	.001	.009	.055	.000	-.361	-.380	-.302	-.235	-.158
Ireland	-.114	.000	.014	.009	.064	.050	-.196	.078	.185	.047	.089	.040
Italy	.014	-.076	-.012	-.016	.048	.004	-.324	-.147	-.121	-.036	-.146	-.101
Luxembourg	-.094	-.086	-.150	-.155	-.140	-.142	-.207	-.048	-.197	-.131	-.134	-.052
Netherlands	-.075	-.061	-.105	-.044	-.011	-.044	.000	.235	.128	.099	.118	.043
Portugal		.054	.065	.004	.050	.038		-.379	-.328	-.318	-.186	-.145
Spain		.014	.019	.033	-.034	-.024		-.083	-.198	-.164	-.122	-.092
Denmark	.078	.221	.149	.175	.199	.155	.136	.244	.337	.321	.457	.510
UK	-.156	.003	-.102	-.076	-.022	-.091	-.221	.070	.213	.297	.013	-.062

Notes: In order to remove the income effect, we regress LOP deviations on income and then utilize the residuals i.e. that component of LOP deviations that excludes the effect of income.

In Table 3, we report q_{jt}, averaging across goods for each country j. More specifically, we present the average q_{ijt} for each country separately for goods that can be broadly categorized as traded versus non-traded. We plot the densities of the q_{ijt} in Figure 1, where we present all LOP deviations together for the 13 countries available for 1985, 1990, 2005 and 2010. Each line represents an estimate of the density of LOP deviations (common currency prices compared to the cross-country mean), good-by-good, for a particular year in the cross-section.

Noting that these densities are consistent with a higher degree of convergence after the process of European monetary unification, we defer a more careful comparison for later on. In Figure 2, we distinguish between traded and non-traded goods and plot their separate distributions for 2010 and 1985. These densities suggest that dispersion is lower for tradeables as compared to non-tradeables, and that dispersion for both tradeables and non-tradeables becomes lower after the process of European monetary unification.

The distinction between traded and non-traded in Table 3 allows us to see that while poorer EU countries like Greece, Portugal and Spain are cheaper for non-tradeables and richer ones like Austria, Denmark and Germany more expensive, the picture is less clear for tradeables. In the case of tradeable goods, some of the richer more productive (in tradeables) countries like Germany and the Netherlands, have actually been relatively cheaper than the EZ average over the period 1985-2010. In Table 3, we also report the median LOP deviation in each country and time period for tradeables and non-tradeables. This is informative about the fraction of goods that are cheaper or more expensive in the country, which will be helpful in interpreting the results of the last section of the paper regarding persistence characterizing cheaper versus more expensive types of goods and whether this has implications about the overall persistence of price advantage or price disadvantage we observe in any given country. In Table 4, we consider again the mean and median LOP deviation for each country and year, after correcting for income. To remove the income effect, we regress LOP deviations on income and then utilize the residuals i.e. the component of LOP deviations that excludes the effect of income. This serves to give us a better sense of countries that might have a productivity or price advantage for traded products, with prices cheaper than their income levels would suggest. Such countries include Germany, Luxembourg, the Netherlands, and the UK for 2010 and most other years in our sample. We note that, while distinguishing between tradeable and non-tradeable goods in this binary manner is useful here, in the next section we will consider that goods are characterized by different degrees of tradeability consistent with a model where each retail good is produced by combining a traded with a non-traded input as in CTZ. In the next section, 3.1, we will thus be using the complete set of prices for tradeable and non-tradeable items and the same goes for section 3.2, while in section 3.3 we will be focusing on goods for which the price arbitrage mechanism is more relevant (i.e. tradeable goods) to learn about the persistence characterizing LOP deviations and the evolution of price advantage for such goods in these European economies.

Following CTZ, tradeability is constructed as $t_{ht} = \frac{\sum_{j=1}^{N}(X_{hjt}+M_{hjt})}{\sum_{j=1}^{N} Y_{hjt}}$, where for each industry h we sum over all countries N which have data for that industry over the period 1985-2010. X_{hjt} (M_{hjt}) stands for exports (imports) of industry h from country j, and Y_{hjt} stands for the gross output of industry h in country j. Export and import data were obtained from the OECD STAN Bilateral Trade Database and gross output from the OECD STAN Database for each country and industry for 1985, 1990, 2005 and 2008 at the ISIC (Revision 3) two-digit level. Moreover, we construct the share of the non-traded input as $\alpha_{ht} = \frac{\alpha_{hUKt}+\alpha_{hFRt}+\alpha_{hGEt}}{3}$, where α_{ht} is the share of the non-traded input required to produce goods in industry h. To best characterize this share representative of each industry's structural production characteristics, we consider the average across three industrial countries: the UK, France and Germany, following CTZ which used input-output data for the UK. We obtained the non-traded input share from the OECD STAN input-output tables for 1985, 1990, 2000 and 2005 at the ISIC (Revision 3) two-digit level.[7] Finally, the VAT variable is constructed as the standard deviation across countries, σ_{ht}, of log VAT levels $v_{hjt} = \ln(VAT_{hjt})$. VAT rates were obtained from the European Commission report on VAT Rates Applied in the Member States of the European Union[8] for June 1st 2005 and January 1st 2011, while for 1985-1990 we used VAT data from the CTZ paper.

Finally, we consider characteristics of the distribution over goods of LOP deviations, such as the kurtosis value and mean price dispersion in different years. The mean (over goods) cross-country price dispersion is computed as:

$$\overline{s}_t = \frac{1}{M_t}\sum_{i=1}^{M_t} s_{it}(q_{ijt}),\ s_{it}(q_{ijt}) = \sqrt{\frac{1}{N_{it}}\sum_{j=1}^{N_{it}} q_{ijt}^2} \tag{2}$$

where q_{ijt} denotes again the LOP deviation for good i in country j at time t relative to the EZ-11 countries calculated using equation (1), N_{it} is the number of countries under study, and M_t is the number of goods at time t. This measure of cross-country price dispersion will be greater when LOP deviations relative to the EZ-11 are greater, and can thus serve as an inverse measure of the degree of integration characterizing any group of countries relative to the EZ-11 at a specific point in time. We explain good level price dispersion, $s_{it}(q_{ijt})$, in section 3.1 next. Then, in section 3.2,

[7] Available at http://www.oecd.org/trade/input-outputtables.htm. Input-output tables in the 2000's were available only for 2000 and 2005, thus we used the non-traded input share of 2000 for 2005 and of 2005 for 2010.

[8] Available at http://ec.europa.eu/taxation_customs/taxation/vat/how_vat_works/rates/index_en.htm

we compare characteristics of the distributions like kurtosis and mean price dispersion $\overline{s}_t$ and more generally compare the distributions over time using a Kolmogorov-Smirnov test.

3 Estimation and empirical results

3.1 Explaining goods-level cross-country dispersion in LOP deviations

We consider the basic retail price determination model proposed in CTZ, where retail goods are produced by combining a traded input with a non-traded input. According to that model, LOP deviations, q_{ijt}, are determined by the share as well as by the cost of the traded input for good i in country j at time t, t_{ijt}, the share of the non-traded input required to produce good i, α_{it}, as well as by the cost of the non-traded input. Thus, deviations from the LOP should be related to variation in traded and non-traded factor input costs and to the production share attributable to each. Traded input costs are in line with models that emphasize transport costs, while non-traded input costs are in line with the Balassa-Samuelson hypothesis where these costs are related to lower relative productivity in the non-traded sector as compared to the traded one.

In our empirical specification, we set out to explain good level dispersion, $s_{it}(q_{ijt})$, as defined in equation (2). This exhibits variation over goods and time that could be explained by variables such as the share of the non-traded input required to produce goods in industry h in which good i belongs to, α_{ht}, and a proxy that measures the tradeability of the final good, t_{ht}, as in CTZ. More specifically, we estimate the following regression equation:

$$s_{it}(q_{ijt}) = \beta_1 \ln t_{ht} + \beta_2 \ln \alpha_{ht} + \beta_3 \sigma_{ht}(v_{hjt}) + \beta_4 D_{ALC\&CIG} + \beta_5 D_t + \varepsilon_{it} \quad (3)$$

That is, we estimate a panel regression across i over t to explain the cross-country price dispersion $s_{it}(q_{ijt})$,[9] with industry-level data on the tradeability of the final good as measured by international trade flows divided by total output to measure t_{ht}, and industry-level data on the share of non-traded inputs required for production as a proxy for α_{ht}.[10] Thus, in line with the model of retail price determination proposed in CTZ, the estimated parameter $\hat{\beta}_1$will capture the role of tradeables

[9] Very similar results are obtained if we use instead the cross-country standard deviation of LOP deviations as dependent variable, where this is given as $\sigma_{it}(q_{ijt}) = \sqrt{\frac{1}{N_{it}-1}\sum_{j=1}^{N_{it}}(q_{ijt} - \overline{q_{it}})^2}$with $\overline{q_{it}}$ the cross-country average LOP deviation for good i at time t.

[10] Anderson and van Wincoop (2004) propose the use of micro price levels comparable across locations at a point in time as a promising route for inferring trade costs. They also emphasize the role of local distribution costs in determining retail price differences.

Table 5: Explaining cross-country price dispersion

	1985-1990		2005-2010	
	(1)	(2)	(3)	(4)
Tradeability	-0.170***	-0.146***	-0.080***	-0.129***
	(0.055)	(0.052)	(0.021)	(0.021)
Non-traded input	0.288***	0.361***	0.286***	0.486***
	(0.096)	(0.083)	(0.101)	(0.077)
VAT	0.046*	0.046*	0.021!	0.053***
	(0.024)	(0.024)	(0.014)	(0.020)
Alcohol&Cigarettes	0.209***	0.197***	0.083***	0.167***
	(0.021)	(0.016)	(0.021)	(0.010)
Time dummy	-0.018*	-0.017	-0.022***	-0.049***
	(0.010)	(0.011)	(0.006)	(0.010)
Observations	2,076	1,497	1,592	1,601
Number of goods	1,412	1,024	1,081	1,091
Number of countries	13	13	13	24
Adjusted R-squared	0.216	0.210	0.171	0.347

Notes: *** p-value<0.01, ** p-value<0.05, * p-value<0.1, ! p-value=0.132. Robust clustered standard errors in parentheses. We explain good-level cross-country price dispersion from equation (2). In column (2) for the 1985-1990 time sample we constrain our sample of goods to those that are also available in 2005 or 2010. There are 13 countries for the 1985-1990 samples and for the first 2005-2010 sample (the eleven eventual Eurozone members: Austria, Belgium, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, along with Denmark and the UK), and 24 countries for the 2005-2010 sample in the last column (the same 13 countries plus the Czech Republic, Estonia, Finland, Hungary, Iceland, Norway, Poland, the Slovak Republic, Slovenia, Sweden and Switzerland. Data for Cyprus, Malta, Latvia and Lithuania were not available.)

in production, while $\hat{\beta}_2$ will be informative about the role of non-traded inputs in determining LOP deviations as per the earlier discussion in relation to the Balassa-Samuelson hypothesis above.[11]

A time dummy is always included to account for otherwise excluded variation (say due to nominal factors) specific to a year but common across goods and countries. Additional control variables include the standard deviation of VAT rates across countries, and dummies for goods such as alcohol and cigarettes typically associated with higher taxes, $D_{ALC\&CIG}$.

In columns (1) and (2) of Table 5, we report results based on the 1985-1990 sample, whereas results for the 2005-2010 period are presented in the remaining columns. For the sake of comparability, in column (2) for the 1985-1990 time sample we constrain our sample of goods to those that are also available in 2005 or 2010, while in columns (3) and (4) for the 2005-2010 sample we constrain our sample of goods to those also available in 1990 or 1985.[12] Column (3) presents results for the same

[11] This parameter estimate will in fact capture the share of non-traded input costs, according to the retail price model and related to the Balassa-Samuelson hypothesis.

[12] Using only goods available in each and every year would perhaps have been best for comparability but would

13 EU countries used in the 1985-1990 sample, while in column (4) we consider the larger number of countries, 24, with available data for that period.

We find that the role of tradeability in lowering cross-country dispersion diminishes in the 2005-2010 period as compared to the 1985-1990 period. The impact of log tradeability on the cross-country standard deviation in columns (1) and (2) of Table 5 for the period 1985-1990 is respectively equal to -0.170 and -0.146 while the estimated impact during the period 2005-2010 shown in column (3) of Table 5 is -0.080 for the same 13-country sample. Instead, considering a broader 24-country sample available for 2005-2010 the estimated coefficient shown in column (4) of Table 5 is -0.129, much higher than the one for the 13-country sample of more comparable, mostly EZ, EU economies shown in column (3) of the table, suggesting that the 24-country sample is characterized by a greater degree of segmentation than the EZ. Comparing the coefficient estimates of tradeability for the four samples (1985-90 vs 2005-2010 with 13 countries, 1985-90 vs 2005-2010 with 24 countries, and 2005-2010 with 24 countries vs 2005-2010 with 13 countries), we find in all cases that the coefficients are statistically different at the one percent level of significance for all possible comparisons.

The impact of log non-tradedness on the cross-country standard deviation for 1985-1990 is respectively 0.288 and 0.361 in columns (1) and (2) of Table 5, and 0.286 for the period 2005-2010 as shown in column (3) of the table for the same 13-country sample. This smaller role of non-traded inputs in raising price dispersion is consistent with a certain degree of convergence in input costs (e.g. lower wage dispersion) and non-traded sector productivity levels for these EU economies over the period under study. The role of non-traded inputs differences for the broader 24-country sample shown in column (4) of Table to equal 0.486. This impact is clearly greater than the one for the 13-country sample of, mostly EZ, EU economies in column (3) for 2005-2010, suggesting a greater role for input cost and non-traded sector productivity level differences in the broader country sample. Comparing the coefficient estimates of non-traded input content between the four samples considered in Table 5, we find that the coefficients are statistically different at the one percent level of significance in all cases except for the comparison of the unconstrained (thus less comparable) sample in 1985-1990 shown in column (1) with the 13-country sample in 2005-2010 shown in column (3).

Finally, the impact of VAT and the alcohol and cigarettes dummy is positive, but the impact of both of these decreases considerably (and becomes marginally insignificant for VAT) as the process of European unification intensifies over the period under study. Once again, both coefficients increase when we consider the 24-country sample for 2005-2010 instead of the 13-country sample, consistent with the importance of VAT and other tax differences being smaller in the narrower group of more

have limited our sample to about 25% of the goods we now use in the regression for 1985-1990 reported in column (2), and to about 40% of the goods we now utilize in the regression for 2005-2010 in column (3).

highly homogeneous EU countries.

The above results on the determinants of price dispersion are consistent with the emphasis of Faber and Stockman (2009) that, using the same CTZ model, find that traded and non-traded input costs and tax harmonization have historically been driving the evolution of price dispersion in Europe over the period 1960-2003. This reaffirms the empirical usefulness of the retail price determination model proposed in CTZ and provides certain insights about how the process of European unification between 1990 and 2005 has affected these empirical relationships.

In addition, the similarity of our qualitative findings here to those in the repeated cross-sections (i.e. 1975, 1989, 1985 and 1990) based study of CTZ suggests a sufficiently high degree of accuracy of our panel data construction procedure that was based on the highly labour-intensive and unprecedented task of matching individual goods across these cross-sections. We then proceed to utilize our panel dataset to make inference about the persistence of the position of individual goods in the distribution of LOP deviations over time. We turn to this task after comparing the empirical density functions of LOP deviations across different periods in the next section.

3.2 Comparing distributions of LOP deviations between years

In this subsection, we compare the density functions of the q_{ijt}, calculated as in equation (1), considering the distribution across different goods for individual countries j and specific time periods t. After considering all LOP deviations together for the thirteen countries that are available for 1985-2010 in Figure 1, we look at the individual distributions for each country separately later on in this section. The density functions in Figure 1 are more highly peaked at zero for both 2005 and 2010 as compared to 1985 or 1990 (with kurtosis values in 2005 and 2010 greater than in the earlier years as shown in the last column of Table 6), implying a greater degree of European integration towards the end of the sample as a result of price convergence in the decade preceding the euro and the half-decade since its inception. Moreover, as shown in the fourth column of Table 6, the average (over goods) cross-country dispersion $\overline{s}_t$ computed as in equation (2), falls over the period from 0.314 in 1985 to 0.303 in 1990 and down to 0.253 in 2005 and 0.234 in 2010, suggesting again a greater degree of integration achieved post-euro.

In addition to the visual evidence, we consider the Kolmogorov-Smirnov test for the null of equality of the empirical distribution functions. As we can see in Table 6, this null can be rejected at the one percent level when we compare distributions after the euro with ones before the euro. This is statistical evidence that the empirical distribution of LOP deviations in 2005 (or 2010) is different than the empirical distribution for 1990 or 1985. Instead, comparing empirical distributions after the euro, between 2005 and 2010, we cannot reject the null of equality at the one percent level.

Table 6: LOP deviations distribution characteristics and tests for the equality of distributions.

	Kolmogorov-Smirnov test			Mean dispersion	Kurtosis values
year	2005	1990	1985		
2010	0.014	0.000	0.000	0.234	5.172
2005		0.000	0.000	0.253	5.148
1990			0.385	0.303	4.084
1985				0.314	3.921
2010^{NEU}	0.000			0.298	3.784
2005^{NEU}				0.349	3.656
2010^{NEZ}	0.000			0.268	4.251
2005^{NEZ}				0.314	3.608
2010^{NEU6}	0.000			0.305	3.424
2005^{NEU6}				0.354	3.789

Notes: For the Kolmogorov-Smirnov test we consider comparisons of LOP deviations distributions between different years. In the first three columns, we report P-values for the Kolmogorov-Smirnov test of the null of equality of distribution functions. In the fourth column, we report the mean (over goods) cross-country price dispersion computed as in equation (2). In the last column, we report kurtosis values for the LOP deviations distributions for each year. The first four rows present comparison between years using the LOP deviations for the thirteen countries (the eleven Eurozone members: Austria, Belgium, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, along with Denmark and the UK). NEU - We report results for the ten new EU members (Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovak Republic, Slovenia). NEZ - We report results for the four new EZ members (Cyprus, Malta, Slovak Republic and Slovenia). NEU6 - We report results for the six non-EZ new EU members (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland).

Moreover, comparing the distributions before the euro, in 1990 versus 1985, we cannot reject the null of equality even at the ten percent level of significance.

Next, we consider the density of LOP deviations q_{ijt}, for ten new EU member countries: Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, the Slovak Republic, and Slovenia, in 2005 and in 2010. The q_{ijt} are calculated again using equation (1) relative to the EZ-11 economies. As shown in Table 6, the kurtosis value characterizing the LOP deviations distribution is greater in 2010 as compared to 2005, and the Kolmogorov-Smirnov test shown in the same Table implies that the distribution of LOP deviations for these countries as a group relative to the EZ changes between 2005 and 2010.

Noting that four of these countries: Cyprus, Malta, Slovakia and Slovenia joined the euro during this period, we take a closer look at these four countries as a group here, and subsequently consider the individual country level to investigate whether convergence is more evident for new EU member countries that adopted the euro after 2005. As we can see in Figure 3, the density function for the new EZ members is more highly peaked at zero for 2010 as compared to 2005. As shown in Table 6, the kurtosis value goes up from 3.608 in 2005 to 4.251 in 2010, while for the six non-EZ new EU

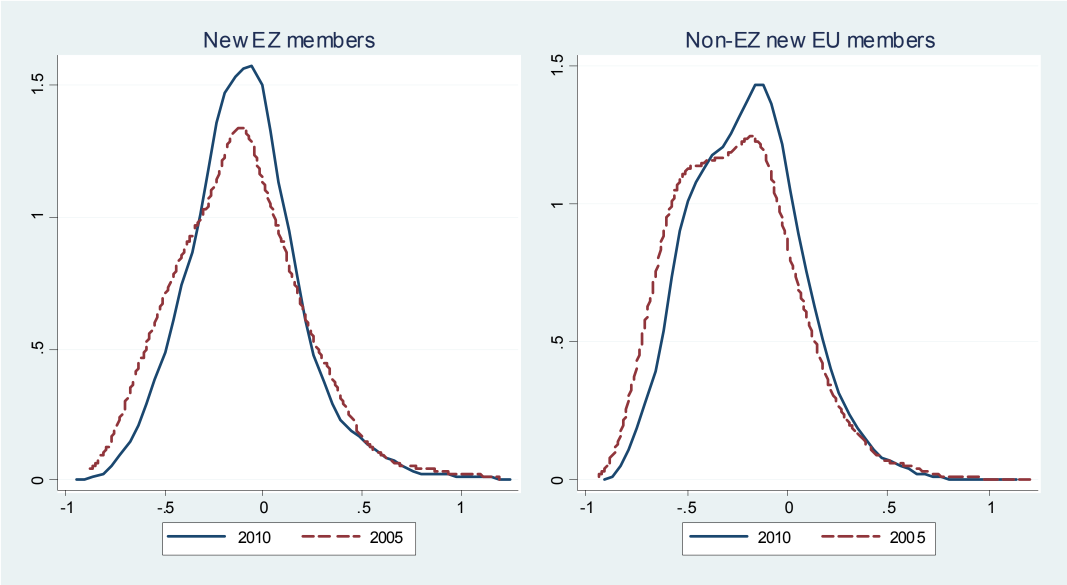

Figure 3: Empirical distributions of LOP deviations for the new EU countries

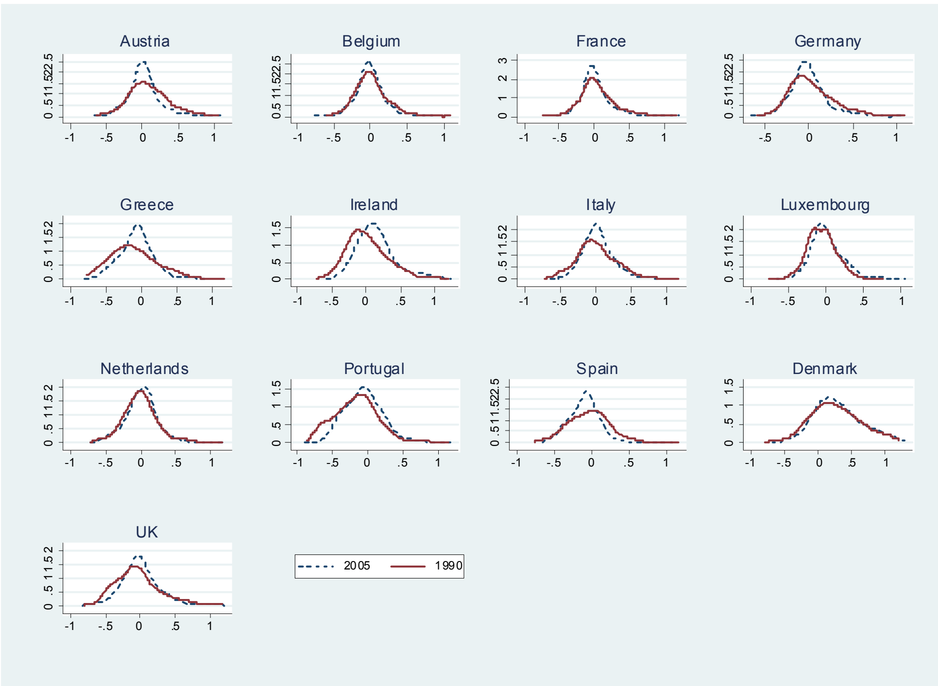

Figure 4: Empirical distributions of LOP deviations before and after the Euro

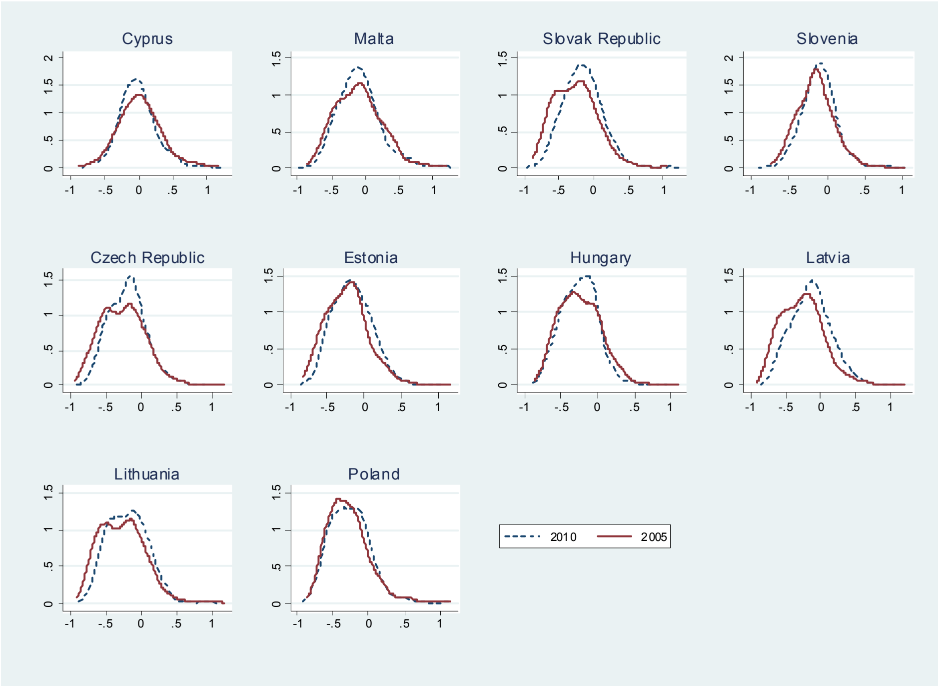

Figure 5: Empirical distributions of LOP deviations for the ten new EU countries

Table 7: Kurtosis values for the distributions of LOP deviations for each country and year

country	2010	2005	1990	1985	country	2010	2005
Austria	5.656	6.234	3.448	3.605	Finland	4.053	3.870
Belgium	4.433	4.773	4.263	4.720	Sweden	3.531	3.540
France	6.750	6.184	4.956	5.222	Cyprus	4.204	3.757
Germany	5.034	5.794	4.287	3.945	Malta	4.070	3.350
Greece	4.860	3.969	3.128	2.955	Slovak Republic	3.843	3.442
Ireland	3.620	4.011	3.797	3.716	Slovenia	4.456	3.860
Italy	4.410	3.962	3.855	4.118	Czech Republic	3.227	3.283
Luxembourg	5.981	4.899	3.856	3.652	Estonia	3.378	4.096
Netherlands	3.984	4.891	5.106	4.528	Hungary	3.673	3.552
Portugal	4.740	3.806	3.698	3.231	Latvia	3.373	3.937
Spain	4.079	6.017	3.547	3.385	Lithuania	2.938	3.604
Denmark	2.895	2.804	2.798	3.099	Poland	4.039	4.689
UK	5.949	5.075	4.066	3.812			

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Table 8: Kolmogorov-Smirnov test for the equality of LOP deviations distributions between different years, for each country.

country		2005	1990	1985
Austria	2010	0.945	0.000	0.000
	2005		0.000	0.000
	1990			0.059
Belgium	2010	0.000	0.000	0.000
	2005		0.041	0.000
	1990			0.115
France	2010	0.485	0.010	0.060
	2005		0.000	0.006
	1990			0.256
Germany	2010	0.197	0.000	0.000
	2005		0.000	0.000
	1990			0.015
Greece	2010	0.000	0.000	0.000
	2005		0.000	0.000
	1990			0.451
Ireland	2010	0.027	0.000	0.001
	2005		0.000	0.000
	1990			0.534
Italy	2010	0.000	0.000	0.004
	2005		0.000	0.000
	1990			0.258
Luxembourg	2010	0.160	0.000	0.000
	2005		0.000	0.000
	1990			0.191

country		2005	1990	1985
Netherlands	2010	0.047	0.283	0.000
	2005		0.038	0.000
	1990			0.000
Portugal	2010	0.040	0.000	0.000
	2005		0.000	0.000
	1990			0.000
Spain	2010	0.373	0.000	0.001
	2005		0.000	0.000
	1990			0.014
Denmark	2010	0.562	0.059	0.267
	2005		0.135	0.488
	1990			0.768
UK	2010	0.000	0.000	0.000
	2005		0.001	0.001
	1990			0.453
Finland	2010	0.616		
Sweden	2010	0.000		
Cyprus	2010	0.000		
Malta	2010	0.042		
Slovak Republic	2010	0.000		
Slovenia	2010	0.000		
Czech Republic	2010	0.000		
Estonia	2010	0.000		
Hungary	2010	0.022		
Latvia	2010	0.000		
Lithuania	2010	0.000		
Poland	2010	0.012		

Notes: We consider comparisons of LOP deviation distributions between different years for each country. We report P-values for the Kolmogorov-Smirnov test of the null of equality of distribution functions.

members the density function for which is also shown in Figure 3, this value starts higher at 3.789 in 2005 but declines to 3.424 by 2010. Moreover, we note that the mean cross-country dispersion for the new EZ members falls to 0.268 by 2010, below the mean dispersion value of 0.305 for the six new non-EZ EU members but above that for the core, 0.234.

In Figure 4, we present the density functions for each of the 13 countries that are available for 1985-2010. Graphs show an estimate of the density of good-by-good deviations from the LOP, q_{ijt}, calculated as in equation (1), for 1990 and 2005 respectively the latest available date before the euro and the earliest available date after monetary unification. In all cases, we observe the density functions to be more highly peaked around zero in 2005 as compared to 1990, with kurtosis values shown in Table 7 to be greater in 2005 than in 1990 for all countries except for the Netherlands which already had a high kurtosis value (the highest among the 13 countries) reflecting a relatively high degree of integration as of 1990.

There is a quite visible shift of the density function to the right for Greece, Ireland and Portugal in Figure 4, suggesting goods there became overall relatively more expensive over time. As shown in Table 3, this comes about due to non-tradeables and (except for Greece) tradeables becoming relatively more expensive between 1990 and 2005 in these countries. The opposite appears to be happening for Spain for both tradeables and non-tradeables over the same period. Our findings regarding the rightward shift of the distributions for Greece and Portugal and the significant difference in the distributions for 2005 as compared to 1990 for both countries, are consistent with Guerreiro and Mignon's (2013) finding of Greece and Portugal losing competitiveness over time while exhibiting convergence.

As shown in Table 8, using the Kolmogorov-Smirnov test, the distribution is statistically different in 2005 as compared to 1990 for all countries except Denmark for which this null cannot be rejected even at the ten percent level with a p-value of 0.135.[13] In fact, Denmark exhibited a very low degree of integration (with the lowest kurtosis value among the thirteen countries) in both 1990 and 2005.

In Figure 5, we present the density functions for each of ten new EU countries that are available for 2005 and 2010. In the case of the four new EU countries that adopted the euro between 2005 and 2010, we can see that the density functions become more highly peaked at zero in 2010 as compared to 2005, with the kurtosis values shown in Table 7 to be greater in 2010 as compared to 2005, which is typically not the case for the countries in the sample that did not adopt the euro during this period. All of the latter countries, except for Hungary, have lower kurtosis values in 2010 than in 2005. Interestingly, this is also the case for non-EZ EU member Sweden but not for

[13] We note that for Belgium and the Netherlands the null of equality can be rejected only at the five percent level. This might be due to the fact that both countries started off with a relatively high degree of integration as reflected by the kurtosis values in 1990.

EZ member Finland[14], with the kurtosis value for the former shown in Table 7 to be lower in 2010 than in 2005 while the latter has a higher kurtosis value in 2010 than in 2005 similar to the four new EZ members Cyprus, Malta, Slovak Republic and Slovenia. Considering the Kolmogorov-Smirnov test in Table 8, we find that the null of equality for the density functions in 2010 versus 2005 can be rejected at the five percent level for each of the ten new EU members.[15]

3.3 How persistent are good-level LOP deviations over time?

In this section, we consider the correlation between LOP deviations of individual goods in different time periods. This only becomes possible because we have linked the cross-sections available to us by matching individual goods prices over time. For this particular section, we find it useful to also consider the 1980 and 1975 cross-sections even though these have a much lower number of goods available, in order to be able to make comparisons of individual goods LOP deviations over the longest possible horizon. We deem this useful here in order to get a better grasp of the aspects of price persistence examined in this section over a sufficiently long span of time. However, we note that at most only 658 goods for only nine EU core countries are available for 1975 and just a handful (23%) of these goods (mostly highly homogeneous ones) are comparable to, say, 2010, rendering comparisons relative to 1975 and especially comparisons for the 35-year gap that depend solely on comparing LOP deviations for 1975 to those for 2010, somewhat problematic. Finally, for the purposes of this section, we will be focusing solely on tradeables in order to get a sense of the persistence of LOP deviations associated with internationally traded products for which price arbitrage can be reasonably assumed to be at work.

We present the overall (over all goods and countries) correlations between the LOP deviations of the goods in different periods in Table 9. These correlations are calculated by stacking the LOP deviations in an ordered vector according to the matched goods identifier by country for one period, then doing the same for the exact same goods and countries ordered in the same manner for a second period, and computing the correlation between any two such ordered vectors (periods). Alternatively, we computed good-by-good correlations[16] and then obtained the average correlation over these goods, with very similar results. For the last six columns of the table, we remove the effect of income to better isolate the traded component of each final retail good, and consider the correlation between LOP deviations of individual goods net of income. Although we use only

[14] Both Nordic countries joined the EU in 1995 and thus exist in our sample only for 2005 and 2010.

[15] In the case of Malta, Hungary and Poland the null is rejected at the five percent but not at the one percent level of significance.

[16] In this case, we consider a vector of the LOP deviations for a specific good for each available country for one year, then construct a vector of LOP deviations for that good ordered the same way with exactly the same countries for another year, and compute the correlation between these two vectors.

Table 9: Correlation of cross-country good-by-good LOP deviations

	Correlations						Correlations after income correction					
gap	1980	1985	1990	2005	2010	mean	1980	1985	1990	2005	2010	mean
5yr	0.638	0.629	0.642		0.589	0.624	0.631	0.622	0.632		0.579	0.616
10yr		0.510	0.590			0.550		0.509	0.581			0.545
15yr			0.498	0.375		0.436			0.495	0.368		0.431
20yr				0.344	0.389	0.366				0.334	0.384	0.359
25yr				0.371	0.338	0.354				0.360	0.329	0.344
30yr				0.306	0.329	0.318				0.325	0.321	0.323
35yr					0.342						0.349	
	alternative (good-by-good) calculation:											
5yr	0.557	0.582	0.606		0.495	0.560	0.532	0.577	0.602		0.500	0.553
10yr		0.423	0.534			0.478		0.407	0.525			0.466
15yr			0.425	0.329		0.377			0.415	0.344		0.380
20yr				0.319	0.333	0.326				0.326	0.349	0.338
25yr				0.316	0.302	0.309				0.323	0.307	0.315
30yr				0.210	0.270	0.240				0.231	0.274	0.253
35yr					0.304						0.315	

Notes: The table presents correlations between the LOP deviations of the goods in different periods. The sample is limited to tradeable goods. For comparability across time, for each period we use goods that were also available in 1990. There are 13 countries in the sample: Austria, Belgium, France, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Spain, Denmark and the UK, except for 1980 for which Austria is missing. In order to remove the income effect we regress LOP deviations on income and then utilize the residuals i.e. the component of LOP deviations that excludes the effect of income.

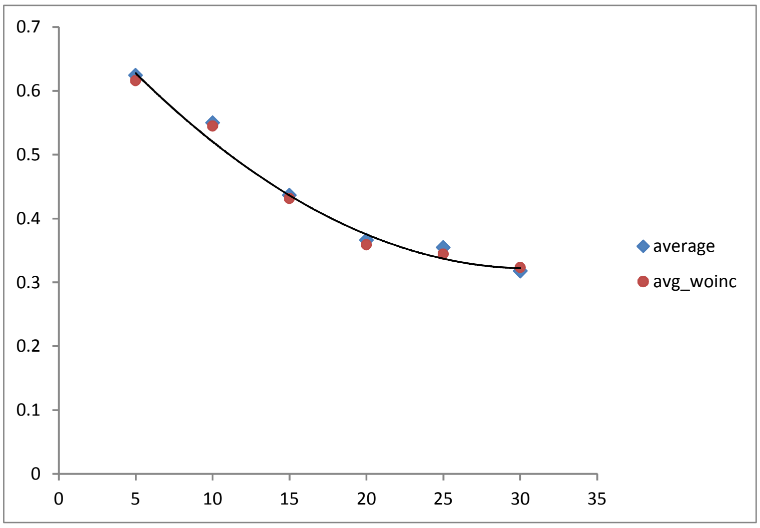

Figure 6: Price persistence for different time gaps length

goods that are traded for the purposes of this section, we find it useful to further decompose these recognizing the fact that there is a non-tradeable input that goes into any final retail good. As income is plausibly more closely associated with the non-traded component, the component we focus on after removing income should be more closely associated with the traded component.

Column headings in Table 9 describe the year being compared in each case, where row descriptions provide the time horizon being considered in each case. We observe high persistence at five year horizons, averaging around 62% (56% using the alternative good-by-good correlations) irrespective of whether we remove the effect of income or not. Similarly, persistence is high at ten year horizons, averaging around 55% (48% using the alternative good-by-good correlations) irrespective of whether we remove the effect of income or not. Considering longer horizons, the mean correlations fall to 37% (33%) or 36% (34%) after removing the effect of income for twenty-year time gaps, and 31.8% (24%) or 32.3% (25%) after removing the effect of income for thirty-year time-gaps. The tendency for these correlations to fall over time irrespective of whether we remove the effect of income ("avg_woinc") or not ("average") is evident in Figure 10 which graphs these average correlations. A similar tendency exists, not shown in Figure 10, when using the alternative good-by-good calculations.

In Table 10, we examine whether this form of persistence of individual goods LOP deviations might differ across different types of goods, based on the Rauch classification for homogeneous versus differentiated goods. Here, we note that differentiated products are on average several times more expensive than homogeneous ones in our dataset. In the first six columns of Table 10, we consider only homogeneous goods and in the last six columns of the table we consider differentiated

Table 10: Correlation of cross-country good-by-good LOP deviations for homogeneous and differenciated goods

	Homogeneous goods						Differentiated goods					
gap	1980	1985	1990	2005	2010	mean	1980	1985	1990	2005	2010	mean
5yr	0.710	0.675	0.725		0.632	0.685	0.507	0.552	0.518		0.537	0.529
10yr		0.563	0.658			0.610		0.423	0.496			0.459
15yr			0.567	0.446		0.506			0.404	0.304		0.354
20yr				0.375	0.470	0.423				0.306	0.304	0.305
25yr				0.384	0.388	0.386				0.351	0.274	0.313
30yr				0.333	0.390	0.362				0.269	0.250	0.260
35yr					0.317						0.364	
	alternative (good-by-good) calculation:											
5yr	0.664	0.637	0.725		0.604	0.658	0.447	0.530	0.513		0.407	0.474
10yr		0.500	0.619			0.559		0.356	0.463			0.410
15yr			0.514	0.456		0.485			0.351	0.247		0.299
20yr				0.393	0.480	0.436				0.255	0.232	0.244
25yr				0.375	0.360	0.367				0.252	0.251	0.251
30yr				0.302	0.359	0.330				0.139	0.182	0.161
35yr					0.284						0.320	

Notes: The table presents correlations between the LOP deviations of the goods in different periods, separately for homogeneous and differentiated goods. There are 13 countries in the sample: Austria, Belgium, France, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Spain, Denmark and the UK, except in 1980 for which Austria is missing. The sample is limited to tradeable goods available in 1990. We specify type of goods according to the Rauch index.

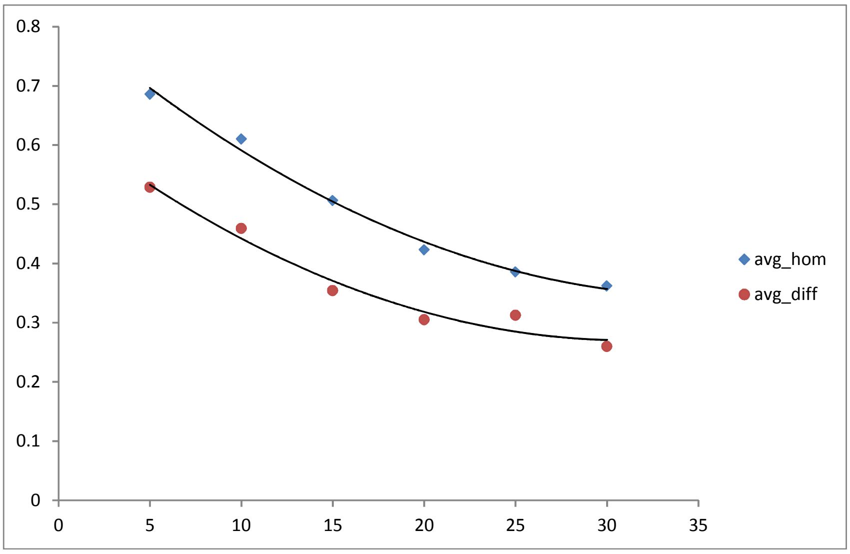

Figure 7: Price persistence for different time gaps length and different types of goods

products.

While the same falling tendency is observed as we go from comparisons made over shorter time gaps to ones over longer periods of time, there emerges a distinct difference between homogeneous and differentiated items with the former characterized by a higher degree of persistence as compared to the latter. The mean correlation at a five-year horizon is 69% (66% using the alternative calculation) for homogeneous goods and 53% (47%) for differentiated ones, while at the ten-year horizon these fall to 61% (56%) and 46% (41%) respectively. At a twenty-year horizon, the mean correlations for homogeneous goods fall to 42% (44%) as compared to 31% (24%) for differentiated ones, and at the thirty-year horizon these mean correlations fall to 36% (33%) and 26% (16%) respectively. The correlations when removing the income effect, not shown here for the sake of brevity, are very similar and confirm the same tendencies, declining over time and being greater for homogeneous as compared to differentiated products. Both the falling tendency of mean correlations of individual LOP deviations and the distinct difference between the correlations for homogeneous ("avg_hom") versus differentiated ("avg_diff") goods are evident in Figure 11. The differences between homogeneous versus differentiated goods correlations using the alternative good-by-good calculation, not shown in Figure 11, are even starker.

The fact that differentiated products are several times more expensive than homogeneous ones in our dataset, might be one explanation for the lower persistence characterizing their LOP deviations. With per unit trade costs declining with the value of the product, one would expect LOP deviations to be arbitraged away faster for high value differentiated products as compared to low value homogeneous products, leading to lower persistence of LOP deviations for the former.

In Table 11, we report a summary of the correlations for all possible time gaps for 2010, 2005 and all other years in our sample for each country. That is, we consider all possible year comparisons to compute an average correlation for each time gap. We consider five, ten, fifteen, twenty, twenty-five, thirty, and thirty-five year gaps. These correlations are calculated as follows: for each country, we order the goods LOP deviations by the goods identifier number for one period, then do this for the exact same goods in the same order for a second period, and take the correlation between these two vectors (periods). Two basic facts come out. First, correlations between LOP deviations typically decline for each country as we increase the gap between the years that are being compared with some exceptions once at the twenty-year gap and beyond. Second, these correlations vary across countries. For example, Ireland always has the greatest correlation for any of the seven different time gaps we consider ranging from 76% for the 5-year gap down to 39% for the 35-year gap, while France and Belgium are typically among the countries with the lowest correlations ranging from 13.5% to 43% in the first case and from 14% to 44% in the second case.

Table 11: Average correlations of LOP deviations by country and time gap.

	Time gaps						
country	5-year gaps	10-year gaps	15-year gaps	20-year gaps	25-year gaps	30-year gaps	35-year gaps
Austria	0.447	-	0.314	0.210	0.191	-	-
Belgium	0.442	0.294	0.189	0.141	0.184	0.300	0.246
France	0.431	0.391	0.269	0.246	0.221	0.135	0.250
Germany	0.589	0.487	0.360	0.231	0.226	0.167	0.216
Greece	0.691	0.621	0.306	0.318	0.341	0.255	-
Ireland	0.762	0.727	0.619	0.520	0.556	0.452	0.392
Italy	0.522	0.478	0.403	0.338	0.296	0.247	0.312
Luxembourg	0.545	0.430	0.279	0.211	0.200	0.306	0.287
Netherlands	0.552	0.496	0.367	0.323	0.399	0.298	0.375
Portugal	0.513	0.487	0.262	0.326	0.156	0.225	-
Spain	0.561	0.502	0.336	0.320	0.278	0.280	-
Denmark	0.677	0.633	0.451	0.335	0.275	0.231	0.212
UK	0.614	0.459	0.304	0.392	0.381	0.339	0.301
Average correl.	0.565	0.500	0.343	0.301	0.285	0.270	0.288
Number of obss	4*	2*	2*	2	2*	2*	1*

Notes: The table presents correlations between the LOP deviations of the goods in different periods for 13 EU countries. The sample is limited to tradeable goods. For comparability across time, for each period we use goods that were also available in 1990. * Exceptions to the number of observations reported in the last row of the table are as follows: for 5-year gaps - Austria (2 observations), Portugal, Spain and Greece (3 observations); for 10-year gaps - Portugal, Spain and Greece (1 observation); for 15-year gaps - Austria, Portugal, Spain and Greece (1 observation); for 25-year gap - Austria (1 observation); for 30-year gaps - Portugal, Spain and Greece (1 observation).

3.3.1 Does good-level price (dis)advantage persist over time?

Having utilized the newly created panel of individual goods over time to investigate the correlations between individual goods LOP deviations over different time horizons, we now further utilize the exact position of each individual good in the distribution of LOP deviations in order to examine whether goods tend to remain systematically cheaper or more expensive in specific countries over time.[17] That is, we trace the position of these LOP deviations for individual tradeable goods over time to infer whether the revealed price advantage of a country tends to persist over time. Persistence of LOP deviations in this case is defined as the percentage of goods which remain on the same side of the distribution (either above or below zero) in both periods of time being compared in each case. We note that the fraction of goods that are cheaper or more expensive in a specific country is suggested by the median LOP deviation presented in Table 3 for each country. Here, we investigate whether the position of a good in the distribution of LOP deviations can be informative about its persistence. We note that the median LOP deviation and persistence of LOP deviations as we define it here, have a two-way relation. That is, in an economy where goods are associated with greater (lower) persistence below than above over a sustained period of time, the median LOP deviation will tend to become negative (positive) over time. On the other hand, an economy where the median is substantially less (more) than zero will be more likely to have higher (lower) values for persistence below zero than for persistence above zero at a given point in time.

We begin by pooling LOP deviations together for all 13 EU countries available for 1985-2010, and report results in Table 12. As we can see in Table 12, persistence below is greater than persistence above for all possible years and time gaps once we correct for income differences, and for all years and time gaps with the exception of the five-year gap for 1980 and the thirty-year gap for 2005 when we do not adjust LOP deviations for income. In what follows, we will see that this holds for most countries individually as well.

In Table 13, we consider each of the 13 EU countries separately. We report measures of persistence above zero and persistence below zero, as defined in the first paragraph of this subsection. For each set of the latter measures, we also present results having removed the effect of income to better isolate the traded component of each final retail good. Again, to remove the income effect, we regress LOP deviations on income. We then compare the residuals i.e. the component of LOP deviations that excludes the effect of income. The presumption here is that income is more closely associated with the non-traded component in the basic model we consider where each good is produced by a traded input combined with a non-traded one. Even though we consider only final

[17] This analysis can then provide evidence about real exchange rate misalignments at the individual goods prices level.

Table 12: Persistence of LOP deviations by year and time gap.

gap	1980		1985		1990		2005		2010		average	
	above	below	above	below	above	below	above	below	above	below	above	below
5	0.360	0.329	0.329	0.385	0.330	0.404			0.326	0.360	0.336	0.370
10			0.305	0.351	0.324	0.372					0.315	0.361
15					0.314	0.333!	0.286	0.335			0.300	0.334
20							0.272	0.331	0.282	0.330	0.277	0.331
25							0.289	0.303!	0.278	0.333	0.283	0.318
30							0.285	0.284!	0.276	0.305	0.280	0.294
35									0.285	0.305!		
	persistence after income correction:											
	1980		1985		1990		2005		2010		average	
gap	above	below	above	below	above	below	above	below	above	below	above	below
5	0.316	0.364	0.316	0.399	0.318	0.413			0.323	0.361	0.318	0.384
10			0.260	0.389	0.310	0.377					0.285	0.383
15					0.275	0.376	0.282	0.343			0.278	0.360
20							0.275	0.343	0.279	0.338	0.277	0.341
25							0.287	0.312	0.274	0.345	0.280	0.328
30							0.258	0.320	0.268	0.312	0.263	0.316
35									0.250	0.348		

Notes: Persistence of LOP deviations is defined here as the percentage of goods which remain on the same side of the distribution (either above or below zero) in both periods of time being compared in each case. The table presents persistence of LOP deviation for all 13 EU countries pooled together. The sample is limited to tradeable goods. For comparability across time, for each period we use goods that were also available in 1990. In order to remove the income effect for the income corrected results, we regress LOP deviations on income and then utilize the residuals i.e. that part of LOP deviations that excludes the effect of income. ! - the difference between persistence above and below is not significant at the five percent level of significance. We test for this using the proportions test for the null of equality of persistence above and below.

Table 13: Persistence of LOP deviations by country and time gap relative to 2010.

country	2010-2005 gap				2010-1990 gap				2010-1985 gap			
	persistence		persistence*		persistence		persistence*		persistence		persistence*	
	above	below	above	below	above	below	above	below	above	below	above	below
Austria	0.294	0.318!	0.277	0.339	0.315	0.228	0.299	0.260!	0.360	0.209	0.333	0.240
Belgium	0.305	0.290!	0.293	0.302!	0.263	0.269!	0.226	0.297	0.330	0.249	0.300	0.271!
France	0.316	0.351!	0.326	0.333!	0.304	0.297!	0.294	0.310!	0.278	0.303!	0.266	0.307!
Germany	0.300	0.428	0.306	0.424	0.258	0.368	0.244	0.378	0.235	0.358	0.226	0.370
Greece	0.272	0.455	0.347	0.354!	0.220	0.394	0.289	0.313!	0.228	0.393	0.304	0.335!
Ireland	0.546	0.175	0.508	0.221	0.396	0.226	0.396	0.226	0.369	0.280	0.369	0.298
Italy	0.316	0.280!	0.349	0.258	0.288	0.284!	0.303	0.280!	0.250	0.323	0.259	0.310!
Luxembourg	0.321	0.366!	0.149	0.578	0.218	0.412	0.107	0.622	0.246	0.381	0.131	0.547
Netherlands	0.361	0.378!	0.332	0.407	0.291	0.353	0.271	0.388	0.225	0.408	0.211	0.474
Portugal	0.227	0.498	0.303	0.383	0.167	0.480	0.262	0.344	0.173	0.426	0.248	0.312
Spain	0.150	0.566	0.203	0.514	0.202	0.426	0.243	0.369	0.187	0.431	0.227	0.378
Denmark	0.705	0.076	0.654	0.084	0.633	0.033	0.605	0.062	0.589	0.053	0.558	0.100
UK	0.214	0.453	0.222	0.469	0.156	0.536	0.156	0.526	0.188	0.505	0.188	0.519
average	0.333	0.356	0.328	0.359	0.285	0.331	0.284	0.337	0.281	0.332	0.278	0.343

Notes: Persistence of LOP deviations is defined here as the percentage of goods which remain on the same side of the distribution (either above or below zero) in both periods of time being compared in each case. The table presents this measure of persistence for 13 EU countries. The sample is limited to tradeable goods. For comparability across time, for each period we use goods that were also available in 1990. * income corrected persistence. In order to remove the income effect we regress LOP deviations on income and then utilize the residuals i.e. that part of LOP deviations that excludes the effect of income. ! the difference between persistence above and below is not significant at the five percent level of significance. We test for this using the proportions test for the null of equality of persistence above and below.

goods that are traded, we find it useful to further decompose these recognizing the fact that there is a non-tradeable input that goes into any final retail good. The component we focus on after removing income should be more closely associated with the traded component so that the notion of price advantage we consider here will thus be plausibly closely related to trade.

Looking at the persistence values reported in Table 13, the most striking fact that emerges is that persistence below zero in the LOP deviations comparisons (a price advantage for an economy) is systematically greater than persistence above zero. This typically holds irrespective of the time gap over which the LOP deviations are being compared, and irrespective of whether one removes the effect of income or not. Denmark and Ireland are two notable exceptions with persistence above zero always greater than persistence below zero for these economies.[18]

In Table 14, we report a summary of the persistence values above and below, for all possible time gaps for every year for each country in our sample. This utilizes the information reported in Table 13 for time gaps relative to year 2010 but in addition uses all other possible year comparisons to compute an average for each of the seven distinct time gaps we can consider. The most striking fact that emerges once again is that persistence below zero in the LOP deviations comparisons (a price advantage for an economy) is systematically greater than persistence above zero.[19] This typically holds irrespective of the time gap over which the LOP deviations are being compared, and irrespective of whether one removes the effect of income or not, even though it becomes somewhat more evident in the latter case. Focusing on income-corrected LOP deviations, we note that countries like the Netherlands, the UK, Luxembourg and Germany have greater persistence below than above for all seven gaps we consider between five and thirty-five years, and the same goes for Spain for all six available gaps. This could reflect a persistent productivity or other cost advantage for tradeables.[20] As we have seen in Table 4, these five are all countries for which the median LOP deviation for tradeable goods after adjusting for income is typically less than zero. The median good will be more likely to exhibit persistence below rather than persistence above zero for these economies which is indicative of persistent price advantage. Denmark is again a notable exception

[18] These results hold also for time comparisons of the LOP deviations for 2005. While we do not report persistence values for 2005 in Table 13, we report a summary of these and all other years' results for each time gap in Table 14.

[19] This finding generally also holds when we consider only cheap goods (lowest 20% or lowest 30% of price levels) or only expensive goods (highest 20% or highest 30% of price levels), except for the 20-year gap in the case of expensive goods. As the median is systematically less than the mean LOP deviation in Table 3 for most countries, perhaps due to a few expensive goods in the sample, in order to examine whether our finding is a mere statistical artifact of this without much economic meaning we investigated whether it holds for cheap or expensive items considered separately.

[20] Interestingly, we observe (not shown in the tables) that persistence below is more evidently greater than persistence above in the case of differentiated products as compared to homogeneous ones. Moreover, this finding is robust for Germany, Luxembourg, the Netherlands and the UK but reverses for Greece Portugal and Spain once we remove the income effect, reflecting the fact that cheaper prices in the latter countries are related to lower income there while cheaper prices for differentiated products in the former countries are consistent with a price advantage due to other factors e.g. higher productivity.

Table 14: Average persistence of LOP deviations by country and time gap.

	Time gaps													
	5-year gaps		10-year gaps		15-year gaps		20-year gaps		25-year gaps		30-year gaps		35-year gaps	
country	above	below	above	below	above	below	above	below	above	below	above	below	above	below
Austria	0.358	0.282!	-	-	0.290	0.263!	0.312	0.233	0.360	0.209	-	-	-	-
Belgium	0.333	0.301!	0.303	0.276!	0.263	0.310!	0.272	0.290!	0.295	0.282!	0.288	0.313!	0.253	0.240!
France	0.380	0.290!	0.400	0.252	0.360	0.256!	0.300	0.293!	0.328	0.264!	0.343	0.199	0.387	0.182
Germany	0.343	0.382!*	0.336	0.343!	0.291	0.363!	0.233	0.392	0.249	0.313!	0.271	0.275!	0.262	0.317!
Greece	0.244	0.507	0.188	0.519	0.174	0.460	0.195	0.416	0.198	0.411	0.179	0.338	-	-
Ireland	0.363	0.399	0.256	0.460	0.318	0.370	0.375	0.223	0.381	0.258	0.282	0.259!	0.224	0.290!
Italy	0.285	0.379!	0.267	0.378	0.310	0.274!	0.312	0.293!	0.328	0.264	0.343	0.199!	0.387	0.182
Luxembourg	0.305	0.417!	0.261	0.413!	0.244	0.396	0.215	0.399	0.256	0.368	0.262	0.355!	0.236	0.285!
Netherlands	0.305	0.389!	0.277	0.391!	0.290	0.363!	0.261	0.342	0.269	0.331!	0.258	0.310!	0.205	0.368
Portugal	0.225	0.535	0.202	0.562	0.190	0.483	0.191	0.435	0.164	0.422	0.162	0.423	-	-
Spain	0.232	0.495	0.220	0.429	0.181	0.416	0.175	0.457	0.156	0.454	0.138	0.382	-	-
Denmark	0.699	0.102	0.711	0.087	0.656	0.075	0.633	0.049	0.649	0.046	0.652	0.047	0.694	0.081
UK	0.228	0.444	0.209	0.480	0.138	0.475	0.191	0.469	0.234	0.389!	0.147	0.372	0.099	0.595
Average	0.331	0.379	0.302	0.383	0.285	0.347	0.282	0.329	0.289	0.314	0.266	0.305	0.285	0.308
	Income corrected persistence													
Austria	0.328	0.303	-	-	0.267	0.280!	0.296	0.263!	0.333	0.240	-	-	-	-
Belgium	0.284	0.350!	0.249	0.346	0.239	0.365	0.248	0.315	0.264	0.334!	0.224	0.364	0.214	0.312
France	0.354	0.320!	0.353	0.306!	0.333	0.300!	0.291	0.303!	0.309	0.272!	0.329	0.218	0.372	0.190
Germany	0.323	0.407!*	0.305	0.390!	0.263	0.388	0.222	0.401	0.244	0.322!	0.262	0.287!	0.248	0.331
Greece	0.303	0.434!*	0.234	0.456	0.226	0.392	0.268	0.352!	0.264	0.358!	0.234	0.276!	-	-
Ireland	0.372	0.380!*	0.286	0.420!	0.328	0.369	0.378	0.239	0.392	0.256	0.313	0.260!	0.234	0.299!
Italy	0.301	0.363!*	0.279	0.359	0.325	0.256!	0.330	0.269!	0.240	0.317!	0.232	0.359!	0.234	0.350
Luxembourg	0.181	0.548	0.149	0.531	0.117	0.566	0.139	0.579	0.155	0.518	0.124	0.499	0.104	0.563
Netherlands	0.269	0.429	0.221	0.428	0.253	0.383!	0.236	0.379	0.256	0.396!	0.231	0.368	0.171	0.427
Portugal	0.311	0.428	0.296	0.419	0.263	0.345	0.275	0.332!	0.232	0.301	0.282	0.303!	-	-
Spain	0.285	0.445	0.257	0.351	0.232	0.369	0.217	0.399	0.200	0.379	0.184	0.322	-	-
Denmark	0.633	0.135	0.628	0.121	0.602	0.117	0.594	0.081	0.617	0.086	0.603	0.082	0.581	0.105
UK	0.230	0.459	0.211	0.480	0.145	0.479	0.182	0.475	0.227	0.407!	0.147	0.368	0.107	0.554
Average	0.321	0.385	0.289	0.384	0.276	0.354	0.283	0.338	0.287	0.322	0.264	0.309	0.252	0.348

Notes: Persistence of LOP deviations is defined here as the percentage of goods which remain on the same side of the distribution (either above or below zero) in both periods of time being compared in each case. The table presents persistence of LOP deviation for 13 EU countries.The sample is limited to tradeable goods. For comparability across time, for each period we use goods that were also available in 1990. In order to remove the income effect for the income corrected results, we regress LOP deviations on income and then utilize the residuals i.e. that component of LOP deviations that excludes the effect of income. We use the proportions test of the null of equality of persistence above and persistence below. !- the difference between persistence above and below is not significant at the five percent level of significance for at least one pair of years for this time-gap. *- the difference between persistence above and below is significant at the five percent level of significance for at least 3 out of 4 pairs of years for this time gap (or at least 2 out ot 3 pairs of years for those countries with only 3 observations listed in the footnote to Table 11).

with persistence above zero always greater than persistence below zero, that could reflect downward rigidities pertaining specifically to goods for which Denmark does not have a price advantage relative to the EZ economies.

In Table 15, we consider a broader group of EU countries, EU candidates, and other European countries to examine whether we can observe systematic differences in revealed price advantage for this diverse group of 31 countries available for 2005 and 2010.

In the first column of Table 15, we report correlations of the LOP deviations in 2010 with 2005 at the individual country level. We can see that these correlations again vary across countries with Turkey and Bulgaria having correlations equal to 78% and 71% respectively, while on the other spectrum Luxembourg and Belgium or Portugal have correlations as low as 42% and 46% respectively.

In the remaining columns of Table 15, we report measures of persistence above zero and persistence below zero, as previously defined. In this case, it becomes even more important than in the more narrow country sample to remove the effect of income on LOP deviations in order to better capture the component related to trade. Once we do this, the same tendency as in Table 13 emerges, with only four Nordic countries (Denmark, Finland, Iceland, and Norway) having a lower value for persistence below zero as compared to persistence above zero, another four countries having comparable persistence below and above (Cyprus, Ireland, Latvia, and Sweden), and the remaining 23 countries clearly having greater persistence below as compared to persistence above.

4 Conclusion

We have tried to answer a number of important questions relating to the determinants and degree of integration in the European Union, as well as the pattern and evolution of price advantage within this group of countries.

First, we have compared the overall distributions of LOP deviations before and after the process of European monetary unification, and showed that these are significantly different. This is consistent with a greater degree of integration by the end of the period under study. As we show, the distributions after the adoption of the euro are more highly peaked, characterized by higher kurtosis values. Importantly, this is the case for the new EZ member countries that adopted the common currency between 2005 and 2010.

Second, having put together a unique paned dataset, we are able to trace the position of individual goods in the distribution of LOP deviations and assess the extent to which the position of an

Table 15: Persistence of LOP deviations for 31 European countries for the 5-year time gap of 2010-2005.

country	correlation	persistence		income corrected persistence	
		above	below	above	below
Austria	0.496	0.296	0.307!	0.164	0.582
Belgium	0.455	0.307	0.291!	0.141	0.553
France	0.481	0.315	0.363!	0.191	0.592
Germany	0.536	0.299	0.417	0.139	0.597
Greece	0.662	0.282	0.459	0.290	0.447
Ireland	0.667	0.546	0.179	0.358	0.349!
Italy	0.482	0.321	0.286!	0.233	0.401
Luxembourg	0.422	0.319	0.362!	0.038	0.823
Netherlands	0.576	0.361	0.383!	0.154	0.608
Portugal	0.460	0.234	0.491	0.291	0.430
Spain	0.639	0.153	0.556	0.127	0.618
Denmark	0.542	0.707	0.075	0.456	0.197
UK	0.499	0.204	0.451	0.136	0.609
Finland	0.692	0.634	0.149	0.430	0.281
Sweden	0.572	0.504	0.158	0.298	0.320!
Cyprus	0.526	0.338	0.305!	0.335	0.305!
Malta	0.463	0.195	0.512	0.281	0.398
Slovak Republic	0.555	0.114	0.572	0.220	0.462
Slovenia	0.537	0.154	0.575	0.201	0.508
Czech Republic	0.581	0.123	0.674	0.193	0.568
Estonia	0.674	0.126	0.661	0.270	0.504
Hungary	0.587	0.089	0.726	0.226	0.484
Latvia	0.678	0.142	0.639	0.388	0.420!
Lithuania	0.663	0.147	0.656	0.312	0.454
Poland	0.660	0.066	0.770	0.191	0.594
Bulgaria	0.714	0.084	0.773	0.336	0.479
Romania	0.690	0.100	0.732	0.309	0.473
Iceland	0.466	0.576	0.083	0.419	0.184
Norway	0.695	0.824	0.050	0.548	0.195
Switzerland	0.693	0.552	0.165	0.305	0.391
Turkey	0.779	0.190	0.675	0.312	0.450
Average	0.585	0.300	0.435	0.267	0.460

Notes: Persistence of LOP deviations is defined here as the percentage of goods which remain on the same side of the distribution (either above or below zero) in both periods of time being compared in each case. The table presents this measure of persistence and correlations between the LOP deviations of the goods in different periods for 31 European countries. The sample is limited to tradeable goods. In order to remove the income effect, we regress LOP deviations on income and compare the residuals i.e. that part of LOP deviations that excludes the effect of income. !- the difference between persistence above and below is not significant at the five percent level of significance. We test for this using the proportions test for the null of equality of persistence above and below.

individual good in the distribution of LOP deviations relates to its position in previous cross-sectional distributions, and the extent to which price advantage or disadvantage persists over time. We find that LOP deviations for these goods are highly correlated, on average, over five or ten year horizons, but much less so over twenty-year or longer horizons, and that these correlations are greater for homogeneous goods as compared to differentiated ones, and vary across countries.

In addition, we find that for most of these European economies and goods, price advantage is typically revealed to be more persistent than price disadvantage. In particular, countries like Germany, Luxembourg, the Netherlands, and the UK appear to have a persistent price advantage for tradeable goods that is not related to lower income, consistent with a productivity advantage. This notion of price advantage could have implications for price competitiveness patterns across economies and goods over time that would be worth exploring deeper in future work.

Lastly, using panels of good-level prices before and after the process of European monetary unification, we have assessed the importance of different determinants of price differences within Europe before and after the process of European monetary unification. We have showed that tradeability and non-traded inputs play a significantly smaller role for cross-country dispersion after the adoption of the euro, and for EZ economies as compared to the broader group of EU economies. However, our results also suggest that the basic retail price determination model proposed in CTZ where retail goods are produced by combining a traded input with a non-traded input, retains its empirical relevance.

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