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Abstract

We use a 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 during these two periods. We find that tradeability plays a substantially smaller role in lowering cross-country dispersion after the adoption of the euro as compared to before, and that the role of non-traded inputs in raising price dispersion is also reduced after the euro. We then compare the overall and country-level distributions of law-of-one-price (LOP) deviations at the early and late part of our sample to inform us about the degree of integration across European economies before and after the euro. Our tests reveal that the distributions after the euro are significantly different than those before, consistent with a greater degree of integration. Utilizing our panel to trace the location of individual goods in the distribution of LOP deviations, we ask how the price advantage or disadvantage of individual economies evident in these price distributions has been shifting 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 the great majority 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

We use a panel of good-level prices for the period 1985-1990 and a panel for 2005-2010, in order to compare the determinants and understand the evolution of goods price dispersion across Europe before and after the completion of the process of European monetary unification. We find that tradeability plays a substantially smaller role in lowering cross-country dispersion after the adoption of the euro as compared to before, suggesting a smaller impact of trade costs on price differences. The role of non-traded inputs in raising price dispersion is also reduced, consistent with a certain degree of convergence in factor input costs and non-traded sector productivity levels for these European Union (EU) economies.

We then proceed to compare the overall and country-level distributions of LOP deviations at the early and late part of our sample. This comparison is informative about the degree of integration characterizing Europe before and after the completion of the process of European monetary unification. Our tests reveal that the distributions of LOP deviations before and after the euro are significantly different. As is evident, the density functions are characterized by a higher degree of integration after the euro as compared to the distribution functions for 1990 or 1985. However, considering individual country pairwise comparisons with Germany we infer that some Eurozone (EZ) economies like Greece, Ireland, Portugal, and Spain always have different distributions of LOP deviations than Germany throughout the period under study, whereas France and Luxembourg have similar distributions of LOP deviations to Germany after the completion of the process of European monetary unification. Among the more recent EZ economies, Cyprus and Malta appear to become more similar to Germany after joining the euro.

Finally, we utilize our panel to trace the location of individual goods in the LOP distribution in order to understand how the price advantage or disadvantage of individual economies has been shifting over time, and 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 homogeneous as compared to differentiated goods and also vary across countries. Furthermore, for the great majority of these European countries and goods, price advantage appears to be more persistent than price disadvantage.

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 validity of the basic retail price determination model proposed in CTZ, where retail goods are produced by combining a traded input with a non-traded input, before and after the euro. 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 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.

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 surverys, 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

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

where p_{ij} is the common currency price of good i in country j at time t . The common currency is the euro for the 2005-2010 sample, and the Belgian Franc (as in CTZ) for the 1975-1990 sample. N_{it} is the number of EZ countries[1] where good i is available at time t. 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

[1] We regard LOP comparisons relative to the EZ-11 mean price to be more meaningful for the purposes of this paper. These are the eleven EZ economies as of January 1st 2001 that are also present in our 1985-1990 EU sample, thus excluding Finland. This also excludes the non-eurozone EU members UK and Denmark. Including the latter two 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.

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 are 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. 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 tha can be matched over longer periods of time. As a 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 the highest 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 necessay 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 11).[2] 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

[2]This might some times present us with a potential quantity discounts problem which we cannot fully resolve (beyond adding fixed year effects) given the available information for this dataset.

the cross-country mean price level.

In Table 2 we report q_{jt}, the average q_{ijt} for each country j. We present these averages separately for goods that can be broaly categorized as traded versus non-traded for each of the six available time periods. This distinction makes it clear that poorer EU countries like Greece, Portugal and Spain are cheaper for non-tradeables and richer countries like Austria, Denmark and Germany are more expensive for non-tradeables. The picture is less clear for tradeables where some of the richer more productive (in tradeables) countries like Germany and the Netherlands, have actualy been relatively cheaper than the EZ average over the period 1985-2010. While distinguishing between tradeable and non-tradeable goods in this binary manner is useful here, in what follows we will consider that goods are characterized by differerent 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.

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.

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.

VAT differences are constructed as $v_{ht} = \sum_{j=1}^{N_t} |\ln(VAT_{hjt}) - \sum_{j=1}^{N_t}(\ln(VAT_{hjt})/N_t)|/N_t$, where for each sector h we take the average of the absolute deviations from the cross-country mean.

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 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

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.

Table 2: 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

Table 3: Explaining cross-country dispersion of LOP deviations

	1985-1990	2005-2010	
	(1)	(2)	(3)
Tradeability	-0.163***	-0.078***	-0.175***
	(0.058)	(0.023)	(0.060)
Non-traded input	0.361***	0.245***	0.425***
	(0.098)	(0.048)	(0.076)
VAT	0.076***	0.039*	0.109***
	(0.023)	(0.021)	(0.033)
Alcohol&Cigarettes	0.227***	0.086***	0.176***
	(0.019)	(0.016)	(0.020)
Time dummy	0.001	-0.010**	-0.058***
	(0.014)	(0.004)	(0.011)
Observations	1,330	1,009	1,014
Number of countries	13	13	24

Notes: *** p<0.01, ** p<0.05, * p<0.1 Robust clustered standard errors in parentheses. We estimate a model with fixed time efffects. There are 13 countries in the 1985-1990 sample and in 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.)

and non-traded factor input costs and to the production share attributable to each. Traded costs are in line with models that emphasize transport costs, with t_{ijt} (positive) negative for countries that have a price (dis)advantage in thus (import) export good i at time t. Non-traded input costs are in line with the Balassa-Samuelson hypothesis where these costs are positively 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 cross-country standard deviations $\sigma(q_{ijt})$ with α_{ht} and t_{ht}, where h is the industry in which good i belongs to, and t_{ht} is the average of t_{hjt} across countries. More specifically, we estimate the following regression equation:

$$\sigma(q_{ijt}) = \beta_1 \ln t_{ht} + \beta_2 \ln \alpha_{ht} + \beta_3 \sigma(VAT_{hjt}) + \beta_4 D_{ALC\&CIG} + \beta_5 D_t \qquad (2)$$

That is, we estimate a panel regression across i over t to explain the standard deviation of LOP deviations q_{ijt}, calculated using equation (1), with industry-level data on the tradeability of the final good as measured by international trade flows divided by total output to proxy for t_{ht}, and industry-level data on the share of non-traded inputs required for production as a proxy for α_{ht}. 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 in production, while $\hat{\beta}_2$ will be informative about the role of non-traded inputs and productivity in determining LOP deviations as per the earlier discussion in relation to the Balassa-Samuelson hypothesis above.

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 us alcohol and cigarettes typically associated with higher taxes, $D_{ALC\&CIG}$.

In column (1) of Table 3, we report results based on the 1985-1990 sample, whereas results for the 2005-2010 period are presented in the remaining columns. Column (2) presents results for the same 13 EU countries used in the 1985-1990 sample, while in column (3) 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 column (1) of Table 3 for the period 1985-1990 is -0.16 while the estimated impact during the period 2005-2010 shown in column (2) of Table 3 is -0.08 for the same 13-country sample.[3] Instead, considering a broader 24-country sample available for 2005-2010 the estimated coefficient shown in column (3) of Table 3 is -0.175. This is close to what was obtained for the 1985-1990 sample but much higher than the one for the 13-country sample of more comparable, mostly EZ, EU economies shown in column (2) of the table, suggesting that the 24-country sample is characterized by a greater degree of segmentation than the EZ.

The role of non-traded input content in raising price dispersion is reduced as we go from the 1985-1990 period to the 2005-2010 period. The impact of log non-tradedness on the cross-country standard deviation is 0.36 for 1985-1990 as shown in column (1) of Table 3, and 0.245 for the period 2005-2010 as shown in column (2) of the table for the same 13-country sample.[4] This smaller role of non-traded inputs in raising price dispersion is consistent with a certain degree of convergence in factor input costs and non-traded sector productivity levels for these EU economies over the period under study. Interestingly, the role of non-traded inputs differences is greater for the broader 24-country sample shown in column (3) of Table to equal $-.425$. This impact is greater than the one for the 13-country sample of, mostly EZ, EU economies in column (2) for 2005-2010 but also greater than the one for the 1985-1990 period shown in column (1) of the table. This suggests than non-traded input share differences play a bigger role in the broader country sample reflecting greater differences in non-traded input costs across those economies.

Finally, the impact of VAT differences and the alcohol and cigarettes dummy is positive, but

[3] This is very similar, $-.077$, using the EZ-11 country sample.

[4] The coefficient using the EZ-11 country sample is .27.

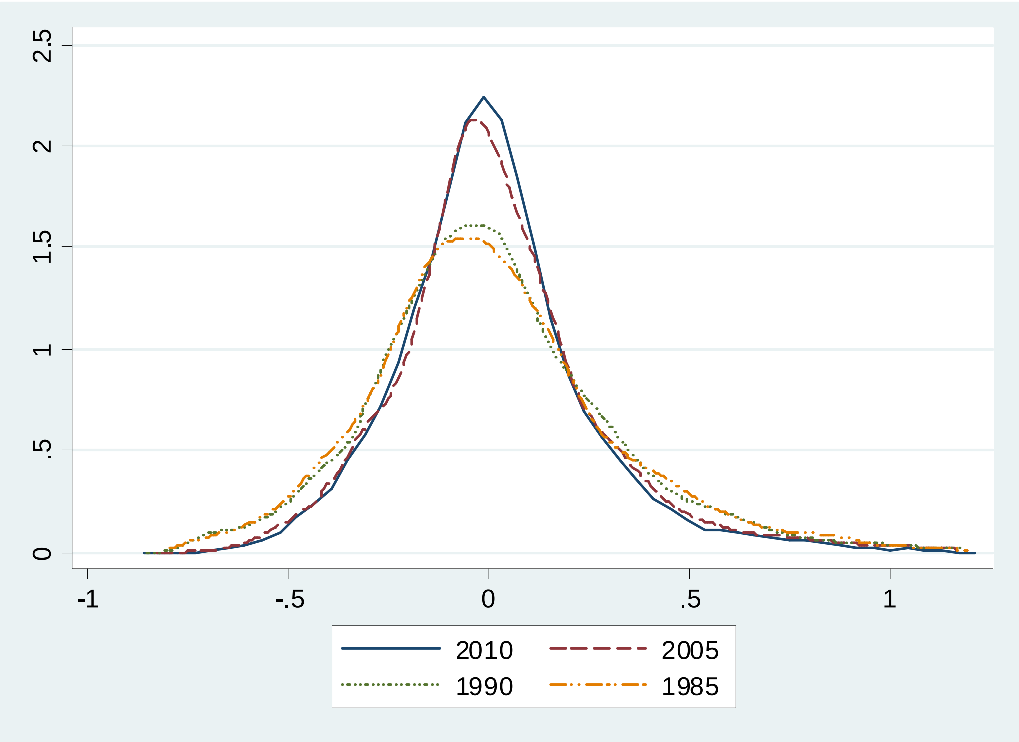

Figure 1: Empirical distributions of LOP deviations for the original 13-country sample

the importance of both of these decreases as the process of European unification intensifies over the period under study. Once again, both coefficients increase again when we consider the 24-country sample for 2005-2010 instead of the 13-country sample, suggesting that VAT and other tax differences are greater among that broader group of more highly heterogeneous countries.

In addition to reaffirming the empirical usefulness of the retail price determination model proposed in CTZ, and providing certain insights about how the process of European unification between 1990 to 2005 has affected these empirical relationships, the similarity of our qualitative findings here to those in the (repeated) cross-sections based study of CTZ suggests a sufficiently high degree of accuracy of our panel data construction procedure that was based on matching individual goods across the existing cross-sections. We then proceed to further use 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 describing the empirical density functions of LOP deviations in the next section.

Table 4: Equality of LOP deviation distributions across years

year	2005*	2005	1990	1985	1980**
2010*	0.000	-	-	-	-
2010		0.014	0.000	0.000	0.000
2005			0.000	0.000	0.000
1990				0.385	0.012
1985					0.006

Notes: We consider comparisons of LOP deviation distributions between different years. We use the Kolmogorov-Smirnov test for the null of equality of distribution functions, and report the corrected P-values. * - Comparison for ten new European countries (Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovak Republic, Slovenia). **- Austria is missing for 1980.

3.2 The distribution of LOP deviations

In this subsection, we plot and compare the density functions of the q_{ijt}, calculated using equation (1), considering the distribution across different goods for individual countries j and specific time periods t. We begin by considering the LOP deviations for the 13 countries available in each of these years, 1985, 1990, 2005 and 2010, as a group in Figure 1 before looking at the distributions for each individual country separately later on in this section. In this case, 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. As we can see in Figure 1, these density functions are more highly peaked at zero for both 2005 and 2010 as compared to 1985-1990, implying a greater degree of European integration towards the end of the sample as a result of price convergence in the decade preceeding the euro and the half-decade since its inception. 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 4, 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 or 1980.)[5] Comparing empirical distributions for periods before or after the euro that are five to ten years apart, we typically do not reject the null at the one percent level.

In addition, in Figure 2 we consider the density of LOP deviations q_{ijt}, for ten new EU 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

[5] Here, we find it useful to include the 1980 cross-section even though only 1090 goods are available in this case for twelve of the thirteen countries excluding Austria, but not 1975 since even less (658) goods are available in that case and for only nine of the thirteen countries.

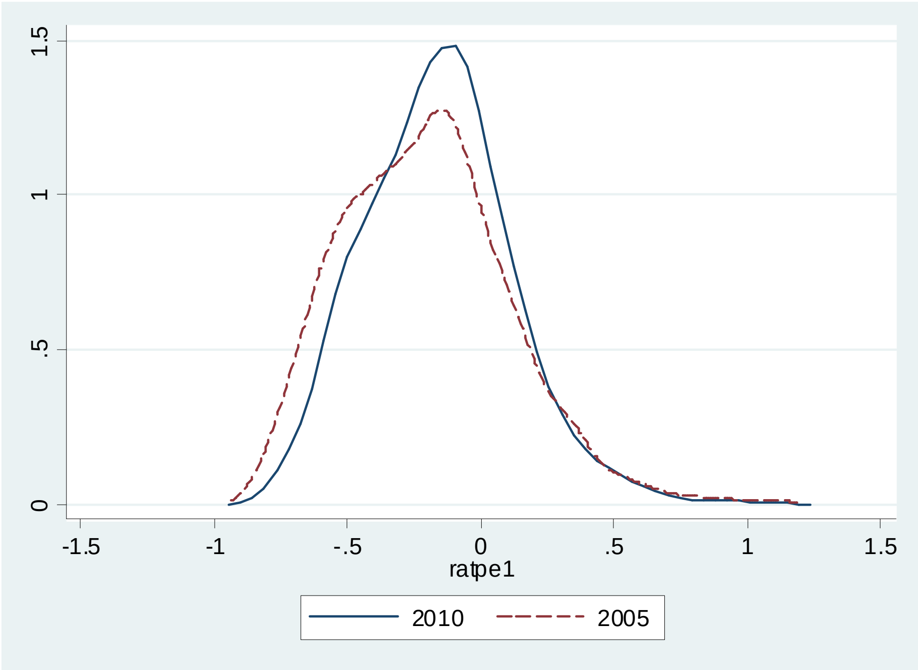

Figure 2: Empirical distributions of LOP deviations for the ten new EU countries

to the EZ-11 economies. The density function is more highly peaked at zero for 2010 as compared to 2005. Indeed, the Kolmogorov-Smirnov test in Table 4 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, the Slovak Republic, and Slovenia joined the euro during this period, we will take a closer look at the individual counry level to investigate whether convergence is more evident for countries that adopted the euro after 2005.

In Figure 3, we present the density functions for each of the 13 countries that are available for both 1985-1990 and 2005-2010. 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. Moreover, we can see that in the cases of Greece, Ireland, and Portugal there is a quite visible shift of the density function to the right suggesting that goods there became overall relatively more expensive over time. As was shown in Table 2, this comes about in part due to non-tradeables becoming relatively more expensive over time in these countries. The opposite appears to be the case for the likes of Spain, Germany, and France. As shown in Table 5, for all of these six countries the

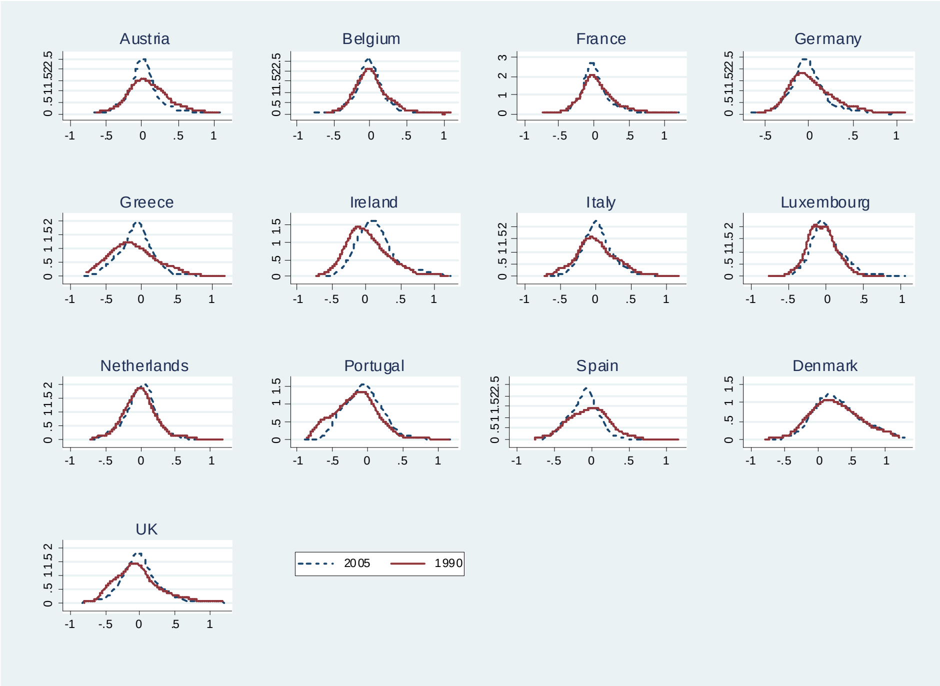

Figure 3: Empirical distributions of LOP deviations before and after the Euro

distribution is different in 2005 as compared to 1990. The same is true for the remaining countries, with the exception of Belgium and the Netherlands for which the null of equality cannot be rejected at the one percent level, and Denmark for which this null cannot be rejected even at the ten percent level.

In Figure 4, we present the density functions for each of ten new EU countries that are available for both 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. The same is true for half of the countries that did not adopt the euro during this period: the Czech Republic, Hungary, and Latvia. Considering the Kolmogorov-Smirnov tests in Table 5, we find that the null of equality can be rejected at the five percent level for each of these seven countries as well as for Estonia, Lithuania and Poland, but cannot be rejected at the one percent level of significance in the case of Malta, Hungary and Poland.

Next, we consider individual country pairwise comparisons with Germany. We compare each country with Germany, first for 1985 in Figure 5, and then for 2010 in Figure 6. A more formal comparison of the density functions for the different sample years based on the Kolmogorov-Smirnov test presented in Table 6, suggests that countries like Greece, Ireland, Portugal, Spain and Denmark

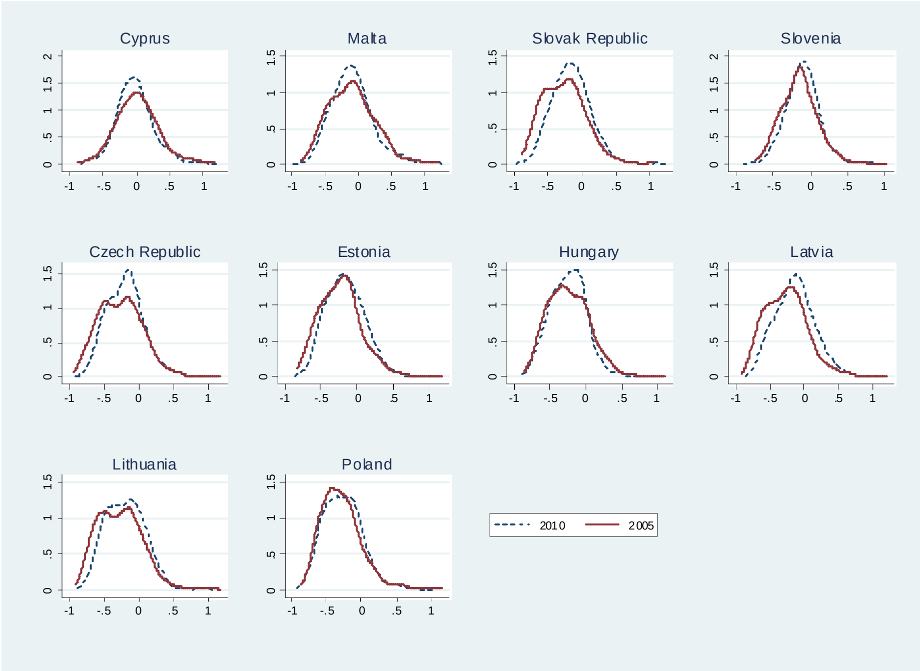

Figure 4: Empirical distributions of LOP deviations for the ten new EU countries

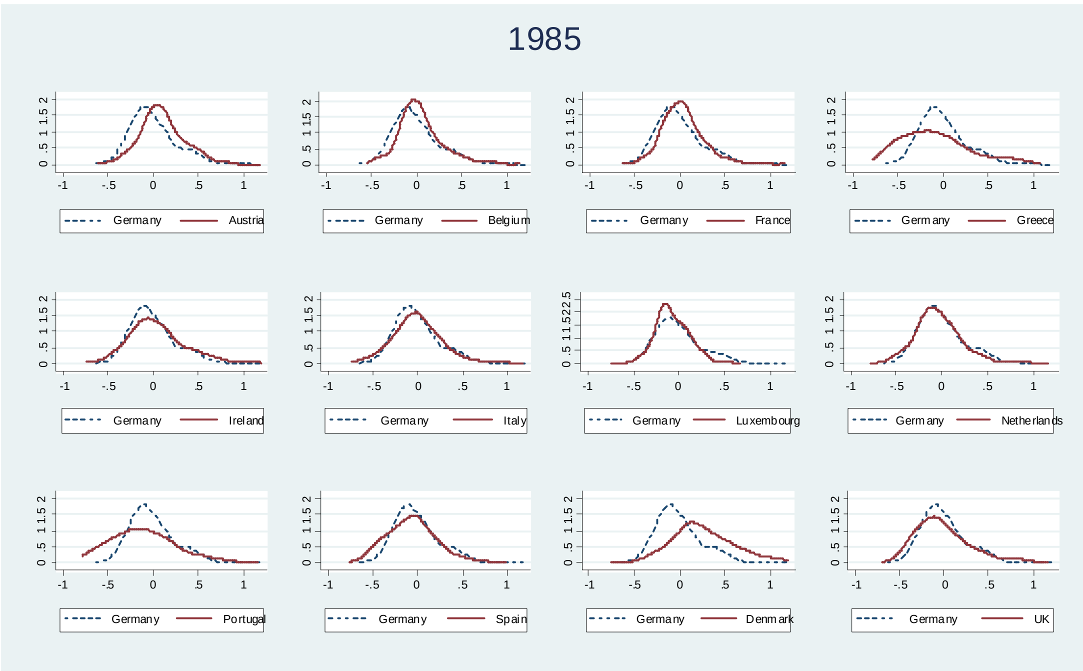

Figure 5: Pairwise comparison of LOP deviations distributions in 1985

Table 5: Equality of LOP deviation distributions across years for every country

country		2005	1990	1985	1980
Austria	2010	0.945	0.000	0.000	-
	2005		0.000	0.000	-
	1990			0.059	-
	1985				-
Belgium	2010	0.000	0.000	0.000	0.001
	2005		0.041	0.000	0.006
	1990			0.115	0.064
	1985				0.411
France	2010	0.485	0.010	0.060	0.000
	2005		0.000	0.006	0.000
	1990			0.256	0.000
	1985				0.000
Germany	2010	0.197	0.000	0.000	0.000
	2005		0.000	0.000	0.000
	1990			0.015	0.020
	1985				0.000
Greece	2010	0.000	0.000	0.000	0.000
	2005		0.000	0.000	0.000
	1990			0.451	0.568
	1985				0.083
Ireland	2010	0.027	0.000	0.001	0.000
	2005		0.000	0.000	0.000
	1990			0.534	0.030
	1985				0.003
Italy	2010	0.000	0.000	0.004	0.000
	2005		0.000	0.000	0.000
	1990			0.258	0.000
	1985				0.000
Luxembourg	2010	0.160	0.000	0.000	0.062
	2005		0.000	0.000	0.258
	1990			0.191	0.000
	1985				0.000

country		2005	1990	1985	1980
Netherlands	2010	0.047	0.283	0.000	0.065
	2005		0.038	0.000	0.355
	1990			0.000	0.267
	1985				0.000
Portugal	2010	0.040	0.000	0.000	0.000
	2005		0.000	0.000	0.000
	1990			0.000	0.004
	1985				0.662
Spain	2010	0.373	0.000	0.001	0.000
	2005		0.000	0.000	0.000
	1990			0.014	0.158
	1985				0.744
Denmark	2010	0.562	0.059	0.267	0.171
	2005		0.135	0.488	0.787
	1990			0.768	0.377
	1985				0.082
UK	2010	0.000	0.000	0.000	0.000
	2005		0.001	0.001	0.129
	1990			0.453	0.000
	1985				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 use the Kolmogorov-Smirnov test for the null of equality of distribution functions, and report the corrected P-values.

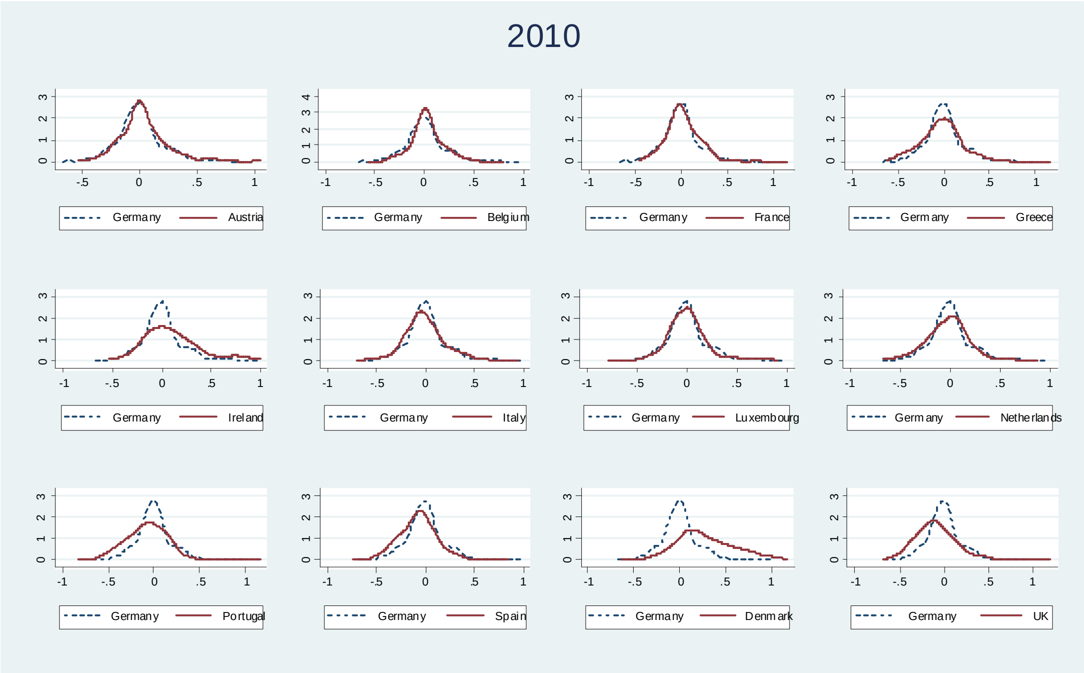

Figure 6: Pairwise country comparison of LOP deviations distributions in 2010

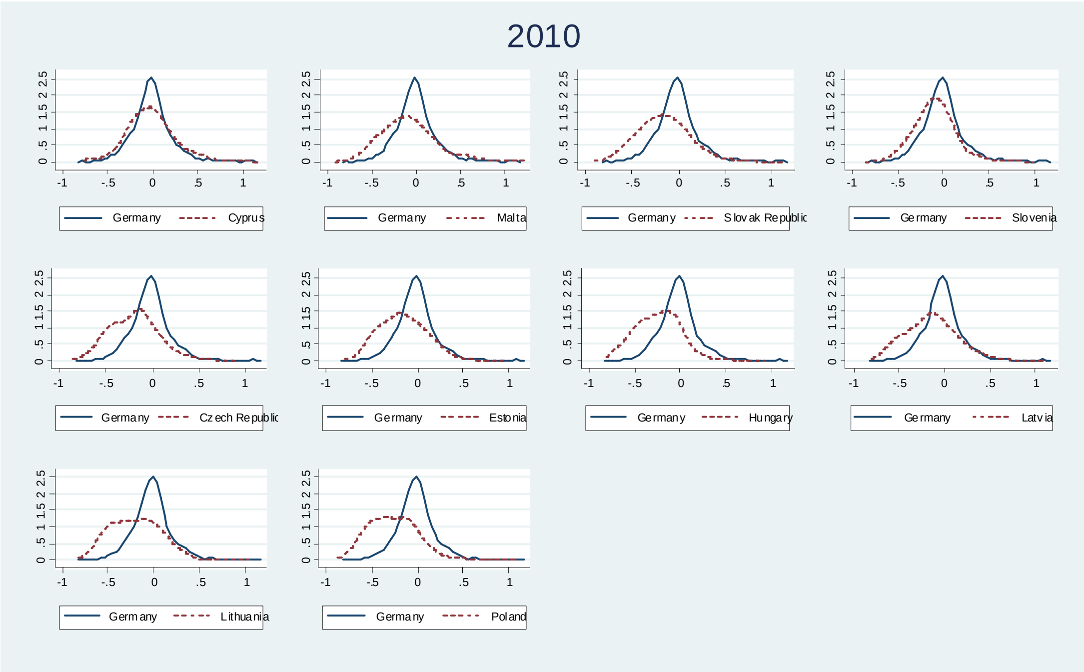

Figure 7: Pairwise country comparison of LOP deviations distributions for the ten new EU countries in 2010

Table 6: Equality of LOP deviation distributions across countries

country	2010	2005	1990	1985	1980
Austria	0.032	0.000	0.000	0.003	-
Belgium	0.001	0.232	0.089	0.000	0.005
France	0.180	0.201	0.003	0.000	0.046
Greece	0.004	0.000	0.000	0.000	0.000
Ireland	0.000	0.000	0.002	0.003	0.000
Italy	0.027	0.000	0.089	0.110	0.000
Luxembourg	0.725	0.236	0.000	0.000	0.001
Netherlands	0.013	0.001	0.026	0.132	0.012
Portugal	0.000	0.000	0.000	0.000	0.000
Spain	0.000	0.000	0.000	0.000	0.000
Denmark	0.000	0.000	0.000	0.000	0.000
UK	0.000	0.008	0.000	0.002	0.422
Cyprus	0.017	0.000	-	-	-
Malta	0.013	0.002	-	-	-
Slovak Republic	0.000	0.000	-	-	-
Slovenia	0.000	0.000	-	-	-
Czech Republic	0.000	0.000	-	-	-
Estonia	0.000	0.000	-	-	-
Hungary	0.000	0.000	-	-	-
Latvia	0.000	0.000	-	-	-
Lithuania	0.000	0.000	-	-	-
Poland	0.000	0.000	-	-	-

Notes: We consider comparisons of LOP deviation distributions between Germany and each one of the other countries. We use the Kolmogorov-Smirnov test for the null of equality of distribution functions, and report the corrected P-values.

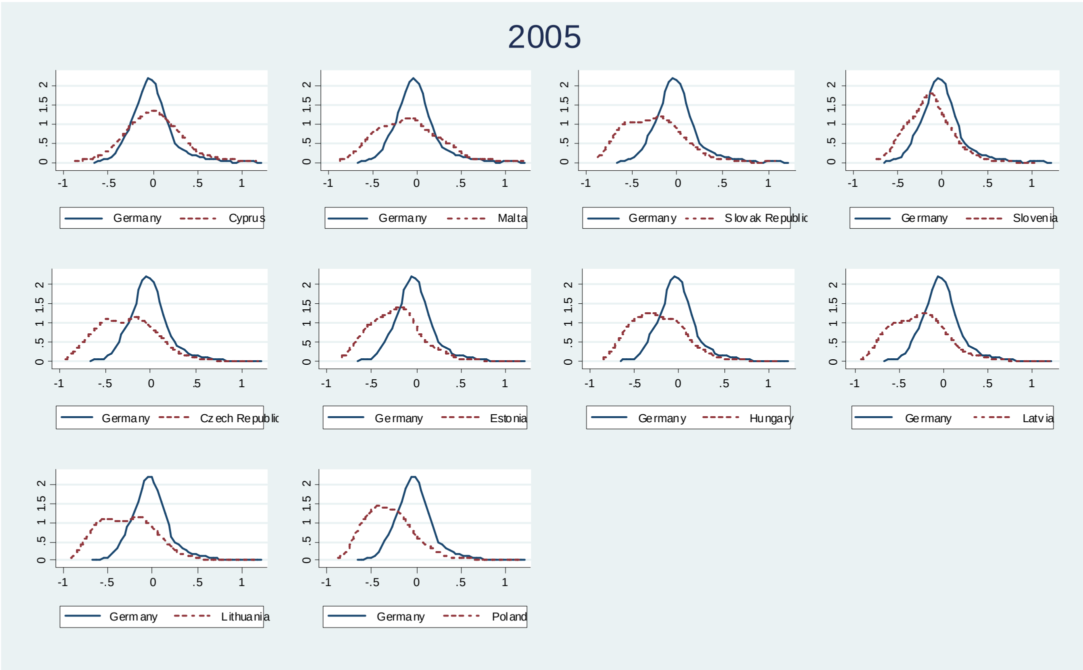

Figure 8: Pairwise country comparison of LOP deviations distributions for the ten new EU countries in 2005

consistently have different LOP deviations density functions than Germany, whereas France and Luxembourg have similar distributions of LOP deviations to Germany after the completion of the process of European monetary unification. Overall, the null of equality could not be rejected at the one percent level for five of the countries in 2010 as compared to two of the countries in 1985.

Figures 7 and 8 present the comparison of the density functions for ten new EU entrants for 2010 and 2005, respectively. As shown in Table 6, whereas the null of equality is rejected for each of the ten countries at the one percent level of significance in 2005, this null cannot be rejected for Cyprus and Malta by 2010 after both of them adopted the euro in 2008. That Cyprus and Malta appear to become more similar to Germany between 2005 and 2010, might be suggestive of integration being faster for monetary union countries.

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

In this subsection, we consider the correlation between LOP deviations of individual goods in different time periods. This becomes possible as we have linked the cross-sections available to us by matching individual goods prices over time. Here, we 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 only 658 goods for only 9 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 somewhat problematic.

We present the overall (over all goods and countries) correlations between the LOP deviations of the goods in different periods in Table 7. These correlations are calculated by stacking the LOP deviations in an ordered vector according to the matched goods id by country for one period, then do the same for the exact same goods and countries ordered in the same manner for a second period, and calculate the correlation between any two such ordered vectors (periods). 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 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. 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 7 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 at 62%. Similarly, persistence is high at ten year horizons, averaging at 55%. Considering longer horizons, the mean correlations fall to 35% or 34% after removing the effect of income for twenty-year time gaps and 32% for thirty-year time-gaps. The tendency for these correlations to fall over time is evident in Figure 9 which graphs these.

In Table 8, 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. In the first six columns of Table 8, we consider only homogeneous goods and in the last six columns of the table we consider differentiated 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% for homogeneous goods and 53% for differentiated ones, while at the ten-year horizon these fall to 61% and 46% respectively. At a twenty-year horizon,

Table 7: Correlation of cross-country good-by-good LOP deviations

	Correlations						Correlations with 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	

Notes: The table represents LOP deviation correlations for different periods of time. The sample is limited to tradeable goods, 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. that part of LOP deviatons that excludes the effect of income.

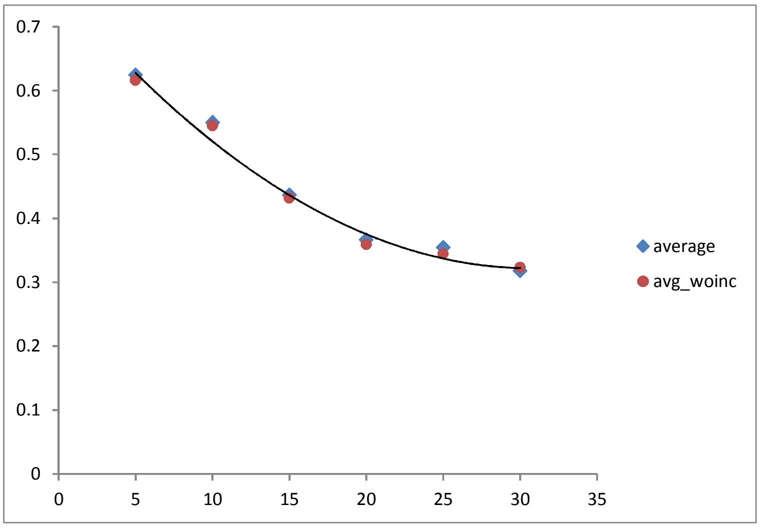

Figure 9: Price persistence for different time gaps length

Table 8: 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	

Notes: The table represents LOP deviation correlations for different periods of time 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 by tradeable goods available in 1990. We specify type of goods according to the Rauch index.

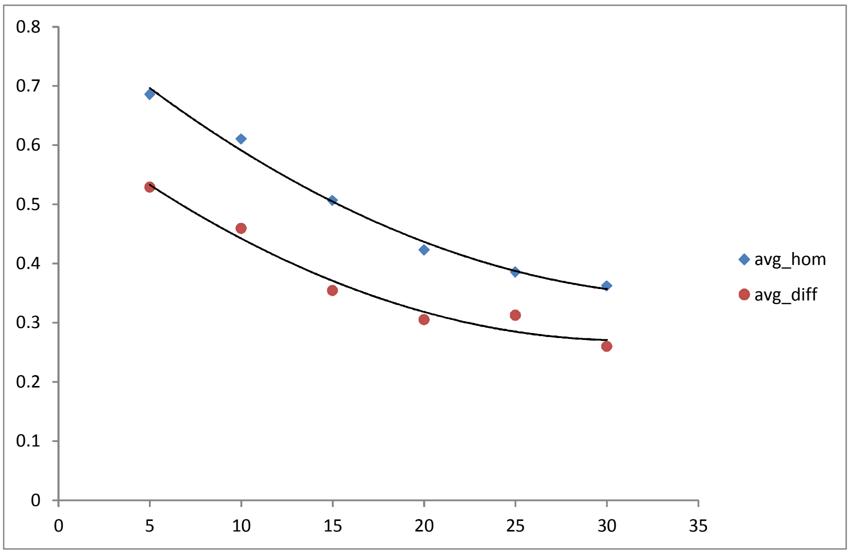

Figure 10: Price persistence for different time gaps length and different types of goods

Table 9: Persistence of cross-country LOP deviations by country

country	2010-2005					2010-1990					2010-1985				
	correl.	persistence		persistence*		correl.	persistence		persistence*		correl.	persistence		persistence*	
		above	below	above	below		above	below	above	below		above	below	above	below
Austria	0.511	0.294	0.318	0.277	0.339	0.250	0.315	0.228	0.299	0.260	0.191	0.360	0.209	0.333	0.240
Belgium	0.449	0.305	0.290	0.293	0.302	0.157	0.263	0.269	0.226	0.297	0.080	0.330	0.249	0.300	0.271
France	0.441	0.316	0.351	0.326	0.333	0.198	0.304	0.297	0.294	0.310	0.132	0.278	0.303	0.266	0.307
Germany	0.549	0.300	0.428	0.306	0.424	0.192	0.258	0.368	0.244	0.378	0.281	0.235	0.358	0.226	0.370
Greece	0.633	0.272	0.455	0.347	0.354	0.335	0.220	0.394	0.289	0.313	0.287	0.228	0.393	0.304	0.335
Ireland	0.679	0.546	0.175	0.508	0.221	0.529	0.396	0.226	0.396	0.226	0.559	0.369	0.280	0.369	0.298
Italy	0.463	0.316	0.280	0.349	0.258	0.350	0.288	0.284	0.303	0.280	0.280	0.250	0.323	0.259	0.310
Luxembourg	0.418	0.321	0.366	0.149	0.578	0.200	0.218	0.412	0.107	0.622	0.250	0.246	0.381	0.131	0.547
Netherlands	0.569	0.361	0.378	0.332	0.407	0.470	0.291	0.353	0.271	0.388	0.422	0.225	0.408	0.211	0.474
Portugal	0.455	0.227	0.498	0.303	0.383	0.404	0.167	0.480	0.262	0.344	0.177	0.173	0.426	0.248	0.312
Spain	0.635	0.150	0.566	0.203	0.514	0.402	0.202	0.426	0.243	0.369	0.281	0.187	0.431	0.227	0.378
Denmark	0.580	0.705	0.076	0.654	0.084	0.245	0.633	0.033	0.605	0.062	0.248	0.589	0.053	0.558	0.100
UK	0.536	0.214	0.453	0.222	0.469	0.425	0.156	0.536	0.156	0.526	0.427	0.188	0.505	0.188	0.519

Notes: Persistence of LOP deviations 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. The table represents correlations and persistence of LOP deviation for 13 EU countries. The sample is limited by tradeable goods, which are set to be the same as in 1990 for all other years. * 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 mean correlations for homogeneous goods fall to 42.3% as compared to 30.5% for differentiated ones, and at the thirty-year horizon these mean correlations fall to 36% and 26% respectively. Both the falling tendency of mean correlations of individual LOP deviations and the distinct difference between the correlations for homogeneous versus differentiated goods are evident in Figure 10.

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 indvidual 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. 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.

In Table 9, we consider the sample of 13 EU countries available for each of 1985, 1990, 2005 and 2010. First, we report correlations of the LOP deviations in 2010 with each of these other three years at the individual country level. These correlations are calculated as follows: for each country, we order the goods LOP deviations by id 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). In addition, we report measures of persistence above zero and persistence below zero, as defined above. 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. To remove the income effect, we regress LOP deviations on income. We then compare the residuals i.e. that part 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 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.

A number of facts are evident from Table 9 at the individual country level. First, with rare exceptions, the correlations between LOP deviations for individual goods for each country decline as we increase the gap between the years that are being compared from five to twenty or twenty-five years. Second, the correlations of LOP deviations across time periods vary across countries. Ireland has the highest correlation for the comparison of LOP deviations between 2010 and 2005 (68%), but also for the 2010-1990 (53%) and the 2010-1985 (56%) comparisons. The Netherlands and the UK also have consistently high correlations. On the other hand, Luxembourg, France, and Belgium consistently have some of the lowest correlations for 2010-2005 (ranging from 42% to 45%), 2010-1990 (16% to 20%) and for 2010-1985 (8% to 25%.)

Looking now at the persistence values reported in Table 9, 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.

In Table 10, 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

Table 10: Persistence of cross-country LOP deviations between 2010 and 2005 for 31 European countries

country	correlation	persistence		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

Notes: Persistence of LOP deviations 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. The table represents LOP deviation correlations and persistence for 31 European countries. The sample is limited to tradeable goods. * income corrected persistence. 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.

10, 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 10, 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 9 emerges, with only four Nordic countries (Denmark, Finland, Iceland, and Norway) countries 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

Using a panel of good-level prices before and after the process of European monetary unification, we have tried to understand and compare the determinants and the distributions of LOP deviations across Europe before and after the euro. We find that tradeability plays a substantially smaller role in lowering cross-country dispersion after the adoption of the euro as compared to before, and that the role of non-traded inputs in raising price dispersion is also reduced after the euro. Comparing the overall distributions of law-of-one-price (LOP) deviations before and after the euro, we have shown that these are significantly different, consistent with a greater degree of integration by the end of the period under study.

Utilizing our panel to trace the location of individual goods in the distribution of LOP deviations, we have asked how the price advantage or disadvantage of individual economies has been shifting over time. We have shown 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. Finally, we have shown that for the great majority of these European economies and goods, price advantage is typically revealed to be more persistent than price disadvantage.

References

[1] Allington, Nigel F.B. , Paul A. Kattumanz, and Florian A. Waldmannx (2005) "One Market, One Money, One Price? Price Dispersion in the European Union," *International Journal of Central Banking* 1(3), 73-115.

[2] Chen, Natalie (2004) "The Behaviour of Relative Prices in the European Union: A Sectoral Analysis," *European Economic Review*, 48(6), 1257-1286.

[3] Christian Dreger, Konstantin Kholodilin, Kirsten Lommatzsch, Jirka Slacalek, and Przemyslaw Wozniak, 2007. "Price Convergence in the Enlarged Internal Market," European Economy - Economic Papers 292, Directorate General Economic and Monetary Affairs (DG ECFIN), European Commission

[4] Corsetti, Giancarlo, John Flemming, Seppo Honkapohja, Willi Leibfritz, Gilles Saint-Pau, Hans-Werner Sinn, and Xavier Vives (2002) "Prices, Wages and Inflation after the Euro - What Europeans Should or Should not Expect," *EEAG Report on the European Economy*, CESifo Group Munich, vol. 0, p. 48-56.

[5] Crucini, Mario, Chris Telmer, and Marios Zachariadis, (2005) "Understanding European Real Exchange Rates," *The American Economic Review* 95:3 724-738.

[6] Faber, RP and Stokman ACJ (2009) "A Short History of Price Level Convergence in Europe" *Journal of Money Credit and Banking*, 41 (2-3) 461-477.

[7] Fischer, Christoph (2012) "Price convergence in the EMU? Evidence from micro data", *European Economic Review* volume 56, issue 4, year 2012, pp. 757 - 776.

[8] Friberg, Richard (2003) "Common Currency, Common Market?" *Journal of the European Economic Association*, 1(2-3): 650-661.

[9] David Guerreiro and Mignon, Valerie (2012) "On price convergence in Eurozone" unpublished manuscript, University of Paris Ouest and CEPII, Working Papers 2011-34, University of Paris West.

[10] Hoeberichts, Marco and Ad Stokman (2011) "Price dispersion in Europe: Does the business cycle matter?" DNB Working Paper No. 285.

[11] Honohan, Patrick and Philip Lane (October 2003) "Divergent Inflation Rates in EMU," *Economic Policy*, 18(37): 357-394.

[12] Inanc, Ozlem and Marios Zachariadis (2012) "The Importance of Trade Costs in Deviations from the Law of One Price: estimates based on the Direction of Trade," *Economic Inquiry* 50:3 667-689.

[13] Palenmark, Sirly (May 2004) "Differences in Relative Prices in the EU," unpublished manuscript, Lund University.

[14] Pellinyi, Gabor (2007) "The Relationship between Relative Productivity and Price Levels in Europe," Working Paper No. 33 ICEG European Center.

[15] Rogers, J.H. (2007) "Monetary union, price level convergence, and inflation: How close is Europe to the USA?" *Journal of Monetary Economics*, 54 (3), 785-796.

[16] Holger, Wolf (2003) "Prices and EMU," *HM Treasury*, Crown Copyright.

[17] Wolszczak-Derlacz J., and Rembert De Blander (2009) "Price convergence in the European Union and in the New Member States," Bank i Kredyt, National Bank of Poland, Economic Institute, vol. 40(2), pages 37-59.

[18] Zd'arek V (2008) "Some thoughts on Nominal Convergence, its drivers and Determinants for the new EU Member States preparing the EURO adoption" *Prague Economic Papers* 17(4) 291-318.

Table 11: Sample record from concordance file for cross-section good matching

match	descr1985	Q85	adj85	descr1990	Q90	adj90	descr2005	Q05	adj05	descr2010	Q10	adj10
1	Long grained rice- in carton	500G	2	Rice long-grained, packed in cartons	1kg	1	Rice, long-grain, Parboiled; 400-600g, cooking time < 10min. / WKB	1000g	1	Long-grain rice, parboiled, WKB	1000g	1
5	Long grained rice - selected brand	400G	2.5	Rice long-grained, specified brand	1kg	1				Long-grain rice, parboiled, SP	1000g	1
12	Wheat flour - without vitamins	1KG	1	Wheat flour	1kg	1	Wheat flour, all-purpose flour, 750 - 1000 g / WKB	1000g	1	Wheat flour, WKB	1000g	1
16	Flaked oats - without vitamins	400G	2.5	Flaked oats, not vitamin enriched	1kg	1	Flaked oats, for cooking, 500 - 1000 g / WKB	500g	2	Flaked oats for cooking, WKB	1000g	1
17	Flaked oats - with vitamins	400G	2.5	Flaked oats, vitamin enriched	1kg	1						
21	Long thin french loaf - white, not prewrapped, not sliced	250G	4	French white bread, neither wrapped nor sliced	1kg	1	Baguette, not industrially prepacked, 200-300g / —	500g	2	Baguette	200g	5
26	White bread - not wrapped, not slic	250G	4	Wholemeal bread, neither wrapped nor sliced	1kg	1						