Department of Economics

Understanding International Price Level Dispersion and Price Convergence

DOCTOR OF PHILOSOPHY DISSERTATION

Marina Glushenkova

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UNDERSTANDING INTERNATIONAL PRICE LEVEL DISPERSION AND PRICE CONVERGENCE

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The present Doctoral Dissertation was submitted in Partial Fulfillment for the Degree of Doctor of Philosophy at the ***Department of Economics*** *and was approved on the 22.01.2016 by the members of the* ***Examinations Committee****.*

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DECLARATION OF DOCTORAL CANDIDATE

The present doctoral dissertation was submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy of the University of Cyprus. It is a product of original work of my own, unless otherwise mentioned through references, notes, or any other statements.

Marina Glushenkova

Περίληψη

Η παρούσα διατριβή διερευνά τις διαφορές τιμών στην ΕΕ και την ύπαρξη ομάδων σύγκλισης τιμών σε όλη την υδρόγειο. Πρώτα, εξετάζουμε τους καθοριστικούς παράγοντες και την εξέλιξη της διασποράς τιμών των εμπορευμάτων σε όλη την Ευρώπη με την πάροδο του χρόνου. Βρίσκουμε ότι η εμπορευσιμότητα και οι μη – εμπορεύσιμες εισροές παίζουν σημαντικά μικρότερο ρόλο στην διασπορά τιμών μεταξύ των χωρών μετά την υιοθέτηση του ευρώ, και για τις οικονομίες στην Ευρωζώνη (ΕΖ) σε σύγκρισή με αυτά της Ευρωπαϊκής Ένωσης (ΕΕ). Στην συνέχεια, συγκρίνουμε τις κατανομές των αποκλίσεων του νόμου της μιας τιμής (LOP) με την πάροδο του χρόνου και ανακαλύπτουμε ότι οι κατανομές μετά την υιοθέτηση του ευρώ είναι συνήθως στατιστικά διαφορετικές σε σύγκριση με αυτά πριν την υιοθέτηση, συνεπής με την ολοκλήρωση σε μεγάλο βαθμό. Επιπλέον, διαπιστώνουμε ότι οι αποκλίσεις του νόμου μιας τιμής (LOP) συσχετίζονται σημαντικά για τους ορίζοντες των πέντε ή δέκα ετών, και οι συσχετίσεις παραμένουν σημαντικά υψηλές για μεγάλους χρονικούς ορίζοντες. Αυτές οι συσχετίσεις είναι μεγάλες για ομοιογενείς σε σχέση με τα διαφοροποιημένα αγαθά, και ποικίλουν από χώρα σε χώρα. Για τις περισσότερες αυτές ευρωπαϊκές οικονομίες και αγαθά, πλεονέκτημα τιμής συνήθως φαίνεται να είναι πιο επίμονο από ότι μειονέκτημα τιμής.

Κατόπιν, εξετάζουμε τις αποκλίσεις από τον νόμο μίας τιμής για την περίπτωση της Κύπρου σε σχέση με την Ευρωπαϊκή Ένωση (Ε.Ε.) μεταξύ 2005 και 2010 για να κατανοήσουμε το ρόλο που διαδραματίζει η διαδικασία υιοθέτησης του ευρώ για αυτή τη συγκεκριμένη χώρα. Συμπεραίνουμε ότι πρώτον, η Κυπριακή οικονομία παρουσίασε σημαντικά αυξημένο βαθμό ολοκλήρωσης εν σχέση με χώρες της Ε.Ε. μεταξύ 2005 και 2010, και δεύτερον, η Κύπρος έγινε σχετικά φθηνότερη κατά αυτήν την περίοδο. Από το 2010 η εμπειρική κατανομή αποκλίσεων από τον νόμο μίας τιμής για την Κύπρο γίνεται στατιστικά ίδια με αυτή χωρών του πυρήνα της ΕΖ όπως η Γερμανία. Αυτό συνάδει με ένα γρήγορο ρυθμό προσαρμογής των σχετικών τιμών κατά την διαδικασία υιοθέτησης του ευρώ, καταδεικνύοντας και τον ψηλό βαθμό προσαρμοστικότητας της Κυπριακής οικονομίας.

Τέλος, εξετάζουμε την ύπαρξη ομάδων σύγκλισης στον μηχανισμό τιμών της κάθε χώρας για 96 αγαθά σε επίπεδο τιμών λιανικής πώλησης για 40 χώρες όπου τα δεδομένα είναι διαθέσιμα σε εξαμηνιαία βάση από 1990 – 2010, χρησιμοποιώντας μη γραμμικό μοντέλο παράγοντα και εργαλεία παλινδρόμησης ορίων (threshold regression). Αυτό το άρθρο είναι το πρώτο, το οποίο βρίσκει ισχυρή ένδειξη για την ύπαρξη ομάδων σύγκλισης για τιμές λιανικής πώλησης . Βρίσκουμε ότι οι

χώρες οι οποίες είναι πιο κοντά στους πιθανούς εμπορικούς εταίρους συγκλίνουν ταχύτερα από ότι οι χώρες στον τομέα της υψηλής απόστασης αν η αρχική παραγωγικότητα εργασίας είναι χαμηλή ή αν έχουν χαμηλό αρχικό εισόδημα, και οι χώρες με χαμηλή αρχική παραγωγικότητα εργασίας συγκλίνουν ταχύτερα από ότι οι χώρες που βρίσκονται στο τομέα υψηλής παραγωγικότητας αν χαρακτηρίζονται από χαμηλή μέση απόσταση από τους εμπορικούς εταίρους. Ερμηνεύουμε τα αποτελέσματα μας ως ένδειξη για την ύπαρξη τοπικού νόμου της μιας τιμής λόγω της ύπαρξης εμπόδιων για την σύγκλιση τιμών τα οποία επηρεάζουν την διάρκεια της επίδρασης διαταραχών των τιμών.

Abstract

The present dissertation investigates price differences in the EU and the existence of price convergence clubs across the globe. First, we study the determinants and 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 and reveal that the distributions after the euro are typically significantly different than those before, consistent with a greater degree of integration. Moreover, we find that LOP deviations are highly correlated over five or ten year horizons, and correlations remain significantly high over longer horizons. These correlations are greater for homogeneous as compared to differentiated goods, and vary across countries. For most of these European economies and goods, price advantage is typically revealed to be more persistent than price disadvantage.

Then, we analyse cross-sectional LOP deviations for the case of Cyprus relative to the EU in 2005 and 2010 in order to understand the role played by the process of monetary unification for this particular economy. We infer that Cyprus became significantly more integrated with EU economies between 2005 and 2010, and relatively cheaper during this period. By 2010, the empirical distribution for Cyprus becomes statistically indistinguishable from that of core EZ economies like Germany, implying a fast pace of relative price adjustment for Cyprus during the process of euro adoption and indicative of the high degree of flexibility characterizing the Cypriot economy.

Finally, we investigate the existence of convergence clubs in the cross-country price mechanism for 96 individual goods retail price levels across 40 countries available semi-annually for 1990-2010, using a nonlinear factor model and threshold regression tools. This is the first paper to find strong evidence for club convergence of retail prices. We find that countries that are physically closer to potential trade partners converge faster than countries in the high distance regime if they have low initial labor productivity or low initial income, and countries with low initial productivity converge faster than those in the high productivity regime if characterized by low average distance from trade partners. We interpret our findings as evidence of a local law of one price due to barriers to price convergence that influence the duration of the effect of price shocks.

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Introduction

What is the importance of different determinants of price differences within Europe before and 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? Do retail prices for individual goods across countries globally converge to a single price or diverge? Do countries form price convergence clubs? If yes, how do these convergence clubs vary across industries? What are the factors that determine these clubs and act as barriers to global price convergence? 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. Moreover, this dissertation contributes to the long-standing debate about price convergence by investigating the existence of club convergence in prices and sheds more light on the determinants of convergence clubs.

In the first essay "Understanding post-Euro Law-of-One-Price Deviations", written in association with Marios Zachariadis, we attempt to offer some answers to the above questions. 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 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 changes in the degree of integration across European economies over time. Finally, utilizing our panel 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.

We continue our analysis and focus on cross-sectional LOP deviations for the case of Cyprus relative to the EU in 2005 and 2010 to understand the role played by the process of monetary unification for this particular economy. The results of this study are presentes in our joint work with Marios Zachariadis "Cypriot LOP deviations Before and After the Euro". Comparing the densities of law-of-one-price (LOP) deviations for Cyprus relative to other Eurozone (EZ) and non-EZ EU economies before and after it adopted the euro, informs us about the changing degree of integration of Cyprus with other EU economies during this important period. We infer that Cyprus (a) became significantly more integrated with EU economies between 2005 and 2010, and (b) the Cypriot distribution of LOP deviations relative to these economies shifted to the left. By 2010, the empirical distribution for Cyprus becomes statistically indistinguishable from that of core EZ economies like Germany, implying a fast pace of relative price adjustment for Cyprus during the process of euro adoption and indicative of the high degree of flexibility characterizing the Cypriot economy.

In the third essay, written in co-authorship with Andros Kourtellos and Marios Zachariadis, we use semi-annual micro price level data for 40 countries and 96 goods and services over the period 1990-2010 and investigate the possibility of clustering in an attempt to identify convergence clubs. We find evidence of meaningful convergence clubs in the cross-country price mechanism. This means that there exists a tendency for prices across countries with identical structural characteristics to converge to one another if their initial prices are in the basin of attraction of the same steady-state equilibrium. We investigate the existence of convergence clubs using the nonlinear time-varying heterogeneous factor model proposed by Phillips and Sul (2007). Using the concept of "relative" convergence, we find ample evidence of lack of global convergence in the form of convergence clubs for nearly all 96 goods. To the extent that price convergence occurs within country clubs, we also try to identify what factors drive this process. In order to better understand determinants of price convergence clubs, we employ a threshold regression methodology proposed by Hansen (2000) using as threshold variables proxies of the traded and non-traded components of a final good, and provide estimates of convergence rates to LOPs. We find no evidence of global conditional β-convergence, but uncover the presence of local β-convergence as evidenced by club convergence within meaningful groups of countries in our sample. The latter is present in all revealed regimes regardless of the choice of threshold variable. Importantly, we uncover the existence of multiple price regimes that are characterized by factors that influence the respective traded and non-traded components of a good such as geography on the one side, and labor productivity, local input costs or economic development on the other side. Clubs are formed due to the interaction of these traded and non-traded factors.

Chapter 1

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

1.1 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 in the period 2005-2010, 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 (Cyprus, Malta, the Slovak Republic and Slovenia) involves a comparison of the distributions for 2005 versus 2010. Our tests reveal that the distributions of LOP deviations are significantly different between 1985-1990 and 2005-2010. As is evident, the density functions are characterized by a higher degree of integration with higher kurtosis and lower cross-country dispersion in 2005 and 2010 as compared to the period 1985-1990. The density functions of the four new EU members that adopted the euro between 2005 and 2010 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. Moreover, inflation for the new EZ members was lower than for the new non-EZ EU members during this period, suggesting that euro introduction did not coincide with price increases relative to non-adopters, contrary to popular belief but consistent with Parsley and Wei (2008).

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. In fact, the location of individual goods' prices in the distribution of LOP deviations persists for decades, with significant correlations of around fifty and around thirty percent respectively one and three decades later. Furthermore, these correlations are greater for 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.[1] Similar models emphasizing the importance of

[1] 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,

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 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 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. Parsley and Wei (2008) using a narrow set of comparable product items across the EU found little effect of the euro introduction for price level convergence. On the other hand,

emphasizing the role of non-traded 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.)

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 1.3, 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.

1.2 Data and preliminary analysis

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

$$q_{ijt} = \frac{p_{ijt}}{\sum_{j'=1}^{N_{it}} p_{ij't}/N_{it}} - 1 \tag{1.1}$$

where p_{ij} is the common currency[2] 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.[3] 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

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

[3] 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.

Table 1.1: 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 1.2: 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 1.3: Mean and median LOP deviations

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	.090	.037	.016
France	.102	.072	.019	.046	.010	.011	.209	.182	.182	.116	.061	.079
Germany	.015	.061	-.035	-.012	-.025	-.013	.200	.226	.194	.277	.165	.125
Greece		-.001	-.019	-.026	-.055	-.002		-.370	-.353	-.385	-.233	-.180
Ireland	-.125	-.007	.059	.042	.146	.120	-.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	.090
Netherlands	-.011	-.001	-.059	-.018	-.003	-.029	.026	.215	.123	.083	.145	.074
Portugal		-.014	-.009	-.098	-.027	-.053		-.481	-.410	-.387	-.239	-.244
Spain		-.036	-.031	-.011	-.088	-.070		-.104	-.192	-.116	-.155	-.122
Denmark	.227	.349	.310	.300	.311	.280	.179	.314	.363	.512	.531	.542
UK	-.136	.047	-.026	-.053	.019	-.095	-.255	.161	.348	.400	.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		-.100	-.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	-.020	.077
Netherlands	-.025	-.015	-.075	-.029	.003	-.025	.050	.280	.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	.010	-.088	-.075	-.012	-.107	-.238	.077	.227	.298	.024	-.077
	Average absolute LOP deviation											
	goods with prices above cross-country mean						goods with prices below cross-country mean					
Austria			.214	.238	.154	.153			.142	.167	.135	.121
Belgium	.113	.151	.242	.188	.144	.125	.098	.155	.145	.149	.135	.107
France	.212	.202	.188	.234	.168	.152	.136	.139	.149	.142	.121	.123
Germany	.181	.250	.202	.191	.152	.140	.132	.155	.177	.160	.141	.135
Greece		.351	.375	.318	.170	.171		.258	.296	.264	.187	.167
Ireland	.236	.256	.328	.315	.278	.288	.264	.188	.195	.198	.140	.143
Italy	.212	.207	.252	.274	.180	.174	.168	.206	.189	.182	.120	.133
Luxembourg	.109	.169	.134	.138	.189	.141	.105	.160	.168	.167	.138	.126
Netherlands	.135	.186	.180	.177	.166	.150	.126	.176	.198	.174	.176	.182
Portugal		.375	.352	.233	.214	.160		.281	.285	.258	.206	.193
Spain		.219	.218	.192	.143	.134		.229	.230	.210	.183	.176
Denmark	.337	.460	.443	.455	.416	.363	.154	.166	.178	.188	.146	.133
UK	.242	.242	.286	.257	.234	.174	.253	.174	.223	0235	.174	.209
Mean country	.197	.256	.263	.247	.201	.179	.160	.191	.198	.192	.154	.150

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 1.1 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)[4] 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 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 co-

[4]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.

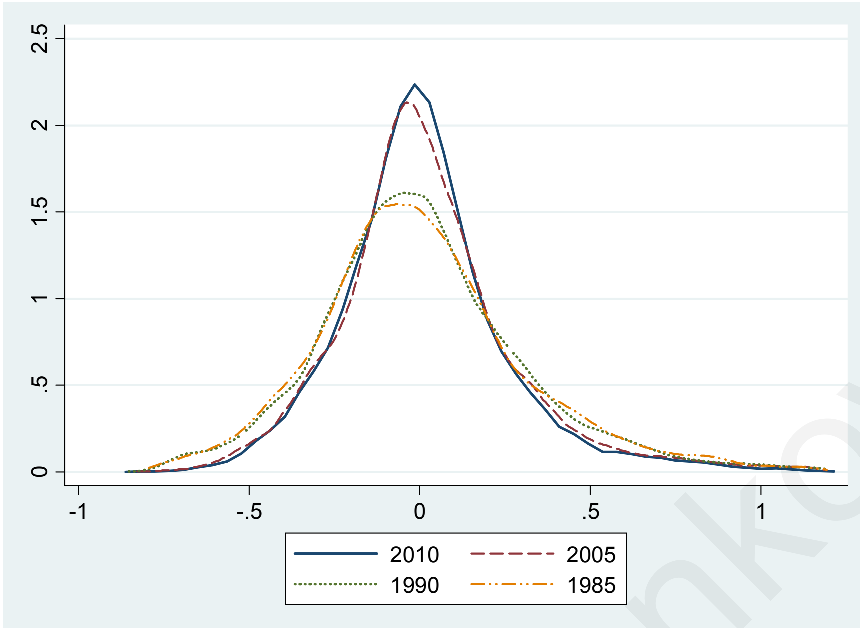

Figure 1.1: Empirical distributions of LOP deviations for the original 13-country sample

efficient. 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 1.2). We note that this might sometimes present us with a potential quantity discounts problem which we cannot address given the available information for this dataset. 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.

In Table 1.3, we report q_{jt}, averaging across goods for each country j. More specifically, in the first panel of Table 1.3 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 1.1, 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 1.2, we plot the densities of the q_{ijt} for the ten new EU member countries:

Table 1.4: Inflation rates for ten new EU member countries between 2005 and 2010

	Inflation for 2005-2010			
	Traded goods		Nontraded goods	
	mean	median	mean	median
Mean: new EZ countries	0.144	0.133	0.298	0.277
Cyprus	0.082	0.051	0.133	0.094
Malta	0.119	0.114	0.195	0.203
Slovak Republic	0.248	0.241	0.507	0.496
Slovenia	0.125	0.125	0.357	0.314
Mean: nonEZ EU countries	0.185	0.171	0.354	0.328
Czech Republic	0.195	0.204	0.508	0.496
Estonia	0.199	0.176	0.395	0.345
Hungary	0.099	0.101	0.164	0.125
Latvia	0.235	0.222	0.523	0.484
Lithuania	0.234	0.180	0.396	0.366
Poland	0.145	0.143	0.141	0.152

Notes: This table presents the inflation rate over the period 2005-2010 characterizing the average and median good in the ten new EU member countries: Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, the Slovak Republic, and Slovenia. New EZ countries - We report average inflation across four new EZ members (Cyprus, Malta, Slovak Republic and Slovenia). NonEZ EU countries - We report average inflation across six non-EZ new EU members (Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland).

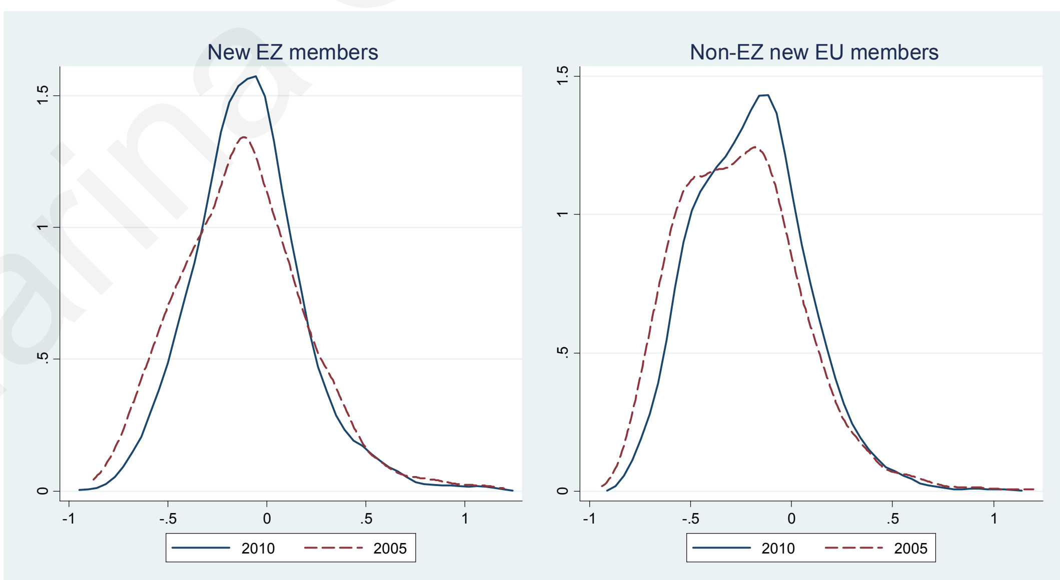

Figure 1.2: Empirical distributions of LOP deviations for the new EU countries

Table 1.5: Mean and median LOP deviations 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			.054	.044	.001	.002			.132	.167	.156	.147
Belgium	-.027	-.029	.031	-.005	-.011	.023	-.003	.141	.109	.031	.029	-.009
France	.071	.043	-.005	.028	.014	.014	.073	.053	.075	.039	.079	.092
Germany	-.008	.037	-.055	-.031	-.020	-.012	.099	.122	.106	.194	.186	.128
Greece		.045	.027	.036	-.009	.040		-.168	-.156	-.114	-.030	.005
Ireland	-.079	.029	.080	.066	.115	.108	-.046	.218	.244	.162	.041	.061
Italy	.023	-.060	0.024	.037	.068	.021	-.187	-.080	-.104	-.080	-.045	-.048
Luxembourg	-.064	-.054	-.110	-.118	-.071	-.093	-.392	-.197	-.317	-.329	-.345	-.299
Netherlands	-.046	-.033	-.079	-.028	-.013	-.043	-.125	.077	.032	.037	.103	.015
Portugal		.082	.087	-.019	.036	.008		-.061	.012	-.047	.046	.029
Spain		.003	.015	.015	-.059	-.042		.068	.007	-.002	-.029	.002
Denmark	.180	.302	.264	.262	.282	.248	-.028	.150	.164	.345	.407	.403
UK	-.125	.042	-.036	-.054	.012	-.085	-.206	.140	.305	.407	.176	.098
	Median LOP deviation											
Austria			.035	.019	-.008	-.012			.148	.187	.116	.077
Belgium	-.034	-.025	-.018	-.029	-.014	.012	-.031	.129	.043	-.018	-.012	-.036
France	.093	.021	-.029	-.017	-.008	-.001	.047	.021	.048	-.012	.066	.077
Germany	-.040	.000	-.089	-.064	-.030	-.018	.051	.107	.127	.163	.106	.072
Greece		-.054	-.028	-.027	-.011	.036		-.225	-.248	-.121	-.099	-.034
Ireland	-.135	-.016	.005	-.002	.078	.056	-.062	.183	.247	.116	-.001	.004
Italy	.007	-.081	-.011	-.011	.042	-.004	-.274	-.115	-.133	-.071	-.105	-.051
Luxembourg	-.069	-.062	-.128	-.128	-.105	-.102	-.373	-.209	-.340	-.305	-.364	-.313
Netherlands	-.059	-.047	-.096	-.040	-.007	-.038	-.101	.142	.067	.069	.090	.004
Portugal		.011	.022	-.031	.022	.011		-.098	-.046	-.090	-.003	.032
Spain		-.004	-.002	.021	-.047	-.037		.032	-.065	-.088	-.038	-.009
Denmark	.099	.238	.170	.192	.212	.169	-.003	.134	.203	.210	.374	.418
UK	-.161	.005	-.098	-.076	-.019	-.096	-.188	.056	.183	.295	-.008	-.032
	Average absolute LOP deviation											
	goods with prices above cross-country mean						goods with prices below cross-country mean					
Austria			.196	.220	.150	.143			.161	.185	.139	.130
Belgium	.087	.125	.228	.176	.142	.119	.129	.186	.160	.162	.137	.113
France	.184	.175	.167	.218	.172	.155	.167	.168	.173	.160	.117	.120
Germany	.160	.228	.184	.174	.157	.140	.154	.178	.196	.179	.136	.134
Greece		.396	.420	.379	.215	.213		.214	.255	.208	.147	.134
Ireland	.281	.291	.349	.338	.250	.276	.221	.156	.175	.176	.170	.155
Italy	.229	.217	.248	.263	.194	.190	.153	.195	.193	.193	.107	.118
Luxembourg	.074	.127	.098	.100	.138	.093	.161	.214	.216	.226	.216	.213
Netherlands	.106	.160	.161	.167	.157	.137	.160	.207	.218	.184	.185	.195
Portugal		.469	.447	.309	.276	.220		.202	.204	.197	.157	.146
Spain		.258	.263	.218	.171	.162		.194	.189	.186	.157	.151
Denmark	.294	.424	.401	.419	.390	.333	.201	.203	.223	.226	.174	.164
UK	.254	.238	.276	.256	.228	.184	.243	.178	.233	.236	.181	.199
Mean country	.185	.259	.264	.249	.203	.182	.177	.191	.200	.194	.156	.152

Cyprus, the Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, the Slovak Republic, and Slovenia, for 2005 and 2010 for EZ and non-EZ members. As seen in Figure 1.2, the density function for the new EZ members (Cyprus, Malta, the Slovak Republic and Slovenia) is more highly peaked at zero for 2010 as compared to 2005. In Table 1.4, we also show the inflation rate over the period characterizing the average and median good in these countries separately for traded and non-traded goods. As we can see in Table 1.4, these inflation rates are typically lower for the period 2005-2010 for the new EU members that adopted the euro during this period, suggesting that euro adoption was not associated with price increases relative to non-adopters in this case. This last result is confirmed by considering a regression of inflation over the 2005-2010 horizon on good dummies and a euro dummy for countries, as in Parsley and Wei (2008). Specifically, we estimate $g_{ij} = \beta_1 Euro_j + \mu_i + \varepsilon_{ij}$ for the ten new EU members in our sample, where $g_{ij} = \ln p_{ij2010} - \ln p_{ij2005}$ is price inflation for good i in country j over the period 2005-2010, $Euro_j$ is a euro dummy, μ_i are good fixed effects and ε_{ij} the regression error. We estimate this for the whole sample of goods and separately for the traded and non-traded goods subsamples. The coefficient estimate for the euro dummy in this pooled (across goods and countries) cross-sectional regression is negative and strongly statistically significant for the whole sample of goods and for traded goods with estimated coefficients and standard errors (in parenthesis) respectively equal to $-.024$ (.008) and $-.029$ (.009), while for non-traded goods this is insignificant and equal to $-.007$. These estimates suggest that euro introduction was not associated with price increases in euro adopters relative to non-adopters.

In Figure 1.3, 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 the first panel of Table 1.3 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 the second panel of Table 1.3, we 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

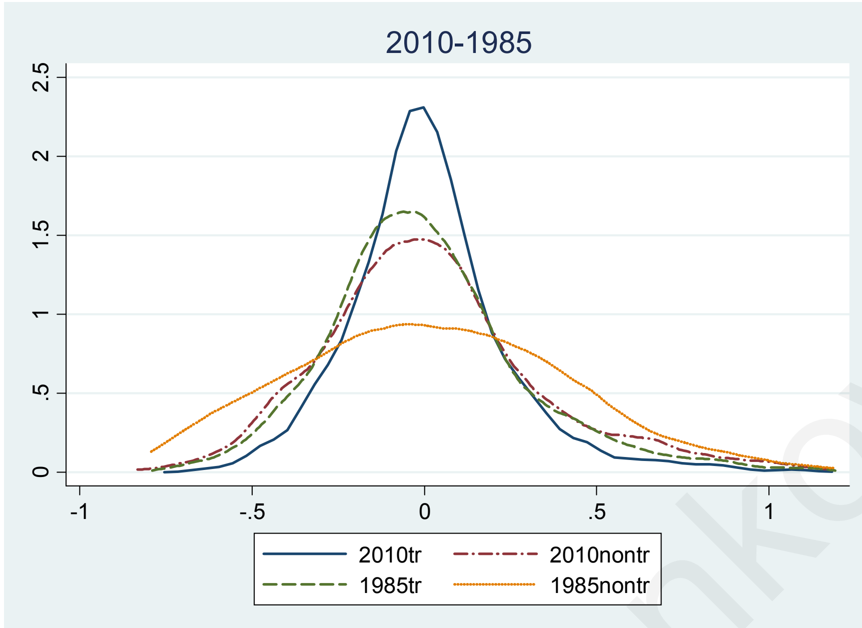

Figure 1.3: Empirical distributions of LOP deviations for the 13-country sample for tradeables (tr) and non-tradeables (nontr)

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. Moreover, in the third panel of Table 1.3, we report the average absolute LOP deviation separately for goods with prices above and below the cross-country mean. This will again be useful in interpreting the results of the last section of the paper regarding the persistence characterizing goods with prices below and above the cross-country mean.

In the three panels of Table 1.5, we consider again the respective mean, median and average absolute LOP deviation for each country and year, after correcting for income per capita. The latter is measured as gross domestic product in current prices divided by midyear population, available from the World Bank WDI database. To remove the income effect, we regress LOP deviations on income deviations, and then utilize the residuals i.e. the component of LOP deviations that excludes the effect of income for each country and year.[5] 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

[5]We define income deviations as $\Delta gdp_{jt} = \ln(gdp_{jt}) - \frac{1}{N}\sum_{j=1}^{N}\ln(gdp_{jt})$ and estimate the regression equation $q_{ijt} = \beta\Delta gdp_{jt} + \varepsilon_{ijt}$ for the panel of goods and countries over time, where $t = 1975, 1980, 1985, 1990, 2005, 2010$. Income corrected LOP deviations for each good i in each country j in year t are then obtained as $q^*_{ijt} = q_{ijt} - \widehat{\beta} * \Delta gdp_{jt}$. We note that as our main focus will be on a small number of mostly similar economies in terms of income, there is not as much income variation that could explain price dispersion here relative to studies using prices available across the globe.

suggest. Overall, adjusting for income has a large impact on LOP deviations with poorer countries becoming more expensive and richer countries cheaper after as compared to before the adjustment. In addition we notice that, as one would expect, the income correction affects non-traded goods prices more than traded ones.

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, 1.3.1, we will thus be using the complete set of prices for tradeable and non-tradeable items and the same goes for section 1.3.2, while in section 1.3.3 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.[6] 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[7] for June 1st 2005 and January 1st 2011, while for 1985-1990 we used VAT data from the CTZ paper.

[6] 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.

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

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:

$$\overline{s}_t = \frac{1}{M_t} \sum_{i=1}^{M_t} s_{it}(q_{ijt}),\ s_{it}(q_{ijt}) = \sqrt{\frac{1}{N_{it}} \sum_{j=1}^{N_{it}} q_{ijt}^2} \tag{1.2}$$

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 (1.1), 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 in section 1.3.1 next. Then, in section 1.3.2, 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.

1.3 Estimation and empirical results

1.3.1 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, given by the standard deviation of LOP deviations, $\sigma_{it}(q_{ijt})$.[8] This exhibits variation over goods

[8] This follows CTZ who use the variance of LOP deviations $\sigma_i^2(q_{ij}) = \frac{1}{N_{it}-1} \sum_{j=1}^{N_{it}} (q_{ij} - \overline{q_i})^2$ for each cross-section t, with $\overline{q_i}$ the cross-country average LOP deviation for good i, and q_{ij} the log LOP deviation for good i in country j. For comparability of our estimates to CTZ, we also utilize log LOP deviations for our regressions here.

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:

$$\sigma_{it}(q_{ijt}) = \beta_1 \ln t_{ht} + \beta_2 \ln \alpha_{ht} + \beta_3 \sigma_{ht}(v_{hjt}) + \beta_4 D_{ALC\&CIG} + \beta_5 D_t + \varepsilon_{it} \tag{1.3}$$

That is, we estimate a panel regression across i over t to explain the cross-country price dispersion $\sigma_{it}(q_{ijt})$,[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 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 1.6, 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 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.

[9] Very similar results are obtained if we instead use as dependent variable the cross-country dispersion of LOP deviations given by $s_{it}(q_{ijt})$ from equation (1.2).

[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.

[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 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).

Table 1.6: Explaining cross-country price dispersion

	1985-1990		2005-2010	
	(1)	(2)	(3)	(4)
Tradeability	-0.187***	-0.156***	-0.057**	-0.114***
	(0.041)	(0.044)	(0.022)	(0.019)
Non-traded input	0.322***	0.366***	0.292***	0.492***
	(0.078)	(0.078)	(0.098)	(0.061)
VAT	0.054**	0.057**	0.040**	0.084***
	(0.025)	(0.022)	(0.015)	(0.023)
Alcohol&Cigarettes	0.160***	0.155***	0.066***	0.098***
	(0.019)	(0.015)	(0.011)	(0.010)
Time dummy	-0.015	-0.015	-0.014**	-0.046***
	(0.009)	(0.010)	(0.006)	(0.006)
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	0.277	0.262	0.191	0.428

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 given by the standard deviation of LOP deviations. 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.)

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 1.6 for the period 1985-1990 is respectively equal to -0.187 and -0.156 while the estimated impact during the period 2005-2010 shown in column (3) of Table 1.6 is -0.057 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 1.6 is -0.114, 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 0.322 and 0.366 in columns (1) and (2) of Table 1.6, and 0.292 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 and non-traded sector productivity levels for these EU economies over the period under study. The impact of non-traded inputs for the broader 24-country sample equals 0.492 as shown in column (4) of Table 1.6. 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. The coefficient on non-traded inputs implies decline in wage dispersion across Europe from 1990 to 2005. Interestingly, the broader 24-country sample shows a larger coefficient on the non-traded input, consistent with greater wage dispersion in this larger group of nations. Comparing the coefficient estimates of non-traded input content between the four samples considered in Table 1.6, we find that the coefficients are statistically different at the one percent level of significance in all cases.

Finally, the impact of VAT and the alcohol and cigarettes dummy is positive, but the impact of both of these decreases 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 in column (4) of Table 1.6 instead of the 13-country sample. This is consistent with the importance of VAT and other tax differences being smaller in the latter narrower group of more highly homogeneous EU countries.

The qualitative and quantitative results described above for tradeability, non-tradedness and the two tax-related variables are not sensitive if instead of LOP deviations relative to the mean we use LOP deviations relative to individualcountries like Germany and other major EZ economies like France and Italy, or Belgium which is the country with the least missing observations in our sample.[13] We note that constructing LOP deviations relative to a particular country reduces the number of observations to product items available in that reference country. Importantly, any price outliers for that particular reference country introduce noise in the LOP deviations for all other countries which would be alleviated if one used the cross-country mean as a reference point. Thus, we prefer to emphasize results based on LOP deviations from the cross-country mean price in our baseline specification that we present in Table 1.6.

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.

1.3.2 Comparing distributions of LOP deviations between years

In this subsection, we compare the density functions of the q_{ijt}, calculated as in equation (1.1), 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 1.1, we look at the individual distribu-

[13]Results available upon request.

tions for each country separately later on in this section. The density functions in Figure 1.1 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 1.7), 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 1.7, the average (over goods) cross-country dispersion $\overline{s}_t$ computed as in equation (1.2), 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 1.7, 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. 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 the 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 (1.1) relative to the EZ-11 economies. As shown in Table 1.7, 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 1.2, the density function for the new EZ members is more highly peaked at zero for 2010 as compared to 2005. As shown in Table 1.7, the kurtosis value for these countries as a group goes up from 3.608 in 2005 to 4.251 in 2010. For the six non-EZ new EU members, the density function for which is also shown in Figure 1.2, this value starts higher at 3.789 in 2005 but declines to 3.424 by 2010. Moreover, we note that the mean

Table 1.7: 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: In the first three columns, we report P-values for the Kolmogorov-Smirnov test of the null of equality of distribution functions. For the Kolmogorov-Smirnov test we consider comparisons of LOP deviations distributions between different years. In the fourth column, we report the mean (over goods) cross-country price dispersion computed as in equation (1.2). In the last column, we report kurtosis values for the LOP deviations distributions for each year. The first four rows present comparisons between years using LOP deviations for 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).

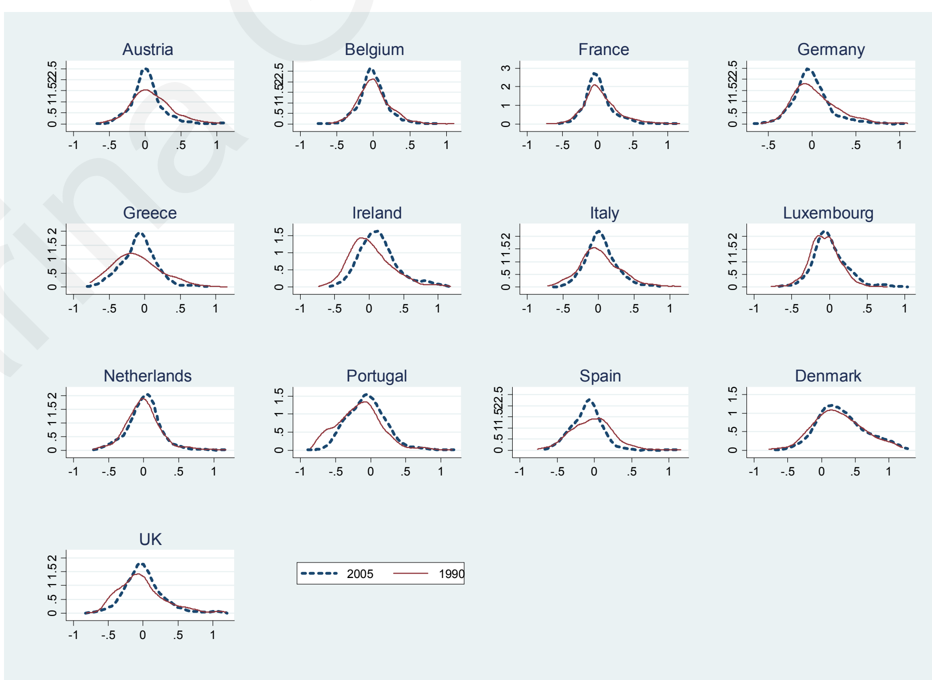

Figure 1.4: Empirical distributions of LOP deviations before and after the Euro

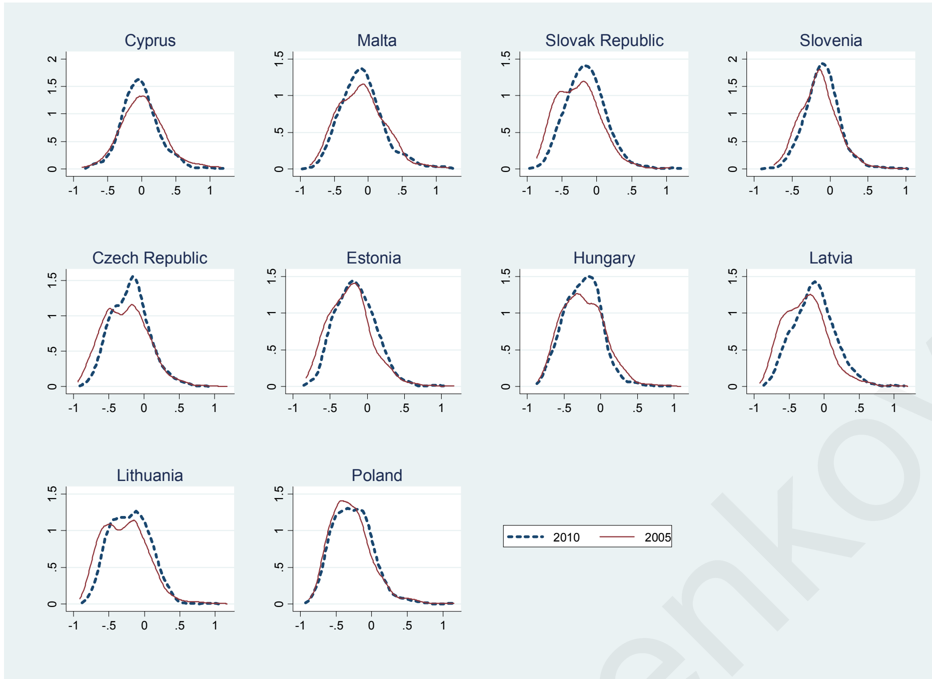

Figure 1.5: Empirical distributions of LOP deviations for the ten new EU countries

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 the 0.234 value characterizing the core.

In Figure 1.4, 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 (1.1), 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 1.8 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 1.4, suggesting goods there became overall relatively more expensive over time. As shown in Table 1.3, 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 1.9, using the Kolmogorov-Smirnov test, the distribution is statistically different in 2005 as compared to 1990 for all countries except non-EZ member Denmark for which this null cannot be rejected even at the ten percent level with a p-value of 0.135.[14] 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 1.5, we present the density functions for each of the ten new EU countries. 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 1.8 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 these 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 EZ member Finland[15], with the kurtosis value for the former shown in Table 1.8 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. Finally, according to the Kolmogorov-Smirnov test in Table 1.9, 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.

1.3.3 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

[14] 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 kurtosis values in 1990.

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

section over a sufficiently long span of time.[16] 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 1.10. These correlations are calculated by pooling the LOP deviations in an ordered vector according to the matched goods identifier for every 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). This then provides us with an estimated correlation across time for the pooled price data. Alternatively, we computed good-by-good correlations and then obtained the average correlation over these goods. That is, in this case we consider a vector of N_i LOP deviations for each specific good i for one year where N_i is the number of available countries, then construct a comparable vector for that good for another year, and compute the correlation between these two vectors. The average of these good-by-good correlations over all goods provides us with our alternative measure reported in Tables 1.10 and 1.11 in this section. To the extent that the correlations we obtain when pooling the data capture aggregate persistence, we would expect[17] that these should be greater than the average of good-by-good correlations.

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 for the purposes of this section, we find it useful to further decompose these recognizing the

[16] We consider non-parametric correlations to get a grasp of the degree of persistence implied by our price data rather than estimating half-lives using standard parametric AR estimation, because we have a very small time series (4 to 6 observations) of very low (5-year) frequency price data that in one case involves mixed frequency imposed by a 15-year gap in the data. This renders estimating meaningful half-lives based on an AR model infeasible. While time averaging is not an issue in our data, the low frequency renders estimation much less precise (Taylor 2001), which along with the fact that small variations of the autoregressive parameter estimate in the region near unity lead to disproportionately large variations in the half-life, can lead to severely misleading estimates of the half-life in the presence of biased or imprecise estimators of the autoregressive parameter (Choi et. al 2006).

[17] Based on the finding of the literature that micro-level prices (e.g. Bils and Klenow, 2004, and Boivin, Giannoni and Mihov, 2009) or LOP deviations (Imbs et. al 2005, Bergin et. al 2013, and Andrade and Zachariadis 2015) are characterized by lower persistence than aggregate measures.

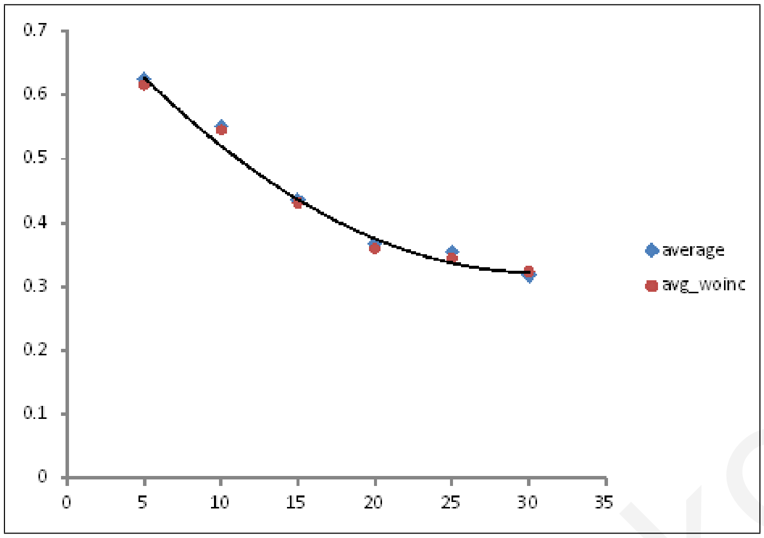

Figure 1.6: Price persistence for different time gaps length

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 1.10 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% (around 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% (around 47% 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. All of these correlations are statistically different from zero at the one percent level of significance. 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 1.6 which graphs these average correlations. A similar tendency exists, not shown in Figure 1.6, when using the alternative good-by-good calculations. However, we note that the good-by-good implied persistence according to Table 1.10 is always lower than the persistence when pooling product prices.

In Table 1.11, 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

Table 1.8: 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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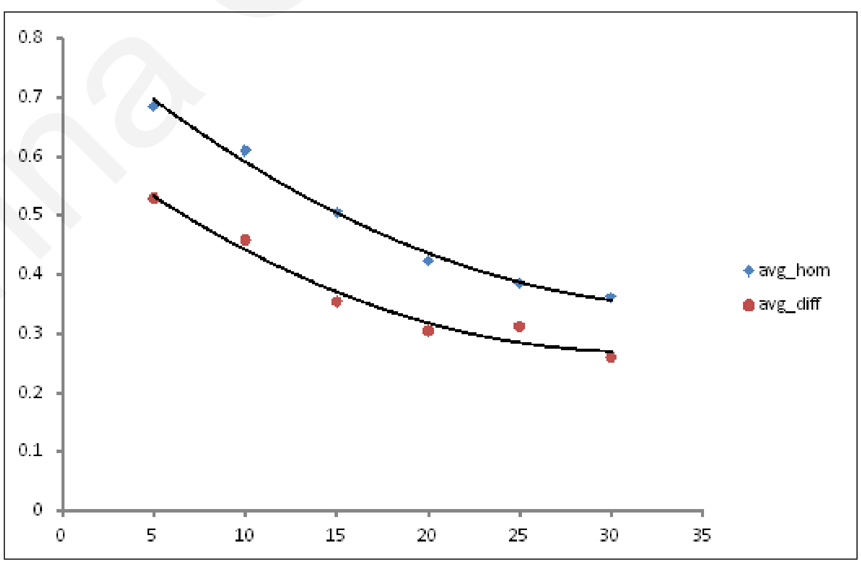


Figure 1.7: Price persistence for different time gaps length and different types of goods

Table 1.9: 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.

Table 1.10: 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 and 1975 for which Greece, Portugal and Spain are also missing. In order to remove the income effect, we regress LOP deviations on income deviations, and then utilize the residuals i.e. the component of LOP deviations that excludes the effect of income for each country and year. All correlations are statistically different than zero at the 1% level of significance.

Table 1.11: Correlation of cross-country good-by-good LOP deviations for homogeneous and differentiated 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 and 1975 for which Greece, Portugal and Spain are also missing. The sample is limited to tradeable goods available in 1990. We specify type of goods according to the Rauch index. All correlations are statistically different than zero at the 1% level of significance.

are on average several times more expensive than homogeneous ones in our dataset. In the first six columns of Table 1.11, 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 in Table 1.11 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 in Table 1.11 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. Once again, these correlations are strongly statistically significant. 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 1.7. The differences between homogeneous versus differentiated goods correlations using the alternative good-by-good calculation, not shown in Figure 1.7, are even starker. Moreover, the tendency for these correlations based on the alternative good-by-good calculations to fall over time is evident in Table 1.11. Finally, as we can see in Table 1.11, this good-by-good implied persistence is typically lower than persistence ontained pooling product prices.

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 ones, leading to lower persistence of LOP deviations for the former. This is in line with e.g Berka (2009).[18] An alternative explanation could depend on the size of LOP deviations for homogeneous versus differentiated goods. That is, if LOP deviations for homogeneous goods were smaller than for

[18]He finds that heterogeneity of marginal transaction costs proxied by price-to-weight ratios explains a large part of the variation in thresholds of no-adjustment and conditional half-lives of LOP deviations, with prices of heavier low-price-to-weight goods deviating further before becoming mean-reverting, and then converging more slowly.

Table 1.12: Average correlations of LOP deviations by country and time gap.

country	Time gaps						
	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 correlations), Portugal, Spain and Greece (3 correlations); for 10-year gaps - Portugal, Spain and Greece (1 correlation); for 15-year gaps - Austria, Portugal, Spain and Greece (1 correlation); for 25-year gap - Austria (1 correlation); for 30-year gaps - Portugal, Spain and Greece (1 correlation). All correlations that constitute the average correlations we present in the table, are significant at the 5 % level except for two cases for France for the 30-year gap (1980-2010 and 1975-2005), one case for Belgium for the 25-year gap (1985-2010) and one case for Portugal for the 25-year gap (1980-2005).

differentiated ones, this would explain the greater implied persistence for homogeneous goods we observe here relative to differentiated ones. However, we find (results available upon request) that absolute LOP deviations are typically greater for homogeneous goods than for differentiated goods. One possible explanation, beyond the one on unit trade costs in relation to the relative value of differentiated products we offer above, is that the presence of perishables in the homogeneous goods category that are arguably less subject to arbitrage, is consistent with both larger LOP deviations and greater persistence for homogeneous relative to differentiated goods.

In Table 1.12, 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.

Given our inability to estimate meaningful half-lives as explained in the beginning of this section, our results are not directly comparable to estimated half-lives using annual or higher frequency data and standard parametric AR models in the existing literature on LOP and PPP convergence. Nevertheless, our unconditional correlations suggest that the location of individual goods' prices in the distribution of LOP deviations persists one or even three decades down the road with significant correlations of around fifty percent and thirty percent respectively. While this is a very different notion of persistence than the one typically considered in the literature, it does suggest that the location of good-level LOP deviations in the distribution tends to be very persistent.

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. This analysis can then provide evidence about real exchange rate misalignments at the individual good level. 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 1.3 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 considering LOP deviations for all 13 EU countries available for 1985-2010 together in Table 1.13. As we can see in Table 1.13, 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 1.14, 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, we regress LOP deviations on income deviations to remove the income effect, and then compare the residuals i.e. the component of LOP deviations that excludes the effect of income for each country and year. 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.

Looking at the persistence values reported in Table 1.14, 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. These results hold also for time comparisons of LOP deviations for 2005. While we do not report persistence values for 2005 in Table 1.14, we report a summary of these and all other years' results for each time gap in Table 1.15 next.

Table 1.13: 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. 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 and 1975 for which Greece, Portugal and Spain are also missing. 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 deviations 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 1.14: 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 deviations, and then utilize the residuals i.e. the component of LOP deviations that excludes the effect of income for each country and year. ! 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 1.15: 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 deviations 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 deviations, and then utilize the residuals i.e. the component of LOP deviations that excludes the effect of income for each country and year. We use the proportions test for 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).

In Table 1.15, 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 1.14 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 1.5, 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 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 1.16, 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 1.16, 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

[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 (results available upon request) that persistence below is more evidently greater than persistence above in the case of differentiated products as compared to homogeneous ones. 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 1.16: 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 deviations, and then utilize the residuals i.e. the component of LOP deviations that excludes the effect of income for each country and year. !- 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.

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 1.16, 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 1.14 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.

The striking finding that persistence below zero in the LOP deviations comparisons (a price advantage for an economy) is systematically greater than persistence above zero calls for an explanation. One possible explanation relates to the size of deviations, where small deviations would be expected to be more persistent as in the literature on non-linearities and threshold effects in LOP deviations. For example, O'Connel and Wei (2002) confirm the Obstfeld and Taylor (1997) finding that large deviations from the LOP are band reverting but small deviations are not, consistent with Michael et. al (1997) that demonstrated the importance of such non-linearities. As we can see in the last row of the third panel in Table 1.3, goods with prices below the cross-country mean are typically associated with smaller absolute LOP deviations as compared to goods with prices above the cross-country mean for most countries, which can then explain the former's relative persistence in those countries. This finding is then related to the literature on non-linearities and threshold effects in LOP deviations where the persistence of LOP deviations is history dependent. However, we note that this is not always the case. For example, for Spain in all cases and in a number of cases for Luxembourg, the Netherlands and Portugal, absolute LOP deviations are smaller for goods with prices above the cross country-mean as we can see in the third panel of Table 3. Thus, according to the above explanation, these goods should be associated with greater persistence as compared to goods with prices below the cross-country mean. However, as we can see for particular pairs of years in Table 1.14 and for all time gaps in Table 1.15, implied persistence is lower for goods with prices above the cross-country mean for all of these countries.[21] Based on the above, the size of

[21] Other counterexamples include Denmark which always has greater absolute LOP deviations and greater persistence for goods with prices above the cross country-mean, and Ireland which typically has greater absolute LOP deviations but often greater persistence associated with such goods.

initial LOP deviations cannot fully explain our finding of typically higher persistence for goods in which a country has a price advantage relative to goods for which it has a price disadvantage.

1.4 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. However, we cannot attribute the increase in integration directly to the launch of the euro but rather to the overall process of monetary unification that affected structural issues not related to euro.

Second, 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 after the introduction of the euro. The regression results show the importance of tradeability and non-traded inputs in explaining changes in cross-country price dispersions over time. Thus greater degree of integration by the end of the period under study can be determined by changes in trade costs and non-traded inputs (e.g. wages and other local input costs). Interestingly, the lower role of non-traded inputs for cross-country dispersion in 2005-2010 implies a certain decline in the wage dispersion across European countries. Moreover, we find that for the broader group of countries coefficient on non-traded input is larger consistent with greater wage dispersion in this group of countries. In this regard as an extension of the paper we could further estimate the changes in the relative effect of traded and non-traded input for cross-country price dispersion over time. More specifically we could follow Crucini et al. (2013) and use good-by-good variance decompositions of LOP deviations in order to evaluate the relative contribution of each regressor of the model.

Third, having put together a unique panel dataset, we were able to trace the position of individual goods in the distribution of LOP deviations and assess the extent to which the position of an 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 showed that LOP deviations for these goods are highly correlated. In fact, the location of individual goods' prices in the distribution of LOP deviations persists for decades, with significant correlations of around fifty and around thirty percent respectively one and three decades later.

Finally, we showed 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. The persistence of price advantages could be studied further using semi-annual EIU price data across the globe for 1990 to 2015.

In addition, this research could be extended by investigation of European integration before and after the recent Crisis using prices for thousands of comparable goods and services across 31 European countries available for 2005, 2010, and 2014. We could show how financial shocks affect prices for different groups of goods and try to investigate price adjustment mechanism and the degree of flexibility for each economy. It would be interesting to explore whether the process of deflation in countries most severely hit by the Crisis relative to core countries has brought prices closer, and if so whether the main driving force has been lower production costs related to non-traded inputs or lower demand affecting both traded and non-traded products.

Chapter 2

Cypriot LOP deviations Before and After the Euro

2.1 Introduction

On July 10th 2007 the conversion rate between the Cyprus pound and the euro, that would become effective on January 1st 2008, was fixed at 0.585274 pounds per euro (or 1.7086 euro per Cypriot pound). The PPP exchange rate implied by our detailed micro price dataset of goods and services that comprise the harmonized CPI for Cyprus and the rest of the European Union (EU), is very much in agreement with this conversion rate. Our data show that as of 2005 the mean (median) across all goods and services of the ratio of Cypriot prices in pounds relative to the average price in euro in the twelve Eurozone (EZ) economies, was 0.59007 (0.575507) pounds per euro, and the mean (median) across tradeable goods for this ratio was 0.603279 (0.588902). These values suggest that Cyprus entered the Eurozone at more or less the right conversion rate, to the extent that this specific metric should be taken into account. In what follows, we will analyze the behavior of prices in Cyprus before (in 2005) and after this conversion to the euro (in 2010), to answer a number of important questions.

Did Cyprus become more integrated with the EZ core and the broader group of EU economies after adopting the euro? How did this process affect its prices relative to its EU partners? Does the degree of integration relative to the EZ as implied by Cypriot price differences vary across goods? Finally, what can explain this variation in Cypriot price differences? We attempt to provide some answers to these questions in what follows.

Our work is closely linked to the work by Crucini, Telmer and Zachariadis (2005) (CTZ) and Glushenkova and Zachariadis (2014). The last two papers attempt to understand LOP deviations in Europe for the period 1975 to 1990, and the period from 1985 to 2010 respectively.[1] CTZ make the case that the Law-of-One-Price (LOP) and Purchasing Power Parity (PPP) are essentially about the cross-sectional distribution of international relative prices rather than the time-series behavior of changes in these.[2] Our paper focuses on cross-sectional LOP deviations for the case of Cyprus relative to the EU in 2005 and 2010 to understand the role played by the process of monetary unification for this particular economy. For example, the use of micro prices for well defined markets allows us to detect markets for specific goods and services where integration has been slower or where barriers have not been removed.

The literature focusing on the effects of the process of European monetary unification has produced mixed results regarding the effect of this process on price dispersion. Allington et al. (2005) find that the euro led to greater integration evidenced by price convergence for tradeables among EMU members between 1995 and 2002. Imbs et al. (2010) use prices for TV sets across European countries and show that EMU countries display lower price dispersion but not necessarily because of the single currency. Similarly, Engel and Rogers (2004) find no tendency for product prices of 101 narrowly defined traded goods from 18 European cities in eleven Eurozone countries to converge after January 1999, but that there has been a significant reduction in price dispersion throughout the decade of the 1990s suggesting an increase in the integration of consumer markets during that period. Along the same lines, 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. Fischer (2012) uses highly comparable washing machine prices across 17 European countries for 1995-2005, and does not find price convergence for EMU countries or that EMU membership is relevant for any small convergence clusters found in the data. Dreger et al. (2007) use comparative price levels for the EU-25 for 1999-2004 and find price convergence that is more pronounced for the EU-10 and for homogeneous products and positively related to tradeability. Guerreiro and Mignon (2013) also use comparative price levels for 12 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 competitiveness over time.

[1] The same data has been used by Inanc and Zachariadis (2012) for 1975 to 1990 across Europe, to study the importance of the direction of trade in estimating the role of distance and trade costs using LOP deviations.

[2] The LOP states that identical goods in different countries at a given point in time should have identical prices once the prices are expressed in common currency units, and PPP states that this should hold on average. Due to data limitations, the literature had until recently been focusing mostly on the *time-series* behavior of these international relative prices.

In the next section, we discuss our data construction and empirical analysis before presenting our results. The final section briefly concludes.

2.2 Data Analysis

2.2.1 Data Construction

Our European prices dataset, sequentially assembled from Eurostat data over the past decade, is described extensively in Glushenkova and Zachariadis (2014). Here, we use a subset of that dataset of local currency prices of individual goods and services, that pertains to Cyprus. In Table 2.1, we list some examples of item descriptions prices for which are available in our dataset.

We define LOP deviations for Cyprus for each good and each time period, omitting good and time subscripts for simplicity of notation, as

$$q_{CY,EU} = \frac{p_{CY}}{\sum_{j=1}^{N} p_{jt}/N} - 1$$

where p_j is the common currency price of the good in Cyprus at a specific time and N is the number of countries comprising the average relative to which Cyprus is being compared. We consider N to be comprised of all EU countries to obtain $q_{CY,EU}$, and in some cases (which we clearly state in each case) we restrict this to be comprised of the EZ twelve to obtain $q_{CY,EZ}$, or of the non-EZ subset of EU countries (to obtain $q_{CY,NEZ}$). The non-EZ EU sample is comprised of EU countries that were not members of the EZ as of 2005: Bulgaria, the Czech Republic, Cyprus, Estonia, Denmark, Hungary, Latvia, Lithuania, Poland, Malta, Romania, the Slovak Republic, Slovenia, Sweden, and the UK. This list includes recent EZ members: Cyprus, Malta, the Slovak Republic and Slovenia. Our EU sample includes these fifteen countries plus the original EZ twelve: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain, for a total of twenty-seven countries.

We also utilize additional data for VAT rates and to construct tradeability and non-traded input share indices. VAT rates for Cyprus and the other EU countries were obtained from the European Commission report on VAT Rates Applied in the Member States of the European Union[3] for June 1st 2005 and January 1st 2011. Export and import data were obtained from the OECD STAN Bilateral Trade Database and gross output from the Statistical Service of Cyprus for each industry for 2005 and 2010. Non-traded input

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

Table 2.1: Exemplary set of goods from the sample

Rice, long-grain, Parboiled; 400-600g, cooking time $<$ 10min. / WKB	Printer, ink-jet, EPSON, Epson Stylus C42, C44 Plus / SB
Wheat flour, all-purpose flour, 750 - 1000 g / WKB	Desktop pc, HP COMPAQ, DELL, FUJITSU-SIEMENS / SB
Flaked oats, for cooking, 500 - 1000 g / WKB	Disposable camera, FUJI, FUJICOLOR QuickSnap Marine 800 / SB
Bread, "pre-baked" baguettes/rolls, 200-300g / WKB	Novel, A.Christie; national, paperback /
Biscuits salted, "Crackers", BAHLSEN,TUC,VERKADE,RITZ, 100-200g / SB	Daily newspaper, INTERNATIONAL HERALD TRIBUNE / SB
Breakfast cereals, NESTLE, Clusters or cheerios, 250-500g / SB	Cutlery set, IKEA, FORNUFT / SB
Beef, Silverside (F2a), Beef for roasting / —	Frying pan,TEFAL Ambiance Essence Activ/SB
Veal, Leg (prime cut A4), w/o bones / —	Secateurs; exclude GARDENA, / WKB
Pork, Loin chop (B2), with bones / —	Light bulb, PHILIPS, SOFTONE / SB
Chicken, roasting, w/o head and feet / —	Battery,DURACELL,Ultra M3 Alkaline MN 1500 - AA Mignon 1.5/SB
Salami, Country typical variety, Made of: pork and /or beef and bacon fat / —	Car hire - HERTZ
Mackerel (- scomber scombrus), Whole fish with head and tail / —	Taxi - 5 km, working day
Salmon (atlantic sal+A50mon - salmo salar), Fresh / —	Urban rail transport, single ticket - up to 3 km / 15 min.
Milk, unskimmed, Fat content: 2.8 - 4 %, 0.8-1.2l / WKB	Coach, single ticket - approx. 35 km
Fruit Yoghurt, DANONE,YOPLAIT, Fat content: 2 - 4 %, 150-350g/ml / SB	Flight, Domestic - return ticket, 200 km
Cheese, Camembert type, Fat content: 45 - 55 %, 180-330g / WKB	Flight, International - London, return ticket
Ice cream, CARTE D'OR, any flavour, Industrial production, 500-1000g / SB	General practitioner / "private" patient
Carbonated drink, Tonic, SCHWEPPES,KINLEY,SEAGRAMS, 0.2 - 0.5 l/SB	Beef steak, grilled - modest R /
White wine, Californian, PAUL MASSON WHITE, Package: bottle, 0.75-1l / SB	Filter coffee, cup - at the counter /
Spirit, Whiskey - American, JACK DANIEL'S, 0.7 - 1 l / SB	Hotel - Cat.1, Capital, excludes HOLIDAY INN etc - 1 night /
Cigarettes, with filter, CAMEL, (Excl.: light) / SB	Services, Cobbler - men's classic shoes
Men's overcoat / WKB-M	Plumber, hourly charge
Ladies' top coat, 85-90% wool,15-10% cash. / SB	Electrician, hourly charge
Children's parka / WKB-M	Decorator, per m2 (64m2)
Bunk bed, IKEA / SB	Water supply, including sewerage - 200 m3
Floor covering laminated INKU,PERGO,TARKETT,ALLOC,QUICK STEP/SB	Electricity: 2,500 kWh
Refrigerator, BOSCH, KTL 16420 "economic" / SB	Gas: 16.75 GJ or 4,652 kWh
Washing machine, AEG, OKO-LAVAMAT 86760, 86800 / Top class / SB	Domestic servant (housework) - registered
Microwave oven, AEG, MICROMAT 153 E / SB	Baby sitting - not registered
Vacuum cleaner, PHILIPS, FC 9126/20 Specialist for carpets / SB	Services, PC technician, replacement of power supply
Fridge-freezer, CANDY, "Biocold" CPDC 381VZ / SB	Driving school
Coffee-maker, MOULINEX, Crystalys with timer AEC 342 / SB	Piano lesson
Motor cars, Diesel engine NISSAN Terrano 2.7 Tdi / SB	Men - scissors cut, dry; suburbs /
Motorcycles YAMAHA DT 50 Supermotard / SB	Ladies - haircut /
Bicycle GIANT X-Sport Mountain bike / SB	Household telephone call, local - off-peak hour
Tyre MICHELIN Energy (E3A, E3B) 175/70 R14 (84)T summer tyre / SB	Monthly total costs, mobile calls to fixed line
Television, SONY, KE-42TS2 / SB	Internet connection - ADSL (digital)
Laptop computer, ACER, TravelMate 800/800LCi / SB	Veterinary service, desexing cat

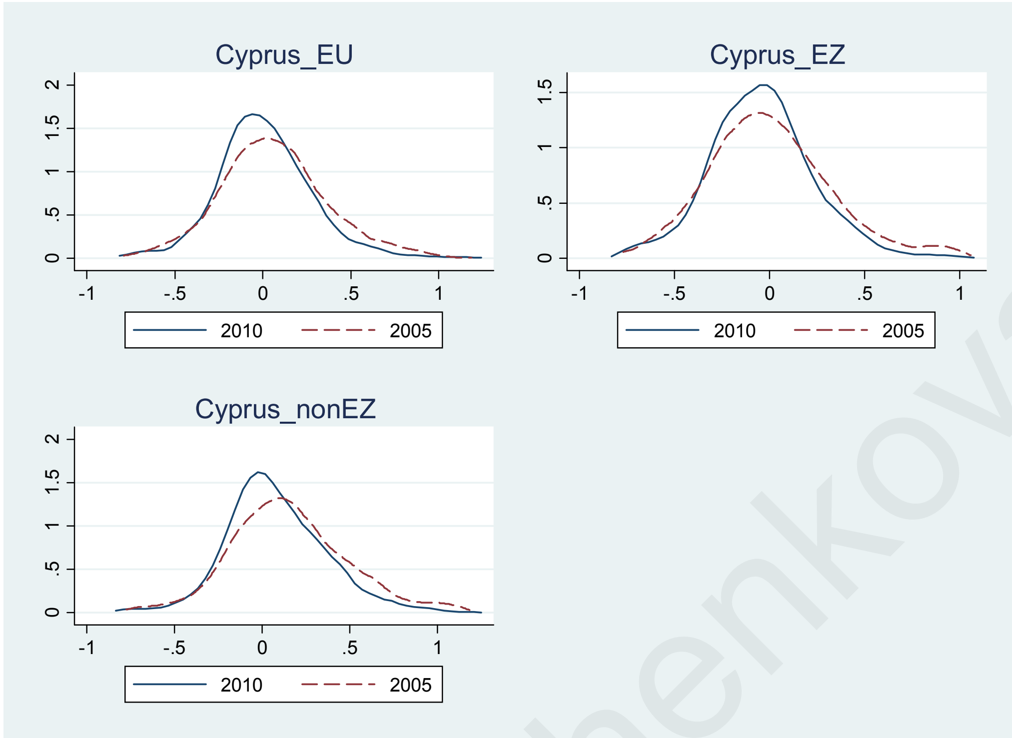


Figure 2.1: Empirical distributions of Cyprus LOP deviations before and after the Euro

shares for each industry in Cyprus were obtained from the Eurostat Supply-Use tables in 2005 and 2009.

2.2.2 Empirical Analysis

Comparing the distribution of Cypriot LOP deviations (relative to the EU, EZ and non-EZ EU) before and after the euro

In Figure 2.1, we present the LOP deviations for all goods and services in Cyprus relative to the EU ($q_{CY,EU}$) but also, separately, relative to the EZ ($q_{CY,EZ}$) and relative to non-EZ EU countries ($q_{CY,NEZ}$).

As shown in the first panel of Figure 2.1, the distribution of LOP deviations for Cyprus relative to the EU moves to the left from 2005 to 2010. This signals that Cyprus did not become relatively more expensive compared to its EU partners as a result of adopting the euro. Quite the contrary. From Figure 2.1, we can also see that Cyprus apparently becomes more integrated with the EU countries between 2005 and 2010. This is also evident in the first row of Table 2.2 where we see how the kurtosis value for the distribution of LOP deviations for Cyprus relative to the EU increases from 3.31 in 2005 to 4.5 in 2010. As we can see in the first row of Table 2.2, using the Kolmogorov-Smirnov (KS) test the null

Table 2.2: Tests for the equality of LOP deviation distributions.

	KS test		Kurtosis	
	2010	2005	2010	2005
Cyprus(EU)	0.000 !	-	4.500	3.307
Cyprus(EZ)	0.007 !	-	3.779	3.427
Cyprus(nonEZ)	0.000 !	-	3.550	3.146
Cyprus(EU) TR	0.002*	0.249*	4.979	3.327
Cyprus(EU) NT	-	-	2.898	2.837
Cyprus(EZ) TR	0.000*	0.000*	4.052	3.497
Cyprus(EZ) NT	-	-	2.632	3.494
Cyprus(non-EZ) TR	0.004*	0.003*	3.735	3.272
Cyprus(non-EZ) NT	-	-	2.635	2.740
Germany(EU)	0.318	0.001	3.961	3.937
Greece(EU)	0.795	0.000	4.001	3.605
UK(EU)	0.000	0.027	4.598	3.674
Ireland(EU)	0.000	0.000	2.977	2.941
Portugal(EU)	0.000	0.000	4.483	3.510
Spain(EU)	0.000	0.000	5.640	4.323

Notes: We report p-values for the Kolmogorov-Smirnov test of the null of equality of distribution functions. The LOP deviatons are constructed relative to the EU, or relative to the EZ. or relative to the non-EZ EU, as indicated in parentheses in the first column of each row. In the last six rows, we consider comparisons of distributions of LOP deviations (relative to the EU) between Cyprus and each of the other countries. ! We compare the distribution of LOP deviations for 2010 to that for 2005. * We compare the distributions of LOP deviations for tradeables versus nontraded goods. EZ - the twelve original Eurozone members: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain. non-EZ EU - includes EU countries that were not members of the Eurozone as of 2005: Bulgaria, the Czech Republik, Cyprus, Estonia, Denmark, Hungary, Latvia, Lithuania, Poland, Malta, Romania, the Slovak Republic, Slovenia, Sweden, and the UK. This list includes new Eurozone members: Cyprus, Malta, the Slovak Republic and Slovenia. EU - includes the EZ12 plus non-EZ EU countries.

hypothesis that the distribution of LOP deviations of Cyprus relative to the EU for 2010 is the same as the 2005 distribution, is rejected at the one percent level of significance.

As shown in the second panel of Figure 2.1, Cyprus also becomes more integrated with EZ countries with the kurtosis values reported in the second row of Table 2.2 going up from 3.43 in 2005 to 3.78 in 2010. As we can see in the second row of Table 2.2, using the KS test, the null hypothesis that the distribution of LOP deviations relative to the EZ for 2010 is the same as the 2005 distribution is rejected at the one percent level of significance.

The third panel of Figure 2.1 portrays information for the distribution of LOP deviations of Cyprus relative to the non EZ EU economies. As is evident from Figure 2.1, Cyprus becomes relatively cheaper than non-EZ EU economies and this leftward shift in the distribution for Cyprus is much more evident here than relative to the EZ economies,

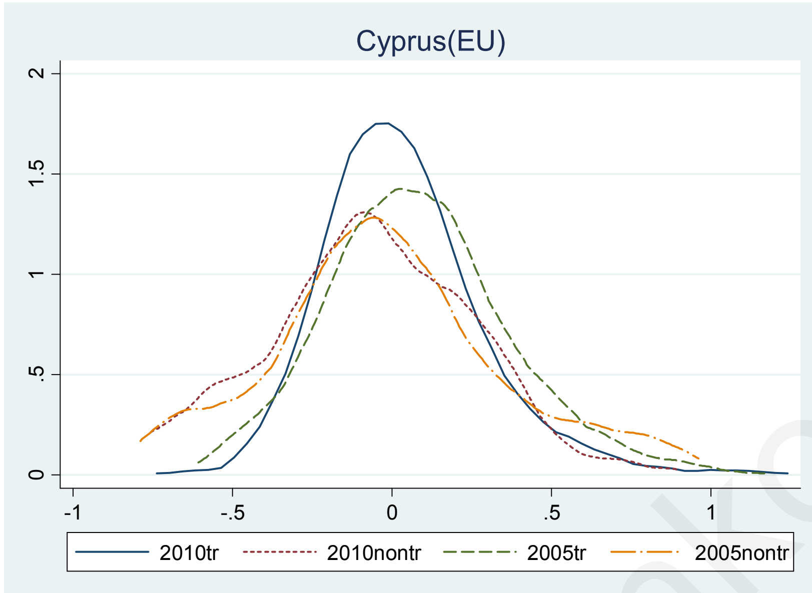


Figure 2.2: Empirical distributions of Cyprus LOP deviations from the EU countries

suggesting that the euro created a less inflationary environment over the period for Cyprus and other EZ as compared to non-EZ economies. Moreover, Figure 2.1 is again consistent with a higher degree of integration in 2010 as compared to 2005. As shown in the third row of Table 2.2, the kurtosis value in this case goes up from 3.15 to 3.55. In the third row of Table 2.2, we see that using the KS test the null hypothesis that the distribution of LOP deviations relative to the EZ for 2010 is the same as the 2005 distribution is rejected at the one percent level of significance.

Distinguishing between traded and non-traded goods and services

In what follows, we will take a separate look at tradeables and non-tradeables in order to better understand the mechanisms behind the changing degree of integration and any shifts in the distribution of LOP deviations for Cyprus relative to the other EU economies.

As we can see in Figure 2.2 for tradeables and non-tradeables separately, the distribution of LOP deviations for Cyprus relative to the EU countries average moves to the left between 2005 and 2010 implying that Cyprus became relatively cheaper for both tradeables and non-tradeables. This is also evident in Table 2.3 where we report the average and median LOP deviation for Cyprus relative to the EU in the first row. There, we see that while Cyprus was 11.6%, on average, more expensive relative to the EU in 2005 for tradeables, it was only 5.3% more expensive by year 2010. The median price for tradeable goods was 9.4% higher in Cyprus relative to the EU in 2005 and only 1.7% more expensive by 2010. For non-tradeables, while Cyprus was 17.9% more expensive in 2005, it became

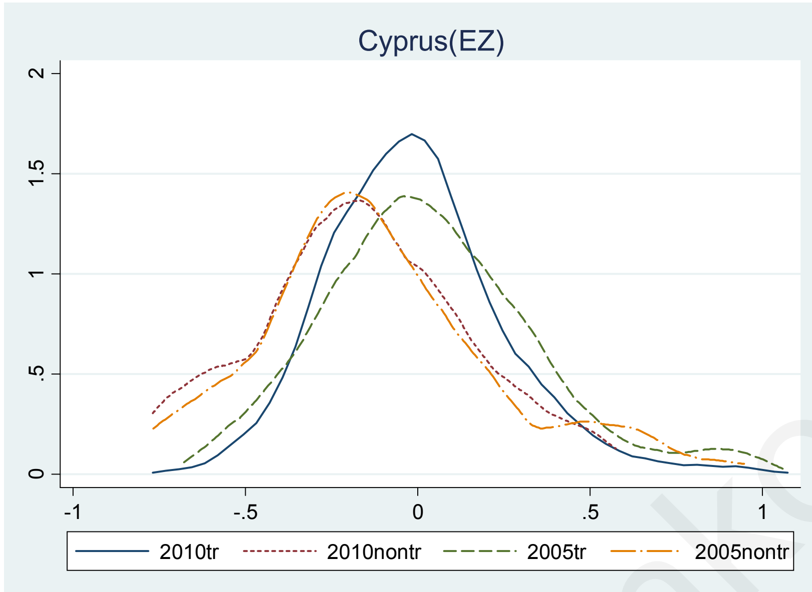


Figure 2.3: Empirical distributions of Cyprus LOP deviations from the original EZ countries

3.4% cheaper than the average EU member by year 2010. Similarly, the median non-tradeable good was 13.5% more expensive in 2005 and 4% cheaper than in the average EU country by 2010. The above results are consistent with gains in competitiveness relative to the average EU country caused by the (process towards and the) adoption of the euro that led to lower inflation relative to non EZ countries.

In addition, as we can see in Figure 2.2, Cyprus apparently becomes more integrated with the EU countries between 2005 and 2010 for both tradeables and non-tradeables. For tradeable goods, this is also evident in the fourth row of Table 2.2 where we see that the kurtosis value for the distribution of LOP deviations for Cyprus relative to the EU increases from 3.33 in 2005 to 4.98 in 2010. For non-tradeables, the kurtosis value reported in the fifth row of Table 2.2 increases only slightly from 2.84 in 2005 to 2.89 in 2010. From these values, we can also see that tradeables appear to be more integrated than non-tradeables for both 2005 and 2010 as one would expect from a higher degree of integration in markets linked by trade as compared to markets linked mostly by labor flows within a fragmented EU. While using the KS test, we cannot reject the null that the tradeables and non-tradeables distributions are identical in 2005 (with a p-value of 0.249), we clearly reject this null beyond the one percent significance level by 2010. This suggests that integration in tradeables for Cyprus relatively to the EU apparently happened much faster than any integration for non-tradeables.

As compared to its Eurozone (EZ) monetary union partners, we see in Figure 2.3

that Cyprus moved slightly to the left in terms of the distribution of relative prices for tradeables. In the second row of Table 2.3, we see that the average (median) tradeable good in Cyprus was 4.2% (0.6%) more expensive than the average EZ country in 2005 but became 0.8% (2.5%) cheaper than average by year 2010. For non-tradeables, we can see from Table 2.3 that the average (median) non-tradeable good in Cyprus was 9.9% (16.3%) cheaper than in the average EZ country in 2005 and 15.4% (17.1%) cheaper than average by year 2010. The latter alludes to the fact that non-tradeables have been on average considerably more expensive in the richer EZ economies as compared to Cyprus. Table 2.4 also reveals that this positive gap in the mean (and median) price of non-tradeables between Cyprus and the EZ shrinks once we remove the effect of income, but with Cyprus still looking cheaper by 8.3% on average in 2010 as compared to the average EZ country while it was, on average, only 1.5% cheaper than average as of 2005.

Moreover, as we can see in Figure 2.3, Cyprus became more integrated with the core EZ countries by 2010 as compared to 2005 for traded goods. As shown in the sixth column of Table 2.2, the kurtosis value increases from 3.497 in 2005 to 4.05 by 2010. This increase in integration with the EZ is not evident for non-tradeables in Figure 2.3 or in Table 2.2 (where we report the kurtosis value for the distribution of LOP deviations for non-tradeables to be 3.494 in 2005 and 2.632 in 2010), suggesting that a channel driving increased integration is via increasing trade in final goods not accompanied by a similar degree of openness for services and factors of production such us labor. Finally, we can see in Figure 2.3 and again from Table 2.2 that tradeables in Cyprus relative to the core EZ countries were clearly more integrated than non-tradeables in 2010. The KS test null that the distributions of LOP deviations of Cyprus relative to the EZ for tradeables is identical to that for non-tradeables in 2010, is rejected beyond the one percent level of statistical significance.

Next, we turn to the non-EZ EU countries. In Figure 2.4, we can see that the distributions of LOP deviations for Cyprus relative to non-EZ EU moves starkly to the left between 2005 and 2010 for both tradeables and non-tradeables. This is also evident in Table 2.3 where we report the average and median LOP deviation for Cyprus relative to non-EZ EU economies in the third row. Cyprus was 21.5%, on average, more expensive relative to the average non-EZ EU country in 2005 for tradeables, and down to 13% more expensive by year 2010. The median price for tradeable goods was 17.8% higher in Cyprus relative to the EU in 2005 and down to 7.1% more expensive by 2010. For non tradeables, Cyprus was on average 42.9% more expensive in 2005, but only 12.1% more expensive than the average non-EZ EU country by 2010. Similarly, the median non-tradeable good

Table 2.3: Average and median LOP deviations of Cyprus relative to other countries

	traded goods				nontraded goods			
	2005		2010		2005		2010	
country	average	median	average	median	average	median	average	median
Cyprus(EU)	1.116	1.094	1.053	1.017	1.179	1.135	0.966	0.960
Cyprus(EZ)	1.042	1.006	0.992	0.975	0.901	0.837	0.846	0.829
Cyprus(nonEZ)	1.215	1.178	1.130	1.071	1.429	1.382	1.121	1.114
Austria	1.104	1.028	1.024	0.979	0.829	0.773	0.868	0.855
Belgium	1.095	0.999	1.001	0.948	0.951	0.838	0.868	0.793
Finland	0.963	0.941	0.911	0.899	0.734	0.677	0.720	0.668
France	1.125	1.048	1.050	0.996	0.911	0.836	0.909	0.830
Germany	1.123	1.051	1.077	1.010	0.960	0.896	0.927	0.899
Greece	1.167	1.093	1.034	1.009	1.089	1.084	1.060	1.019
Ireland	0.964	0.942	0.973	0.950	0.922	0.756	0.773	0.713
Italy	1.048	0.968	1.038	0.976	0.999	0.949	0.934	0.856
Luxembourg	1.094	1.021	1.020	0.979	0.889	0.807	0.874	0.821
Netherlands	1.170	1.096	1.103	1.030	0.897	0.751	0.903	0.838
Portugal	1.150	1.057	1.133	1.035	1.220	1.093	1.152	1.118
Spain	1.244	1.144	1.151	1.077	1.111	1.042	1.034	0.989
Malta	1.235	1.132	1.148	1.072	1.574	1.373	1.523	1.474
Slovak Republic	1.532	1.385	1.236	1.114	2.059	1.815	1.372	1.326
Slovenia	1.242	1.178	1.131	1.043	1.308	1.201	1.077	1.017
Bulgaria	1.792	1.560	1.505	1.339	2.337	2.275	2.156	2.083
Czech Republic	1.509	1.306	1.311	1.169	2.036	1.778	1.525	1.502
Denmark	0.898	0.872	0.840	0.801	0.649	0.580	0.652	0.569
Estonia	1.457	1.316	1.251	1.109	1.629	1.489	1.333	1.247
Hungary	1.477	1.338	1.352	1.209	1.620	1.539	1.736	1.568
Latvia	1.525	1.360	1.250	1.111	1.957	1.860	1.383	1.294
Lithuania	1.575	1.407	1.315	1.167	1.892	1.615	1.551	1.494
Poland	1.664	1.505	1.472	1.292	1.570	1.520	1.590	1.584
Romania	1.809	1.563	1.445	1.286	3.015	2.930	1.916	1.898
Sweden	0.946	0.880	0.978	0.902	0.772	0.708	0.744	0.667
United Kingdom	1.121	1.033	1.214	1.159	0.903	0.742	0.951	0.911
Iceland	0.787	0.723	0.936	0.860	0.611	0.524	0.887	0.722
Norway	0.829	0.784	0.790	0.738	0.614	0.563	0.582	0.522
Switzerland	0.951	0.901	0.923	0.876	0.775	0.690	0.713	0.638
Turkey	1.445	1.302	1.396	1.264	1.604	1.407	1.495	1.445

Notes: The current Table reports mean and median LOP deviations for Cyprus relative to each EU economy and to the non-EU economies of Iceland, Norway, Switzerland andTurkey that are excluded from the analysis elsewhere. In the first three rows, Cypriot LOP deviations are relative to the EU, the EZ, and the non-EZ EU respectively.

Table 2.4: Average and median LOP deviations after income correction

	traded goods				nontraded goods			
	2005		2010		2005		2010	
	average	median	average	median	average	median	average	median
Cyprus(EU)	1.086	1.065	1.028	0.992	1.150	1.106	0.941	0.935
Cyprus(EZ)	1.125	1.090	1.063	1.046	0.985	0.920	0.917	0.900
Cyprus(nonEZ)	1.052	1.015	0.992	0.934	1.266	1.218	0.983	0.976
Austria	1.281	1.204	1.191	1.146	1.005	0.949	1.035	1.022
Belgium	1.261	1.165	1.153	1.100	1.117	1.004	1.020	0.945
Finland	1.142	1.119	1.070	1.058	0.913	0.855	0.879	0.827
France	1.269	1.192	1.169	1.115	1.055	0.980	1.029	0.949
Germany	1.264	1.193	1.205	1.138	1.102	1.037	1.055	1.027
Greece	1.155	1.080	1.007	0.982	1.076	1.071	1.033	0.992
Ireland	1.236	1.214	1.149	1.126	1.194	1.028	0.949	0.889
Italy	1.156	1.076	1.105	1.043	1.107	1.056	1.001	0.923
Luxembourg	1.545	1.471	1.480	1.440	1.339	1.257	1.334	1.281
Netherlands	1.365	1.291	1.284	1.211	1.092	0.947	1.084	1.018
Portugal	1.076	0.984	1.039	0.941	1.146	1.020	1.059	1.025
Spain	1.296	1.197	1.176	1.102	1.164	1.094	1.059	1.014
Malta	1.090	0.986	1.025	0.948	1.428	1.227	1.400	1.351
Slovak Republic	1.294	1.147	1.042	0.921	1.821	1.576	1.178	1.132
Slovenia	1.162	1.098	1.063	0.975	1.228	1.121	1.008	0.948
Bulgaria	1.162	0.930	0.984	0.819	1.708	1.646	1.635	1.563
Czech Republic	1.310	1.106	1.174	1.032	1.836	1.578	1.388	1.365
Denmark	1.162	1.136	1.088	1.048	0.913	0.844	0.900	0.817
Estonia	1.185	1.044	1.011	0.868	1.357	1.216	1.093	1.007
Hungary	1.225	1.086	1.079	0.936	1.368	1.287	1.463	1.294
Latvia	1.115	0.950	0.915	0.776	1.547	1.450	1.049	0.959
Lithuania	1.195	1.027	0.993	0.845	1.513	1.235	1.229	1.172
Poland	1.300	1.141	1.185	1.005	1.206	1.157	1.303	1.297
Romania	1.251	1.005	0.993	0.834	2.457	2.371	1.464	1.445
Sweden	1.158	1.092	1.179	1.102	0.984	0.920	0.945	0.867
United Kingdom	1.307	1.219	1.306	1.251	1.089	0.928	1.043	1.003
Iceland	1.101	1.037	1.058	0.982	0.925	0.838	1.009	0.844
Norway	1.206	1.161	1.186	1.134	0.992	0.940	0.978	0.918
Switzerland	1.245	1.195	1.249	1.202	1.068	0.984	1.039	0.964
Turkey	1.042	0.900	1.040	0.908	1.201	1.004	1.139	1.090

Notes: The current Table reports mean and median LOP deviations for Cyprus relative to each EU economy and to the non-EU economies of Iceland, Norway, Switzerland andTurkey that are excluded from the analysis elsewhere. In the first three rows, Cypriot LOP deviations are relative to the EU, the EZ, and the non-EZ EU respectively. 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.

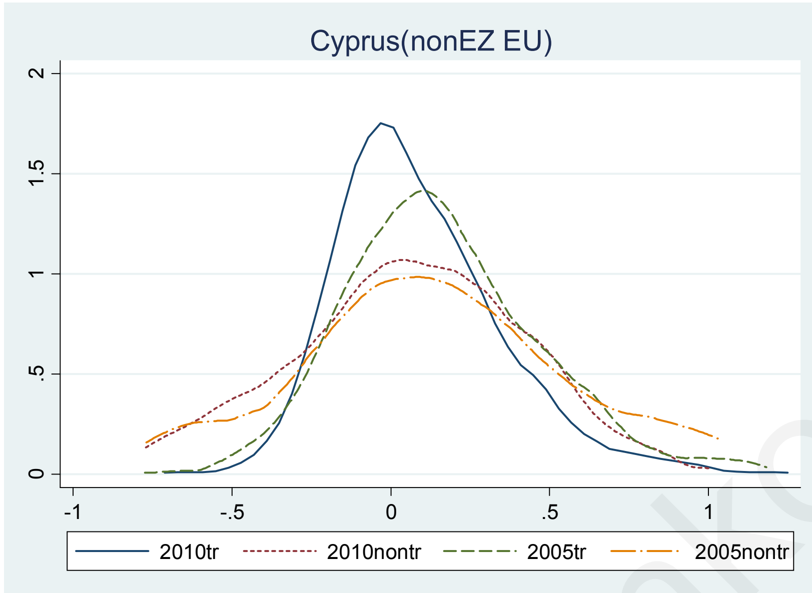


Figure 2.4: Empirical distributions of Cyprus LOP deviations from the nonEZ countries

was 38.2% more expensive in Cyprus in 2005 and 11.4% more expensive in 2010. The above results suggest that the process towards and the adoption of the euro constrained inflation in Cyprus relative to non EZ countries. This led to a smaller price gap between Cyprus and these countries for both tradeables and non-tradeables.

Additionally, as we can see in Figure 2.4, Cyprus became more integrated with non-EZ EU countries for tradeables between 2005 and 2010. In the eighth row of Table 2.2, we see that the kurtosis value for the distribution of LOP deviations for Cyprus relative to the EU increased from 3.27 in 2005 to 3.74 in 2010. For non-tradeables, the kurtosis value reported in the ninth row of Table 2.2 actually fell slightly from 2.74 in 2005 to 2.64 in 2010. From these values, we can also see that tradeables appear to be more integrated than non-tradeables for both 2005 and 2010, with the KS test null that the tradeables and non-tradeables distributions are identical clearly rejected at the one percent level of statistical significance for both 2005 and 2010.

Comparing the distribution of Cypriot LOP deviations (relative to the EU) with individual economies

In Figure 2.5, we compare Cyprus to Germany for 2005 and for 2010. The striking fact that emerges is that by 2010 the distribution of prices for Cyprus moves all the way to the left to meet the German distribution. From the information reported in Table 2.3, we can see that this leftward shift in the distribution of LOP deviations for Cyprus as compared to that of Germany, is mostly due to traded goods becoming relatively cheaper

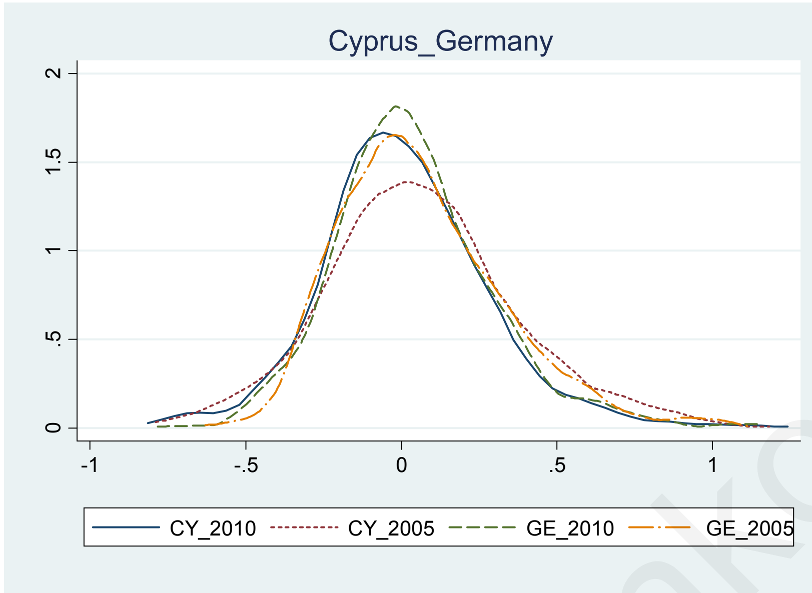


Figure 2.5: LOP deviations distributions for Cyprus and Germany

over time for Cyprus. The average (median) LOP deviation in Cyprus relative to Germany for traded goods is reported in Table 2.3 to be 12.3% (5.1%) higher in Cyprus relative to Germany in 2005, and 7.7% (1%) higher in 2010. The fact that Cyprus was still somewhat more expensive for tradeables than Germany as of 2010 might be explained by the greater geographic distance from potential trade partners as well as the small economic size characterizing the Cypriot market, in the presence of transport costs that increase with distance and the positive relation of size with the degree of potential competition[4] respectively.

The high degree of integration of Cyprus relative to Germany in 2010 as compared to 2005 is striking. These changes render the Cypriot distribution statistically indistinguishable from the German one in 2010, and apparently more similar to the German distribution in 2005 or 2010 than to the Cypriot distribution of LOP deviations in 2005! The KS test implies that the null that the distributions for Cyprus and Germany are identical in 2010 cannot be rejected even at the ten percent significance level, with a p-value of 0.318 as we report in Table 2.2. The statistical coincidence of the German and Cypriot distributions for year 2010 occurs via the movement of Cyprus to the left and the increased degree of integration for Cyprus relative to the EU without any apparent changes in the German

[4]Given a fixed cost of producing, size would imply a lower number of potential domestic producers, while given a fixed cost of entering a market, size would imply a smaller number of exporters to that market, both factors reducing the degree of potential competition in a small economy, especially so if this economy is relatively distant and faces higher transportation costs for exporting (amplifying the first factor) or importing (likely amplifying the second factor.)

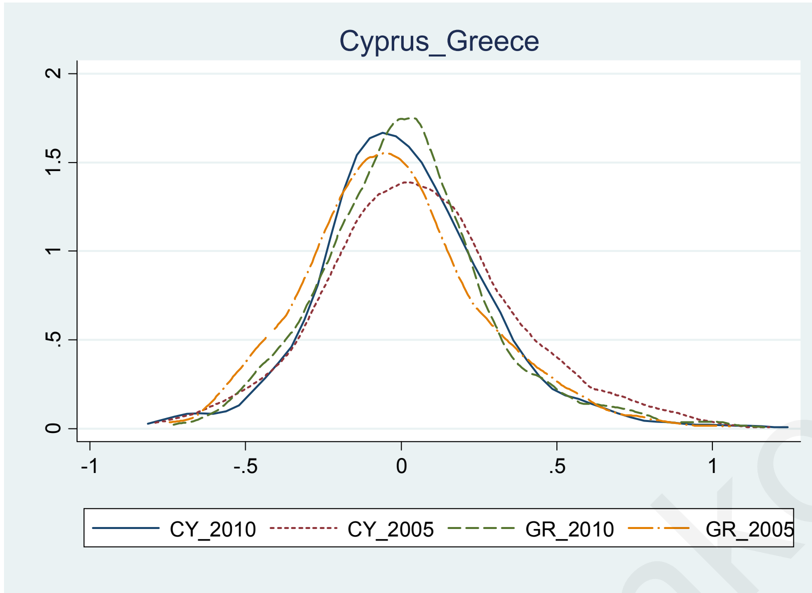


Figure 2.6: LOP deviations distributions for Cyprus and Greece

distribution of LOP deviations relative to the EU between 2005 and 2010.

To the contrary, as we show in Figure 2.6, the statistical coincidence of the Greek and Cypriot distributions in 2010 occurs both via the shift of the Cypriot distribution to the left as well as the shift of the Greek distribution to the right, and because both distributions exhibit a higher and similar degree of integration relative to the EU by year 2010. In Table 2.3, we show that the average (median) tradeable good in Cyprus was 16.7% (9.3%) more expensive than in Greece in 2005 but only 3.4% (0.9%) more expensive in 2010, while the average (median) non-traded good was 8.9% (8.4%) more expensive in 2005 and 6% (1.9%) more expensive in 2010. It is useful to note here that Guerreiro and Mignon (2013) use comparative price levels for twelve EZ members at the monthly frequency between January 1970 and July 2011 and find that Greece (as well as Portugal) exhibit fast convergence but mainly due to their loss of competitiveness over time. Glushenkova and Zachariadis (2014) show that between 1990 and 2005, Portugal, Greece, and Ireland become more integrated relative to Europe but also relatively more expensive over time with their distributions of LOP deviations shifting to the right. This is not the case for Cyprus that, apparently, experienced lower prices relative to other EZ and non-EZ EU economies during its process of monetary unification between 2005 and 2010.[5]

Also evident in Figure 2.6 is that the change in the degree of integration between 2005

[5] Glushenkova and Zachariadis (2014) show that the distribution of LOP deviations for Spain relative to the EZ also shifts to the left between 1990 and 2005 during the process of monetary unification.

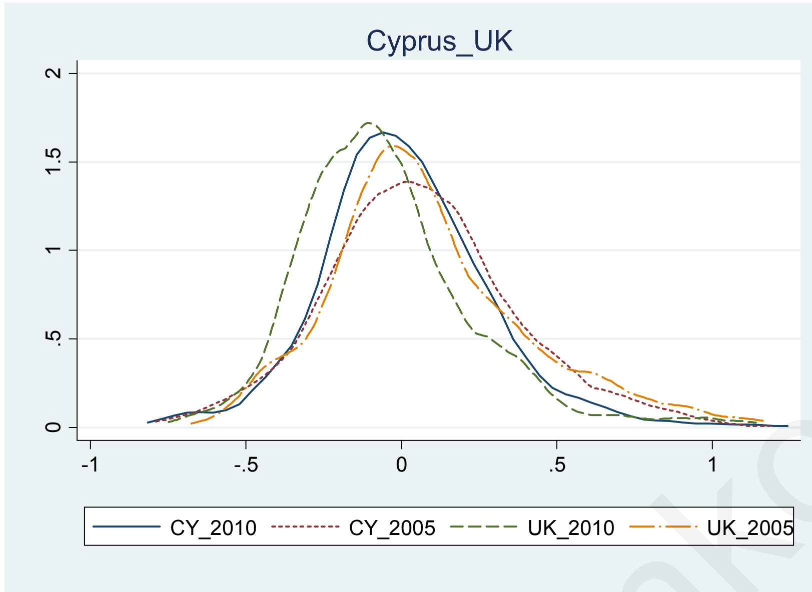


Figure 2.7: LOP deviations distributions for Cyprus and UK

and 2010 is greater for Cyprus than Greece, (the kurtosis values reported in Table 2.2 equal 4.5 for Cyprus in 2010 as compared to 3.3 in 2005, and 4.0 for Greece in 2010 as compared to 3.6 in 2005) perhaps due to the process of monetary unification that takes place for Cyprus during this period. While we reject the KS test null that the distribution of LOP deviations of Cyprus relative to the EU is identical to that of Greece in 2005, by 2010 we cannot reject the null that the distributions for Cyprus and Greece even at the ten percent level of significance, with an astonishingly high p-value equal to 0.795 as we report in Table 2.2.

Comparing Cyprus to the UK, one of its main trade partners outside the EZ, the findings are somewhat different than above. Both the UK and Cyprus distributions move leftward relative to the average EU country as shown in Figure 2.7, becoming relatively cheaper over the period 2005-2010. As we can see in Table 2.3, the average (median) tradeable good in Cyprus was 12% (3.3%) more expensive in 2005 and 21.4% (15.9%) more expensive by 2010, while on the other hand the average (median) non-traded good was 9.7% (25.8) cheaper in Cyprus than in the UK in 2005 and just 4.9% (8.9%) cheaper by 2010. All this suggests Cyprus was likely becoming less competitive during the period relative to one of its main trading partners.

Importantly, there are no visible signs in Figure 2.7 of Cyprus becoming more integrated with the UK during this period as compared to the integration taking place between Cyprus and individual EZ countries like Germany and Greece, during this period. Unlike the comparisons with Germany and Greece, the KS test reported in Table 2.2 implies that the null that the distributions for Cyprus and the UK are identical can be rejected at the one percent significance level in 2010 whereas the p-value for 2005 was 0.027 so that we could not have rejected the null at the one percent level (but just at the five percent level) back in 2005. This suggests that Cyprus became somewhat less integrated with one of its main trading partners outside the EZ during the process of monetary unification from 2005 to 2010.

A perhaps surprising fact is that despite the general tendency for Cyprus to become cheaper over time relative to the EU or EZ average and relative to individual countries like France, Germany, Italy, and Spain for both tradeables and non-tradeables, the average tradeable good in Cyprus remained somewhat more expensive than in EU economies like France, Germany, Italy, Spain and the UK for 2005 and 2010 as shown in Table 2.3. This is the case even after we remove the effect of income differences between Cyprus and these countries, as shown in Table 2.4. Greater geographic distance from potential trade partners along with the small economic size characterizing the Cypriot market are two candidate explanations for this fact. Given a fixed cost of producing, size would imply a lower number of potential domestic producers, while given a fixed cost of entering a market, size would imply a smaller number of exporters to that market. Both of these factors would then reduce the degree of potential competition in a small economy, especially so if this economy is relatively distant and faces higher transportation costs for exporting (that would amplify the first factor) or importing (that would likely amplify the second factor.) Given these characteristics Cyprus shares to some extent with Malta, it is then instructive to note that by 2010 the average (median) tradeable good was 14.8% (7.2%) more expensive in Cyprus down from 23.5% (13.2%) in 2005 as shown in Table 2.3, and that once we correct for income differences between Cyprus and Malta the average tradeable good is shown in Table 2.4 to be just 2.5% more expensive and the median tradeable goods 5.2% cheaper in Cyprus as compared to Malta by 2010.[6]

Comparing categories

So far, we have considered the distributions of Cypriot LOP deviations before and after the euro and compared these to the distributions for other EU economies, to understand the changes that occurred after euro adoption. We have also looked at the mean and median LOP deviation for Cyprus relative to other countries in our sample for tradeable as well as for non-tradeable goods and services to understand whether the movements over

[6] However, Cyprus remained significantly more expensive than Malta for non-tradeable services during this period.

Table 2.5: LOP deviations in Cyprus for different industries

		petrol	water	electr.	cars	pub.trans.	taxi	pharm.	doctors	tobacco	alcohol
2005:											
mean	CY-EU	0.834	-	-	1.159	-	-	1.155	1.318	1.320	1.399
	CY-EZ	0.774	0.671	0.797	1.154	0.928	0.743	1.035	0.871	1.116	1.563
	CY-nonEZ	0.890	-	-	1.178	-	-	1.260	1.781	1.572	1.289
2010:											
mean	CY-EU	0.851	0.771	1.195	0.982	1.040	0.882	1.193	0.950	1.073	1.065
	CY-EZ	0.822	0.709	1.113	0.960	0.832	0.704	1.089	0.685	0.900	1.104
	CY-nonEZ	0.876	0.824	1.264	1.018	1.248	1.193	1.306	1.232	1.286	1.032

		drinks	cell tel.	teleph.	food	restaur.	hotels	coffee	car rental	flights	internet
2005:											
mean	CY-EU	1.460	-	0.210	1.150	1.314	0.912	1.842	-	1.614	1.130
	CY-EZ	1.448	0.299	0.468	1.022	1.119	0.865	1.618	1.024	1.821	1.115
	CY-nonEZ	1.488	-	0.230	1.329	1.591	0.963	2.065	-	1.501	1.177
2010:											
mean	CY-EU	1.291	0.390	0.389	1.101	1.137	1.087	1.671	0.892	1.262	1.262
	CY-EZ	1.226	0.344	0.404	0.999	1.003	0.971	1.516	0.823	1.318	1.370
	CY-nonEZ	1.341	0.450	0.377	1.231	1.315	1.210	1.812	1.016	1.229	1.210

Notes: This table presents Cypriot LOP deviations for sub-categories of goods and services between 2005 and 2010. To do so, we consider the group mean over all individual LOP deviations in each group for the goods or services belonging in each category. EZ - the twelve original Eurozone members: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain. non-EZ EU - includes EU countries that were not members of the Eurozone as of 2005: Bulgaria, the Czech Republic, Cyprus, Estonia, Denmark, Hungary, Latvia, Lithuania, Poland, Malta, Romania, the Slovak Republic, Slovenia, Sweden, and the UK. This list includes new Eurozone members: Cyprus, Malta, the Slovak Republic and Slovenia. EU - includes the EZ12 plus non-EZ EU countries.

time differ across these two important categories. In the current subsection, we consider Cypriot LOP deviations for a number of smaller sub-categories of goods and services to understand how these have changed between 2005 and 2010. To do so, we consider the group mean over all individual LOP deviations in each group for the goods or services belonging in each category. The results of this exercise are reported in Table 2.5 for a number of categories.

As we can see in Table 2.5, there are important differences in how the mean LOP deviation changed between 2005 and 2010 for different types of goods and services. We see some spectacular changes in the average and median Cypriot LOP deviations for some categories of goods between 2005 and 2010. For example, electricity becomes 11.3% more expensive than the EZ average in 2010 while it was 20.3% cheaper than the EZ average in

2005. Relative to the EU, Cyprus is 19.5% more expensive in 2010. As this is an important input into the production of most goods and services, this increase in cost placed a serious burden on other industries.[7]

The opposite happens for automobiles: on average, Cyprus was 15.4% more expensive in 2005 relative to the EZ but became 4% cheaper by 2010. Alcohol and Tobacco also become significantly cheaper in Cyprus between 2005 and 2010 and the same goes for the important tourism-related categories of restaurants (on average, 11.9% more expensive in 2005 but at parity with the EZ by 2010, and 31.4% more expensive relative to the EU in 2005 but down to 13.7% more expensive by 2010), international flights (on average, 82% more expensive relative to the EZ in 2005 but down to 32% more expensive by 2010) and car rentals (on average, 2.4% more expensive relative to the EZ in 2005 but 17.7% cheaper by 2010), while hotels become more expensive during this period (respectively, 13.5% and 8.8% cheaper in Cyprus relatively to the EZ and the EU in 2005, but just 2.9% cheaper than the EZ and 8.7% more expensive than the average EU country by 2010.) The latter findings might suggest that Cyprus was not able to keep up with productivity gains in hotel services experienced in other EZ and EU economies, and as a result became less competitive in this most important tourism-related category.

There are also some persistently strikingly cheap or expensive categories in Cyprus relative to other EU and EZ economies. For example, phone calls are much cheaper than the EZ or EU average (both via cellular and ground lines). On the other hand, non-alcoholic drinks and coffee served at coffee shops are persistently way more expensive in Cyprus relative to other EZ and EU economies, even though both categories become a bit less expensive in 2010 as compared to 2005.

Explaining absolute Cypriot LOP deviations relative to the EU

In this subsection, we consider the determinants of absolute LOP deviations for Cyprus relative to the EU for a short panel comprised of observations for individual goods in 2005 and 2010. We estimate a panel regression of Cypriot LOP deviations over countries, goods and time with Cypriot industry-level data on tradeability and the share of non-traded inputs required for production.

[7] According to the Eurostat Supply-Use Tables for Cyprus for 2007, about 10% of the input cost of Retail trade and Other Service activities is due to electricity use, and the same goes for the manufacturing industry of rubber and plastic products. This is followed by the electricity input intensity of 9% into the manufacture of non-metallic mineral products and 7.4% for Hotels and Restaurants. A number of other manufacturing and service industries have an electicity use intensity that exceeds five percent of the total input costs into production. Similar numbers for the share of input costs attributed to electricity use for each industry, were obtained using the OECD Input-Output Tables in the mid 2000's.

More specifically, we set out to explain absolute LOP deviations ($|q_{ijs}|$) for Cyprus relative to each EU country i for good j at time s with tradeability, $t_{hs} = \frac{(X_{hs}+M_{hs})}{Y_{hs}}$, defined as imports ($M_{hs}$) plus exports ($X_{hs}$) of Cyprus over gross output (Y_{hs}) of industry h in Cyprus in period s, the share of non-traded inputs required to produce goods in industry h in Cyprus at time s, α_{hs}, the absolute value of differences between log vat rates for industry h in Cyprus and each country i, v_{his}, an alcohol and cigarettes dummy variable, $D_{ALC\&CIG}$, and a time dummy for year 2010, D_s. According to 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 in determining LOP deviations.

Thus, we estimate the following regression equation over 47246 observations for 1057 goods and services for Cyprus relative to the other twenty-six EU countries[8] and obtain the following results:

$$
\begin{array}{lccccccccccc}
|q_{ijs}| = & \beta_0 & + & \beta_1 & \ln t_{hs}+ & \beta_2 & \ln \alpha_{hs}+ & \beta_3 & v_{his}+ & \beta_4 & D_{ALC\&CIG}+ & \beta_5 \quad D_s \\
& 0.494 & & -.073 & & 0.179 & & .046 & & .077 & & -.102 \\
& (.030) & & (.012) & & (.063) & & (.011) & & (.021) & & (.014)
\end{array}
$$

Importantly, the negative estimated coefficient for tradeability and positive for non-tradedness (both significant at the one percent level), are in line with the retail price determination proposed in CTZ. The importance of tradeability in explaining (reducing) absolute LOP deviations in Cyprus relative to other EU countries suggests that explanations based on trade costs can be important in order to understand Cypriot price differences, while the importance of non-traded inputs implies a role for wages and other local input costs in determining these. In addition, vat differences also explain some of the price differences observed in Cyprus and so do special taxes related to alcohol and cigarettes. Both of these variables enter significantly at the one percent level.

As we show in previous sections Cyprus experienced lower prices over time relative to the EU or EZ average and relative to individual countries. One possible explanation of this effect is the process of deflation caused by financial crisis that hit a number of EU countries in 2008. However, Cyprus economy faced crises only in 2012, thus the fact that Cyprus became cheaper between 2005 and 2010 could not be attributed to the crises. Basic retail price determination model proposed in CTZ suggests that share and cost of non-traded

[8] These are: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Malta, the Slovak Republic, Slovenia, Bulgaria, the Czech Republic, Estonia, Denmark, Hungary, Latvia, Lithuania, Poland, Romania, Sweden, and the UK.

Table 2.6: Labor cost levels between 2004 and 2012

country	2004	2008	country	2004	2008
Mean EU	15.9	18.4	Cyprus	12.6	16.7
Mean EZ	23.5	25.7	Malta	9.6	11.4
Mean nonEZ EU	9.9	12.5	Slovakia	4.1	7.3
Austria	25.2	26.4	Slovenia	11.2	13.9
Belgium	29.2	32.9	Bulgaria	1.6	2.6
Finland	24.4	27.1	Czech Republic	5.8	9.2
France	28.2	31.2	Denmark	29.6	34.6
Germany	26.8	27.9	Estonia	4.3	7.8
Greece	15.3	16.7	Hungary	5.9	7.8
Ireland	25.5	28.9	Latvia	2.9	6.0
Italy	22.4	25.2	Lithuania	3.2	5.9
Luxembourg	30.3	31.0	Poland	4.7	7.6
Netherlands	27.3	29.8	Romania	1.9	4.2
Portugal	11.3	12.2	Sweden	29.0	31.6
Spain	16.5	19.4	Norway	30.1	37.8
United Kingdom	21.5	20.9			

Notes: The current Table reports hourly labor cost levels by countries between 2004 and 2008. The levels are presented in euro. Total labor cost data were obtained from the Eurostat Labour Market Database for each country for 2004 and 2008. EZ - the twelve original Eurozone members: Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain. non-EZ EU - includes EU countries that were not members of the Eurozone as of 2005: Bulgaria, the Czech Republic, Cyprus, Estonia, Denmark, Hungary, Latvia, Lithuania, Poland, Malta, Romania, the Slovak Republic, Slovenia, Sweden, and the UK. EU - includes the EZ12 plus non-EZ EU countries.

inputs play significant role in explanation of these price differences, thus relatively lower wages in Cyprus might be one explanation for these changes. To see this we consider labor cost levels in Cyprus and other EU countries for the period 2004-2012. Table 2.6 shows that Cyprus had lower labor cost than the EZ and EU average between 2004 and 2008. Mean EZ and EU labor cost in 2004 (2008) was €23.5 (€25.7) and €15.9 (€18.4) respectively, while Cypriot labor cost was at level €12.6 (€16.7) in 2004 (2008). Moreover, labor cost in Cyprus was lower than in its major trade partners, such as Germany (with labor cost equals €26.8 in 2004 and €27.9 in 2012) and the UK (€21.5 in 2004 and €20.9 in 2008). Cypriot labor cost was lower in 2005 but at parity with Greece in 2008. These numbers suggest that changes in LOP deviations for Cyprus relative to other EU countries can be partly determined by changes in non-traded input such as labor cost.

2.3 Conclusion

We have compared the densities of LOP deviations for Cyprus relative to other EZ and non-EZ EU economies before and after it adopted the euro. This has informed us about the changing degree of integration of Cyprus with other EU economies during this important period. More specifically, we infer that Cyprus became more integrated between 2005 and 2010 especially relative to EZ economies, and that the Cypriot distribution of LOP deviations shifted to the left, especially relative to non-EZ EU economies.

However, we also document important differences in the price behavior for specific goods and services within that distribution. For example, while restaurants became significantly cheaper over the period from 2005 to 2010, hotels became significantly more expensive over this period. Moreover, there was a dramatic increase in the cost of electricity during this period as compared to other EZ and EU economies. Finally, we show that price differences for Cyprus relative to other EU countries can be adequately explained by the share of non-traded inputs into production, tradeability, and differences in taxation. The importance of non-traded inputs in particular, implies a key role for local input costs in determining price differences between Cyprus and other European economies. It follows that policies which encourage liberalization in the labor market and the broader service sector could help make the Cypriot economy more price competitive.

While previous work finds that Greece, Portugal and Ireland become more integrated relative to Europe during the process of monetary unification by becoming more expensive over time as their LOP deviation distributions shift to the right, we find that Cyprus becomes more integrated by experiencing lower prices relative to other EZ and non-EZ

EU economies during its process of monetary unification between 2005 and 2010. The empirical distribution of Cyprus became statistically indistinguishable to that of core EZ economies like Germany by 2010, implying a fast pace of relative price adjustment for Cyprus during the process of Euro adoption and indicative of a high degree of downward flexibility characterizing the Cypriot economy. The latter can be important in order to understand the response of the Cypriot economy within the Troika program during the past year and the anticipated response in the years to come.

Chapter 3

Barriers to price convergence

3.1 Introduction

This paper contributes to the long-standing debate about price convergence by investigating the existence of club convergence in prices using semi-annual micro price level data for 40 countries and 96 goods and services over the period 1990-2010. To our knowledge, this is the first study to find evidence of meaningful convergence clubs in the cross-country price mechanism. This means that there exists a tendency for prices across countries with identical structural characteristics to converge to one another if their initial prices are in the basin of attraction of the same steady-state equilibrium.[1] In our context, we find that this tendency is induced by the interaction of traded and non-traded input components of retail prices. Hence, our goal is to answer the following set of questions. Do retail prices for individual goods across countries globally converge to a single price or diverge? Do countries form price convergence clubs? If yes, how do these convergence clubs vary across industries? What are the factors that determine these clubs and act as barriers to global price convergence?

At the heart of the debate about price convergence is the Law of One Price (LOP) which asserts that, as a result of arbitrage, identical goods sold in different locations will have identical prices when expressed in terms of the same currency. Empirical evidence in favor of the LOP is mixed. According to one strand of the literature the LOP does hold in the long run, conditional on cross-country structural heterogeneity including transport costs and other barriers to trade. During the last decade, a number of studies have utilized micro price levels to assess the rate of price convergence and understand the mechanisms that determine cross-country price convergence. This includes Goldberg and Verboven (2005) who use European car prices, Crucini and Shintani (2008) who use Economist Intelligence

[1] By structural characteristics we usually mean preferences, technology, institutions, and government policies, etc., see, Galor (1996).

Unit (EIU) annual price level data for 1990-2005, Broda and Weinstein (2008) and Burstein and Jaimovich (2009) who use barcode prices, and Andrade and Zachariadis (2015) who find relatively low half-lives in part due to the use of semi-annual EIU prices. Typically, this literature provides evidence of faster convergence rates than the ones in older studies using aggregate data and finding half-lives of several years as described in the survey by Obstfeld and Rogoff (2001). This recent evidence suggests that the persistence of LOP deviations is sharply reduced and convergence across countries appears to be relatively fast when based on micro prices with higher comparability across locations.

One problem with the empirical literature on price convergence is that little attention has been paid to nonlinearities. This is surprising since some important theoretical contributions suggest that the cross-country good price process is not necessarily linear. For example, Dumas (1992) and Sercu, Uppal, and Van Hulle (1995) argued that threshold nonlinearities may arise due to transactions costs in international arbitrage that create a "band of inaction" within which the marginal cost of arbitrage exceeds the marginal benefit and hence prices behave as a random walk. In contrast, outside the no-arbitrage band, arbitrage acts as a convergence force to the LOP. These transaction costs should be interpreted more broadly as "market frictions" which capture sunk costs of international arbitrage so that traders enter the market only when large enough opportunities arise (Dixit, 1989, Krugman, 1989), or costs associated with changes in preferences and technology (O'Connell and Wei, 2002). Lee and Shin (2010) argue that the introduction of non-traded goods can magnify the effect of transaction costs. Nonlinearities can also occur due to heterogeneity in agents expectations because of differences in factors such as risk aversion and constraints due to laws, regulations and institutions (e.g. Brock and Hommes, 1997), or due to incomplete or gradual reforms since individuals or local governments can engage in rent-seeking behavior leading to market fragmentation (Young, 2000). Furthermore, multiple equilibria can arise due to asset market imperfections (Corsetti and Dedola, 2005) or endogenous currency choice with price stickiness (Gopinanth, 2015).

Most empirical studies that depart from linear models employ threshold-type autoregressive models to uncover the "band of inaction" within which no trade takes place. For example, Obstfeld and Taylor (1989) investigate monthly subindices of the consumer price index (CPI) as well as aggregated CPIs for 32 city and country locations for 1980-1995 using a three-regime threshold autoregressive (TAR) model; Michael, Nobay, and Peel (1997) and Taylor, Peel, and Sarno (2001) employ a smooth transition autoregressive model using aggregate historical data for a number of countries; Imbs, Mumtaz, Ravn, and Rey (2003) and Sarno (2004) apply a TAR model to disaggregate non-harmonized price indices for a number of countries. More recently, Choi, Murphy, and Wu (2015) employ the TAR model to study the magnitude and persistence of market segmentation in U.S. consumer markets using a panel of retail prices for 45 products in 48 U.S. cities at quarterly frequency for 1985-2009.

One important limitation of the aforementioned empirical work on nonlinearities has been the failure to adequately account for parameter heterogeneity in the cross-country price mechanism due to alternative theories that suggest the existence of convergence clubs. While it is easy to see that the price theory that departs from the LOP naturally implies threshold-like structures for price convergence, the empirical literature is silent as to whether lack of global convergence to the LOP is associated with convergence clubs (groups of countries that converge locally but not globally). Specifically, existing works have focused on a particular form of threshold regression model, namely the three regime TAR, to uncover threshold effects of the lagged log price on log price differences when the lagged log price is above or below a particular lagged price threshold value. The hypothesis is that, inside the band, price deviations from the LOP are persistent while above or below this band arbitrage takes place and deviations from the LOP are mean-reverting. The alternative hypothesis that has been considered is simply that there is no nonlinearity and hence, ignores other possible reasons for nonlinearities.

Thus, in this paper, we contribute to the literature of price convergence by testing for convergence clubs and providing estimates of convergence rates to a Local Law of One Price (LLOP). By local, we refer to the idea that the LOP applies to meaningful subsets of countries and varies across these groups due to group-specific structural heterogeneity.[2] In particular, considering any final good as being comprised of a traded and a non-traded input component as in the retail pricing model of Crucini, Telmer, and Zachariadis (2005), the price level for any individual final good should be determined by a variety of factors pertaining to its respective traded and non-traded components. Its traded component is influenced by trade costs and the ability to exploit arbitrage opportunities, while its non-traded component by local input costs and productivity. Thus, theory would suggest that, in addition to productivity and local input costs, physical distance from potential trade partners and initial price levels might characterize different regimes. In this sense, we posit that countries which converge to different LLOPs depending on differential degrees of physical remoteness from potential trade partners, could belong in different price level regimes. Similarly, countries with differences in local input costs or productivity would be

[2] The identification of meaningful clubs is not a trivial issue as it requires countries to remain in a club for a long-enough time.

expected to form different price level regimes.[3]

Our work is closely related to Chen, Choi, and Devereux (2008) who test for σ-, β-, and stochastic-convergence allowing for club convergence clubs using a clustering algorithm proposed by Hobijn and Franses (2000) that identifies groups of converging countries based on a multivariate test for stationarity. Using historical price levels since 1890 for eleven developed economies, they find that global sigma and beta price levels convergence occurs later and to a lesser extent than is the case for income. Importantly, they do not find evidence of stochastic convergence or price convergence within meaningful clubs, in contrast to what has been found in the empirical growth literature regarding income convergence. Our paper differs in several important dimensions including data and methods. Notably, we employ a large panel of disaggregate data for a large number of goods and countries at the semi-annual frequency in order to alleviate cross-sectional aggregation biases (Imbs et.al., 2005).[4]

In spirit, our work is also related to the recent empirical economic growth literature. This literature has provided ample evidence of multiple regimes and nonlinearities in the cross-country growth process, consistent with the existence of club convergence (e.g., Durlauf and Johnson, 1995, Liu and Stengos,1999, Durlauf, Kourtellos, and Minkin, 2001, Masanjala and Papageorgiou, 2004, Canova, 2004, Tan, 2010). If price convergence clubs were solely driven by economic development, there would be limited scope for investigating price convergence clubs given the large existing literature on club convergence in economic growth. However, as argued by Chen, Choi, and Devereux (2008), income and price levels convergence differ in a number of ways. Importantly, certain factors that determine different price regimes might be distinct from those that determine income regimes. This makes price convergence clubs a potentially distinct and interesting topic of study.

We start by investigating the existence of convergence clubs using the nonlinear time-varying heterogeneous factor model proposed by Phillips and Sul (2007). An appealing feature of this nonlinear factor model is that it distinguishes between economies that have converged and economies that are converging, by explicitly addressing the question of invariance of the time-series process for prices. As argued by Phillips and Sul (2009), this methodology also addresses the issue of validity of conventional price convergence tests (e.g., (panel) unit root, β- or σ-convergence tests). Using the concept of "relative" convergence, we find ample evidence of lack of global convergence in the form of convergence

[3]In the latter case, however, price level regimes would plausibly be similar to income level regimes that have been the focus of the relevant growth literature.

[4]Moreover, our data do not suffer from the type of temporal aggregation shown by Taylor (2001) to introduce severe biases in the estimation of convergence parameters.

clubs for nearly all 96 goods. These findings generally also carry over to the industry level. Given that the latent factor which determines these clubs appears to be associated with differences in the traded and non-traded components of the goods, we then ask the question which specific variables can generate these convergence clubs.

So, to shed more light on the determinants of convergence clubs, we employ a threshold regression methodology proposed by Hansen (2000) using as threshold variables proxies of the traded and non-traded components of a final good, and provide estimates of convergence rates to LLOPs. Using income or labor productivity as threshold variables, we examine whether poorer countries behind the technology frontier tend to exhibit faster price convergence leading to price convergence via the non-traded component of final prices, consistent with the Balassa-Samuelson hypothesis. Using physical distance or initial prices as thresholds, we examine whether countries with smaller distance from potential trade partners in the first instance or more able to exploit arbitrage opportunities in the second instance[5], exhibit relatively faster price convergence via the traded inputs channel.

Consistent with our findings based on the nonlinear factor model, we find no evidence of global conditional β-convergence, but uncover the presence of local β-convergence as evidenced by club convergence within meaningful groups of countries in our sample. The latter is present in all revealed regimes regardless of the choice of threshold variable. Importantly, we uncover the existence of multiple price regimes that are characterized by factors that influence the respective traded and non-traded components of a good such as geography on the one side, and labor productivity, local input costs or economic development on the other side. Clubs are formed due to the interaction of these traded and non-traded factors. For example, trade appears to be conducive to price convergence for countries that also have the non-traded Balassa-Samuelson catch up process operating in full force given low initial productivity, labor cost or income, while being behind the technology frontier appears to be more conducive to price convergence for countries with relatively small physical distance from potential trade partners than for countries in the high-distance regime. In addition, we find an asymmetry in the extent that arbitrage opportunities related to international trade are exploited, with low initial price regime countries exhibiting faster convergence from below than high initial price regime countries exhibit from above, consistent with less resistance to exporting than to importing due to

[5]Intuitively, we would expect less resistance to exporting (the case of initially cheap countries) than to importing (the case of initially expensive countries) so that resistance to international trade and the resulting ability to arbitrage away price differences could be asymmetric, with countries in the low initial price regime facing less resistance and thus better able to exploit arbitrage opportunities via international trade.

political economy considerations. Finally, convergence is significantly faster for countries with low initial productivity (income) as compared to high initial productivity (income) countries, in the case of countries associated with high control of corruption but not for those associated with low corruption control. This suggests that the catch up process operating via the Balassa-Samuelson channel is present for countries that are successful in controlling corruption via appropriate institutions but not for countries with low control of corruption.

The rest of the paper proceeds as follows. In the next section, we describe the data we use. Section 3.3 describes the nonlinear factor model of prices that we use to identify price convergence clubs, and reports the corresponding results. Section 3.4 describes the threshold regression methodology and discusses the findings. Section 3.5 briefly concludes.

3.2 Data

The retail price data are drawn from the Economist Intelligence Unit (EIU) and described extensively in Bergin and Glick (2013) and Andrade and Zachariadis (2015). The price data for each item is collected for supermarkets or chains, and for mid-priced outlets. To alleviate possible measurement error, we choose to average prices across stores where possible and obtain one representative price per item. The EIU survey covers 140 cities in 90 countries, but availability of data varies across locations. In order to analyze price convergence across countries, we choose the city with the largest available set of data for each country. Moreover, to be able to apply the Phillips and Sul analysis we utilize only prices of items that are available in all time periods. For the purpose of comparability, we use goods available in more than two-thirds of the countries.

We organize goods in groups using industry classification ISIC rev 2. Our price dataset contains different numbers of items for different industries, with the largest number in food manufacturing (a total of 41 items) and the smallest number of items in tobacco manufactures (just 3 items). To allow sufficient cross-industry variation, we exclude countries with less than two thirds of the goods of an industry available. At the same time, we exclude industries with small numbers of goods (less than 5 items). The excluded industries are Tobacco Manufactures (3 items), Soft Drinks (4 items), Manufacture of Motor Vehicles (4 items), and Electricity, Gas and Steam (4 items). Similarly, we exclude Manufacture of Alcohol Beverages, Transport, Storage and Communication, and Real Estate, since retention of these would lead to the exclusion of nine countries[6] with insufficient data for

[6] Canada, Germany, Guatemala, Kenya, Mexico, New Zealand, Philippines, Poland and the U.S..

these items. We end up with a sample of 96 unique product items in 40 countries available semiannually from 1990S1 to 2010S1.

In Section 3.4 we utilize data for control of corruption and democratic accountability to detect the institutional determinants of price convergence. These data were obtained from the International Country Risk Guide from the PRS group for 1990-2010. For these variables, higher score means lower risk. As a measure of initial economic performance of the country we use lagged log real GDP per capita and lagged labor productivity data, obtained from the Penn World Tables 7.1. for 1989-2010. We calculate average distance from each city to all other cities in the sample as a measure of geographic isolation from potential trade partners. We also utilize data for labor cost obtained from the EIU for 1990-2010, available for only 31 countries. More details about all data are given in Table (A10) of the Appendix.

3.3 Price convergence clubs

3.3.1 A Nonlinear factor model for prices

We assume that for each good j the logarithm of prices p_{ijt} in country i at time t is described by a nonlinear factor model proposed by Phillips and Sul (2007). This model includes a price growth component and a time varying idiosyncratic component that allows for general heterogeneity across countries and over time and takes the form of

$$p_{ijt} = \delta_{ijt}\mu_{jt} \tag{3.1}$$

where μ_{jt} is a good specific common trend, which can be deterministic and/or stochastic, with time-varying factor loading coefficients δ_{ijt} that include both country and good specific permanent and transitory components.[7] δ_{ijt} is a vector of weights that describes the transition path of good j in economy i to the common steady state price growth path determined by μ_{jt}. Put differently, these weights can be interpreted as the price gap between the price p_{ijt} and the common trend μ_{jt}.

Following Phillips and Sul (2007) we define the concept of "relative" long-run equilibrium or convergence between two series as follows.[8] Specifically, relative price convergence

[7] Equation (3.1) can be derived from an additive panel model, $\delta_{ijt} = \frac{g_{ij}+\varepsilon_{ijt}}{\mu_{jt}}$, where g_{ij} and ε_{ijt} are the permanent and transitory components, respectively.

[8] While the cointegration literature considers the difference or linear combinations between the variables of interest, the idea here is to use their ratio to define a convergence statistic.

for each good j means

$$\lim_{k\to\infty} \frac{p_{ijt+k}}{p_{ljt+k}} = 1 \text{ for all } i \text{ and } l. \tag{3.2}$$

In the case of the nonlinear factor model in equation (3.1) the above condition can be expressed in terms of the factor loading coefficients

$$\lim_{k\to\infty} \delta_{ijt+k} = \delta_j. \tag{3.3}$$

Relative convergence is related to standard convergence definitions used in the empirical growth literature (e.g., Bernard and Durlauf, 1995, 1996, and Evans and Karras, 1996). While relative convergence in the discrete time series implies price growth convergence in the long-run, it does not generally imply level convergence. Specifically, when the weight δ_{ijt} converges faster than the divergent rate of the common component μ_{jt} in equation (3.1), then relative convergence implies absolute or level convergence, but otherwise relative convergence does not imply level convergence.

3.3.2 Transition curves

One difficulty is the presence of deterministic and stochastic elements in δ_{jt} that makes its modeling impossible. Phillips and Sul (2007) proposed the relative transition curve, h_{ijt}, that eliminates the common growth component by standardizing the transition element by the cross sectional average

$$h_{ijt} = \frac{p_{ijt}}{N^{-1}\sum_{i=1}^{N} p_{ijt}} = \frac{\delta_{ijt}}{N^{-1}\sum_{i=1}^{N}\delta_{ijt}} \tag{3.4}$$

The relative transition curve is a useful tool in understanding the transition dynamics. While these curves may exhibit heterogeneity across countries in the short-run, they allow for convergence in the long-run. In particular, a transition curve measures the price behavior of country i for good j in relation to other economies, and at the same time describes the relative departures of economy i from the common steady-state price growth path μ_{jt}.[9] This means that the presence of divergence from μ_{jt} is reflected in the transition paths h_{ijt}. For example, in the case of global convergence, the price of good j in all countries moves towards the same trend, $h_{ijt} \to 1$ for all i as $t \to \infty$ and the cross-sectional variance of h_{ijt} converges to zero so that the sample transition distance

$$D_{jt} = \frac{1}{N}\sum_{i=1}^{N}(h_{ijt}-1)^2 \to 0, \text{ as } t \to \infty. \tag{3.5}$$

[9] Following Phillips and Sul (2007, 2009) we first use the Whittaker-Hodrick-Prescott smoothing filter to remove the business cycle component before we apply the log t test.

By contrast, when an economy diverges from others the transition path can measure the extent of the divergent behavior and assess whether or not this is transient.

3.3.3 The log t test

For each good j, we test for the null of relative convergence versus the alternative of no-relative convergence using the log t test of Phillips and Sul (2009) based on the auxiliary least-squares regression

$$\log\left(\frac{D_{1j}}{D_{tj}}\right) - 2\log\log t = \lambda_{0j} + \lambda_{1j}\log t + u_{tj} \tag{3.6}$$

for $t = [rT], [rT] + 1, ..., T$ with some trimming percentage $r > 0$. For the null of global convergence the test takes the form of a sign restriction on the slope coefficient of $\log t$, $H_0 : \lambda_{1j} \geq 0$ vs. $H_1 : \lambda_{1j} < 0$, which can be tested using a conventional one-sided t-test constructed with a heteroskedasticity and autocorrelation-consistent (HAC) estimator from the residuals of equation (3.6).

The magnitude of the coefficient $\lambda_{1j} = 2\alpha_j$ measures the convergence speed of δ_{ijt} since the parameter α denotes the rate at which the cross-sectional variation across the transition paths decays to zero over time.[10] Under the condition that the common component δ_{ijt} follows a random walk with drift or a trend stationary process, we have growth convergence if $0 \leq \lambda_{1j} < 2$ and level convergence in log prices if $\lambda_{1j} \geq 2$.

3.3.4 Club convergence procedure

Rejecting the null of global convergence leaves open the possibility of convergence within some clubs of countries. Following Phillips and Sul (2009), we employ the above test sequentially in subgroups of observations to uncover multiple price regimes. The procedure comprises of four steps: (1) observations are sorted from the latest to the earliest time period of the panel; (2) using the log t test, a primary convergence club is formed against which other countries may be compared; (3) sieving through countries one at a time to check for possible membership of the primary convergence club using the log t regression; (4) repeat steps 2 and 3 and if no further convergence clubs emerge, classify the remaining observations as displaying divergent behavior. In the Appendix we provide a detailed description of this clustering procedure.

[10] To see this, note that under the null of growth convergence, Phillips and Sul (2007) showed that the (sample) mean square transition distance D_{jt} converges to $A/(\log(t))^2 t^{2a}$, where $A > 0$ is a positive constant. This yields auxiliary equation (3.6).

3.3.5 Results

Price convergence clubs

We first document the substantial evidence for lack of global convergence and provide evidence for club convergence by investigating 96 individual goods. Table 3.1 presents results for the log t-test and for the club convergence procedure, described in sections 3.3 and 3.4 respectively.[11] The first column of Table 3.1 shows the global convergence coefficient for the whole sample of countries. We find that the null hypothesis of global convergence is rejected for 92 of the 96 goods.[12]

In the next four columns of Table 3.1 we present results of the local convergence coefficients for each club. Our results show the existence of up to four different convergence clubs and that this number varies across goods.[13] For some goods there is a set of countries that do not form any club. We label such subsets of countries for particular goods as divergent, and report the estimated coefficient for such divergent groups of countries in the last column of Table 3.1. Using the definition of relative convergence, for the majority of goods we find evidence for price growth convergence within clubs since $0 \leq \lambda_{1j} < 2$. Price level convergence occurs only within the third club and for merely three goods: "White rice", "Tea bags" and "Socks, wool mixture", for which the third club is comprised of just two countries.[14]

Next, we qualify the above convergence clubs in three alternative ways. First, in the first column of Table 3.2, we present average prices by good across all countries in the sample, followed by average prices across countries within each club in the remaining columns of the table. As we can see, the first club is characterized by the highest price level for each good, the second club by the second highest price and so on. Hence, in what follows, we will refer to the first, second, third, and fourth clubs as high-price, medium-price, low-price, and cheap clubs, respectively.

Second, in Table 3.3 we present the frequency of belonging to each club for each country,

[11] Phillips and Sul (2009) suggest the $\log t$ test for $t = [rT], [rT]+1, ..., T$ and show that the choice of a trimming percentage r equal to 0.3 is appropriate for samples less than 50 time-series observations. Thus, we start from the 13th time-series observation which leaves 29 time-series observations for the $\log t$ test.

[12] The exceptions are "Personal computer", "Peanut or corn oil", "Potatoes" and "Olive oil". For "Personal computer", λ exceeds two thus we can infer that price level, not just price growth, convergence occurs.

[13] The fourth club exists for nine items: "Peas, canned", "Instant coffee", "Dry cleaning, trousers", "Laundry detergent", "Toothpaste with fluoride", "Men's business shirt", "Laundry", "Kodak color film", and "Razor blades". For "razor blades" we actually find a fifth club but opt to ignore this in the Tables since it does not arise for any other good or service in our sample.

[14] A detailed description of convergence club classifications for every good in our sample is available upon request from the authors.

i.e., the share of goods for which the country lies in the high-, medium-, low-price, and cheap clubs. We find that a number of developed economies e.g., Denmark, Germany, Finland, Spain, Switzerland, Norway, Belgium, Luxembourg, Australia, Japan, France, UK, Italy, Austria, Sweden, and the US lie in the high-price club for the great majority (for more than 60%) of the goods while lying in the low-price club for less than ten percent of the goods. This is also the case for Turkey and Poland. Figure 3.1 shows a heatmap for these shares for each country. Here, color defines club (blue for the high-price club, orange for the medium-price club, green for the low-price club, red for the cheap club, and grey for the divergent group) and depth of color represents frequency of belonging in a certain club.

Third, in Table A1 of the Appendix we take a closer look at the high-price club, distinguishing between low, medium, and high income countries forming the first club, and present average prices over the period 1990-2010 across the subset of countries in each of these three income groups for each good. We observe that average prices vary substantially for some goods within the same club depending on income group. For the sake of brevity we do not provide similar information for the medium, low-price and cheap clubs for each individual good but do undertake this at the industry-level in the next subsection.

Industry level analysis

We now discuss our findings using aggregated prices at the industry level as a way to summarize the information across the various goods. This type of analysis will also allow us to discern whether convergence patterns observed at the individual good level carry over to the industry level. In particular, we aggregate prices up to the industry level and proceed to define clubs for eight separate industries. We organize goods in groups using industry classification ISIC rev 2, calculate the median price across goods in each industry for every country, and use these data to define clubs at the industry level. Then, as in the good level analysis, for each industry we test for global convergence and club convergence.

Table 3.4 shows that the industry level results are generally consistent with the good-level analysis. Specifically, while the null hypothesis of global convergence is rejected for all industries, we do find evidence of club convergence. For half of the industries, the maximum number of formed clubs equals two (manufacture of food, textile, chemicals and metal products), and for other industries this number equals three (agriculture, paper products, hotel and restaurants, and other services). Moreover, for agriculture and manufacture of paper products there is a set of countries that do not form any club with any other country, thus we also have a divergent group for these industries. Figure 3.2 presents the set of countries in each convergence club by industry. Table A2 of the Appendix provides a detailed description of the convergence club classification for each industry.

Figure 3.3 presents the transition path for each industry and club over time. The relative transition path shows the time variation of the average transition coefficient defined by equation (3.4) across the countries forming each club for each industry over the period 1990-2010.[15] Overall, we find no evidence of global convergence, since we do not observe monotonic convergence to unity for all three clubs for any industry. On the contrary, there is an apparent divergent path for clubs at the end of the period. Moreover, the transition curves shown in Figure 3.3 illustrate that the first club, irrespective of industry, includes countries with relatively higher prices, while the second and third clubs have smaller prices. For some industries, countries forming different clubs have similar initial states, e.g., agriculture (the second and third club), manufacture of food (the first and second club) and hotel and restaurants (the first and second club), but exhibit transitional divergence starting at some later point in time. For other industries like manufacture of textile or community, social and personal services, transitional divergence appears from the beginning of the period. Interestingly, for most industries, clubs are characterized by converging transitional paths till the middle of the period after which transition paths start to diverge. These time series patterns could then be used to identify factors behind the existence and formation of clubs, e.g., due to specific physical or technological events related to certain industries, that occur at some point in time and affect countries and industries differently. Moreover, the results are consistent with the good-level transition curves presented in Figure A1 of the Appendix, albeit the latter are a lot more noisy.

The convergence clubs formed at the industry level generally appear to share the same characteristics as the ones formed using the individual good level data. For example, the first club is always associated with the highest average price and the third club with the lowest price, as we show in Table A3 of the Appendix where we present average prices over the countries and period under study, for each industry in each club. Furthermore, when we distinguish between low, medium, and high income countries that form each club we have identified, we now see that average prices over the period 1990-2010 across the subset of countries in each of these three income groups for each industry do not always decline with income. Evidently, for some industries, price convergence clubs are highly associated with country income level while it is clearly not the case for other industries.

[15] The average transition curve for each club k and each industry h is calculated as $\widehat{h_{kht}} = \frac{1}{N_k}\sum_{i=1}^{N_k}(h_{iht})$, where $h_{iht} = \frac{p_{iht}}{N^{-1}\sum_{i=1}^{N} p_{iht}}$.

Figure 3.4 shows the relationship between average prices and average real GDP per capita (averaged over the period of study) for each of the eight industries. We mark the clubs different countries belong in by different colors. Once again, blue is for the first club, orange for the second club, and green for the third club. We can see that for some industries like agriculture and social and personal services, price convergence clubs are highly associated with country income level, while it is clearly not the case for other industries, e.g., manufacture of food or chemicals. We can infer that income might potentially play a role in the formation of different clubs, at least in the case of some categories of goods.

In the next section, we investigate more systematically the role income and other factors might play in determining the convergence clubs.

3.4 Determinants of convergence clubs

3.4.1 Threshold regressions and club convergence

In this section, we investigate the factors that sort the countries into price convergence clubs. While the nonlinear factor model in equation (3.1) allowed us to identify convergence clubs using very weak assumptions, it did not allow us to identify the sources of this heterogeneity as this is latent. To do so, we use a threshold regression model, which classifies the countries into price convergence clubs depending on whether the observed value of a threshold variable is above or below a sample split value estimated from the data.

As threshold variables q_{sit}, $s = 1, ..., p$ we use a set of variables that relate to the non-traded or traded components of final goods prices. As proxies for the non-traded component we use initial log real GDP per capita, initial labor productivity, control of corruption and democracy, while for the traded component we use distance and initial prices. The first set of threshold variables, helps us examine whether poorer countries behind the technology frontier tend to exhibit faster price convergence leading to price convergence via the non-traded component of final prices in line with the Balassa-Samuelson hypothesis. The second set of threshold variables helps us examine whether countries with smaller distance from potential trade partners or more able to exploit arbitrage opportunities due to lower resistance to trade, exhibit relatively faster price convergence via the traded inputs channel.

Using the growth of price in period t for good j in country i, $g_{ijt} = p_{ijt} - p_{ijt-1}$, we specify the following threshold model, which is based on a panel of semiannual price data for 96 goods from 1990 to 2010 across 38 countries.[16]

$$g_{ijt} = \mu_{s1t} + \alpha_{s1i} + \eta_{s1j} + \beta_{s1} p_{ijt-1} + \pi'_{s1} z_{it} + \varepsilon_{ijt} = \theta'_{s1} x_{ijt} + \varepsilon_{ijt}, \ q_{sit} \leq \gamma_s \quad (3.7)$$
$$g_{ijt} = \mu_{s2t} + \alpha_{s2i} + \eta_{s2j} + \beta_{s2} p_{ijt-1} + \pi'_{s2} z_{it} + \varepsilon_{ijt} = \theta'_{s2} x_{ijt} + \varepsilon_{ijt}, \ q_{sit} > \gamma_s \quad (3.8)$$

where $x_{ijt} = (d_i', d_j', d_t', p_{ijt-1}, z_{it}')'$, with d_i, d_j and d_t country, good, and time dummies. γ_s is the scalar threshold parameter or sample split value, μ_{1st} , α_{1si} and η_{s1j} are time, country and good fixed effects respectively, p_{ijt-1} is the lagged price level, q_{sit}, $s = 1, .., p$, are threshold variables, and z_{it} is a vector of observable traded and non-traded related explanatory variables that belong to the vector $\underline{q} = [q_{1it}, ..., q_{pit}]$ of threshold variables, $z_{it} \in \underline{q}$. This vector includes initial income, initial productivity, distance, control of corruption, democracy, and initial prices. The term ε_{ijt} is the regression error. The slope coefficients β_{s1} and β_{s2} are related to the idea of conditional β-convergence or "catching up" in terms of prices, i.e., the higher the initial absolute price level the lower the price growth rate. Specifically, when $\beta_{s1} < 0$ and $\beta_{s2} < 0$ we say that we have club β-convergence for both regimes.

It is convenient to write the above threshold regression model in a single equation using the indicator variable $I(q_{sit} \leq \gamma_s) = 1$ if $q_{sit} \leq \gamma_s$ and $I(q_{sit} \leq \gamma_s) = 0$ if $q_{sit} > \gamma_s$. This yields

$$g_{ijt} = \theta'_s x_{ijt} + \delta'_s x_{ijt} I(q_{sit} \leq \gamma_s) + e_{ijt}, \quad (3.9)$$

where $\delta_s = \theta_{s1} - \theta_{s2}$ is the threshold effect and $\theta_s = \theta_{s2}$. When $\delta_s = 0$, the threshold regression model in equation (3.9) yields the linear model, which Chen, Choi, and Devereux (2008) use to test for β-convergence. The statistical theory for the above model is provided by Hansen (2000) who proposed a concentrated least squares method for the estimation of the threshold parameter.

Our test for club convergence involves testing for the presence of threshold effects and unit roots. First, we test for threshold effects using the hypothesis $H_0 : \delta_s = 0$ vs. $H_1 : \delta_s \neq 0$, i.e., the null hypothesis of a linear model (no threshold effects) against the alternative of a threshold regression model. To do so, we use a heteroskedasticity-autocorrelation consistent Lagrange multiplier (LM) test and compute the p-values by a bootstrap method proposed by Hansen (1996). Second, we test whether the countries

[16] Hong Kong and Singapore are excluded as data on our threshold variables are not available for these. In models with labor cost as threshold variable, the sample of countries is down to 31 due to limited labor cost data availability.

converge or diverge using a threshold autoregressive unit root test proposed by Caner and Hansen (2001) and extended for the panel-data model by Beyaert and Camacho (2008). In model (3.9), if $\beta_{s1} = \beta_{s2} = 0$ then we say that the countries diverge. If both parameters are negative, then we have club β-convergence for both regimes. If the countries converge under one regime but not under the other then partial convergence occurs. Finally, we employ the above tests sequentially by testing for threshold effects and unit roots within each of the two subsamples.

3.4.2 Evidence from threshold regression models

Testing for threshold effects and unit root

Consistent with the evidence from the non-linear factor model in section 3.3, we proceed to investigate the presence of up to four convergence clubs using our baseline threshold model which includes initial prices as well as country-, good-, and time-fixed effects as explanatory variables in Table 3.5. The first two columns of Table 3.5 describe the threshold variables that define the threshold regression models. In particular, level 1 threshold variables (q_1) are used in the two-regime model while level 2 threshold variables (q_2) are used in the second-level of the four-regime model. The next six columns present the estimated threshold parameters and the corresponding 95% confidence intervals for the two-regime and four-regime models. The results of the threshold and unit root tests are presented as superscripts to the threshold estimate by a significance star and dagger, respectively. The last column reports the Akaike information criterion (AIC).

We start by documenting the global divergence of prices, which emerges as a result of the interaction of traded and non-traded factors in the form of threshold effects. Specifically, using sequential testing for the presence of threshold effects as in Hansen (1999), we uncover the presence of four regimes, which we call clubs, in almost all models by rejecting the linear model most of the times at the 1% and in some cases at the 5% significance level. The only exception is when democracy is used as a threshold variable for both levels. Nevertheless, even in this case we find strong evidence for a three-regime model. We also reject the null of unit roots in the context of the threshold regression in all cases at the 1% significance level.

According to AIC the strongest evidence for a threshold split occurs when distance is one of the threshold variables. Specifically, the top three models with the lowest AIC values use democracy/distance, distance/initial productivity, and distance/initial income as level 1/level 2 threshold variables. For example, the second best model organizes the countries in four clubs: (C1) distance below 8.798 and initial productivity below 10.861; (C2) distance below 8.798 and initial productivity above 10.861; (C3) distance above 8.798 and initial productivity below 10.127; and (C4) distance above 8.798 and initial productivity above 10.127. The distance threshold value 8.798 corresponds to Turkey, the 18th least distant country in our sample. The initial productivity threshold values 10.861 and 10.127 correspond to Spain and Mexico in 1997, the 16th and 21st most productive country in our sample in 1997, respectively.

Local convergence rates

Next, in Table 3.6, we present the estimated β-coefficients for each club that correspond to the threshold regression models presented in Table 3.5. The first column ranks the threshold models according to their AIC values and the next two columns describe their corresponding threshold variables. The models are ordered by AIC. The next eight columns show estimates of the β-coefficients and the corresponding speed of price convergence within each club.[17] The speed of convergence shows the percentage semi-annual movement of the country to its local steady state relative to the remaining distance.[18] The last column reports the AIC value. We note that we only present unique threshold regression models chosen by AIC. That is, for each pair of threshold variables q_1 and q_2 in Table 3.5, the sequential testing procedure gives rise to two four-regime threshold models depending on the order with which the threshold variables were chosen to split the sample. We select the model that yields the lowest AIC value and present it in Table3.6. This limits the number of models to 21.

Consistent with the predictions of theories on multiple steady states, we find strong evidence of club convergence consistent with our earlier unconditional results that were based on the nonlinear factor model. That is, the β-coefficient is always estimated to be negative and strongly significant, implying the presence of club β-convergence in all regimes. This finding holds regardless of the choice of threshold variable.

We find a number of theory-relevant results. First, the findings in models 2 and 3 in Table 3.6 are of particular theoretical interest as these models account for the effect of distance and labor productivity (or income) on price convergence, which respectively capture the traded and non-traded components of final prices on price convergence. Notably,

[17] In Table A4 of the Appendix, we present the results of the test for the equality of β-coefficients for each pair of regimes in each model.

[18] We calculate the speed of convergence using the coefficient for the initial price level in equations (3.7) and (3.8): $-(1-e^{-\lambda_k t}) = \beta_k$, for regime $k = 1, 2$ and $t = 1$, where λ_k denotes the speed of price convergence.

these models are respectively ranked as the 2nd and 3rd best according to the AIC. Based on the model with distance and initial labor productivity as threshold variables (model 2), countries in the low distance regime converge faster than countries in the high distance regime as long as they have low initial labor productivity. This suggests trade is conducive to price convergence for countries that also have the non-traded Balassa-Samuelson catch up process operating in full force given low initial productivity. In addition, we find that within the low distance regime, countries with low initial productivity converge significantly faster than those in the high productivity regime. In the high-distance regime, implied convergence is not significantly higher in the low productivity regime as compared to the high productivity one. Thus, being behind the technology frontier appears to be conducive to price convergence, presumably via the Balassa-Samuelson channel, for countries with relatively small physical distance from potential trade partners that have easier access to international trade but not for countries in the high-distance regime. This suggests, again, an interaction between the non-traded and traded channels via which price convergence occurs.

The finding that price convergence depends on the interaction between the traded and non-traded channels is also preserved when we replace the level 2 threshold variable initial productivity with initial income (model 3 in Table 3.6). We find that countries in the low distance regime converge faster than those in the high distance regime as long as they have low initial income. We also find that convergence is faster in the low-income regime as compared to the high-income regime irrespective of whether a country lies in the low or high distance regimes. However, the difference in the speed of convergence coefficients is much greater for low versus high income countries in the low distance regime (0.151 versus 0.065) as compared to within the high distance regime (0.090 versus 0.070 respectively for low and high income regime countries). In any case, the implication is that poorer countries behind the frontier tend to exhibit faster inflation leading to price convergence. This effect is consistent with the Balassa-Samuelson hypothesis, according to which prices will increase (and thus converge) faster in poorer countries as they catch-up by growing faster over the period. This form of price convergence occurs via convergence in the non-traded component of final prices. We find similar evidence consistent with this notion in other threshold models we consider with initial income or labor productivity as first or second level threshold variables. That is, the typical finding from such models (models 2, 3, 7, 8, 9, and 11 to 16) is that countries in the low initial income or initial labor productivity regimes are associated with higher implied convergence than countries in the respective high regimes.

Second, based on the model with distance and initial prices as first and second thresholds respectively (model 10 in Table 3.6), countries in the low distance regime tend to converge faster than countries in the high distance regime irrespective of initial price regime. The basic result that the low distance regime is associated with faster implied convergence than the high distance regime, is quite common amongst the models we consider with distance as a first or second-level threshold variable (models 1, 2, 3, 5, 6 and 10 in Table 3.6).

Importantly, based on model 10, countries in the low initial prices regime converge faster than those in the high initial prices regime, irrespective of whether they are in the low or high distance regime. In fact, looking at other models with initial prices as second threshold variable (such as models 11, 13, 18, 19 and 21 in Table 3.6) we see that the coefficients of initial prices are always higher (and significantly so, except for model 21 in the high regime) for low initial price level regime countries as compared to high-regime ones. This implies that countries in the low initial price regime exhibit faster catch up than countries in the high initial price regime. That is, there appears to be an asymmetry in the extent that arbitrage opportunities related to international trade are exploited, with low initial price regime countries exhibiting faster convergence from below than high initial price regime countries exhibit from above. This could be related to the fact that we would typically expect less resistance to exporting (the case of initially cheap countries) than to importing (the case of initially expensive countries) where some local producers and workers stand to lose out. Thus, resistance to international trade and the resulting ability to arbitrage away price differences would be asymmetric, with countries in the low initial price regime facing less resistance and thus better able to exploit arbitrage opportunities via international trade.

Furthermore, the results in models 11 and 13 are of particular theory interest as these models capture the effect on price convergence of two variables in each case (labor productivity or income versus initial prices) that map onto the respective non-traded versus traded components of final prices. In the model with labor productivity and initial prices as threshold variables (model 11), countries in the low labor productivity regime converge faster than those in the high productivity regime, irrespective of whether they are in the low or high initial price regime. Furthermore, as we already noted above, countries with lower initial prices converge faster than countries with high initial prices, irrespective of whether a country lies in the low or high productivity regime. Similarly, in the model with initial income and initial prices as threshold variables (model 13), countries with low initial income converge faster than countries with high initial income irrespective of the initial price regime they lie in, and countries with lower initial prices converge faster than countries with high prices irrespective of whether they lie in the low or high initial income regime. These results are then consistent with a retail pricing model where final goods prices have a non-traded and traded component related to income (or labor productivity) and initial prices respectively.

Third, the institutions-related variable control of corruption appears to be conducive to price convergence. This is evident in model 4 in Table 3.6 where we use control of corruption with democracy as first and second threshold variables respectively, and in model 5 where we use control of corruption and distance as first and second threshold variables.

Using control of corruption and labor productivity as first and second threshold variables respectively (model 7 in Table 3.6), convergence in the high control of corruption regime is higher than in the low regime as long as the country has low productivity. In addition, for the high but not for the low control of corruption regime, convergence is faster for low initial productivity as compared to high productivity countries. This suggests that being behind the technology frontier appears to be conducive to price convergence, presumably via the Balassa-Samuelson channel, for countries that have good institutions successful in controlling corruption but not for countries in the low control of corruption regime.

Similarly, using control of corruption and initial income as the respective first and second threshold variables (model 14), convergence in the high control of corruption regime is higher than in the low regime as long as the country has low initial income. Interestingly, for the high but not for the low control of corruption regime, convergence is significantly faster for low initial income as compared to high income countries, suggesting that the catch up process operating via the Balassa-Samuelson channel is present for countries that are successful in controlling corruption but not for countries with low control of corruption.

In the model with control of corruption and initial prices as threshold variables (model 19 in Table 3.6), countries with high control of corruption converge faster as long as they have low initial prices. Thus, control of corruption is likely to affect the ability to arbitrage away existing price differences. We would expect that countries with higher control of corruption can more readily rip the benefits of international trade and as a result would tend to exhibit relatively more rapid price convergence. In addition, higher values of this variable could be associated with higher competition in the local market that in turn reinforces price convergence. Finally, the basic finding that control of corruption facilitates convergence comes out in model 20 as well, where corruption control enters as both a first and second level threshold variable.

Fourth, we find that the best model according to the AIC is the one that splits with democratic accountability and distance. We find that convergence in low democracy regimes is greater than in high democracy regimes irrespective of distance regime. Moreover, within the low democracy regime, countries with smaller distance from potential trade partners converge faster. Typically, in the models with democratic accountability as first threshold variable (models 1, 17 and 18) or as second threshold variable (models 4, 8, 9 and 17) reported in Table 3.6, convergence in the low democracy regime is higher than in the high-democracy regime. Models 8 and 9 with initial productivity or income as the respective first threshold variable and democracy as second threshold variable, are of particular interest. For these models, the result that low democracy leads to convergence holds only for the low initial productivity or for the low income regime and is not the case for high productivity or rich countries. The explanation could lie in political pressures that limit Central Bank independence and lead to more expansionary monetary policies resulting in higher inflation in initially backward (proxying for poor institutions that limit the degree of Central Bank independence) countries. Here, faster convergence would not coincide with higher market integration but would just be an unintended consequence of policies leading to higher inflation in initially poor countries with initially lower prices.

3.4.3 Further results

In addition to our baseline results presented above, we consider two further exercises using alternative samples and model specifications. First, we present threshold regression estimation results that use labor cost as a threshold variable in Table 3.7. This variable, however, restricts the sample to 31 countries due to data unavailability.[19] As for our baseline sample, we reject the null hypothesis of global β-convergence and find strong evidence for club convergence. The best model according to the AIC, is the model that splits with labor cost (level 1) and democracy (level 2). In this case, we can see that countries in the low labor cost regime exhibit faster implied convergence than those in the high labor cost regime. Moreover, we can see that countries in the low democracy regime exhibit faster implied convergence than those in the high democracy regime, but only as long as they are in the low labor cost regime. This finding resembles the result discussed earlier regarding low democracy regime countries with low initial income or low initial labor productivity.

[19] For brevity, we show the threshold tests in Table A7 of the Appendix.

The second best model shown in Table 3.7 which splits using distance (level 1) and labor cost (level 2) is, however, the most theoretically appealing one. This model shows that within the low distance regime, countries with lower labor cost converge significantly faster than countries with high labor cost. This resembles the result for labor productivity in model 2 of Table 3.6, and is again suggestive of an interaction between the non-traded and traded channels via which price convergence occurs. Moreover, countries with low distance tend to converge faster than those with high distance from potential trade partners as long as they have lower labor cost. This result resembles the findings for labor productivity and initial income in models 2 and 3 from Table 3.6. It makes good sense as distance matters for trade and countries with lower labor costs might be more able to engage successfully in international trade. For example, countries with lower labor costs might face less political resistance in engaging in international trade than countries with high labor costs where some local players would lose out from engaging in international trade.

The remaining theoretically interesting models in Table 3.7 are models 5 and 7, which include labor cost as second threshold with control of corruption or initial prices as the respective first threshold variables. Results for model 5 in Table 3.7 suggest that control of corruption helps convergence for countries with low labor cost, and that countries with low labor costs converge significantly faster than those with high labor cost as long as they have high control of corruption. Both of these results resemble what we saw in the case of initial productivity and initial income in models 7 and 14 respectively shown in Table 3.6.

Results for model 7 in Table 3.7 where labor cost enters as second threshold variable and initial prices as first threshold variable, resemble those from models 11 and 13 in Table 3.6 where initial prices enter as second threshold variable with initial productivity and initial income as the respective first threshold variables. That is, countries with low labor costs converge faster than countries with high labor costs irrespective of the initial price regime they lie in, and countries with lower initial prices converge faster than countries with high prices irrespective of whether they lie in the low or high labor cost regime.

In the second exercise further to our baseline results, we use our baseline sample to estimate the threshold regression model in equations 3.7 and 3.8 by including initial income, control of corruption and democracy in addition to initial prices and fixed effects.[20] We present the estimation for the augmented threshold regressions in Table 3.8.[21] In general, we find that for factors related to the non-traded component of final prices,

[20] Initial productivity was excluded from the vector z_{it} due to multicollinearity issues. Distance is also not included since it is a country-specific variable and the model includes country fixed effects.

[21] Threshold tests and tests for the equality of the β-coefficients for each pair of the regimes in each model are given in Tables A5 and A6 of the Appendix, respectively.

high values of initial income, labor productivity and democratic accountability hinder convergence, while high control of corruption reinforces convergence. Similarly, factors related to the traded component of final prices such as distance and initial prices have a suppressing effect on price convergence, i.e., countries with higher distance or higher initial prices tend to have lower convergence rates.[22]

3.4.4 Classification of countries in convergence clubs

In this section we attempt to classify the countries in various convergence clubs using information from threshold regressions based on our baseline sample. In the four panels of Figure 3.5, we present the countries that belong to the various regimes using cross-plots between the two threshold variables q_1 and q_2 for four of the best models from Table 3.6 that include pairs of variables capturing respectively each of the two theoretically distinct components of final prices. These four models include distance to capture the traded component in each case, and labor productivity, initial income or institutions to capture the non-traded component of final prices. Specifically, we consider Model 1 with q_1=Democracy and q_2=Distance in Panel (a); Model 2 with q_1=Distance and q_2=Initial Productivity in Panel (b); Model 3 with q_1=Distance and q_2=Initial Income in Panel (c); and Model 5 with q_1=Control of Corruption and q_2=Distance in Panel (d).

We calculate the share of years for which the country lies in one of the regimes and obtain frequencies of forming a regime for each country in each model. If the country lies in one of the regimes for more than 50% of the period, then it is classified in that regime. There are four possibilities marked by different colors: blue denotes dismal conditions in both variables; orange denotes bad conditions in q_1 but good conditions in q_2; green denotes good conditions in q_1 and bad q_2 conditions; and red denotes good conditions for both q_1 and q_2.[23] The size of the circles shows speed of convergence within each regime.

Overall, the results verify at the country level the findings described in Table 3.6. The "best" regime, that is, the regime with the most favorable economic conditions in both threshold variables, typically includes most of the European countries while the "bad" regime typically comprises Latin American and South East Asian countries. Interestingly, other high income countries such as the US, Canada and Japan appear to belong

[22] We also estimate the augmented threshold regression models using the restricted sample of countries that include labor cost. The results are similar and can be found in Tables A7 and A8 of the Appendix.

[23] Except for distance and initial prices, for most threshold variables low values reflect bad economic conditions and high values good economic conditions. Thus, good conditions for q_i typically correspond to the high q_i regime obtained in the threshold models, except in the case of distance and initial prices where good conditions correspond to the low q_i regime in the threshold models.

to intermediate regimes, which are only partially characterized by favorable conditions. Moreover, these regimes exhibit substantial differences in their convergence rates to their local long run equilibria. In particular, Panel (a) shows that countries with low democracy and low distance (in orange) appear to have the highest convergence pace. Panels (b) and (c) exhibit similar patterns. They show that countries (in green) with low distance and low initial income or productivity converge faster than other countries. Finally, Panel (d) shows that countries (in red) with high control of corruption and low distance converge faster than the rest.

In general, our results in this section imply a similar classification of countries to the one based on the nonlinear factor model in Table 3.3.[24] For example, countries that lie in the threshold regime described by the best conditions (both threshold variables reflecting good conditions) for more than 50% of models, i.e., the Netherlands, Norway, Luxembourg, Switzerland, Sweden, Finland, Denmark, Austria, Germany, UK, Belgium, France, Spain and Australia, are countries that lie in the high-price club for more than 50% of the goods in our sample. Similarly, the majority of countries that lie in the threshold regime with worst conditions for more than 50% of the estimated models, i.e., Panama, Philippines, Guatemala, Thailand, Colombia, Peru, South Africa, Uruguay, Venezuela, Brazil, Paraguay and Kenya, are countries that lie in the medium or low price clubs for more than 50% of the goods in our sample.

3.5 Conclusion

We have investigated the existence of convergence clubs in the cross-country mechanism of retail prices using a sample of 96 goods in 40 countries for 1990 to 2010 at the semi-annual frequency, by doing two things. First, we employ a nonlinear factor model that distinguishes between economies that have converged and those that are converging. While we do not find evidence of global price convergence, we do find strong evidence of convergence clubs. Second, we examine the factors that determine price convergence clubs using a threshold regression methodology which allows us to model the determinants of convergence clubs using observed threshold variables related to traded and non-traded factors, and to estimate regime-specific β-coefficients common within regimes. These regime-specific estimated coefficients map onto local rates of convergence consistent with

[24] This is shown in Table A9 of the appendix where we present country-specific frequencies of forming a regime based on the 36 estimated threshold regression models from Table 3.6. As in Figure 3.5, we calculate the share of years for which the country lies in one of the regimes and obtain frequencies of forming each regime for each country in each model. Then, using these frequencies we compute the share of models for which the country lies in each of the regimes.

a local law of one price. In line with our findings based on the nonlinear factor model, we find strong evidence of club convergence.

We reject the null of global β convergence, typically in favor of four convergence clubs which are due to traded and non-traded factors and the interaction between these. These factors can be viewed as barriers to global price convergence that organize countries into price convergence clubs. Here, different price convergence regimes arise both due to factors associated with convergence in the non-traded component of final prices related to non-traded input cost differences across countries (e.g., income, labor productivity or labor cost) and due to convergence in the traded component of final prices (e.g., physical distance or initial prices), consistent with a retail pricing model where traded and non-traded inputs comprise the final good. Our results are suggestive of the economic mechanisms that are at work here. With either initial income or initial productivity as one of the threshold variables, implied convergence rates for the low regime are typically higher than for the high regime, consistent with the Balassa-Samuelson hypothesis and convergence via the non-traded component of final prices. With physical distance or initial prices as thresholds, implied convergence is typically higher in the low regime than in the high regime, suggesting that countries with smaller distance from potential trade partners and those more able to exploit arbitrage opportunities experience faster convergence.[25]

Importantly, our findings point to interactions between the non-traded and traded channels via which price convergence occurs. Countries in the low distance regime converge faster than countries in the high distance regime if they have low initial labor productivity, low labor input costs or low initial income, and countries with low initial productivity or low labor input costs converge significantly faster than those in the respective high productivity or high labor cost regimes, if characterized by low average distance from trade partners. In the first instance, trade appears to be conducive to price convergence for countries that have the non-traded Balassa-Samuelson catch up process operating given low initial productivity, labor cost or initial income levels. In the second instance, being behind the technology frontier appears to be more conducive to price convergence for countries with relatively small physical distance from potential trade partners that have easier access to international trade than for countries in the high-distance regime.

In addition, we find an asymmetry in the extent that arbitrage opportunities related to international trade are exploited, with low initial price regime countries exhibiting faster

[25] Future work would do well to focus on structural threshold regression models that account for endogeneity, e.g., Kourtellos, Stengos, and Tan (2015), and can potentially be used to identify such mechanisms provided that appropriate instruments can be found.

convergence from below than high initial price regime countries exhibit from above. This can be explained by lower resistance to exporting (the case of initially cheap countries) than to importing (the case of initially expensive countries) where some local producers and workers stand to lose out, so that resistance to international trade and the resulting ability to arbitrage away price differences is rendered asymmetric, with countries in the low initial price regime facing less resistance and thus better able to exploit arbitrage opportunities via international trade.

Our results are important for two different strands of the literature. First, they relate to the price convergence literature where no previous study has shown the presence of multiple regimes we find here. Second, our results relate to the literature on club convergence which has focused on assessing economic growth regimes. Our detection of multiple regimes and the relevance of a number of factors in determining these shown here, suggest that there is much to be learned regarding club convergence by focusing on prices in addition to real GDP per capita.

Figure 3.1: **Heatmap for Clubs by Country**

This figure shows a heatmap of the frequency of a country to form a club for the countries in our sample. Color defines club with blue, orange, green and red colors standing respectively for the high-price, medium-price, low-price and cheap clubs. Depth of color represents frequency of belonging in a certain club.

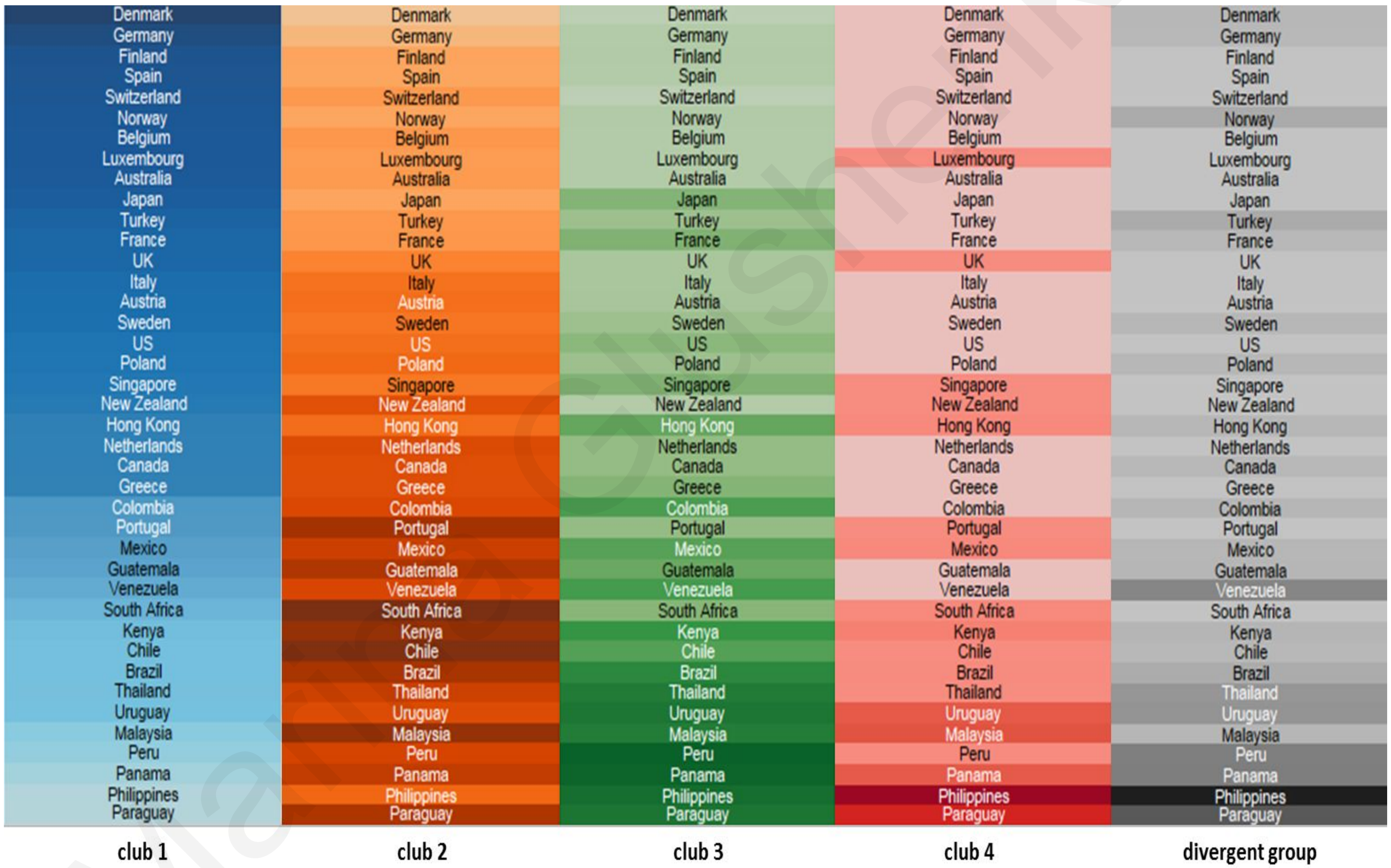


Figure 3.2: **Price Convergence Clubs by Industry**

This figure shows a geographical map of countries that belong to the various convergence clubs by industry. Color defines club: blue, orange, green and red colors stand respectively for the high-price, medium-price, low-price and cheap clubs.

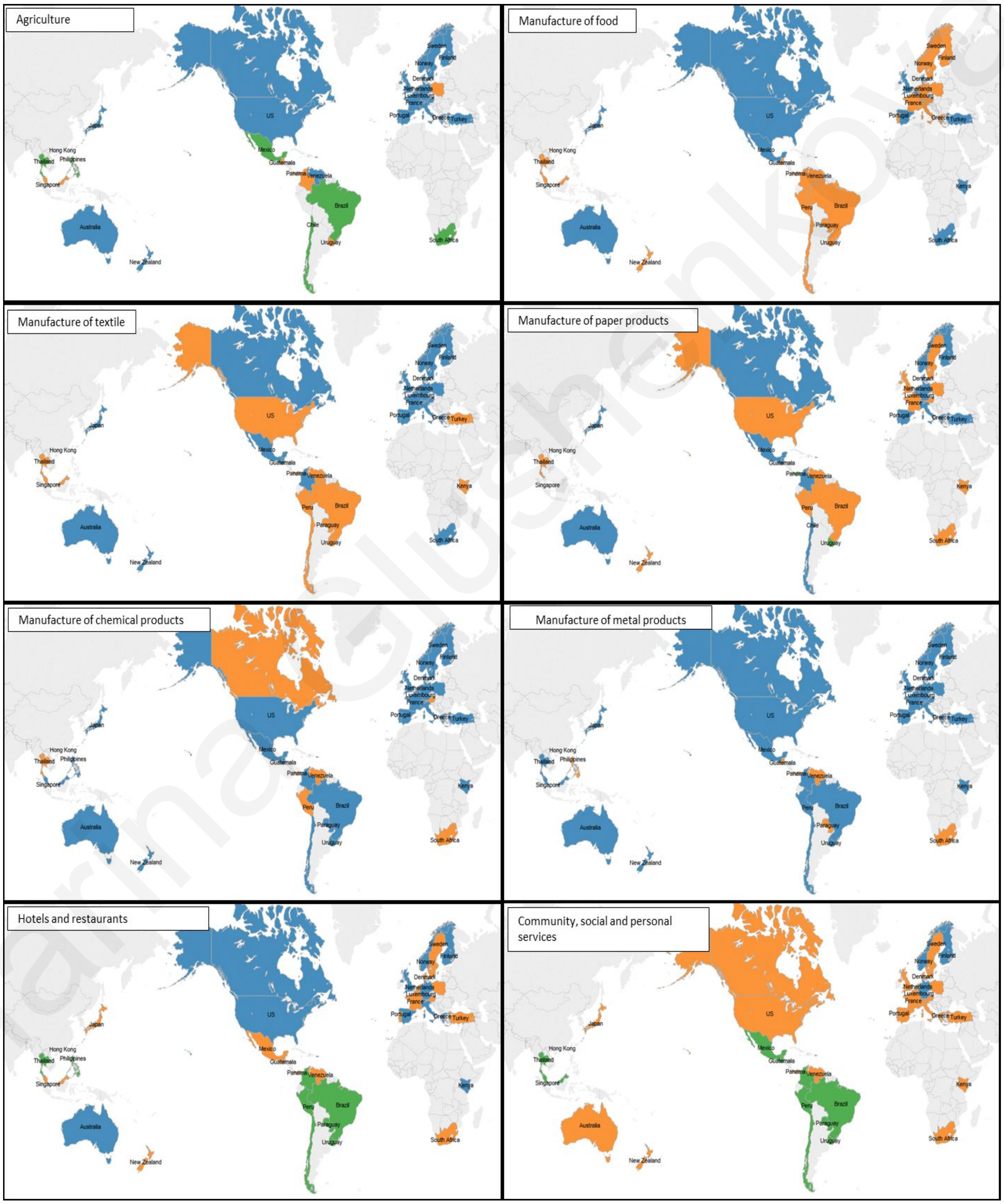


Figure 3.3: **Transition Paths for Clubs by Industry**

This figure shows transition curves for each of the three clubs defined at the industry level. The relative transition curve for each club is calculated as the average transition coefficient across countries that form the club for each industry, where the transition coefficient is defined by equation (3.4). Colors denote different clubs: blue is for the first club, orange for the second club and green for the third.

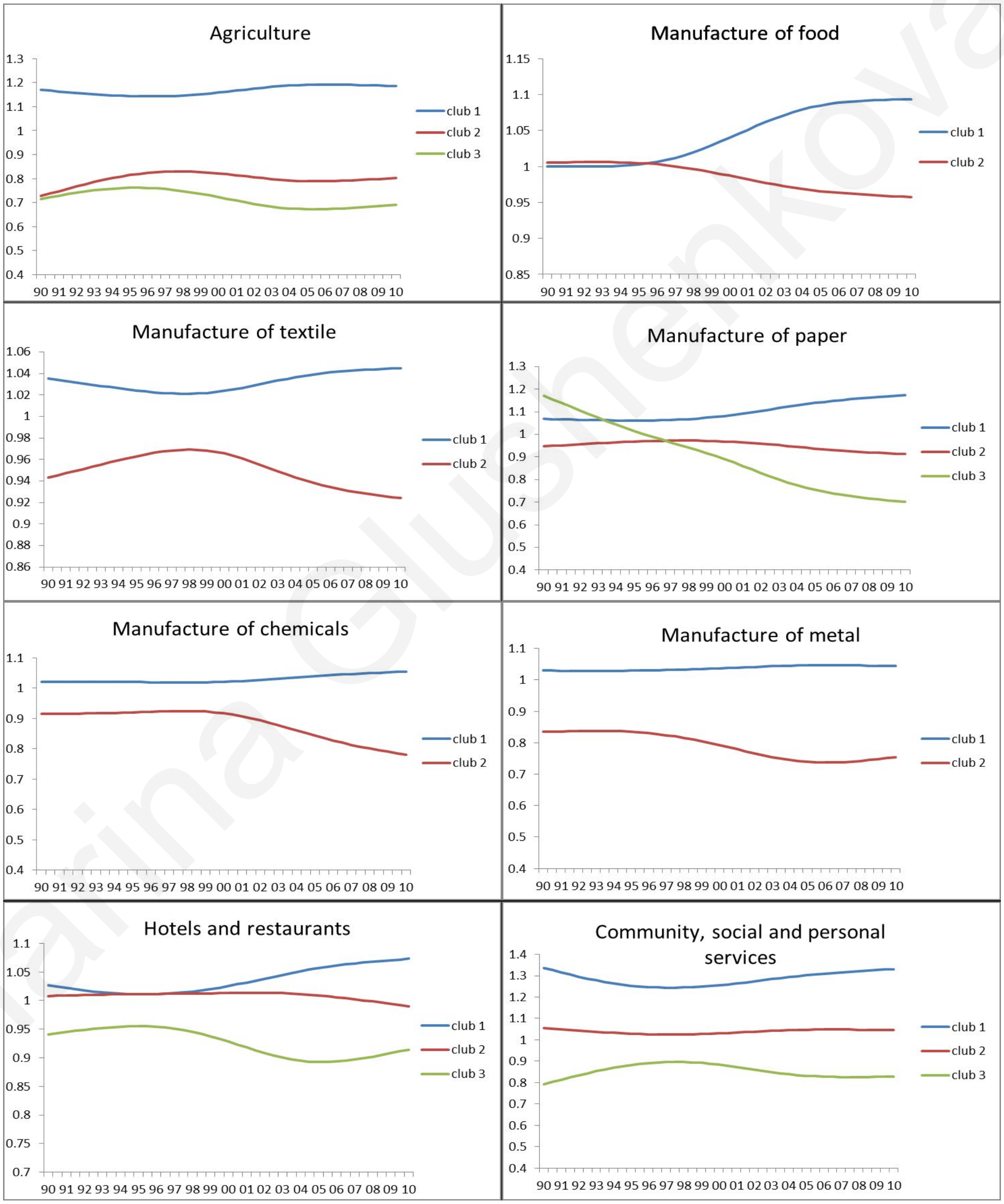


Figure 3.4: **Price-Income Relation by Industry**

This figure shows the relation between average prices and average real gdp per capita (averaged over the period of study) for each of the eight industries. We mark the clubs different countries belong in by different colors, blue is for the first club, orange for the second club, and green for the third club.

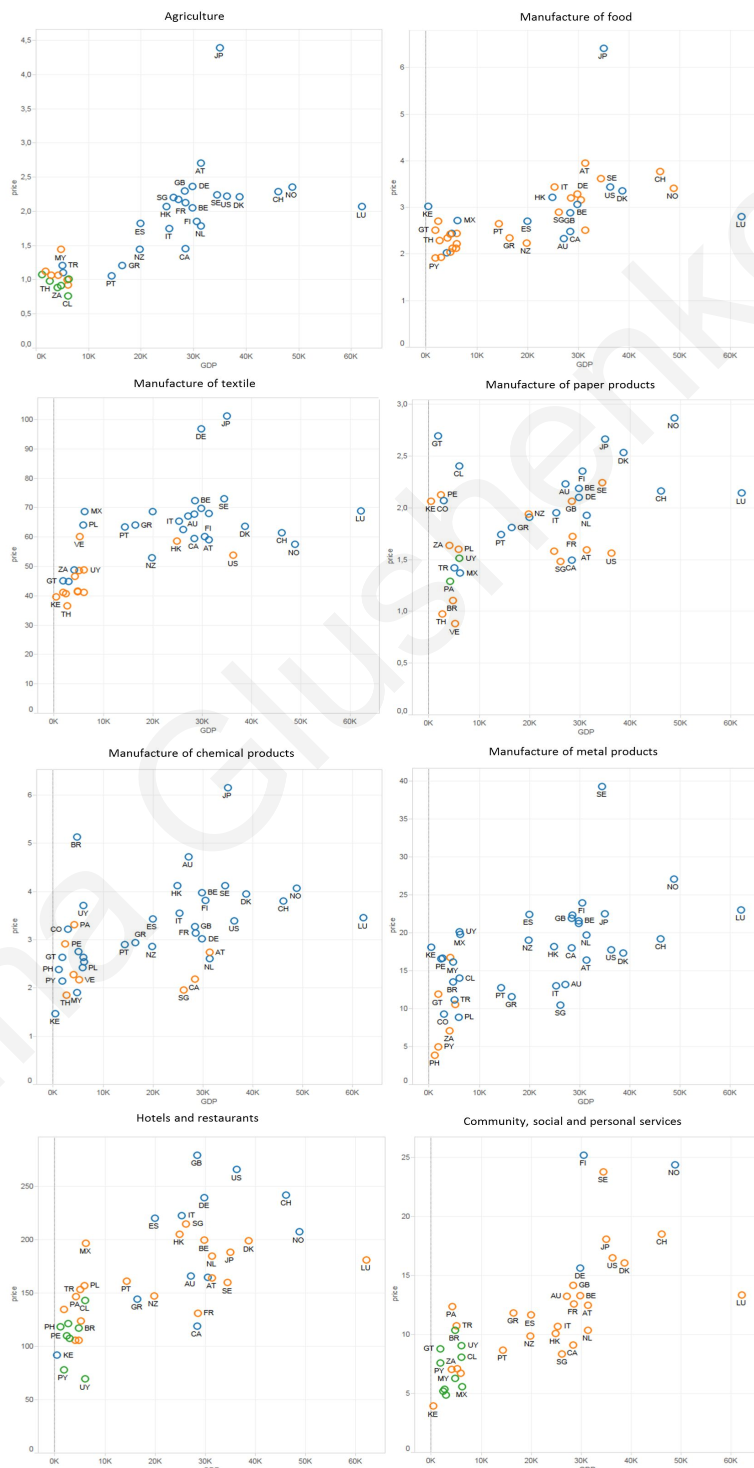
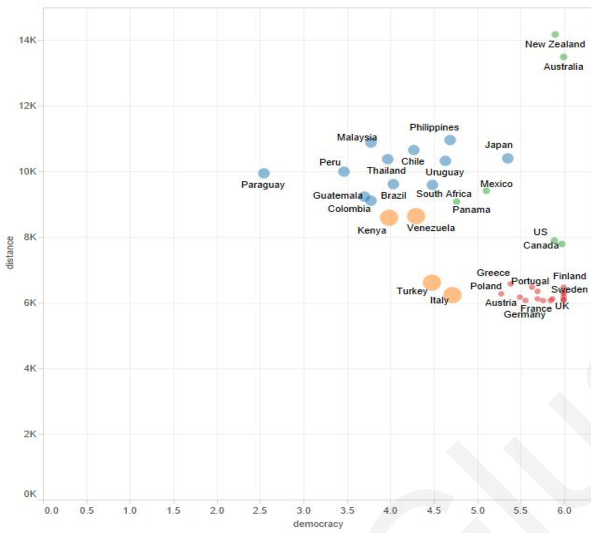
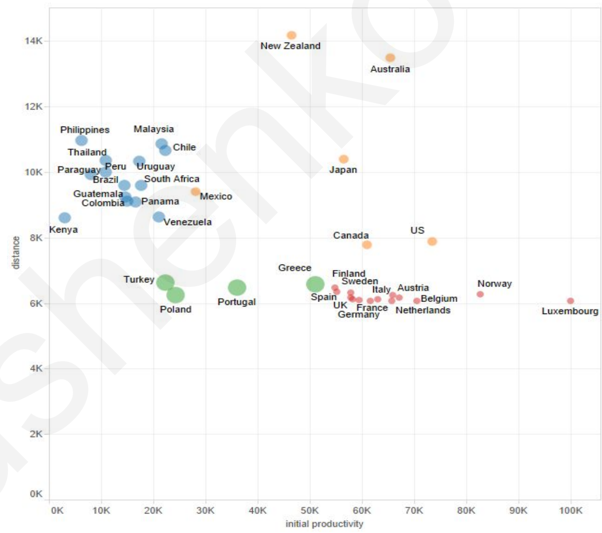


Figure 3.5: **Classification of Countries into Convergence Clubs**

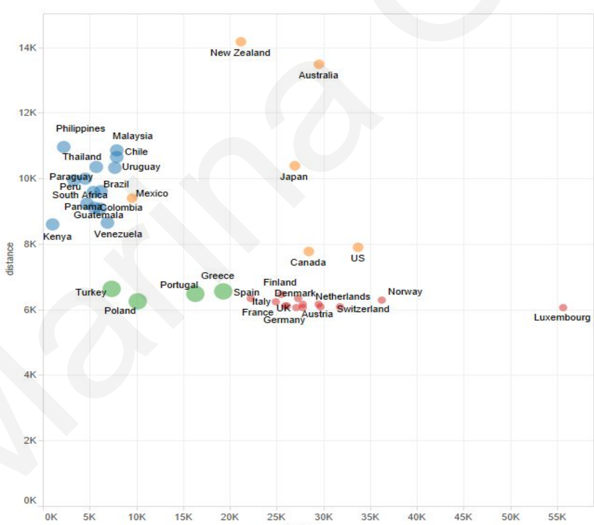
This figure shows the classification of countries into regimes using different pairs of threshold variables for four of the best models estimated in Table 3.6. On the vertical and horizontal axis we draw the values of the two threshold variables in each case. We mark the regime different countries belong in by different colors: blue is for the worst regime, orange for the second-worse regime, green for the second-best regime and red for the best regime (i.e., low distance, high income, high productivity, high control of corruption and high democratic accountability). The size of the circles shows speed of convergence within a regime.



(a) Model 1: q_1=Democracy, q_2=Distance



(b) Model 2: q_1=Distance, q_2=Initial productivity



(c) Model 3: q_1=Distance, q_2=Initial income

(d) Model 5: q_1=Control of corruption, q_2=Distance

Table 3.1: **Convergence Coefficients by Good**

				Convergence Coefficient		
Item	**Global**	**Club 1**	**Club 2**	**Club 3**	**Club 4**	**Divergent group**
Personal computer	2.104	-	-	-	-	-
Peanut or corn oil	0.587	-	-	-	-	-
Potatoes	0.103	-	-	-	-	-
Olive oil	0.081	-	-	-	-	-
One good seat at cinema	-0.084*	0.180	-	-	-	-0.226**
Milk, pasteurised	-0.091**	0.394	-0.063	-	-	-
Intl. weekly news magazine	-0.091**	0.434	-	-	-	-0.678***
Four best seats at cinema	-0.093*	0.170	-	-	-	-0.306**
Regular unleaded petrol	-0.179*	0.111	-	-	-	-
White bread	-0.218*	-0.030	0.410	-	-	-
Carrots	-0.239*	-0.059	-	-	-	-4.537**
Mushrooms	-0.261*	-0.077	0.796	-	-	-
Lettuce	-0.300*	0.258	0.177	-	-	-
Flour, white	-0.314*	-0.020	0.040	-	-	-
Aspirins	-0.315*	0.095	0.327	-	-	-
Tomatoes, canned	-0.321*	0.024	0.569	-	-	-
Pineapples, canned	-0.328*	0.103	0.246	-	-	-
White rice	-0.345*	-0.050	0.662	6.820	-	-
Intl. fgn. daily newspaper	-0.350*	0.017	-	-	-	-0.269**
Beef: filet mignon	-0.365*	-0.024	0.237	-	-	-
Apples	-0.370*	-0.036	-	-	-	-3.988***
Fresh fish	-0.393*	0.358	0.064	-	-	-
Beef: steak, entrecote	-0.394*	-0.055	-0.103	-	-	-
Drinking chocolate	-0.397*	0.528	0.453	-	-	-
Beef: stewing, shoulder	-0.409*	0.225	-0.044	-	-	-
Hourly rate for domestic cleaning help	-0.432*	-0.049	0.024	-	-	-
Beef: ground or minced	-0.445*	0.075	0.365	-	-	-0.426***
Hand lotion	-0.451*	-0.024	-0.786	-1.860	-	-
Cornflakes	-0.474*	0.321	-0.036	-	-	-
Cost of developing 36 colour pictures	-0.474*	0.248	0.181	-	-	-
Beef: roast	-0.477*	0.620	-0.013	-	-	-
Ground coffee	-0.497*	0.192	0.202	-0.103	-	-
Maid's monthly wages	-0.498*	0.141	0.158	-0.114	-	-
Babysitter's rate per hour	-0.513*	0.799	0.176	-0.289	-	-
Spaghetti	-0.532*	0.242	0.141	-	-	-
3-course dinner at top restaur. for 4 ppl.	-0.537*	0.220	0.167	-	-	-
Onions	-0.547*	0.175	0.023	-	-	-
Chicken: fresh	-0.553*	0.291	-0.079	-	-	-4.517**
Tomatoes	-0.562*	0.371	-0.024	-0.770	-	-
Two-course meal for two people	-0.575*	0.052	0.056	0.156	-	-
Eggs	-0.585*	0.143	-0.069	1.426	-	-
Toilet tissue	-0.592*	-0.067	0.355	-	-	-
Peas, canned	-0.621*	0.039	0.487	-0.559	-0.116	-
Dishwashing liquid	-0.654*	0.521	0.715	0.261	-	-
Bananas	-0.662*	-0.004	0.090	0.177	-	-
Cost of a tune up (but no major repairs)	-0.681*	0.164	0.536	-	-	-
Man's haircut	-0.683*	0.135	0.006	-	-	-1.551**
Pork: chops	-0.685*	0.039	0.038	1.026	-	-
Child's shoes, dresswear	-0.703*	0.071	0.063	-	-	-

Table 3.1 continued

Item	Global	Convergence Coefficient Club 1	Club 2	Club 3	Club 4	Divergent group
Light bulbs	-0.714*	0.623	0.141	-	-	-
Daily local newspaper	-0.720*	-0.070	0.046	-	-	-0.839**
Instant coffee	-0.721*	0.620	0.440	0.047	1.311	-
Peaches, canned	-0.724*	0.078	0.116	-	-	-
Margarine	-0.752*	0.079	1.757	-	-	-
Woman's cut & blow dry	-0.755*	0.519	0.297	1.210	-	-
Sugar, white	-0.773*	0.057	0.049	0.152	-	-
Dry cleaning, woman's dress	-0.796*	0.631	0.082	0.557	-	-
Oranges	-0.803*	0.330	0.202	0.211	-	-
Cheese, imported	-0.805*	0.528	0.794	-	-	-
Soap	-0.829*	0.521	0.530	-	-	-
One drink at bar of first class hotel	-0.841*	0.217	0.488	0.162	-	-
Dry cleaning, trousers	-0.861*	0.224	0.232	0.400	0.458	-
Dry cleaning, man's suit	-0.907*	0.019	0.134	-	-	-1.659*
Girl's dress	-0.923*	0.243	0.106	-	-	-1.355*
Moderate hotel, SRO, 1 night, BB	-0.923*	1.046	0.064	0.375	-	-
Tea bags	-0.932*	0.433	0.255	4.409	-	-7.509**
Frying pan	-0.965*	0.319	0.069	1.069	-	-
Yoghurt, natural	-0.968*	-0.007	0.405	0.185	-	-
Women's dress, daytime	-0.973*	0.221	0.083	0.389	-	-
Women's shoes, town	-0.992*	-0.038	0.070	0.208	-	-
Lemons	-0.997*	-0.188	-0.055	0.228	-	-
Shampoo	-1.008*	-0.039	0.118	-	-	-
Boy's dress trousers	-1.018*	0.037	-0.029	0.831	-	-
Butter	-1.052*	0.670	0.300	0.930	-	-
Batteries	-1.054*	0.852	0.236	1.241	-	-
Men's business suit, two piece	-1.067*	-0.031	0.035	-	-	-
Facial tissues	-1.114*	0.063	-0.006	-	-	-
Laundry detergent	-1.144*	1.129	0.158	-0.556	0.365	-
Child's jeans	-1.166*	0.154	-0.069	1.649	-	-
Business trip, typical daily cost	-1.187*	0.653	-0.137	-	-	-2.630*
Simple meal for one person	-1.192*	-0.609	0.436	-	-	-1.198**
Women's tights, panty hose	-1.200*	0.250	-0.060	-	-	-5.341**
Toothpaste with fluoride	-1.230*	-1.089	0.459	0.168	0.416	-
Men's shoes, business wear	-1.253*	0.975	0.218	-0.038	-	-3.789**
Child's shoes, sportswear	-1.257*	-0.076	-0.015	-	-	-0.326**
Men's business shirt, white	-1.263*	1.298	-0.073	0.493	0.164	-
Laundry	-1.282*	0.042	0.716	0.477	-0.025	-
Paperback novel	-1.286*	1.785	0.162	0.033	-	-
Socks, wool mixture	-1.350*	0.116	0.490	2.178	-	-4.195*
Television, colour	-1.378*	0.084	0.432	1.230	-	-
Kodak colour film	-1.457*	0.040	0.004	-0.069	-0.522	-
Compact disc album	-1.531*	-0.032	0.272	0.064	-	-
Electric toaster	-1.533*	1.388	0.112	0.533	-	-
Hilton-type hotel, SRP, 1 night, BB	-1.542*	-0.085	0.324	0.229	-	-
Razor blades	-1.841*	0.152	0.688	0.311	0.024	-
Lipstick (deluxe type)	-1.886*	0.269	0.563	-	-	-3.195*

Notes: This table presents estimates of the convergence coefficient λ_{1j} in equation (3.6) and convergence tests using the log t test of Phillips and Sul (2009). Column 2 presents the global convergence coefficients. The next four columns present estimates of the four club convergence coefficients based on the procedure described in section 3.4. The last column presents coefficient estimates of the divergent group. *, **, ***, refer to the significance level of 1%, 5%, and 10%, respectively, at which the null of convergence, $H_0 : \lambda_{1j} \geq 0$ is rejected.

Table 3.2: **Average Price within Clubs by Good**

Item	**Overall**	**Club 1**	**Club 2**	**Club 3**	**Club 4**	**Divergent Group**
Personal computer	891.48	891.48				
Peanut or corn oil	2.62	2.62				
Potatoes	2.13	2.13				
Olive oil	9.13	9.13				
One good seat at cinema	7.09	7.32				4.20
Milk, pasteurised	1.02	1.07	0.86			
Intl. weekly news magazine	3.72	3.80				2.37
Four best seats at cinema	28.36	29.30				16.81
Regular unleaded petrol	0.90	0.92				0.07
White bread	2.67	2.79	1.17			
Carrots	1.29	1.33				0.58
Mushrooms	5.37	5.75	3.56			
Lettuce	1.28	1.48	1.00			
Flour, white	1.04	1.13	0.91			0.97
Aspirins	9.00	9.66	3.87			
Tomatoes, canned	0.54	0.56	0.45			
Pineapples, canned	1.51	1.62	0.87			0.70
White rice	2.14	2.41	0.97	0.76		
Intl. fgn. daily newspaper	2.56	2.65				1.65
Beef: filet mignon	24.10	27.39	7.63			
Apples	1.93	1.97				1.09
Fresh fish	15.71	17.44	8.22			
Beef: steak, entrecote	17.04	21.07	6.16			
Drinking chocolate	2.96	3.44	2.67			
Beef: stewing, shoulder	8.82	11.07	6.44			
Hourly rate for domestic cleaning help	9.94	12.27	3.18			1.25
Beef: ground or minced	7.60	9.16	5.43			2.94
Hand lotion	2.85	2.99	2.07	1.48		
Cornflakes	2.41	2.68	2.08			
Cost of developing 36 colour pictures	14.79	17.17	12.00			
Beef: roast	10.90	15.46	7.86			
Ground coffee	5.83	8.39	5.10	3.01		
Maid's monthly wages	863.98	1410.56	517.85	286.39		
Babysitter's rate per hour	8.24	10.69	4.64	2.89		
Spaghetti	2.46	2.67	2.22			1.24
3-course dinner at top restaur. for 4 ppl.	424.35	497.23	223.15			121.38
Onions	1.13	1.35	0.88			
Chicken: fresh	4.09	5.39	3.37			2.20
Tomatoes	1.97	2.65	1.45	0.75		
Two-course meal for two people	126.43	147.85	81.37	51.99		
Eggs	1.76	2.18	1.26	0.97		
Toilet tissue	1.01	1.13	0.71			
Peas, canned	0.71	0.88	0.61	0.57	0.52	0.50
Dishwashing liquid	2.20	2.82	1.83	0.91		
Bananas	1.31	1.58	1.03	0.62		0.35
Cost of a tune up (but no major repairs)	223.26	255.85	140.31			
Man's haircut	26.16	30.38	11.96			10.46
Pork: chops	7.48	9.20	5.42	2.85		
Child's shoes, dresswear	49.38	74.75	46.39			
Light bulbs	1.68	2.02	1.25			3.35

Table 3.2 continued

Item	Overall	Club 1	Club 2	Club 3	Club 4	Divergent Group
Daily local newspaper	0.85	1.21	0.66			0.36
Instant coffee	4.49	6.56	4.51	3.41	2.03	
Peaches, canned	1.46	1.61	1.29			
Margarine	1.87	2.02	1.26			
Woman's cut & blow dry	43.60	55.68	34.82	20.88		10.58
Sugar, white	1.08	1.88	1.16	0.77		
Dry cleaning, woman's dress	8.27	22.13	8.44	5.32		2.52
Oranges	1.65	2.16	1.44	1.04		
Cheese, imported	9.68	12.31	7.71			
Soap	0.64	0.80	0.41			
One drink at bar of first class hotel	10.76	16.74	11.31	8.23		
Dry cleaning, trousers	5.09	8.16	4.81	3.85	2.63	
Dry cleaning, man's suit	10.24	12.01	7.97			11.87
Girl's dress	65.11	83.88	55.86			59.66
Moderate hotel, SRO, 1 night, BB	155.88	204.44	152.65	102.56		67.95
Tea bags	1.71	1.94	1.47	0.87		2.72
Frying pan	23.98	29.61	21.85	16.80		9.69
Yoghurt, natural	0.71	0.84	0.59	0.48		
Women's dress, daytime	231.85	326.57	195.80	140.26		
Women's shoes, town	122.06	141.82	113.77	69.01		
Lemons	1.94	2.55	1.13	0.82		0.55
Shampoo	6.60	7.08	5.98			4.30
Boy's dress trousers	45.31	57.47	33.50	19.85		
Butter	3.23	4.62	3.19	2.39		2.11
Batteries	3.66	4.51	3.34	1.99		
Men's business suit, two piece	491.36	550.33	390.26			
Facial tissues	1.44	1.51	0.85			
Laundry detergent	12.11	14.76	12.06	9.79	6.78	4.40
Child's jeans	43.03	51.02	35.82	25.87		
Business trip, typical daily cost	389.70	472.16	322.58			369.85
Simple meal for one person	36.80	39.62	22.24			18.01
Women's tights, panty hose	9.57	12.94	8.08			5.54
Toothpaste with fluoride	2.27	3.12	1.82	1.53	1.24	
Men's shoes, business wear	152.14	259.69	162.90	114.08		173.98
Child's shoes, sportswear	52.33	55.97	47.22			28.83
Men's business shirt, white	69.22	88.84	66.61	41.88	33.64	
Laundry	3.17	5.67	3.30	2.20		
Paperback novel	13.13	18.97	14.32	10.85		
Socks, wool mixture	10.65	12.27	8.49	5.56		6.20
Television, colour	927.86	1046.15	785.32	616.92		1682.99
Kodak colour film	6.30	8.12	6.31	5.09	3.88	
Compact disc album	20.64	24.14	20.08	17.39		
Electric toaster	39.79	46.98	41.00	34.25		19.91
Hilton-type hotel, SRP, 1 night, BB	257.52	299.21	224.57	197.57		
Razor blades	4.71	7.99	4.78	3.66	3.27	
Lipstick (deluxe type)	25.25	26.61	22.78			19.66

The first column of this table presents average prices across all countries in the sample for each good. The next four columns report average prices across countries that form each club. The last column shows the average prices of goods across divergent countries that do not form any club.

Table 3.3: **Club Formation**

Country	High-price club	Medium-price club	Low-price club	Cheap club	Divergent Group
Denmark	0.86	0.13	0.00	0.00	0.01
Germany	0.82	0.16	0.01	0.00	0.01
Finland	0.78	0.21	0.01	0.00	0.00
Spain	0.77	0.21	0.01	0.00	0.00
Switzerland	0.76	0.24	0.00	0.00	0.00
Norway	0.76	0.21	0.01	0.00	0.02
Belgium	0.75	0.24	0.01	0.00	0.00
Luxembourg	0.75	0.23	0.01	0.01	0.00
Australia	0.74	0.23	0.01	0.00	0.00
Japan	0.73	0.21	0.06	0.00	0.00
Turkey	0.70	0.24	0.03	0.00	0.02
France	0.68	0.24	0.07	0.00	0.01
UK	0.68	0.29	0.02	0.01	0.00
Italy	0.66	0.32	0.02	0.00	0.00
Austria	0.65	0.33	0.02	0.00	0.00
Sweden	0.64	0.31	0.03	0.00	0.01
US	0.62	0.33	0.05	0.00	0.00
Poland	0.61	0.34	0.04	0.00	0.01
Singapore	0.60	0.31	0.07	0.01	0.00
New Zealand	0.59	0.39	0.01	0.01	0.00
Hong Kong	0.55	0.33	0.09	0.01	0.01
Netherlands	0.55	0.40	0.04	0.00	0.00
Canada	0.55	0.40	0.04	0.00	0.01
Greece	0.54	0.40	0.06	0.00	0.00
Colombia	0.46	0.41	0.12	0.00	0.01
Portugal	0.46	0.49	0.04	0.01	0.00
Mexico	0.44	0.44	0.11	0.01	0.01
Guatemala	0.42	0.47	0.09	0.00	0.01
Venezuela	0.40	0.41	0.12	0.00	0.06
South Africa	0.36	0.56	0.06	0.01	0.00
Kenya	0.32	0.51	0.14	0.01	0.01
Chile	0.32	0.55	0.11	0.01	0.01
Brazil	0.31	0.48	0.17	0.01	0.02
Thailand	0.31	0.43	0.20	0.01	0.04
Uruguay	0.31	0.40	0.22	0.02	0.05
Malaysia	0.25	0.52	0.20	0.02	0.01
Peru	0.23	0.42	0.27	0.01	0.07
Panama	0.20	0.45	0.26	0.02	0.07
Philippines	0.16	0.34	0.24	0.06	0.19
Paraguay	0.16	0.48	0.22	0.04	0.11

Notes: This table presents the frequency of a country to form a club. These frequencies are calculated as the share of goods for which the country lies in one of the clubs. The last column shows the share of goods for which the country does not form any club. Countries are sorted according to the frequency of forming the first club.

Table 3.4: **Convergence Coefficients at the Industry Level**

	Convergence Coefficient				
Industry	**Global**	**Club 1**	**Club 2**	**Club 3**	**Divergent group**
Agriculture	-0.752*	0.163	0.707	0.000	-0.653**
Food	-0.296*	0.540	-0.049	-	-
Textile	-1.940*	-0.134	0.503	-	-
Paper products	-1.119*	0.771	-0.119	4.946	-1.406*
Chemicals	-0.407*	0.101	0.117	-	-
Metal products	-0.385*	0.246	0.117	-	-
Hotels and restaurants	-0.927*	0.184	-0.075	0.165	-
Other services	-0.736*	0.125	0.100	0.142	-

Notes: This table presents estimates of the convergence coefficient λ_{1j} in equation (3.6) and convergence tests using the log t test of Phillips and Sul (2009) at the industry level of analysis. Column 2 presents the global convergence coefficients. The next three columns present estimates of the three club convergence coefficients based on the procedure described in section 3.4. The last column presents coefficient estimates of the divergent group. *, ** refer to the significance level of 1% and 5%, respectively, at which the null of convergence, $H_0 : \lambda_{1j} \geq 0$ is rejected.

Table 3.5: **Threshold Estimation and Testing**

Threshold variables		**Threshold point and interval estimates**						**AIC**
Level 1 (q_1)	**Level 2 (q_2)**	**Two-regime TR model**		**Four-regime TR model**				
				Low q_1		**High q_1**		
		Threshold value	**95%CI**	**Threshold value**	**95%CI**	**Threshold value**	**95%CI**	
Distance	Initial income	8.798*†	[8.717, 9.246]	9.944*†	[9.658, 10.498]	8.955*†	[8.157, 10.120]	-3.502
	Initial productivity	8.798*†	[8.717, 9.246]	10.861*†	[10.558, 11.177]	10.127*†	[9.179, 10.935]	-3.503
	Distance	8.798*†	[8.717, 9.246]	8.727*†	[8.710, 8.774]	9.243*†	[9.058, 9.293]	-3.500
	Control of corruption	8.798*†	[8.717, 9.246]	4.292*†	[3.000, 5.917]	4.000*†	[2.000, 4.917]	-3.497
	Democracy	8.798*†	[8.717, 9.246]	5.375*†	[5.000, 5.917]	5.208*†	[3.000, 5.917]	-3.502
	Initial prices	8.798*†	[8.717, 9.246]	1.223**†	[0.312, 4.324]	1.655**†	[-0.100, 4.037]	-3.498
Initial prices	Initial income	1.656**†	[0.089, 4.183]	9.521*†	[8.376, 10.333]	9.244*†	[8.564, 10.418]	-3.493
	Initial productivity	1.656**†	[0.089, 4.183]	10.471*†	[9.475, 11.115]	10.720*†	[9.621, 11.144]	-3.493
	Distance	1.656**†	[0.089, 4.183]	8.798*†	[8.719, 9.246]	8.798*†	[8.714, 9.246]	-3.498
	Control of corruption	1.656**†	[0.089, 4.183]	3.083*†	[2.000, 5.042]	3.083*†	[2.375, 5.417]	-3.492
	Democracy	1.656**†	[0.089, 4.183]	5.000*†	[3.667, 5.917]	5.000*†	[4.000, 5.917]	-3.490
	Initial prices	1.656**†	[0.089, 4.183]	-0.027**†	[-0.340, 1.287]	3.672***†	[2.050, 5.316]	-3.488
Initial income	Initial income	9.521*†	[8.457, 10.380]	8.973*†	[8.077, 9.108]	10.065*†	[9.877, 10.527]	-3.495
	Initial productivity	9.521*†	[8.457, 10.380]	9.669*†	[9.018, 10.103]	10.892*†	[10.815, 11.210]	-3.497
	Distance	9.521*†	[8.457, 10.380]	9.169*†	[9.058, 9.246]	8.789*†	[8.712, 8.973]	-3.498
	Control of corruption	9.521*†	[8.457, 10.380]	2.000*†	[2.000, 3.833]	4.792*†	[3.792, 5.917]	-3.495
	Democracy	9.521*†	[8.457, 10.380]	4.333*†	[3.000, 4.917]	5.000*†	[5.000, 5.917]	-3.498
	Initial prices	9.521*†	[8.457, 10.380]	-0.047**†	[-0.194, 3.949]	2.220**†	[0.344, 4.368]	-3.496
Initial productivity	Initial income	10.471*†	[9.545, 11.131]	8.973*†	[8.077, 9.122]	10.065*†	[9.879, 10.527]	-3.494
	Initial productivity	10.471*†	[9.545, 11.131]	10.095*†	[9.018, 10.112]	10.892*†	[10.823, 11.210]	-3.496
	Distance	10.471*†	[9.545, 11.131]	9.169*†	[9.058, 9.246]	8.789*†	[8.712, 8.959]	-3.499
	Control of corruption	10.471*†	[9.545, 11.131]	2.000*†	[2.000, 3.833]	4.833*†	[4.000, 5.917]	-3.496
	Democracy	10.471*†	[9.545, 11.131]	4.333*†	[3.000, 5.000]	5.000*†	[5.000, 5.917]	-3.499
	Initial prices	10.471*†	[9.545, 11.131]	-0.067**†	[-0.190, 3.949]	2.222**†	[0.342, 4.364]	-3.497
Control of corruption	Initial income	3.083*†	[2.000, 5.417]	8.597*†	[8.055, 9.425]	10.005*†	[9.544, 10.517]	-3.496
	Initial productivity	3.083*†	[2.000, 5.417]	9.901*†	[9.009, 10.285]	10.893*†	[10.536, 11.200]	-3.499
	Distance	3.083*†	[2.000, 5.417]	9.058*†	[8.798, 9.243]	8.798*†	[8.712, 9.243]	-3.500
	Control of corruption	3.083*†	[2.000, 5.417]	2.083*†	[2.000, 2.958]	4.917*†	[4.000, 5.917]	-3.492
	Democracy	3.083*†	[2.000, 5.417]	4.333*†	[3.000, 5.458]	5.000*†	[5.000, 5.917]	-3.502
	Initial prices	3.083*†	[2.000, 5.417]	1.767**†	[-0.134, 4.032]	1.223**†	[0.260, 4.288]	-3.493
Democracy	Initial income	5.000*†	[4.000, 5.917]	9.190*†	[8.142, 9.881]	9.686*†	[9.686, 10.527]	-3.496
	Initial productivity	5.000*†	[4.000, 5.917]	10.929*†	[9.177, 10.929]	10.793*†	[10.558, 11.206]	-3.494
	Distance	5.000*†	[4.000, 5.917]	9.064*†	[8.754, 9.249]	8.789*†	[8.712, 9.058]	-3.512
	Control of corruption	5.000*†	[4.000, 5.917]	3.083*†	[2.000, 3.833]	5.417*†	[3.500, 5.917]	-3.495
	Democracy	5.000*†	[4.000, 5.917]	3.250*†	[3.000, 4.917]	5.667	[5.667, 5.917]	-3.495
	Initial prices	5.000*†	[4.000, 5.917]	-0.036**†	[-0.134, 4.008]	2.220**†	[0.301, 4.346]	-3.494

Notes: This table presents threshold estimates at the good level of analysis. In the first six columns, we report the corresponding threshold estimate and its 95% confidence interval for the first and second level of sample splitting respectively. The last column reports the Akaike information criterion (AIC). Each row presents one model with two specific threshold variables. All models estimate equation (3.9) with the following vector of regressors $x_{ijt} = (d_i', d_j', d_t', p_{ijt-1})'$, where d_i, d_j and d_t are country, good and time dummies, and p_{ijt-1} is initial price level. *, **, ***, refer to the significance level of 1%, 5%, and 10%, respectively, at which the null of linearity is rejected. † - reject the null of a unit root at the 1% significance level based on the threshold autoregressive unit root test introduced by Caner and Hansen (2001) and extended for the panel-data model by Beyaert and Camacho (2008). Results for both tests are calculated using standard heteroskedasticity and autocorrelation corrected estimators.

Table 3.6: **Club Convergence: Evidence from Threshold Regressions**

Model	**Threshold Variable**		**β-coefficients**				**Speed of convergence**				**AIC**
	Level 1 (q_1)	**Level 2 (q_2)**	**low q_1**		**high q_1**		**low q_1**		**high q_1**		
			low q_2	**high q_2**	**low q_2**	**high q_2**	**low q_2**	**high q_2**	**low q_2**	**high q_2**	
1	Democracy	Distance	-0.139*†	-0.081††	-0.066	-0.067	0.150	0.085	0.068	0.069	-3.512
2	Distance	Initial productivity	-0.146*†	-0.065	-0.083	-0.070	0.158	0.067	0.087	0.072	-3.503
3	Distance	Initial income	-0.140*†	-0.063	-0.087*	-0.067	0.151	0.065	0.090	0.070	-3.502
4	Control of corruption	Democracy	-0.098*†	-0.057†	-0.146*	-0.070	0.103	0.059	0.158	0.072	-3.502
5	Control of corruption	Distance	-0.079††	-0.080† † †	-0.092	-0.089	0.082	0.084	0.097	0.093	-3.500
6	Distance	Distance	-0.068*	-0.116†	-0.084***	-0.070	0.071	0.123	0.088	0.072	-3.500
7	Control of corruption	Initial productivity	-0.078*†	-0.083†	-0.138*	-0.060	0.081	0.086	0.149	0.062	-3.499
8	Initial productivity	Democracy	-0.110*†	-0.080†	-0.071	-0.069	0.117	0.083	0.073	0.071	-3.499
9	Initial income	Democracy	-0.111*†	-0.077†	-0.066	-0.070	0.118	0.080	0.068	0.073	-3.498
10	Distance	Initial prices	-0.138*†	-0.069††	-0.097*	-0.062	0.149	0.071	0.102	0.063	-3.498
11	Initial productivity	Initial prices	-0.153*†	-0.082†	-0.088*	-0.049	0.166	0.085	0.092	0.050	-3.497
12	Initial income	Initial productivity	-0.084*†	-0.113†	-0.102*	-0.058	0.088	0.120	0.108	0.060	-3.497
13	Initial income	Initial prices	-0.153*†	-0.081†	-0.088*	-0.050	0.166	0.084	0.092	0.051	-3.496
14	Control of corruption	Initial income	-0.084†	-0.075†	-0.134*	-0.056	0.087	0.078	0.144	0.058	-3.496
15	Initial productivity	Initial productivity	-0.098	-0.087†	-0.102*	-0.058	0.104	0.091	0.108	0.060	-3.496
16	Initial income	Initial income	-0.103*	-0.072	-0.093*	-0.054	0.109	0.075	0.097	0.055	-3.495
17	Democracy	Democracy	-0.129*†	-0.085†	-0.067		0.138	0.089	0.069		-3.495
18	Democracy	Initial prices	-0.154*†	-0.084†	-0.086*	-0.049	0.167	0.087	0.089	0.050	-3.494
19	Control of corruption	Initial prices	-0.093*†	-0.064	-0.136*	-0.067	0.097	0.066	0.146	0.069	-3.493
20	Control of corruption	Control of corruption	-0.064*††	-0.090† † †	-0.090	-0.092	0.066	0.094	0.095	0.097	-3.492
21	Initial prices	Initial prices	-0.144*†	-0.087†	-0.067	-0.063	0.155	0.091	0.070	0.065	-3.488

Notes: This table presents coefficient estimates for the initial price level in the threshold regression models using threshold variables q_1 and q_2 at the first and second levels of sample splitting, respectively. All the coefficients are estimated to be significant at the 1% level. *, **, *** - reject the null that the coefficient for the low q_2 equals the respective high q_2 coefficient within the same q_1 regime at the 1%, 5%, and 10% level of significance, respectively. †, ††, † † †- reject the null that coefficient for the low q_1 equals the respective coefficient for high q_1 at the 1%, 5%, and 10% level of significance, respectively. Each row presents one model with two specific threshold variables. All models estimate equation (3.9) with the following vector of regressors $x_{ijt} = (d_i', d_j', d_t', p_{ijt-1})'$, where d_i, d_j and d_t are country, good and time dummies, and p_{ijt-1} is initial price level. The first four columns present beta coefficients for the four regimes, followed by the respective speed of convergence for the four regimes in the next four columns, and the AIC value for each model in the last column. The models are ordered by AIC.

Table 3.7: **Club Convergence: Evidence from Threshold Regressions (Restricted Sample of Countries)**

Model	Threshold Variable		β-coefficients				Speed of convergence				AIC
	Level 1 (q_1)	Level 2 (q_2)	low q_1		high q_1		low q_1		high q_1		
			low q_2	high q_2	low q_2	high q_2	low q_2	high q_2	low q_2	high q_2	
1	Labor cost	Democracy	-0.130*†	-0.087†	-0.057		0.139	0.091	0.059		-3.516
2	Distance	Labor cost	-0.133*†	-0.062	-0.088	-0.080	0.143	0.064	0.092	0.083	-3.509
3	Initial income	Labor cost	-0.099*	-0.142†	-0.101*	-0.056	0.104	0.153	0.106	0.057	-3.508
4	Initial productivity	Labor cost	-0.097*	-0.142†	-0.102*	-0.056	0.102	0.153	0.108	0.057	-3.507
5	Control of corruption	Labor cost	-0.092†	-0.084†	-0.126*	-0.060	0.097	0.088	0.135	0.062	-3.501
6	Labor cost	Labor cost	-0.097***†	-0.115†	-0.065	-0.056	0.102	0.122	0.067	0.057	-3.500
7	Initial prices	Labor cost	-0.127**†	-0.099†	-0.081*	-0.044	0.136	0.104	0.085	0.045	-3.496

Notes: This table presents coefficient estimates for the initial price level in the threshold regression models using threshold variables q_1 and q_2 at the first and second levels of sample splitting, respectively. The models are estimated on the restricted sample of 31 countries for which we have data on labor cost. All the coefficients are estimated to be significant at the 1% level. *, **, *** - reject the null that the coefficient for the low q_2 equals the respective high q_2 coefficient within the same q_1 regime at the 1%, 5%, and 10% level of significance, respectively. † - reject the null that coefficient for the low q_1 equals the respective coefficient for high q_1 at the 1% level of significance. All models estimate equation (3.9) with the following vector of regressors $x_{ijt} = (d_i', d_j', d_t', p_{ijt-1})'$, where d_i, d_j and d_t are country, good and time dummies, and p_{ijt-1} is initial price level. Each row presents one model with two specific threshold variables. The first four columns present beta coefficients for the four regimes, followed by the respective speed of convergence for the four regimes in the next four columns, and the AIC value for each model in the last column. The models are ordered by AIC.

Table 3.8: **Club Convergence: Evidence from Augmented Threshold Regressions**

Model	**Threshold Variable**		**β-coefficients**				**Speed of convergence**				**AIC**
	Level 1 (q_1)	**Level 2 (q_2)**	**low q_1**		**high q_1**		**low q_1**		**high q_1**		
			low q_2	**high q_2**	**low q_2**	**high q_2**	**low q_2**	**high q_2**	**low q_2**	**high q_2**	
1	Democracy	Distance	-0.138*†	-0.081†††	-0.066	-0.067	0.149	0.085	0.068	0.070	-3.513
2	Distance	Initial income	-0.143*†	-0.063	-0.085*	-0.072	0.154	0.065	0.088	0.075	-3.508
3	Distance	Initial productivity	-0.143*†	-0.065	-0.083	-0.070	0.154	0.068	0.087	0.073	-3.504
4	Control of corruption	Democracy	-0.097*†	-0.057†	-0.129*	-0.072	0.102	0.058	0.138	0.075	-3.503
5	Control of corruption	Distance	-0.077†	-0.080††	-0.092	-0.091	0.080	0.083	0.096	0.095	-3.502
6	Distance	Distance	-0.069*	-0.114†	-0.085***	-0.070	0.071	0.121	0.089	0.072	-3.502
7	Initial productivity	Democracy	-0.109*†	-0.080	-0.071	-0.069	0.115	0.083	0.073	0.071	-3.501
8	Control of corruption	Initial productivity	-0.077*†	-0.081†	-0.138*	-0.060	0.080	0.084	0.149	0.062	-3.501
9	Initial income	Democracy	-0.110*†	-0.077	-0.066	-0.070	0.117	0.080	0.068	0.073	-3.500
10	Distance	Initial prices	-0.127*†	-0.068††	-0.097*	-0.062	0.136	0.070	0.102	0.064	-3.499
11	Initial productivity	Initial prices	-0.151*†	-0.082†	-0.089*	-0.050	0.164	0.085	0.093	0.051	-3.498
12	Control of corruption	Initial income	-0.083†	-0.075††	-0.133*	-0.057	0.087	0.078	0.143	0.058	-3.498
13	Initial income	Initial prices	-0.151*†	-0.081†	-0.088*	-0.050	0.164	0.084	0.092	0.051	-3.498
14	Initial productivity	Initial productivity	-0.098	-0.087†	-0.102*	-0.0586	0.103	0.091	0.108	0.060	-3.497
15	Initial income	Initial income	-0.102*	-0.074††	-0.093*	-0.054	0.108	0.077	0.098	0.056	-3.496
16	Initial income	Initial productivity	-0.098†††	-0.086†	-0.102*	-0.059	0.103	0.089	0.108	0.060	-3.496
17	Democracy	Democracy	-0.109*†	-0.082	-0.067		0.115	0.086	0.069		-3.496
18	Democracy	Initial prices	-0.152*†	-0.083†	-0.086*	-0.048	0.165	0.087	0.090	0.050	-3.495
19	Control of corruption	Control of corruption	-0.064*†	-0.089††	-0.091	-0.092	0.066	0.094	0.095	0.097	-3.494
20	Control of corruption	Initial prices	-0.092*†	-0.063	-0.136*	-0.067	0.096	0.065	0.146	0.070	-3.494
21	Initial prices	Initial prices	-0.143*†	-0.085†	-0.066	-0.060	0.154	0.089	0.068	0.062	-3.489

Notes: This table presents coefficient estimates for the initial price level in the threshold regression models using threshold variables q_1 and q_2 at the first and second levels of sample splitting, respectively. All the coefficient are estimated to be significant at the 1% level. *, **, *** - reject the null that the coefficient for the low q_2 equals the respective high q_2 coefficient within the same q_1 regime at the 1%, 5%, and 10% level of significance, respectively. †, ††, † † †- reject the null that coefficient for the low q_1 equals the respective coefficient for high q_1 at the 1%, 5%, and 10% level of significance, respectively. Each row presents one model with two specific threshold variables. All models estimate equation (3.9) with the following vector of regressors $x_{ijt} = (d'_i, d'_j, d'_t, p_{ijt-1}, z'_{it})'$, where d_i, d_j and d_t are country, good and time dummies, p_{ijt-1} is initial price level, and z_{it} is a vector of observable factors that belongs to q_{sit} such as initial income, control of corruption and democracy. Initial productivity was excluded from the vector z_{it} due to the problem of multicollinearity with initial income. Distance is out of the model as well, since it has no time series variation thus could not be included in the model with fixed country effects. The first four columns present β coefficients for the four regimes, followed by the respective speed of convergence for the four regimes in the next four columns, and the AIC value for each model in the last column. The models are ordered by AIC.

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Appendix

Clustering procedure

Following the Phillips and Sul (2009) methodology, we order countries based on the values of their most recent price observation (from high to low) for each good or industry.[1] Based on this ordering, we select the first k highest countries in the panel to form the subgroup G_k from some $N > k \geq 2$, run the log t regression and calculate the convergence test statistic $t_k = t(G_k)$ for this subgroup for each good or industry. We choose the core subgroup size k^* by maximising t_k over k according to the criterion: $k^* = \arg\max_k(t_k)$ subject to $\min(t_k) > -1.65$. Next, we add a country at a time to the k^*core members of G_{k^*} and run the log t test. We include a country in the convergence club, if the t-statistic from this regression is more than some critical value c, $(\widehat{t} > c)$.[2] We repeat this procedure for each country, and form the first sub-convergence group. Next, we run the log t test for this first sub-convergence group. If $t_{\widehat{b}} \leq -1.65$ for the whole group, we raise the critical value c to increase the discriminatory power of the log t test, and repeat this step until $t_{\widehat{b}} > -1.65$ for the first sub-convergence group. To check whether the remaining countries for which $\widehat{t} < c$ form a club we again run the log t test. If $t_{\widehat{b}} > -1.65$, we conclude that there are two convergent subgroups in the panel. If not, then we repeat the clustering procedure on this subgroup to determine whether there is a smaller subgroup of convergent members of the panel. If there is no k for which $t_k > -1.65$, we conclude that the remaining countries diverge. Next we test jointly if any two neighbor clubs are converging. If $t_{\widehat{b}} > -1.65$, we find evidence of relative convergence among two clubs, and then we merge these clubs into one.

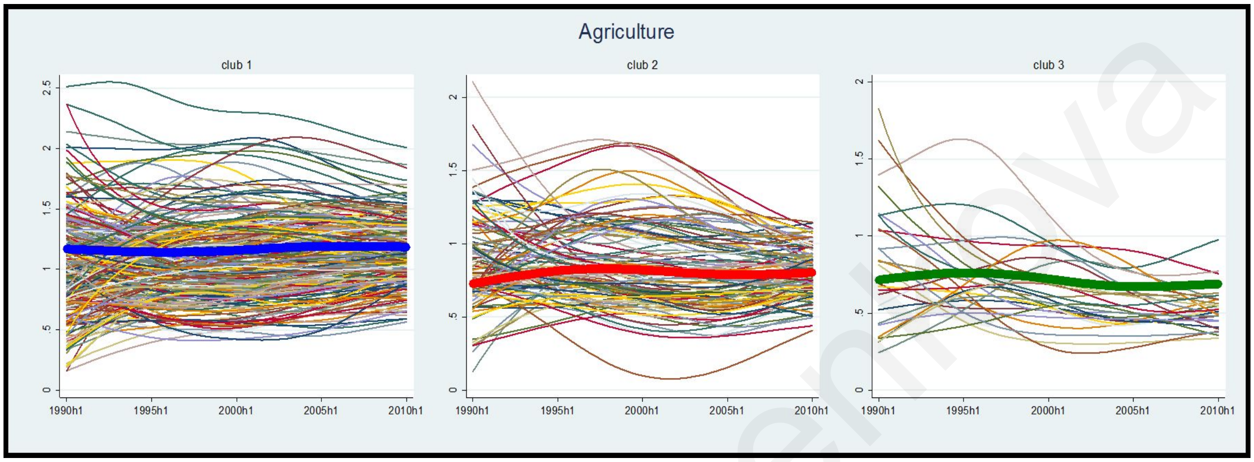
In case when more than two neighbor club converge, we test for joint convergence of all clubs. If convergence coefficient is significant, $t_{\widehat{b}} > -1.65$, we merge all clubs in one, otherwise we merge only the most significantly converging clubs. If there is no evidence of convergence among clubs, we keep all defined clubs for further analysis.

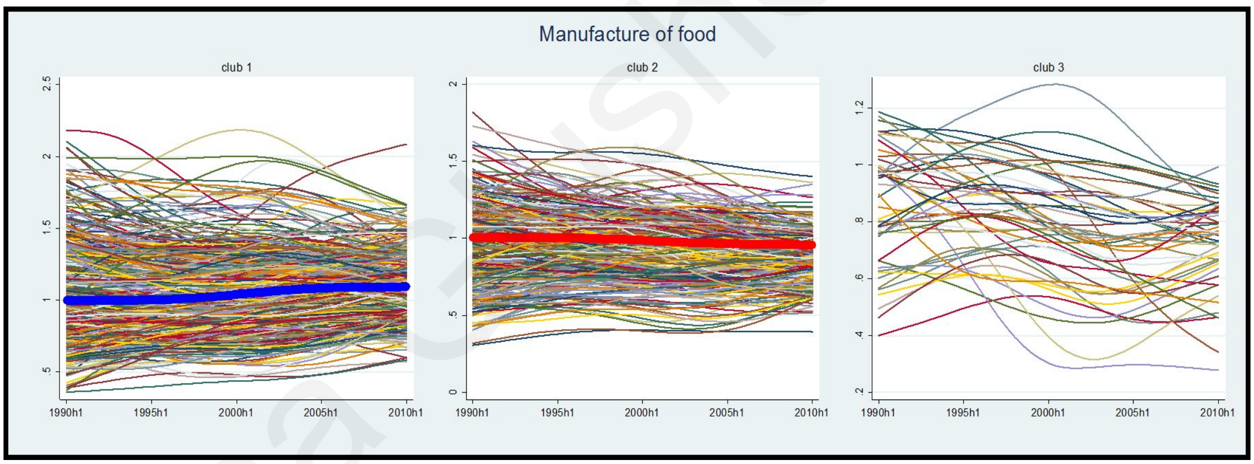
[1] At the industry (good) level of analysis, we consider the panel of countries for each industry (each of the ninety-six goods) separately, and order the countries according to the latest price observation for each individual industry (good). Then, using the Phillips and Sul technique we define price convergence clubs for each industry (good).

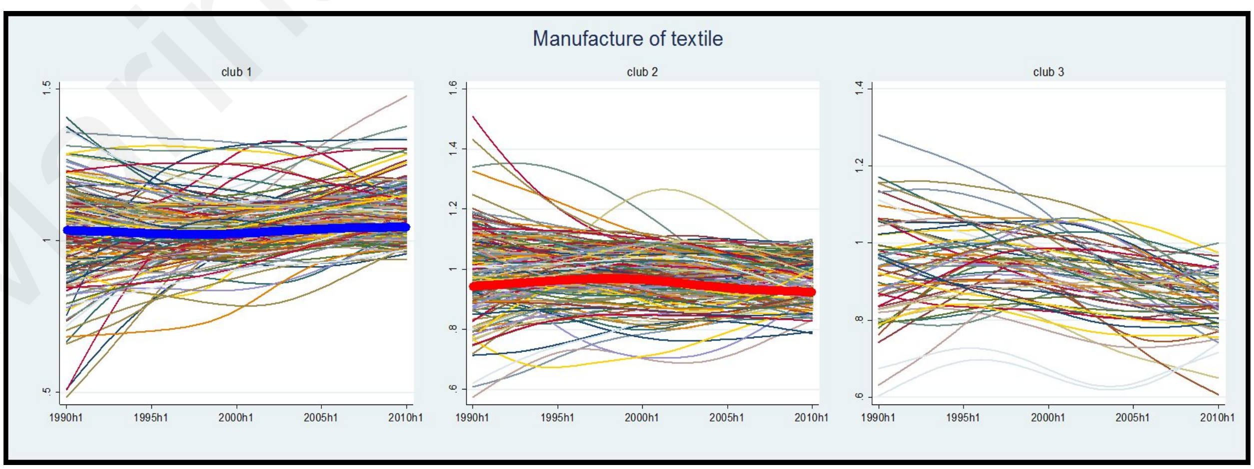
[2] Following Phillips and Sul (2009) we use the 50% critical value, that is c=0.

Figure A1: **Transition Paths for Countries at the Good Level**

This figure shows transition curves for each country and each good organized by industries. The solid blue, red and green lines present transition curves for the first, second and third clubs, respectively, calculated at the industry level of analysis analogous to those presented in Figure 3.3.







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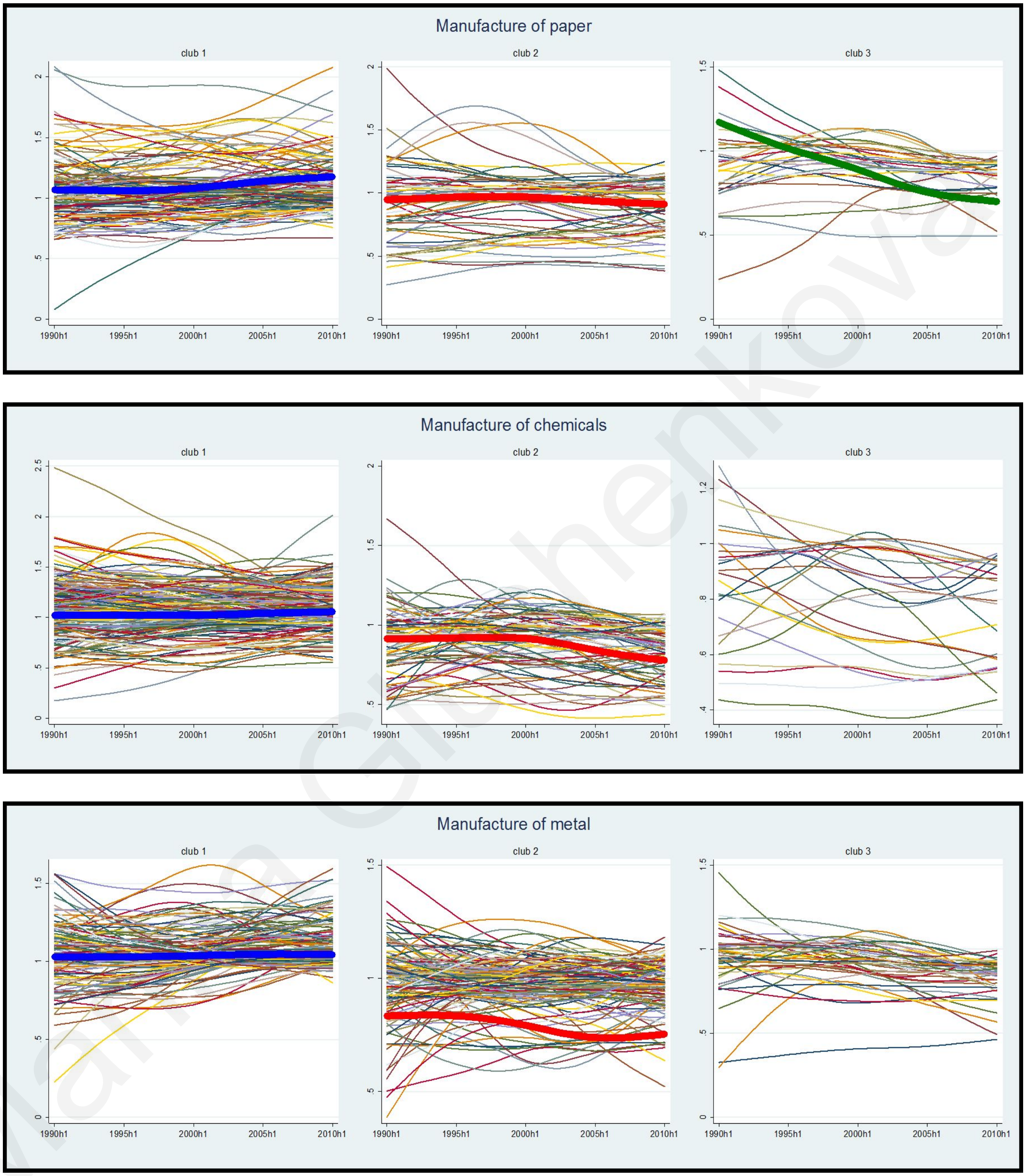

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Figure A1 continued

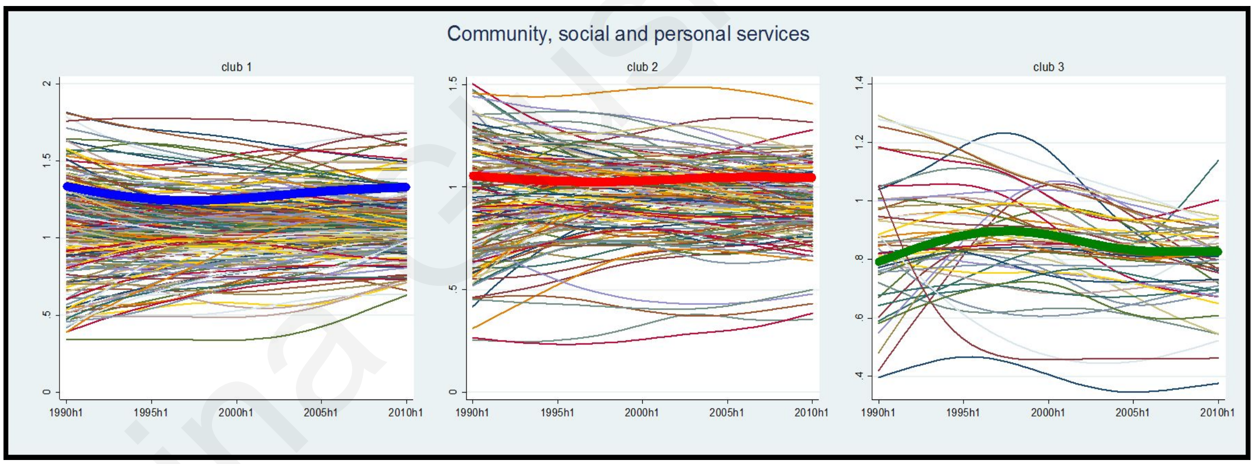

Table A1: **Average Prices in First Club for Different Groups of Countries**

Item	**High Inc**	**Medium Inc**	**Low Inc**	**Item**	**High Inc**	**Medium Inc**	**Low Inc**
Potatoes	2.40	1.75	1.27	Child's shoes	74.75		
Onions	1.39	1.13		Child's shoes (sport)	57.45	56.71	39.72
Mushrooms	5.93	5.60	2.92	Girl's dress	91.80	45.36	43.16
Tomatoes	2.86	1.60		Boy's dress trousers	59.59	37.34	
Carrots	1.53	0.84	0.98	Toilet tissue	1.15	0.99	1.65
Oranges	2.22	1.17	2.36	Facial tissues	1.70	1.15	1.13
Apples	2.18	1.51	1.63	Intl. fgn daily newspaper	2.60	2.50	3.65
Lemons	2.60	1.41		Daily local newspaper	1.21		
Bananas	1.78	0.89		Intl. weekly news magazine	4.03	3.03	3.68
Lettuce	1.55	0.99		Paperback novel	17.89	21.12	
Eggs	2.22	1.37		Soap	0.83	0.61	0.66
White bread	3.17	2.09	1.52	Laundry detergent	14.70	15.44	
Butter	4.62	4.63		Dishwashing liquid	2.73	4.01	2.34
Margarine	2.08	1.94	1.05	Aspirins	11.64	5.61	3.28
White rice	2.76	1.49	1.12	Toothpaste	3.22	2.31	
Spaghetti	2.83	2.49	1.75	Hand lotion	3.07	2.90	2.46
Flour, white	1.30	0.82	1.08	Shampoo	7.39	5.76	6.65
Sugar, white	2.23	1.17		Lipstick (deluxe type)	26.47	27.06	
Cheese, imported	11.51	13.92		Regular unleaded petrol	1.07	0.66	0.62
Cornflakes	2.62	2.88	2.55	Light bulbs	2.07		1.19
Yoghurt, nat.	0.89	0.48	0.85	Batteries	4.60	3.17	
Milk, pasteurised	1.15	0.86	0.85	Frying pan	30.41	18.41	
Olive oil	9.12	9.59	8.12	Electric toaster	44.73	53.74	
Peanut or corn oil	2.87	2.16	2.08	Razor blades	8.46	6.44	8.61
Peas, canned	0.89	0.89	0.80	Compact disc album	23.86		27.16
Tomatoes, canned	0.55	0.62	0.38	Television, colour	1076.70	874.36	839.85
Peaches, canned	1.55	1.87		Kodak colour film	8.12		
Pineapples, canned	1.54	1.93	2.09	Personal computer	899.06	874.53	881.78
Beef: filet mignon	32.10	11.90		3-course dinner at top restaur. for 4 ppl	563.11	377.72	256.75
Beef: steak, entrecote	23.60	9.94		Business trip	472.16		
Beef: stewing, shoulder	11.78	7.16	8.39	Hilton-type hotel, SRO, 1 night, BB	302.39	267.43	
Beef: roast	15.88	10.00		Moderate hotel, SRO, 1 night, BB	204.44		
Beef: ground or minced	9.64	5.72	6.00	One drink at bar of first class hotel	16.67	17.01	
Pork: chops	9.80	4.49	7.31	2-course meal for 2 ppl	162.32	104.02	106.98
Chicken: fresh	5.64	1.94		Simple meal for one person	43.16	26.55	32.86
Fresh fish	18.70	13.96	4.86	Laundry (one shirt)	5.67		
Instant coffee	6.54	6.71		Dry cleaning, man's suit	13.33	7.08	
Ground coffee	9.08	4.63	9.77	Dry cleaning, woman's dress	22.13		
Tea bags	2.01	1.76	1.08	Dry cleaning, trousers	9.31	4.14	
Drinking chocolate	3.48	3.32		Man's haircut	33.59	20.10	15.17
Men's business suit, 2 pc.	544.18	573.70		Woman's cut & blow dry	59.70	43.48	27.90
Men's business shirt	85.91	102.05		Domestic cleaning help (hr)	13.88	3.01	
Men's shoes	276.27	226.51		Maid's monthly wages	1504.56		94.62
Socks, wool	12.36	12.64	10.56	Babysitter's rate (hr)	10.69		
Women's dress	328.52	319.44		Developing 36 colour pic.	18.01	9.39	9.83
Women's shoes	152.36	103.88		4 best seats at cinema	35.91	17.52	9.51
Women's tights	12.82	9.74	17.48	Cost of a tune up	253.75	169.05	651.41
Child's jeans	53.13	32.02		1 good seat at cinema	8.98	4.38	2.38

We present average prices over the period 1990-2010 across low, medium and high income countries, for each good.

Table A2: **Convergence Club Classifications by Industry**

Industry	**Initial Classification**			**Test of Club Merging (γ)**				**Final Classification**		
		n	γ	**1+2**	**2+3**	**3+4**	**4+5**		**n**	γ
Agriculture	club 1	25	0.163	-0.087**				club 1	25	0.163
	club 2	3	2.183		0.707			club 2	6	0.707
	club 3	3	0.024			-0.662*		club 3	6	0.000
	club 4	6	0.000				-1.396*	group	3	-0.653*
	group	3	-0.653*							
Food	club 1	14	0.540	-0.172*				club 1	14	0.540
	club 2	25	-0.049		-0.253*			club 2	25	-0.049
	group	1	NA					group	1	NA
Textile	club 1	9	0.812	-0.134				club 1	26	-0.134
	club 2	17	0.598		-0.796*			club 2	13	0.503
	club 3	13	0.503			-0.107*		group	1	NA
	group	1	NA							
Paper products	club 1	20	0.771	-0.426*				club 1	20	0.771
	club 2	15	-0.119		-0.453*			club 2	15	-0.119
	club 3	2	4.946			-1.299*		club 3	2	4.946
	group	3	-1.406*					group	3	-1.406*
Chemicals	club 1	32	0.101	-0.407*				club 1	32	0.101
	club 2	8	0.117					club 2	8	0.117
Metal products	club 1	34	0.246	-0.385*				club 1	34	0.246
	club 2	6	0.117					club 2	6	0.117
Hotels and restaurants	club 1	6	1.176	0.184				club 1	12	0.184
	club 2	6	0.022		-0.185*			club 2	20	-0.075
	club 3	20	-0.075			-0.637*		club 3	8	0.165
	club 4	8	0.165							
Other services	club 1	3	0.125	-0.211*				club 1	3	0.125
	club 2	26	0.100		-0.499*			club 2	26	0.100
	club 3	10	0.142			-0.376*		club 3	10	0.142
	group	1	NA					group	1	NA

This table presents results of the clustering procedure application for each industry. The first three columns show the initial club classification, number of countries, n, and the convergence coefficient γ, for each club. If there are counties that do not form any clubs we label them as a divergent "group". We also test whether any of two neighbouring clubs can be merged in one convergence club, with results of this exercise presented in the middle panel. If any two clubs converge, we merge them and reflect these changes in the final classification results for which are shown in the last three columns. *, ** refer to the significance level of 1% and 5%, respectively, at which the null of convergence, $H_0 : \lambda_{1j} \geq 0$ is rejected.

Table A3: **Average Prices in Club at the Industry Level**

	club 1				club 2				club 3			
Industry	**All**	**High**	**Med**	**Low**	**All**	**High**	**Med**	**Low**	**All**	**High**	**Med**	**Low**
Agriculture	2.02	2.09	1.16	-	1.10	0.96	1.19	1.12	0.94	0.76	0.95	1.08
Food	3.07	3.27	2.40	3.03	2.70	2.95	2.27	2.21	-	-	-	-
Textile	65.20	67.62	54.13	45.02	46.05	50.57	45.10	40.34	-	-	-	-
Paper products	2.10	2.15	1.62	2.70	1.64	1.75	1.34	2.07	1.40	1.51	1.29	-
Chemicals	3.32	3.57	3.11	2.16	2.42	2.29	2.50	-	-	-	-	-
Metal products	18.12	19.04	14.73	18.10	9.19	-	11.47	6.91	-	-	-	-
Hotels and restaurants	197.12	206.69	-	91.93	163.20	176.65	138.83	134.70	108.15	106.23	114.08	98.22
Other services	21.73	21.73	-	-	11.94	12.82	9.31	3.92	7.11	8.58	6.26	8.19

This table presents average prices across countries that form each club defined using industry prices. The first column reports average prices over the period 1990-2010 across all countries belonging to the same club. We also present average prices for low, medium and high income countries in each club for each industry in the subsequent columns.

Table A4: **Test for the Equality of the Convergence Coefficients**

Model	**Threshold Variable**		**P-value for the null of equality**					
	level 1 (q_1)	**level 2 (q_2)**	**c1-c2**	**c1-c3**	**c1-c4**	**c2-c3**	**c2-c4**	**c3-c4**
1	Democracy	Distance	0.000	0.000	0.000	0.214	0.041	0.781
2	Distance	Initial productivity	0.000	0.000	0.000	0.339	0.591	0.237
3	Distance	Initial income	0.000	0.000	0.000	0.001	0.189	0.000
4	Control of corruption	Democracy	0.000	0.000	0.000	0.000	0.000	0.000
5	Control of corruption	Distance	0.781	0.027	0.122	0.004	0.092	0.347
6	Distance	Distance	0.000	0.240	0.373	0.000	0.000	0.077
7	Control of corruption	Initial productivity	0.004	0.000	0.148	0.000	0.000	0.000
8	Initial productivity	Democracy	0.001	0.000	0.000	0.642	0.594	0.539
9	Initial income	Democracy	0.000	0.000	0.000	0.529	0.866	0.547
10	Distance	Initial prices	0.000	0.000	0.000	0.001	0.018	0.000
11	Initial productivity	Initial prices	0.000	0.001	0.000	0.001	0.000	0.000
12	Initial income	Initial productivity	0.000	0.000	0.001	0.655	0.000	0.000
13	Initial income	Initial prices	0.000	0.001	0.000	0.000	0.000	0.000
14	Control of corruption	Initial income	0.301	0.000	0.000	0.000	0.009	0.000
15	Initial productivity	Initial productivity	0.737	0.226	0.000	0.090	0.000	0.000
16	Initial income	Initial income	0.000	0.433	0.000	0.000	0.130	0.000
17	Democracy	Democracy	0.000	0.000		0.034		
18	Democracy	Initial prices	0.000	0.000	0.000	0.017	0.000	0.000
19	Control of corruption	Initial prices	0.000	0.000	0.000	0.000	0.232	0.000
20	Control of corruption	Control of corruption	0.000	0.011	0.000	0.463	0.061	0.751
21	Initial prices	Initial prices	0.000	0.000	0.000	0.001	0.001	0.274

Notes: The table presents p-values for the null that any two coefficients in the models presented in Table 3.6 are equal. C1, c2, c3 and c4 denote the coefficients for the low q_1-low q_2, low q_1-high q_2, high q_1-low q_2 and high q_1-high q_2 regimes, respectively.

Table A5: **Threshold Estimation and Testing for the Augmented Model**

Threshold variables		**Threshold point and interval estimates**						**AIC**
Level 1 (q_1)	**Level 2 (q_2)**	**Two-regime TR model**		**Four-regime TR model**				
				Low q_1		**High q_1**		
		Threshold value	**95%CI**	**Threshold value**	**95%CI**	**Threshold value**	**95%CI**	
Distance	Initial income	8.798*†	[8.717, 9.246]	9.917*†	[9.658, 10.498]	9.332*†	[8.157, 10.120]	-3.508
	Initial productivity	8.798*†	[8.717, 9.246]	10.864*†	[10.558, 11.177]	10.127*†	[9.179, 10.935]	-3.504
	Distance	8.798*†	[8.717, 9.246]	8.727*†	[8.710, 8.774]	9.243*†	[9.058, 9.293]	-3.502
	Control of corruption	8.798*†	[8.717, 9.246]	4.292*†	[3.000, 5.917]	3.083*†	[2.000, 4.917]	-3.500
	Democracy	8.798*†	[8.717, 9.246]	5.375*†	[5.000, 5.917]	5.000*†	[3.000, 5.917]	-3.503
	Initial prices	8.798*†	[8.717, 9.246]	1.693**†	[0.312, 4.324]	1.655**†	[-0.100, 4.037]	-3.499
Initial prices	Initial income	2.043**†	[0.089, 4.183]	9.542*†	[8.394, 10.336]	9.154*†	[8.574, 10.431]	-3.494
	Initial productivity	2.043**†	[0.089, 4.183]	10.471*†	[9.493, 11.116]	10.720*†	[9.627, 11.145]	-3.493
	Distance	2.043**†	[0.089, 4.183]	8.798*†	[8.717, 9.246]	8.798*†	[8.714, 9.246]	-3.498
	Control of corruption	2.043**†	[0.089, 4.183]	3.083*†	[2.000, 5.083]	3.083*†	[2.417, 5.417]	-3.493
	Democracy	2.043**†	[0.089, 4.183]	5.000*†	[3.750, 5.917]	5.000*†	[4.000, 5.917]	-3.490
	Initial prices	2.043**†	[0.089, 4.183]	-0.027**†	[-0.267, 1.590]	5.432***†	[2.407, 5.505]	-3.489
Initial income	Initial income	9.542*†	[8.457, 10.380]	8.973*†	[8.081, 9.122]	10.064*†	[9.879, 10.527]	-3.496
	Initial productivity	9.542*†	[8.457, 10.380]	10.095*†	[9.018, 10.112]	10.892*†	[10.823, 11.210]	-3.496
	Distance	9.542*†	[8.457, 10.380]	9.169*†	[9.058, 9.246]	8.789*†	[8.712, 8.959]	-3.500
	Control of corruption	9.542*†	[8.457, 10.380]	2.292*†	[2.000, 3.833]	4.833*†	[3.792, 5.917]	-3.497
	Democracy	9.542*†	[8.457, 10.380]	4.333*†	[3.000, 4.917]	5.000*†	[5.000 , 5.917]	-3.500
	Initial prices	9.542*†	[8.457, 10.380]	-0.047***†	[-0.193, 3.950]	2.220**†	[0.346, 4.367]	-3.498
Initial productivity	Initial income	10.471*†	[9.545, 11.131]	8.973*†	[8.077, 9.122]	10.064*†	[9.879, 10.527]	-3.495
	Initial productivity	10.471*†	[9.545, 11.131]	10.095*†	[9.018, 10.112]	10.892*†	[10.823, 11.210]	-3.496
	Distance	10.471*†	[9.545, 11.131]	9.169*†	[9.058, 9.246]	8.798*†	[8.712, 8.959]	-3.500
	Control of corruption	10.471*†	[9.545, 11.131]	2.000*†	[2.000, 3.833]	4.833*†	[4.000, 5.917]	-3.498
	Democracy	10.471*†	[9.545, 11.131]	4.333*†	[3.000, 5.000]	5.000*†	[5.000 , 5.917]	-3.501
	Initial prices	10.471*†	[9.545, 11.131]	-0.066***†	[-0.190, 3.949]	2.220**†	[0.342, 4.364]	-3.498
Control of corruption	Initial income	3.083*†	[2.000, 5.417]	8.597*†	[8.055, 9.425]	10.005*†	[9.544, 10.517]	-3.498
	Initial productivity	3.083*†	[2.000, 5.417]	9.901*†	[9.009, 10.285]	10.893*†	[10.536, 11.200]	-3.501
	Distance	3.083*†	[2.000, 5.417]	9.058*†	[8.798, 9.243]	8.798*†	[8.712, 9.243]	-3.502
	Control of corruption	3.083*†	[2.000, 5.417]	2.083*†	[2.000, 2.958]	4.917*†	[4.000, 5.917]	-3.494
	Democracy	3.083*†	[2.000, 5.417]	4.333*†	[3.000, 5.458]	5.917*†	[5.000* , 5.917]	-3.503
	Initial prices	3.083*†	[2.000, 5.417]	1.812**†	[-0.134, 4.032]	1.223**†	[0.260, 4.288]	-3.494
Democracy	Initial income	5.000*†	[4.000, 5.917]	9.190*†	[8.142, 9.881]	9.686*†	[9.686, 10.527]	-3.498
	Initial productivity	5.000*†	[4.000, 5.917]	10.929*†	[9.177, 10.929]	10.596*†	[10.558, 11.206]	-3.495
	Distance	5.000*†	[4.000, 5.917]	9.064*†	[8.754, 9.249]	8.789*†	[8.712, 9.058]	-3.513
	Control of corruption	5.000*†	[4.000, 5.917]	3.083*†	[2.000, 3.833]	5.417*†	[3.500, 5.917]	-3.497
	Democracy	5.000*†	[4.000, 5.917]	4.333*†	[3.000, 4.917]	5.667	[5.667, 5.917]	-3.496
	Initial prices	5.000*†	[4.000, 5.917]	-0.036**†	[-0.134, 4.008]	2.220**†	[0.301, 4.346]	-3.495

Notes: This table presents threshold estimates at the good level of analysis. In the first six columns, we report the corresponding threshold estimate and its 95% confidence interval for the first and second level of sample splitting respectively. The last column reports the Akaike information criterion (AIC). Each row presents one model with two specific threshold variables. All models estimate equation (3.9) with the following vector of regressors $x_{ijt} = (d_i', d_j', d_t', p_{ijt-1}, z_{it}')'$, where d_i, d_j and d_t are country, good and time dummies, p_{ijt-1} is initial price level, and z_{it} is a vector of observable factors that belongs to q_{sit} such as initial income, control of corruption and democracy. *, **, ***, refer to the significance level of 1%, 5%, and 10%, respectively, at which the null of linearity is rejected. † - reject the null of a unit root at the 1% significance level based on the threshold autoregressive unit root test introduced by Caner and Hansen (2001) and extended for the panel-data model by Beyaert and Camacho (2008). Results for both tests are calculated using standard heteroskedasticity and autocorrelation corrected estimators.

Table A6: **Test for the Equality of the Convergence Coefficients in the Augmented Threshold Model**

Model	Threshold Variable		P-value for the null of equality					
	level 1 (q_1)	**level 2 (q_2)**	**c1-c2**	**c1-c3**	**c1-c4**	**c2-c3**	**c2-c4**	**c3-c4**
1	Democracy	Distance	0.000	0.000	0.000	0.266	0.086	0.827
2	Distance	Initial income	0.000	0.000	0.000	0.004	0.480	0.000
3	Distance	Initial productivity	0.000	0.000	0.000	0.337	0.486	0.260
4	Control of corruption	Democracy	0.000	0.004	0.000	0.000	0.000	0.000
5	Control of corruption	Distance	0.875	0.007	0.115	0.003	0.040	0.408
6	Distance	Distance	0.000	0.289	0.453	0.000	0.000	0.098
7	Initial productivity	Democracy	0.002	0.000	0.000	0.678	0.606	0.566
8	Control of corruption	Initial productivity	0.006	0.000	0.211	0.000	0.000	0.000
9	Initial income	Democracy	0.001	0.000	0.000	0.417	0.994	0.747
10	Distance	Initial prices	0.000	0.001	0.000	0.002	0.029	0.000
11	Initial productivity	Initial prices	0.000	0.001	0.000	0.001	0.000	0.000
12	Control of corruption	Initial income	0.319	0.000	0.000	0.000	0.021	0.000
13	Initial income	Initial prices	0.000	0.001	0.000	0.000	0.000	0.000
14	Initial productivity	Initial productivity	0.649	0.180	0.000	0.020	0.000	0.000
15	Initial income	Initial income	0.000	0.532	0.000	0.000	0.037	0.000
16	Initial income	Initial productivity	0.418	0.081	0.000	0.011	0.000	0.000
17	Democracy	Democracy	0.006	0.000		0.425		
18	Democracy	Initial prices	0.000	0.001	0.000	0.005	0.000	0.000
19	Control of corruption	Control of corruption	0.000	0.008	0.000	0.387	0.024	0.733
20	Control of corruption	Initial prices	0.000	0.000	0.002	0.000	0.148	0.000
21	Initial prices	Initial prices	0.000	0.000	0.000	0.002	0.000	0.352

Notes: The table presents p-values for the null that any two coefficients in the models presented in Table 3.8 are equal. C1, c2, c3 and c4 denote the coefficients for the low q_1-low q_2, low q_1-high q_2, high q_1-low q_2 and high q_1-high q_2 regimes, respectively.

Table A7: **Threshold Estimation and Testing for Regressions (Restricted Sample of Countries)**

Threshold variables		**Threshold point and interval estimates**						**AIC**
Level 1 (q_1)	**Level 2 (q_2)**	**Two-regime TR model**		**Four-regime TR model**				
				Low q_1		**High q_1**		
		Threshold value	**95%CI**	**Threshold value**	**95%CI**	**Threshold value**	**95%CI**	
Labor cost	Democracy	2.955*†	[0.542, 3.239]	4.333*†	[3.583, 5.917]	5.000	[5.000, 5.917]	-3.518
Distance	Labor cost	8.798*†	[8.717, 9.249]	2.976*†	[1.991, 3.408]	1.338*†	[0.182, 2.918]	-3.515
Initial income	Labor cost	9.494*†	[8.653, 10.380]	1.105*†	[0.095, 1.440]	2.955*†	[2.580, 3.401]	-3.511
Initial productivity	Labor cost	10.750*†	[9.656, 11.131]	1.135*†	[0.095, 1.369]	2.986*†	[2.477, 3.398]	-3.509
Control of corruption	Labor cost	3.083*†	[2.500, 5.417]	0.378*†	[0.113, 2.674]	2.955*†	[2.019, 3.395]	-3.504
Labor cost	Labor cost	2.955*†	[0.542, 3.239]	1.275*†	[0.270, 2.797]	3.077*†	[3.035, 3.520]	-3.505
Initial prices	Labor cost	1.909**†	[0.146, 4.226]	1.426*†	[0.432, 3.215]	2.955*†	[0.673, 3.340]	-3.497

Notes: This table presents threshold estimates at the good level of analysis. In the first six columns, we report the corresponding threshold estimate and its 95% confidence interval for the first and second level of sample splitting respectively. The last column reports the Akaike information criterion (AIC). Each row presents one model with two specific threshold variables. The models are estimated on the restricted sample of 31 countries for which we have data on labor cost. All models estimate equation (3.9) with the following vector of regressors $x_{ijt} = (d_i', d_j', d_t', p_{ijt-1})'$, where d_i, d_j and d_t are country, good and time dummies, and p_{ijt-1} is initial price level. *, **, refer to the significance level of 1% and 5% respectively, at which the null of linearity is rejected. † - reject the null of a unit root at the 1% significance level based on the threshold autoregressive unit root test introduced by Caner and Hansen (2001) and extended for the panel-data model by Beyaert and Camacho (2008). Results for both tests are calculated using standard heteroskedasticity and autocorrelation corrected estimators.

Table A8: β **Convergence: Evidence from Augmented Threshold Regressions with Labor Cost as a Threshold (Restricted Sample of Countries)**

Model	**Threshold Variable**		**β-coefficients**				**Speed of convergence**				**AIC**
	level 1 (q_1)	**level 2 (q_2)**	**low q_1**		**high q_1**		**low q_1**		**high q_1**		
			low q_2	**high q_2**	**low q_2**	**high q_2**	**low q_2**	**high q_2**	**low q_2**	**high q_2**	
1	Labor cost	Democracy	-0.129*†	-0.087†	-0.057		0.138	0.091	0.059		-3.518
2	Distance	Labor cost	-0.132*†	-0.062††	-0.088	-0.090	0.142	0.064	0.092	0.094	-3.515
3	Initial income	Labor cost	-0.099*	-0.143†	-0.094*	-0.057	0.105	0.154	0.099	0.059	-3.511
4	Initial productivity	Labor cost	-0.098*	-0.137†	-0.082†	-0.058	0.103	0.147	0.086	0.060	-3.509
5	Labor cost	Labor cost	-0.098***††	-0.116†	-0.064***	-0.056	0.103	0.123	0.066	0.057	-3.505
6	Control of corruption	Labor cost	-0.093†	-0.085†	-0.125*	-0.060	0.097	0.088	0.134	0.062	-3.504
7	Initial prices	Labor cost	-0.114†	-0.112†	-0.081*	-0.044	0.121	0.119	0.085	0.045	-3.497

Notes: This table presents coefficient estimates for the initial price level in the threshold regression models using threshold variables q_1 and q_2 at the first and second levels of sample splitting, respectively. The models are estimated on the restricted sample of 31 countries for which we have data on labor cost. All the coefficient are estimated to be significant at the 1% level. *, **, *** - reject the null that the coefficient for the low q_2 equals the respective high q_2 coefficient within the same q_1 regime at the 1%, 5%, and 10% level of significance, respectively. †, †† - reject the null that coefficient for the low q_1 equals the respective coefficient for high q_1 at the 1% and 5% level of significance, respectively. Each row presents one model with two specific threshold variables. All models estimate equation (3.9) with the following vector of regressors $x_{ijt} = (d_i', d_j', d_t', p_{ijt-1}, z_{it}')'$, where d_i, d_j and d_t are country, good and time dummies, p_{ijt-1} is initial price level, and z_{it} is a vector of observable factors that belongs to q_{sit} such as initial income, control of corruption and democracy. Initial productivity was excluded from the vector z_{it} due to the problem of multicollinearity with initial income. Distance is out of the model as well, since it is country specific variable that could not be included in the model with fixed country effects. The first four columns present beta coefficients for the four regimes, followed by the respective speed of convergence for the four regimes in the next four columns, and the AIC value for each model in the last column. The models are ordered by AIC.

Table A9: **Likelihood of Club Formation**

Country	**Price Club**	**Convergence Clubs**			
		bad q_1		**good** q_1	
		bad q_2	**good** q_2	**bad** q_2	**good** q_2
Netherlands	High	1%	4%	15%	80%
Norway	High	1%	6%	14%	79%
Luxembourg	High	1%	7%	16%	76%
Switzerland	High	1%	7%	18%	74%
Sweden	High	1%	8%	21%	70%
Finland	High	1%	8%	22%	70%
Denmark	High	1%	8%	21%	69%
Austria	High	3%	10%	23%	63%
Germany	High	3%	11%	24%	62%
UK	High	2%	9%	30%	59%
Belgium	High	3%	12%	26%	59%
France	High	5%	12%	26%	57%
Spain	High	2%	8%	33%	56%
Australia	High	2%	19%	28%	51%
US	High	7%	16%	27%	49%
Greece	High	9%	14%	32%	45%
Canada	High	8%	21%	27%	44%
Italy	High	11%	18%	29%	41%
New Zealand	High	5%	22%	36%	36%
Portugal	Low-Med	9%	14%	42%	35%
Japan	High	11%	29%	28%	32%
Poland	High	23%	26%	31%	19%
Turkey	High	37%	26%	28%	9%
Mexico	Low-Med	34%	44%	17%	5%
Malaysia	Low-Med	38%	42%	14%	5%
Panama	Low-Med	59%	21%	15%	4%
Chile	Low-Med	44%	37%	15%	4%
Philippines	Low-Med	57%	30%	9%	4%
Guatemala	Low-Med	69%	16%	11%	4%
Thailand	Low-Med	54%	32%	10%	4%
Colombia	Low-Med	59%	27%	10%	3%
Peru	Low-Med	58%	31%	8%	3%
South Africa	Low-Med	58%	30%	10%	3%
Uruguay	Low-Med	51%	40%	6%	3%
Venezuela	Low-Med	59%	30%	8%	3%
Brazil	Low-Med	59%	30%	9%	3%
Paraguay	Low-Med	70%	20%	8%	2%
Kenya	Low-Med	73%	15%	10%	2%

Notes: The table presents frequencies of forming a regime for each country in the 36 estimated simple threshold models. The countries shown are sorted according to the frequency of lying in the most favorable regime based on both threshold variables considered in each model (e.g., associated with a pair of the following conditions: low initial prices, low distance, high income, high productivity, high control of corruption, high democratic accountability). In addition, countries are classified in two clubs based on the share of goods that lie in the high-price club as defined in Section 3.3.5. These clubs are presented in the second column of the table. The first club (high) includes countries with more than fifty percent of goods in the high-price club, and the rest of the countries are placed in a second club (Low-Med).

Table A10: **Data Appendix**

Variable	**Variable Description**
Income	Logarithm of real GDP per capita. Annual data for the period 1990-2010. Source: PWT 7.1.
Initial income	Lagged values of the variable ”income” over the period 1989-2009. Source: PWT 7.1.
Control of corruption	The PRS measure of the corruption within the political system reflects actual or potential corruption in the form of excessive patronage, nepotism, job reservations, “favor-for-favors”, secret party funding, and suspiciously close ties between politics and business. In PRSs view these sorts of corruption pose risk to foreign business, potentially leading to popular discontent, unrealistic and inefficient controls on the state economy, and encourage the development of the black market. This variable ranges from zero to six and higher values mean less risk of corruption. Annual data for the period 1990-2010. Source: International Country Risk Guide.
Democratic Accountability	Measure of how responsive government is to its people. This variable ranges from zero to six,where the highest number of risk points (lowest risk) is assigned to Alternating Democracies, while the lowest number of risk points (highest risk) is assigned to Autarchies. Annual data for the period 1990-2010. The max value for this variable is 6. Source: International Country Risk Guide.
Distance	Logarithm of average distance from one city to each other city in the sample.
Labor productivity	Logarithm of PPP Converted GDP Chain per worker at 2005 constant prices. Annual data for the period 1990-2010. Source: PWT 7.1.
Initial productivity	Lagged values of the variable ”labor productivity” over the period 1989-2009. Source: PWT 7.1.
Labor cost	Logarithm of labor cost per hour. Annual data for the period 1990-2010. Note: Data for Guatemala, Kenya, Luxembourg, Panama, Paraguay, South Africa, and Uruguay are not available. Source: Economist Intelligence Unit