HIGH VERSUS LOW INFLATION: IMPLICATIONS FOR PRICE-LEVEL CONVERGENCE

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High versus Low Inflation: Implications for Price-Level Convergence

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Abstract

This paper investigates the relationship between the level of inflation and regional price-level convergence utilizing micro-level price data from Turkey during two clearly distinguishable periods of high and low inflation. The results indicate that higher persistence and slower convergence of price levels are evident during the low-inflation period, which corresponds to the inflation-targeting (IT) regime. During the low-inflation IT regime, inflation convergence across regions appears to occur more quickly and may be responsible for the slower pace of convergence in price levels. Overall, IT in Turkey, which was successful in lowering and maintaining inflation at acceptable levels, also appears to be associated with faster convergence in inflation rates at the expense of slower convergence in price levels.

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Keywords: Price Convergence, Inflation Convergence, Micro-level Prices, Turkey.

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1   Introduction

Previous research on aggregate-level price convergence has focused on the rate of convergence across countries utilizing aggregate price data to test the Purchasing Power Parity (PPP) hypothesis. This task was accomplished by testing the stationarity of real exchange rates as defined by price indexes, such as CPIs. The consensus of this body of literature is that prices expressed in common currency converge, but this convergence occurs at a very slow rate.[1]

Many other studies have approached price convergence by considering possible aggregation problems (i.e., utilizing micro-price data and testing the Law of One Price, LOP) or considering the convergence of prices across regions that share a common currency. Such approaches provide a more controlled environment by eliminating problems due to aggregation and exchange rate fluctuations (or factor market rigidities). Nevertheless, the results of this body of research have not produced a consensus, and conflicting results on the rate of convergence are common in the literature. [2]

This paper approaches the issue of price convergence from a different angle and considers the effect of the inflation rate on price-level convergence across regions, which, to the best of our knowledge, has not been investigated in earlier studies. In

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[1]Real exchange rates are stationary but very persistent with estimated half-lives in the range of 3-5 years (see Choi et al. (2006), Murray and Papell (2005), Frankel and Rose, 1996)

[2]Using disaggregated U.S. consumer prices, Parsley and jin Wei (1996) estimate half-lives that range from 12 to 45 months, which suggest significantly faster convergence to PPP than the typical cross-national estimates. In sharp contrast to this result, Cecchetti et al. (2002) estimated much larger half-life figures (9 years!) utilizing the consumer price indices of U.S cities. In a recent study, Crucini and Shintani (2008) utilized a large disaggregated retail price dataset that included several cities and countries and provided median half-life estimates of 18, 19 and 12 months for US cities, OECD and non-OECD cities, respectively. Yazgan and Yilmazkuday (2011) provided evidence of relatively faster convergence using U.S. city-level price data. The evidence outside the U.S. is presented in several studies. Wolszczak-Derlacz and De Blander (2009), using consumer prices in European Union cities, report an average half-life of 20 months. Ceglowski (2003) and Li and Huang (2006) report average half-lives of 6.60 and 4.72 months for disaggregated retail and consumer prices in Canadian cities, respectively. Both Fan and Wei (2003) and Lan and Sylwester (2010) utilize datasets that consist of 96 and 44 goods prices, respectively, for 36 Chinese cities and provide half-lives estimates of only a few months with a maximum of 5 months. Ritola (2008) uses price data for a small set of commodities and services in Chinese cities and estimates average half-lives of 3.5 months. The evidence provided by Morshed et al. (2006), obtained from aggregate consumer price indices (CPI)for 25 major Indian cities, indicates an average half-life of approximately 3 months; however, Das and Bhattacharya (2008) utilize (aggregate) CPI series for 76 cities to estimate half-lives of 8.14 and 22.89 months for common and local shocks, respectively. Wimanda (2009) provides estimated median half-lives of 16-17 months using data from 45 Indonesian cities. Finally, Gluschenko (2006) estimates an average half-life of 2 months for the cost of a basket of food in Russia.

particular, we investigate the regional price-level convergence properties of individual goods in an emerging market economy, Turkey, which provides a unique dataset including two periods of high inflation (i.e., before inflation targeting, the pre-IT period) and low inflation (i.e., inflation-targeting, the IT period). Therefore, this study provides an excellent opportunity to analyze the convergence characteristics of different price levels utilizing data (for two different periods) from the same country while controlling for many other factors. To the best of our knowledge, this is also the first study utilizing regional price data for goods in Turkey. By applying these micro-level price data comparatively, we provide evidence of the effect of the inflation rate regime on the convergence of regional prices. The results obtained using state-of-the-art persistence measures indicate that greater persistence and slower convergence (across regions) are evident for prices during the low-inflation period (corresponding to the IT regime) compared to the high-inflation period.

To understand the details of this result, since, given initial deviations from LOP, convergence in inflation rates would correspond to a divergence in price levels, we repeat the convergence analysis for inflation rates. We show that, for an increasing number of goods and region pairs, inflation rates have converged during the low-inflation period, which suggests that relative convergence in inflation rates might have caused the relative divergence or slower convergence of price levels during that period.

In terms of policy implications, inflation convergence suggests that real regional interest rates (defined as the difference between nationally determined nominal interest rates and region-specific inflation rates) have been converging during the low-inflation period, which indicates the success of the IT regime in Turkey because any benevolent policy maker (considering inequality) would balance economic standards (e.g., real variables such as the real interest rate) across regions. Despite the success of the IT regime in reducing inequality across regions in terms of real interest rates, the relatively lower convergence of price levels suggests that market integration has slowed down during the low-inflation period, which indicates an increase in trade costs (that potentially harm the national growth rate) across regions (e.g., due to higher energy prices, search costs) during the same period. Therefore, the low-inflation period in Turkey coincides with reductions in both inequality and market integration across regions, which reflects a trade-off from a policy perspective.

The rest of the paper is organized as follows. Section 2 describes the dataset. Section 3 introduces the empirical strategy. Section 4 presents the empirical results. Section 5 expands the investigation to include the convergence of inflation rates. Section 6 concludes. The Appendix elaborates the robustness analyses.

2 Data and Descriptive Statistics

We utilize seasonally adjusted goods-level prices for cities and regions in Turkey that have been obtained from the Turkish Statistical Institute (TurkStat). The monthly prices are reported at the retail level where the total number of retail stores is 22,886 throughout Turkey, although the number of stores varies by region.[3] The prices for each good in each region were averaged across retail stores to calculate region-specific good prices; these raw retail prices are used to calculate the consumer price index in Turkey.[4]

A change in the collection of price data in 2003 created two sample periods. The first covers the monthly periods between 1994M1 and 2002M12 and includes 554 good prices from 23 regions in Turkey. The second covers the monthly periods between 2003M1 and 2010M12 and includes 449 good prices from 26 regions in Turkey. Because our main objective is a robust comparison of the high and low-inflation periods, we focus on the common set of cities/regions and goods, which includes the prices of 128 goods and 13 cities/regions.

In Turkey, as depicted in Figure 1, the year 2002 represents the transition between the high-inflation period 1994M1-2001M12 (with an average inflation rate of 55%) and the low-inflation period 2003M1-2010M12 (with an average inflation rate of 9%). Although the structural break in the inflation rate is clearly observed in Figure 1, for robustness, we also test for the presence of a break in inflation following the sequential procedure elaborated in Bai and Perron (1998, 2003) for the period 1994M1-2010M12. The results suggest strong evidence of a single break in the mean inflation rate.[5] The estimated break date is the first month of 2002, which coincides with the beginning of IT, with a 95 percent confidence interval of 2001M12-2002M8. Therefore, we can safely claim that 1994M1-2001M12 corresponds to the high-inflation period, 2003M1-2010M12 corresponds to the low-inflation period, and 2002 corresponds to the transition period from high to low inflation.

The corresponding descriptive statistics for the good prices (for 128 goods and

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[3]These stores do not change over time unless a store closed or a particular product was no longer available in that store.

[4]The link between the good-level price data utilized in this paper and the aggregate CPI data is achieved through good- and region-specific weights assigned to the individual prices; such weights are not provided by TurkStat at the good level.

[5]We use the consumer price index series published by TurkStat. The test statistic value of supFT(1), which tests the null hypothesis of single break, is 124 and therefore highly significant, whereas supFT(2/1), which tests the null hypothesis of two breaks, is 0.69 and insignificant. Hence, we reject the null hypothesis of 2 breaks. See Bai and Perron (1998, 2003) for the details of these tests.

13 cities/regions) are provided in Appendix Tables A.1.1 and A.1.2. As is evident in Table A.1.1, the mean and dispersion of inflation were consistent across good categories during the high-inflation period, and they differed slightly across good categories during the low-inflation period. Nevertheless, according to Table A.1.2, the mean and dispersion of inflation rates were consistent across regions during both periods. This suggests that inflation differences across goods (displayed in Table A.1.1) offset each other at the region level (displayed in Table A.1.2). The dispersion of inflation rates across goods and regions is higher during the low-inflation period despite the use of a dispersion measure (i.e., the coefficient of variation) that controls for scale effects. Therefore, we expect to find evidence for higher persistence in price levels (and/or inflation rates) across regions during the low-inflation period. Such a claim requires formal investigation, which we describe in the next section.

3   Methodology

The logarithm of relative prices between regions r and k at time t, for the same good g, is represented by the following equation:

$$q_{rk,t}^{g} = p_{r,t}^{g} - p_{k,t}^{g}; \quad g = 1, ..., G, \quad r = 1, ..., R \quad (r \neq k), \quad t = 1, ..., T, \qquad (1)$$

where $p_{r,t}^{g}$ is the log price of good g in the region r at time t. $G = 128$ and $R = 13$ are the total number of goods and regions/cities, respectively. For each good g, we consider all, $R(R-1)/2 \ (= 78)$, region pairs for $r = 1, 2, ..., R-1, \ k = i+1, 2, ..., R$, and analyze convergence properties of log price gaps, $q_{rk,t}^{g}$ across all region pairs $rk = 1, 2, ..., R(R-1)/2$.

We assume that log relative prices are described by the following equation:

$$q_{rk,t}^{g} \backsim I(d), \qquad (2)$$

where d is the fractional differencing parameter that provides a measure of the persistence of convergence. In this case, the magnitude of d indicates the degree of persistence in the log price gap between regions r and k for the same good g.

In the absence of serious impediments to inter-regional trade, arbitrage requires rapidly converging prices, which requires that d values satisfy $-0.5 < d \leq 0$. However, the presence of barriers to inter-regional trade may cause different values of d to be observed depending on the characteristics of the goods under consideration. Specifically, different values of d correspond to different properties of price-level convergence across regions; therefore, d is a measure of the persistence of this convergence

(see Stengos and Yazgan (2014a,b)). Accordingly, the following cases (i.e., intervals of d) summarize the properties of convergence:

Case 1: Rapid convergence ($-0.5 < d \leq 0$): This case represents a short memory process, where *rapid convergence* (or *fast catching-up*) occurs.

Case 2: Stationary convergence ($0 < d \leq 0.5$): This case represents a long memory, but stationary process, where the value of d represents relatively slow convergence or smooth decay in the catching-up process. Higher values of d imply slower rates of convergence. Past price level differences linger in current price differences, although they exert a smaller influence.

Case 3 Mean reverting convergence ($0.5 < d < 1$): This case represents a long memory process, which is non-stationary but, mean reverting. In this case, the process is characterized by a high degree of persistence, and past price differences exert a long-lasting influence.

Case 4 Non-convergence ($d \geq 1$): When $d = 1$, this represents the case of a unit root process where any initial difference is not expected to be reversed. In this case, convergence does not occur. Divergence (i.e., initial differences expand in the future) is possible when $d > 1$.

To simplify the empirical results presented below, the first three cases represent *convergence* and the last case represents *divergence*.

To compare the convergence properties of good prices (across regions) between the high- and low-inflation periods, we estimate the fractional differencing parameter d for each good and for each region pair in our sample for both periods. We follow Stengos and Yazgan (2014a,b) to estimate d utilizing a variety of different estimators, namely, the Exact Local Whittle estimator in Shimotsu and Phillips (2005, 2006), the Two Stage Feasible Exact Local Whittle in Shimotsu (2010), and the fully extended local Whittle estimator in Abadir et al. (2007). The latter two estimators can also be computed after detrending the data (see Shimotsu (2010)). Unlike the other estimators of d, these Whittle estimators are consistent and produce the same $N\left(0, \frac{1}{4}\right)$ limit distribution for a wide range of values of d, especially in the non-stationary region.[6] In addition to these Whittle estimators, for robustness purposes, we use wavelet estimators of d developed by Fay et al. (2009) and Moulines et al. (2008) that are also valid under non-stationarity. Space constraints allow us to report only the Two Stage Feasible Exact Local Whittle estimator without detrending. The results, which are presented in the next section, remain qualitatively the same across

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[6]See Shimotsu (2010) (Stengos and Yazgan (2014a,b)) for the differences among these Whittle estimators. While using Whittle estimators, the bandwidth parameter, v, is set at $T^{0.65}$ as suggested by Shimotsu (2010). However, the results are qualitatively similar for different values of the bandwidth parameter.

estimators.[7]

4   Empirical Results

We estimate the fractional differencing parameter d for each good and city/region pair, i.e., for each of the 128 goods, we estimate the relative prices across 78 city/region pairs and obtain a total of 9,984 $(= 128 \times 78)$ estimated ds for both periods. Because displaying all the results is impossible, we summarize the estimated ds by either (i) fixing the region pairs and focusing on the number of goods that fall into each convergence category (i.e., the intervals of d) or (ii) fixing the goods and focusing on the number of region pairs in each convergence category. The convergence results based on region pairs are displayed in Figure 2, which distinguishes between high- and low-inflation periods. In particular, for each region pair in the x-axis that is represented by a stacked column, the top (middle) panel of Figure 2 indicates the number of goods that fall into each interval of d for the high (low)-inflationary period. As is evident in the top and middle panels of Figure 2, for most region pairs, there is relatively more evidence of fast convergence for more goods during the high-inflation period compared to low-inflation period. The middle panel of Figure 2 clearly indicates that there are more goods with lower speeds of convergence during the low-inflation period, but the portion of goods in each interval of d is stable across region pairs during that period.

  Because we have four intervals of d for each region pair, we calculate the change in the number of goods falling into each interval of d for low- and high-inflation periods in the bottom panel of Figure 2, where each *city/region pair* is represented by a clustered column with four categories. The results in the bottom panel of Figure 2 are replicated in Table 1 to clarify the change in convergence for good prices between the two periods. These results confirm that the number of goods for which prices has rapidly (slowly or not) converged across regions has decreased (increased) during the low-inflation period, except for the region pairs including the region of Antalya for which there is evidence of faster convergence for many good prices during the low-inflation period. Therefore, we can safely claim that most good prices have converged (or diverged) relatively slowly across regions during the low-inflation period.

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[7]The estimators with detrending naturally behave differently in terms of magnitudes of the estimated ds but not in terms of the general results. Estimated ds with detrending are smaller in magnitude and provide evidence of convergence. Because the price data under consideration are relative prices, we do not detrend the data before estimation. However, ds estimated by detrending methods do not dramatically change the results and main conclusions remain valid. The results obtained by other estimators are available upon request.

The convergence results based on goods are displayed in Figure 3, which also distinguishes between high- and low-inflation periods. In Figure 3, each *good* in the x-axis is represented by a stacked column. Therefore, the top (middle) panel of Figure 3 indicates the number of city/region pairs that fall into each interval of d for the high (low)-inflationary period. The bottom panel of Figure 3 and Table 2 both indicate the number of changes in region pairs that fall into each convergence case for both periods. The results show that for each good, the number of region pairs for which we observe relatively rapid price convergence (slow or non-convergence) has decreased (increased) during the low-inflation period. Therefore, the summary of estimated ds provided in Figures 2 and 3 and Tables 1 and 2 suggests that good prices have converged relatively slowly or not converged (i.e., diverged) across regions during the low-inflation period.

Appendix 2 formally tests the difference between the mean ds in both regimes. As explained in Appendix 2, when the averaged across city pairs, the evidence suggests that the average ds, persistence, is higher during the low-inflation period for 75 percent of goods; only for 17 percent of them does the evidence suggests the opposite. For the remaining goods, we find no statically significant difference. Similarly, when the averaged across goods for 85 percent of city pairs, the statistical evidence indicates that persistence is higher during the low-inflation period. There are only 12 city pairs for which the evidence is not consistent with the high persistence hypothesis during the low-inflation regime. Consistent with the above observations, all 12 of these city pairs include the city of Antalya.

Overall, the evidence suggests that once price levels reach a lower plateau, shocks to relative prices across regions become more persistent, which implies that price differences across regions have are more difficult to eliminate under the low-inflation IT regime.

5   Convergence in Inflation Rates

The above analysis clearly implies that persistence in relative prices is higher and convergence is slower during the low-inflation period compared to the high-inflation period. This result is likely caused by relative convergence in inflation rates during the low-inflation period; therefore, in this section, we focus on the convergence properties of inflation rates across Turkish regions during the high- and low-inflation periods. Such an investigation is particularly important in the context of price-level convergence because, given initial deviations from LOP, possible convergence in inflation rates (for example, due to low inflation during the IT regime) would correspond

to a divergence in price levels.[8]

Accordingly, we repeat our analysis for good-level inflation rates and depict the results in Figures 4 and 5 and Tables 3 and 4. Rapid convergence, or fast catching-up, (i.e., $-0.5 < d \leq 0$) is dominant during both periods, while stationary convergence (i.e., $0 < d \leq 0.5$) is relatively rare across regions.[9] A closer examination of Tables 3 and 4 reveals that the number (in terms of goods or city/region pairs) of stationary convergence cases ($0 < d < 0.5$) increases from high to low inflation while the change in the other cases remains constant when evaluated at either means or medians. Because this result suggests that the relative convergence of inflation rates during the low-inflation IT regime coincides with slower convergence in price levels across regions, the relative convergence of inflation rates might have caused the relative divergence or slower convergence of price levels during that period.

6   Concluding Remarks and Policy Implications

To the best of our knowledge, the relationship between national inflation rates and price-level convergence across regions has not been previously investigated theoretically or empirically. The empirical evidence presented in this paper clearly demonstrates that good-level price convergence across regions is slower during the low-inflation IT period compared to the previous high-inflation period of the Turkish economy.

The results also indicate that for an increasing number of goods and region pairs, inflation rates have converged during the low-inflation period, which suggests that relative convergence in inflation rates might have caused the relative divergence of price levels during that period. Overall, the IT regime in Turkey, which was successful in lowering and maintaining inflation to acceptable levels, seems to be associated with faster convergence in inflation rates at the expense of slower convergence in price levels.

Slower convergence of price levels during the low-inflation period suggests that market integration has slowed down during this period, which is a potential indicator of increased trade barriers (that can harm national growth) across regions (e.g., due to higher energy prices, search costs). Despite the negative effect of slow price-level convergence or divergence (during the low-inflation period), in terms of monetary policy, the results of this paper also suggest that real regional interest rates (defined

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[8]In relative terms, it is important to emphasize that convergence in inflation rates is a sufficient (but not necessary) condition for divergence in price levels.

[9]We exclude a small number of ds estimated in the non-invertible region, i.e., $-0.5 > d$. They are reflected as empty parts of the bars in the figures.

as the difference between nationally determined nominal interest rates and region-specific inflation rates) have converged during the low-inflation period, which is an indicator of success for the IT regime in Turkey because a benevolent policy maker (considering inequality) would like to balance economic standards (e.g., real variables such as the real interest rate) across regions. Therefore, there is a potential trade-off between these two effects, which requires further investigation and is beyond the scope of the present paper.

Table and Figures

Figure 1 - Annual Inflation Rates in Turkey
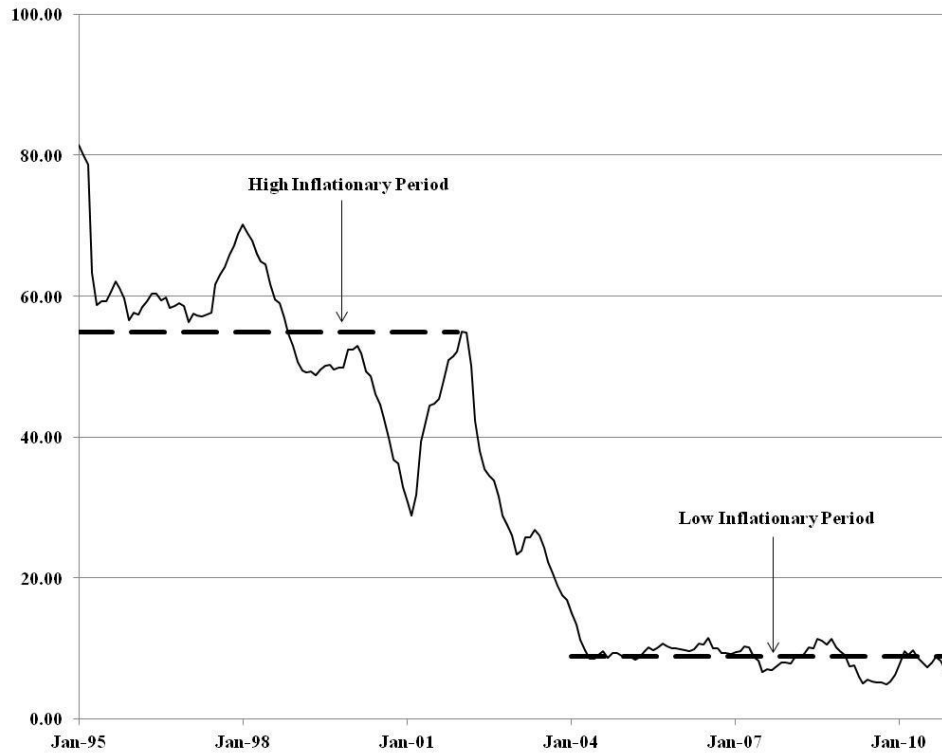
Notes: The solid line represents the annual inflation calculated as the twelve month log difference in Turkish CPI. The dashed lines represent the average annual inflation rates during the high and low inflationary periods, which are about 55% and 9%, respectively.

Figure 2 - Convergence Results based on City-Pairs
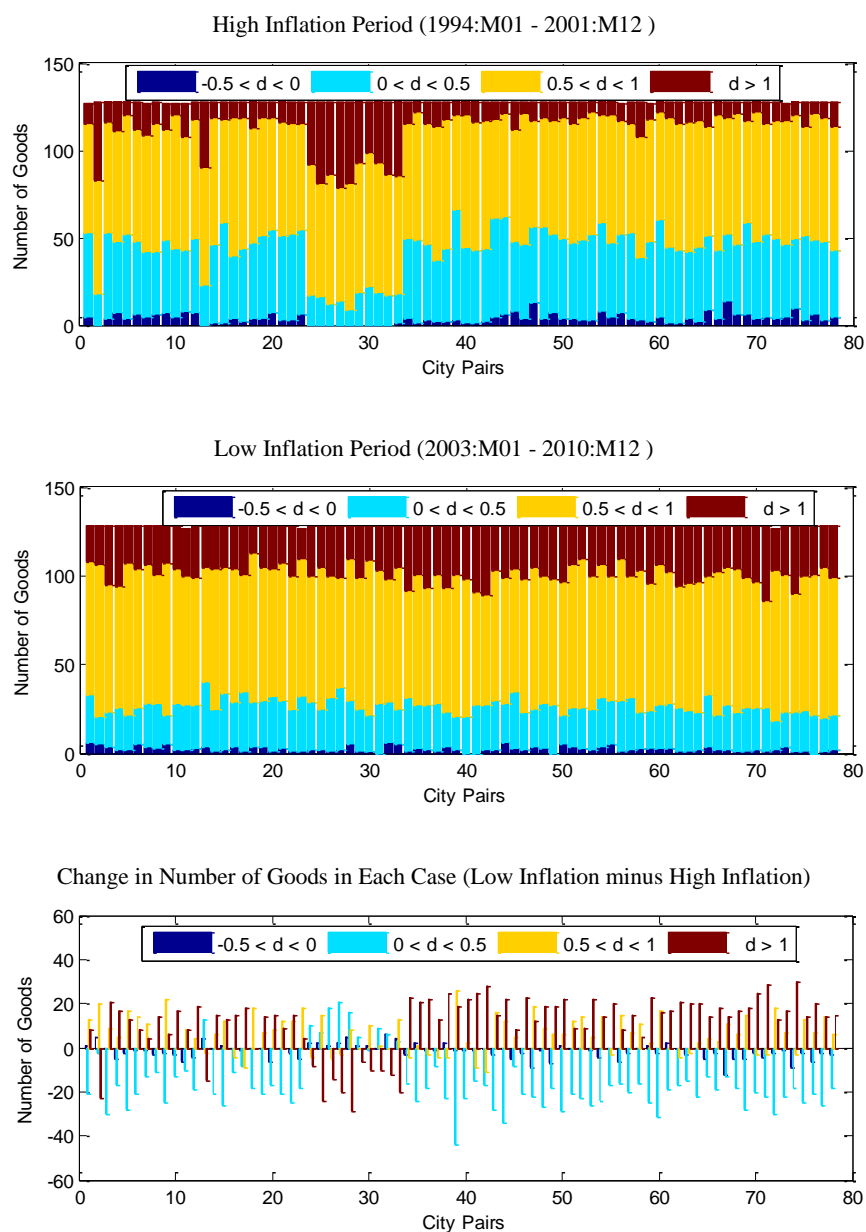
High Inflation Period (1994:M01 - 2001:M12)

Low Inflation Period (2003:M01 - 2010:M12)

Change in Number of Goods in Each Case (Low Inflation minus High Inflation)

Notes: Each city pair in the bottom graph has four bars, each representing the change in the number of goods for different intervals of d estimates. The information in the bottom graph is also given in Table 1.

Figure 3 - Convergence Results based on Goods
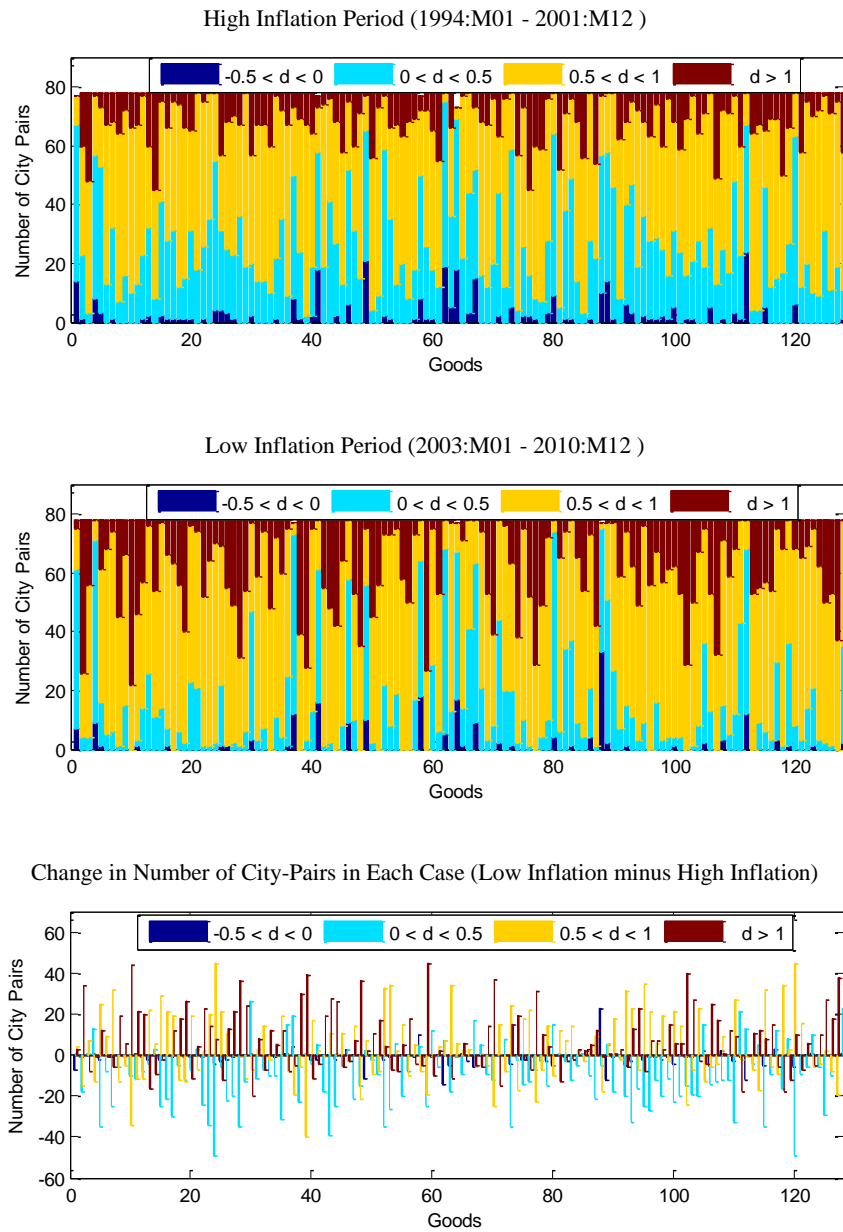
High Inflation Period (1994:M01 - 2001:M12)

Low Inflation Period (2003:M01 - 2010:M12)

Change in Number of City-Pairs in Each Case (Low Inflation minus High Inflation)

Notes: Each good in the bottom graph has four bars, each representing the change in the number of city pairs for different intervals of *d* estimates. The information in the bottom graph is also given in Table 2.

Figure 4 - Convergence Results for Inflation Rates based on City-Pairs

High Inflation Period (1994:M01 - 2001:M12)

Low Inflation Period (2003:M01 - 2010:M12)

Change in Number of Goods in Each Case (Low Inflation minus High Inflation)

Notes: Each city pair in the bottom graph has four bars, each representing the change in the number of goods for different intervals of *d* estimates. The information in the bottom graph is also given in Table 3.

Figure 5 - Convergence Results for Inflation Rates based on Goods

High Inflation Period (1994:M01 - 2001:M12)

Low Inflation Period (2003:M01 - 2010:M12)

Change in Number of City-Pairs in Each Case (Low Inflation minus High Inflation)

Notes: Each good in the bottom graph has four bars, each representing the change in the number of city pairs for different intervals of *d* estimates. The information in the bottom graph is also given in Table 4.

Table 1 - Change in Number of City-Pairs in Each Case (Low minus High Inflation)

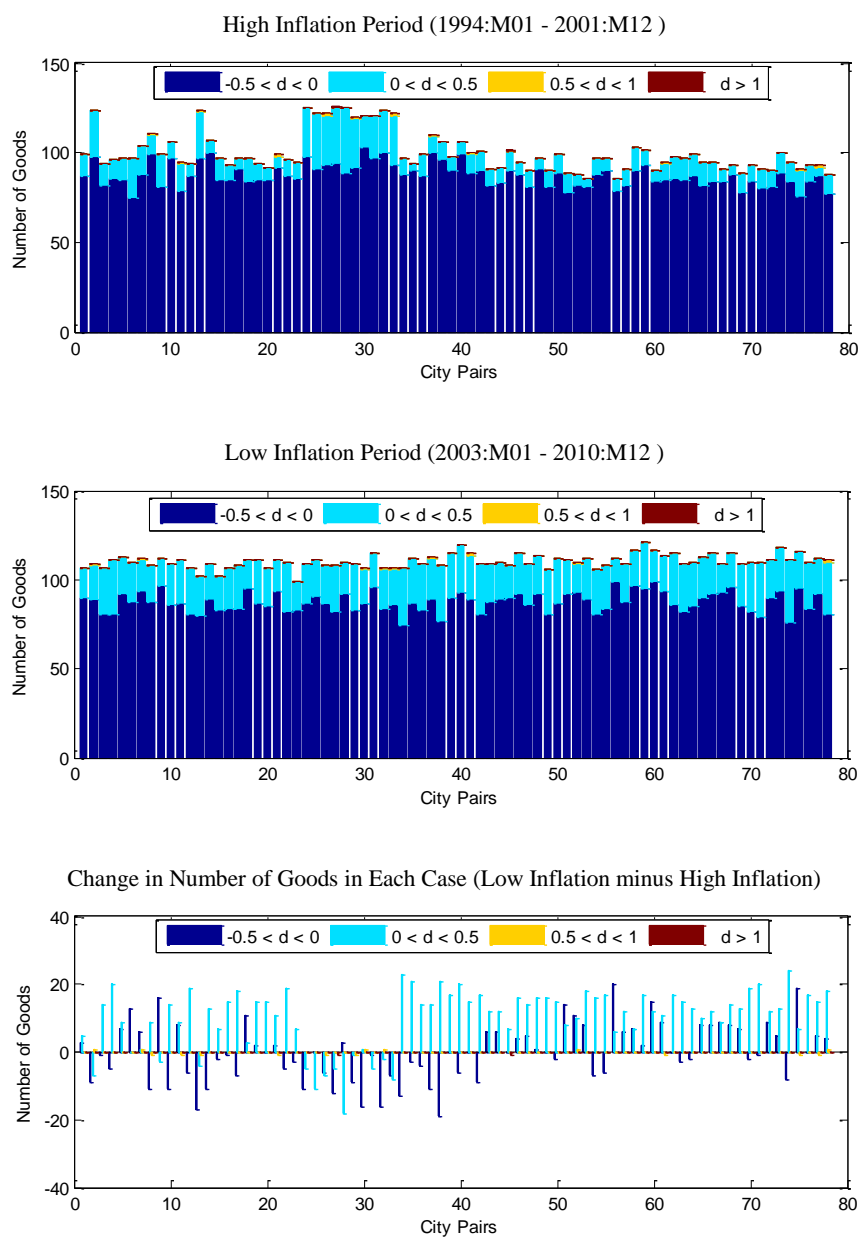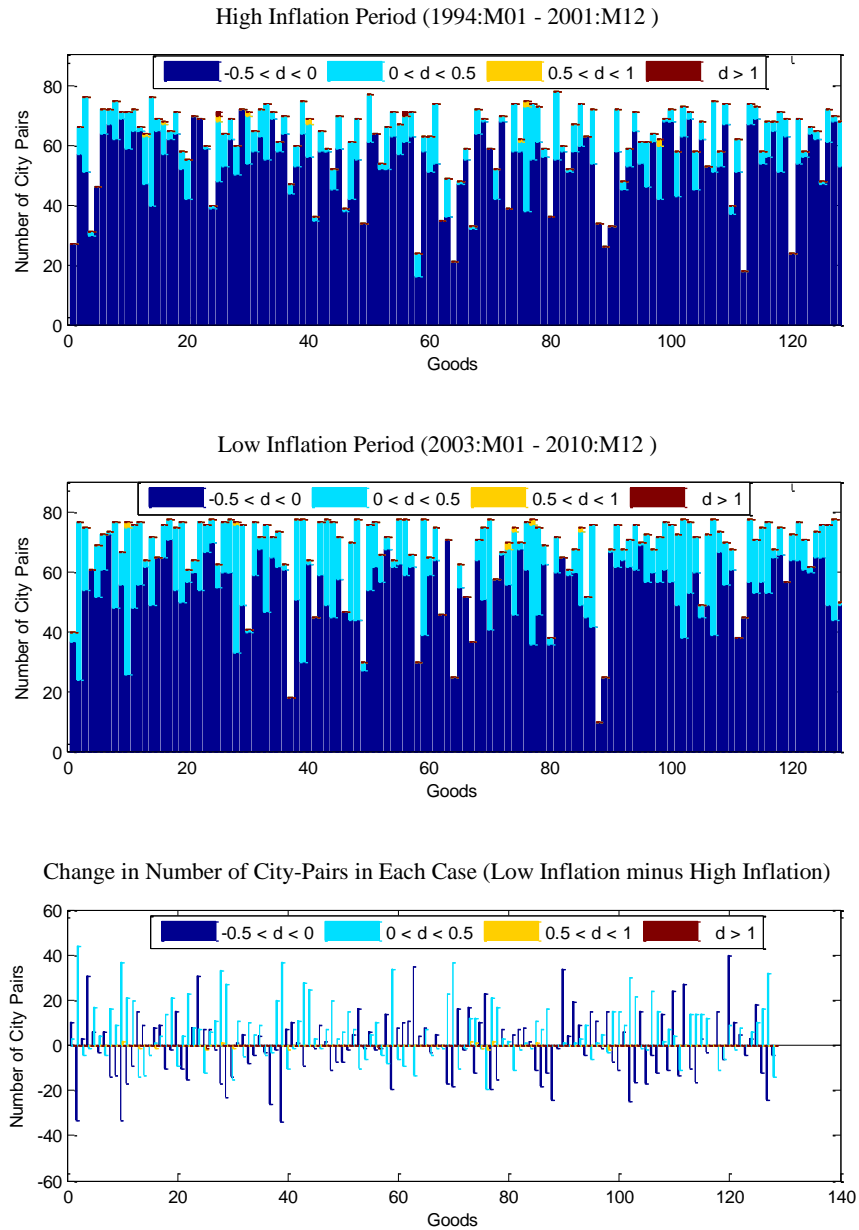| Goods	Change in Number of City-Pairs in the Case of:					Goods	Change in Number of City-Pairs in the Case of:			
	$-0.5 < d < 0$	$0 < d < 0.5$	$0.5 < d < 1$	$d > 1$			$-0.5 < d < 0$	$0 < d < 0.5$	$0.5 < d < 1$	$d > 1$
Apples	-7	1	4	3		Lump sugar	1	-9	2	6
Baby food	-1	-18	-15	34		Macaroni	-3	0	3	0
Baby's pijamas	0	1	7	-8		Margarine	-6	17	-6	-5
Bananas	1	13	-13	-1		Men's footwear	0	5	1	-6
Beer	-2	-35	25	12		Men's footwear repair	0	-9	-5	14
Belts	0	-8	9	-1		Men's Hairdressing	0	-12	-25	37
Biscuits for babies	-1	-25	32	-6		Milk	0	0	15	-15
Blanket	0	-6	-13	19		Mineral water	0	8	-8	0
Boiled and pounded wheat	0	-1	-5	6		Mini bus fare	-4	-35	24	15
Box of coloured pencils	0	-10	-34	44		Motor oil	0	-2	-17	19
Broiled meat	1	-11	-11	21		Mutton	-2	-14	18	-2
Bus fare	-1	-8	-11	20		Nescafe	-2	-13	22	-7
Butter	-2	-4	22	-16		Notebook	-1	-7	-23	31
Cacao	0	3	6	-9		Olive	0	-3	-7	10
Cake	-2	-25	29	-2		Olive oil	-3	-15	14	4
Canned vegetables	0	-21	21	0		Onions	-5	15	-10	0
Carbonated frutiy beverages	-1	-30	19	12		Overall for baby	0	1	12	-13
Carpet	-1	-5	-12	18		Packaged soup	-1	-3	7	-3
Cd	-1	-12	-13	26		Parsley	0	-12	14	-2
Chickpeas	-1	-7	19	-11		Peanuts	0	-5	2	3
Children's footwear	0	3	-7	4		Pijamas	0	1	-3	2
Chocolate	-1	-24	2	23		Pistachio	3	-10	2	5
Cinema	0	-34	20	14		Plastic household utentils	0	-21	9	12
City bus fare	-4	-49	45	8		Potatoes	23	-5	-18	-1
Coffee	-3	-6	21	-12		Poultry	-12	5	6	1
Coke	-2	-22	11	13		Powdered sugar	-1	-18	18	1
Cologne	-1	-20	0	21		Pumpkin seeds	0	-1	-2	3
Condimend-spices	0	-35	-1	36		Raisins	-5	-20	31	-6
Confectionery	0	-13	-11	24		Rice	-3	-33	23	13
Corn oil	1	26	-7	-20		Rice flour	0	-16	-7	23
Cotton cloth	0	-11	3	8		Roasted chick-peas	-2	-25	35	-8
Cotton wool	0	-7	14	-7		Salami	-1	-27	21	7
Curtain	0	-10	-2	12		Salt	-1	-12	6	7
Deodorant for women	-1	-10	6	5		Sausage	-2	-20	19	3
Desserts	0	-31	19	12		Sewing-Thread	-1	-11	-3	15
Detergents	1	15	-8	-8		Sponge for dish washing	-4	-23	21	6
Diesel oil	4	19	-19	-5		Stationery	0	-20	14	6
Dishwasher detergents	-1	-23	-6	30		Steel kitchen utentils	-1	-15	-24	40
Driver course fare	0	1	-40	39		Stove pipe	-1	-19	-7	27
Dry beans	-2	-4	17	-11		Sun flower seeds	0	-20	23	-3
Egg	-2	5	2	-4		Sun-flower oil	2	15	-13	-4
Expenditure on the purchase of glass	0	-18	-1	19		Taxi fare	-5	-14	-6	25
Film development	0	-39	11	28		Teflon household utentils	0	-13	-4	17
Flat bread	-2	-25	1	26		Thin dough	2	-12	9	1
Fruit Juices	0	-5	11	-6		Toilet paper	0	-12	0	12
Garlic	3	3	-3	-3		Toiletsoaps	-3	-33	27	9
Garlic-flavored sausage	0	-21	14	7		Tomato sauce	-1	21	-2	-18
Glass household utentsils	0	-15	-21	36		Tomatoes	-12	13	-1	0
Green onions	-11	2	7	2		Towel	0	-4	-7	11
Hair dryer	0	-2	-9	11		Travel goods	0	5	-17	12
Hamburger	0	-9	-8	17		Tube gas	-5	-35	32	8
Hazelnuts	-2	-35	33	4		Tulle	0	-9	-6	15
Helva	-1	-26	34	-7		Veal	3	12	-9	-6
Honey	0	6	2	-8		Water	0	-16	34	-18
Injector	0	-20	15	5		Wermicelli	1	8	3	-12
Iron	0	-8	-10	18		White bread	-6	-49	45	10
Jam	-1	0	5	-4		White cheese	0	-9	16	-7
Jewellery	10	4	-8	-5		Wine	0	-6	0	6
Knitting wool	-1	-25	-19	45		Women's footwear	1	10	-6	-5
Kosher cheese	-1	12	-1	-10		Women's footwear repair	0	-6	-4	10
Lace-Thread	0	-6	4	2		Women's Hairdressing	0	-29	2	27
Lemons	-14	7	7	0		Woolen fabrics	0	-10	-8	18
Lentils	-5	-18	34	-11		X-ray fees	0	-19	-19	38
Lettuce	-1	-1	6	0		Yoghurts	1	23	-4	-20
Mean	-1	-10	4	7						
Minimum	-14	-49	-40	-20						
25th Percentile	-1.5	-20	-7	-4						
Median	0	-9.5	2	5						
75th Percentile	0	0	15	15						
Maximum	23	26	45	45						

Table 2 - Change in Number of Goods in Each Case (Low minus High Inflation)

City-Pair	-0.5 < d < 0	0 < d < 0.5	0.5 < d < 1	d > 1		City-Pair	-0.5 < d < 0	0 < d < 0.5	0.5 < d < 1	d > 1
Adana - Ankara	1	-21	13	8		Balıkesir - Konya	-1	-23	2	22
Adana - Antalya	5	-2	20	-23		Balıkesir - Manisa	-1	-15	-9	25
Adana - Balıkesir	0	-30	9	21		Balıkesir - Samsun	0	-17	-11	28
Adana - Bursa	-5	-17	5	17		Bursa - Denizli	-3	-28	16	15
Adana - Denizli	-2	-28	17	13		Bursa - İstanbul	0	-34	12	22
Adana - İstanbul	-1	-21	14	8		Bursa - İzmir	-5	-8	5	8
Adana - İzmir	-1	-13	11	4		Bursa - Kayseri	-2	-21	0	23
Adana - Kayseri	-3	-11	0	14		Bursa - Kocaeli	-9	-22	19	12
Adana - Kocaeli	-2	-25	22	6		Bursa - Konya	-1	-27	9	19
Adana - Konya	-3	-13	0	17		Bursa - Manisa	-7	-18	6	19
Adana - Manisa	-6	-10	8	8		Bursa - Samsun	1	-29	6	22
Adana - Samsun	-4	-19	4	19		Denizli - İstanbul	0	-21	12	9
Ankara - Antalya	4	13	-2	-15		Denizli - İzmir	0	-23	14	9
Ankara - Balıkesir	0	-21	6	15		Denizli - Kayseri	-1	-26	5	22
Ankara - Bursa	1	-26	12	13		Denizli - Kocaeli	-4	-24	14	14
Ankara - Denizli	0	-11	-4	15		Denizli - Konya	0	-17	-3	20
Ankara - İstanbul	-1	-8	-9	18		Denizli - Manisa	-6	-16	15	8
Ankara - İzmir	0	-18	18	0		Denizli - Samsun	-2	-20	7	15
Ankara - Kayseri	0	-21	7	14		İstanbul - İzmir	0	-16	11	5
Ankara - Kocaeli	-6	-17	8	15		İstanbul - Kayseri	1	-25	2	23
Ankara - Konya	0	-21	12	9		İstanbul - Kocaeli	-2	-31	17	16
Ankara - Manisa	-2	-25	12	15		İstanbul - Konya	2	-19	0	17
Ankara - Samsun	-5	-18	18	4		İstanbul - Manisa	0	-17	-4	21
Antalya - Balıkesir	2	10	-4	-8		İstanbul - Samsun	-3	-15	-2	20
Antalya - Bursa	2	7	15	-24		İzmir - Kayseri	0	-22	2	20
Antalya - Denizli	1	18	-5	-14		İzmir - Kocaeli	-5	-13	4	14
Antalya - İstanbul	2	21	-3	-20		İzmir - Konya	-2	-19	3	18
Antalya - İzmir	5	16	8	-29		İzmir - Manisa	-12	-13	11	14
Antalya - Kayseri	1	5	0	-6		İzmir - Samsun	-5	-18	6	17
Antalya - Kocaeli	1	-1	10	-10		Kayseri - Kocaeli	-5	-28	15	18
Antalya - Konya	0	9	1	-10		Kayseri - Konya	-2	-20	-3	25
Antalya - Manisa	6	6	0	-12		Kayseri - Manisa	-4	-22	-3	29
Antalya - Samsun	4	3	13	-20		Kayseri - Samsun	-2	-30	18	13
Balıkesir - Bursa	-3	-16	-4	23		Kocaeli - Konya	-1	-22	7	17
Balıkesir - Denizli	2	-24	1	21		Kocaeli - Manisa	-9	-18	-3	30
Balıkesir - İstanbul	-1	-18	-3	22		Kocaeli - Samsun	-2	-25	13	14
Balıkesir - İzmir	-1	-8	-4	13		Konya - Manisa	-6	-21	7	20
Balıkesir - Kayseri	2	-23	-4	25		Konya - Samsun	-2	-26	14	14
Balıkesir - Kocaeli	-1	-44	26	19		Manisa - Samsun	-3	-18	6	15
Mean	-1	-16	6	11						
Minimum	-12	-44	-11	-29						
25th Percentile	-3	-23	0	8						
Median	-1	-19	6	15						
75th Percentile	0	-13	13	20						
Maximum	6	21	26	30						

Table 3 - Change in Number of City-Pairs in Each Case (Low minus High Inflation) for Inflation Convergence

Goods	Change in Number of City-Pairs in the Case of:				Goods	Change in Number of City-Pairs in the Case of:			
	-0.5 < d < 0	0 < d < 0.5	0.5 < d < 1	d > 1		-0.5 < d < 0	0 < d < 0.5	0.5 < d < 1	d > 1
Apples	10	3	0	0	Lump sugar	8	7	0	0
Baby food	-33	44	0	0	Macaroni	-3	-4	0	0
Baby's pijamas	3	-4	0	0	Margarine	5	-1	0	0
Bananas	31	-1	0	0	Men's footwear	0	-1	0	0
Beer	6	17	0	0	Men's footwear repair	-17	23	0	0
Belts	-3	4	0	0	Men's Hairdressing	-18	37	0	0
Biscuits for babies	6	-4	0	0	Milk	16	-10	0	0
Blanket	-14	16	0	0	Mineral water	-2	-1	0	0
Boiled and pounded wheat	-13	9	0	0	Mini bus fare	17	12	2	0
Box of coloured pencils	-33	37	2	0	Motor oil	-12	12	1	0
Broiled meat	-17	21	0	0	Mutton	10	-1	-1	0
Bus fare	-9	20	0	0	Nescafe	23	-19	-2	0
Butter	15	-14	-1	0	Notebook	-19	21	2	0
Cacao	9	-13	0	0	Olive	-15	17	0	0
Cake	0	-4	0	0	Olive oil	7	3	0	0
Canned vegetables	8	1	-1	0	Onions	0	2	0	0
Carbonated frutiy beverages	9	4	0	0	Overall for baby	5	-11	0	0
Carpet	-10	14	0	0	Packaged soup	7	-2	0	0
Cd	-2	21	0	0	Parsley	8	1	0	0
Chickpeas	15	-9	0	0	Peanuts	2	-1	0	0
Children's footwear	-10	4	0	0	Pijamas	-11	11	1	0
Chocolate	-15	23	0	0	Pistachio	-18	7	0	0
Cinema	8	8	0	0	Plastic household utentils	-12	16	0	0
City bus fare	31	7	0	0	Potatoes	-24	0	0	0
Coffee	7	-12	-2	-1	Poultry	-1	0	0	0
Coke	7	6	0	0	Powdered sugar	34	1	0	0
Cologne	-2	11	0	0	Pumpkin seeds	4	0	0	0
Condimenent-spices	-17	33	1	0	Raisins	19	1	0	0
Confectionery	-23	27	0	0	Rice	9	3	0	0
Corn oil	-14	-15	-1	0	Rice flour	-4	9	0	0
Cotton cloth	1	11	0	0	Roasted chick-peas	15	-6	0	0
Cotton wool	5	-5	0	0	Salami	11	1	0	0
Curtain	-8	10	0	0	Salt	-1	5	0	0
Deodorant for women	-4	5	0	0	Sausage	15	-3	-2	0
Desserts	4	9	0	0	Sewing-Thread	-7	15	0	0
Detergents	-3	-4	0	0	Sponge for dish washing	-11	15	0	0
Diesel oil	-26	-3	0	0	Stationery	6	9	0	0
Dishwasher detergents	-2	20	0	0	Steel kitchen utentils	-25	30	0	0
Driver course fare	-34	37	0	0	Stove pipe	-16	22	0	0
Dry beans	7	-10	-2	0	Sun flower seeds	15	-1	0	0
Egg	10	-1	0	0	Sun-flower oil	-17	-2	0	0
Expenditure on the purchase of glass	1	11	0	0	Taxi fare	-4	24	0	0
Film development	-9	28	0	0	Teflon household utentils	-12	15	0	0
Flat bread	0	25	0	0	Thin dough	14	2	0	0
Fruit Juices	-1	3	0	0	Toilet paper	-11	7	0	0
Garlic	9	-1	0	0	Toiletsoaps	24	4	0	0
Garlic-flavored sausage	2	7	0	0	Tomato sauce	-13	-11	0	0
Glass household utentsils	-11	20	0	0	Tomatoes	27	0	0	0
Green onions	-7	3	0	0	Towel	-10	14	0	0
Hair dryer	-7	6	0	0	Travel goods	-16	14	0	0
Hamburger	-2	15	0	0	Tube gas	3	14	0	0
Hazelnuts	5	7	0	0	Tulle	-3	12	0	0
Helva	16	-10	0	0	Veal	0	0	0	0
Honey	-1	-6	0	0	Water	15	-11	0	0
Injector	6	5	0	0	Wermicelli	-6	-6	0	0
Iron	-2	10	0	-1	White bread	40	9	0	0
Jam	-1	-4	0	0	White cheese	10	-2	0	0
Jewellery	14	-8	0	0	Wine	5	8	0	0
Knitting wool	-19	34	0	0	Women's footwear	-4	0	0	0
Kosher cheese	8	-6	0	0	Women's footwear repair	3	6	0	0
Lace-Thread	10	-9	0	0	Women's Hairdressing	18	10	0	0
Lemons	11	0	0	0	Woolen fabrics	-12	16	0	0
Lentils	35	-13	0	0	X-ray fees	-24	32	0	0
Lettuce	4	0	0	0	Yoghurts	-4	-14	0	0
Mean	0	6	0	0					
Minimum	-34	-19	-2	-1					
25th Percentile	-11	-2	0	0					
Median	0	4	0	0					
75th Percentile	9	14	0	0					
Maximum	40	44	2	0					

**Table 4 - Change in Number of Goods in Each Case (Low minus High Inflation)
for Inflation Convergence**

City-Pair	Change in Number of Goods in the Case of:				City-Pair	Change in Number of Goods in the Case of:			
	-0.5 < d < 0	0 < d < 0.5	0.5 < d < 1	d > 1		-0.5 < d < 0	0 < d < 0.5	0.5 < d < 1	d > 1
Adana - Ankara	3	5	0	0	Balıkesir - Konya	-6	20	0	0
Adana - Antalya	-9	-7	1	0	Balıkesir - Manisa	0	15	0	0
Adana - Balıkesir	-1	14	0	0	Balıkesir - Samsun	-9	17	0	0
Adana - Bursa	-5	20	0	0	Bursa - Denizli	6	12	0	0
Adana - Denizli	7	9	0	0	Bursa - İstanbul	6	12	0	0
Adana - İstanbul	13	0	0	0	Bursa - İzmir	0	7	0	-1
Adana - İzmir	6	1	1	0	Bursa - Kayseri	4	16	0	0
Adana - Kayseri	-11	9	-1	0	Bursa - Kocaeli	5	14	0	0
Adana - Kocaeli	16	-3	0	0	Bursa - Konya	1	16	0	0
Adana - Konya	-11	14	0	0	Bursa - Manisa	0	16	0	0
Adana - Manisa	8	9	-1	0	Bursa - Samsun	-2	15	0	0
Adana - Samsun	-6	19	0	0	Denizli - İstanbul	14	8	0	0
Ankara - Antalya	-17	-4	-1	0	Denizli - İzmir	11	10	1	0
Ankara - Balıkesir	-11	13	0	0	Denizli - Kayseri	8	18	0	0
Ankara - Bursa	-2	7	0	0	Denizli - Kocaeli	-7	16	0	0
Ankara - Denizli	-1	15	0	0	Denizli - Konya	-6	17	0	0
Ankara - İstanbul	-7	18	0	0	Denizli - Manisa	20	6	0	0
Ankara - İzmir	11	3	0	0	Denizli - Samsun	6	12	0	0
Ankara - Kayseri	2	15	0	0	İstanbul - İzmir	7	7	0	0
Ankara - Kocaeli	0	15	0	0	İstanbul - Kayseri	2	17	0	0
Ankara - Konya	2	11	-1	0	İstanbul - Kocaeli	15	12	0	0
Ankara - Manisa	-5	19	0	0	İstanbul - Konya	9	11	-1	0
Ankara - Samsun	-3	7	0	0	İstanbul - Manisa	0	17	0	0
Antalya - Balıkesir	-11	-5	0	0	İstanbul - Samsun	-3	15	0	0
Antalya - Bursa	0	-11	0	0	İzmir - Kayseri	-2	13	0	0
Antalya - Denizli	-6	-7	-1	0	İzmir - Kocaeli	8	10	0	0
Antalya - İstanbul	-12	-5	0	-1	İzmir - Konya	8	12	0	0
Antalya - İzmir	3	-18	0	0	İzmir - Manisa	9	9	0	0
Antalya - Kayseri	-9	-1	-1	0	İzmir - Samsun	8	14	0	0
Antalya - Kocaeli	-16	1	1	0	Kayseri - Kocaeli	7	13	0	0
Antalya - Konya	-1	-5	0	0	Kayseri - Konya	-2	19	0	0
Antalya - Manisa	-16	-2	1	0	Kayseri - Manisa	-1	20	0	0
Antalya - Samsun	-7	-8	0	0	Kayseri - Samsun	9	12	0	0
Balıkesir - Bursa	-13	23	0	0	Kocaeli - Konya	5	13	0	0
Balıkesir - Denizli	-3	21	0	0	Kocaeli - Manisa	-8	24	0	0
Balıkesir - İstanbul	-4	14	0	0	Kocaeli - Samsun	19	7	-1	0
Balıkesir - İzmir	-11	14	0	0	Konya - Manisa	0	17	0	0
Balıkesir - Kayseri	-19	21	0	0	Konya - Samsun	5	15	-1	0
Balıkesir - Kocaeli	0	17	0	0	Manisa - Samsun	4	18	1	0
Mean	0	10	0	0					
Minimum	-19	-18	-1	-1					
25th Percentile	-6	7	0	0					
Median	0	13	0	0					
75th Percentile	6	16	0	0					
Maximum	20	24	1	0					

References

Abadir, K., W. Distaso, and L. Giraitis (2007). Nonstationarity-extended local whittle estimation. *Journal of Econometrics 141*, 1353–1384.

Bai, J. and P. Perron (1998). Estimating and Testing Linear Models with Multiple Structural Changes. *Econometrica 66*(1), pp. 47–78.

Bai, J. and P. Perron (2003). Computation and analysis of multiple structural change models. *Journal of Applied Econometrics 18*(2), 1–22.

Cecchetti, S. G., N. C. Mark, and R. J. S. (2002) (2002). Price index convergence among united states cities. *International Economic Review 43 (4)*, 1081–99.

Ceglowski, J. (2003). The law of one price: Intranational evidence for canada. *Canadian Journal of Economics 36 (2)*, 373–400.

Choi, C., N. Mark, and D. Sul (2006). Unbiased estimation of the half-life to ppp convergence in panel data. *Journal of Money, Credit and Banking 38 (4)*, 921938.

Crucini, M. J. and M. Shintani (2008). Persistence in law of one price deviations: Evidence from micro-data. *Journal of Monetary Economics 55*(3), 629–644.

Das, S. and K. Bhattacharya (2008). Price convergence across regions in india. *Empirical Economics 34*, 299313.

Fan, C. and S. Wei (2003). The law of one price: Evidence from the transitional economy of china.

Fay, G., E. Moulines, F. Roueff, and M. S. Taqqu (2009). Estimators of long-memory: Fourier versus wavelets. *Journal of econometrics 151*(2), 159–177.

Gluschenko, K. (2006). Russias common market takes shape: Price convergence and market integration among russian regions. *BOFIT Discussion Papers 13*.

Lan, Y. and K. Sylwester (2010). Does the law of one price hold in china? testing price convergence using disaggregated data. *China Economic Review 21*(2), 224–236.

Li, N. and J. Huang (2006). Price convergence and market integration: Strong evidence using canada data. *The Empirical Economics Letters 5*(1), 13–28.

Morshed, A., S. K. Ahn, and M. Lee (2006). Price convergence among indian cities: a cointegration approach. *Journal of Asian Economics 17*(6), 1030–1043.

Moulines, E., F. Roueff, and M. S. Taqqu (2008). A wavelet whittle estimator of the memory parameter of a nonstationary gaussian time series. *The Annals of Statistics 36*(4), 1925–1956.

Murray, C. and D. Papell (2005). Do panels help solve the purchasing power parity puzzle? *Journal of Business and Economic Statistics 23 (4)*, 410415.

Parsley, D. and S. jin Wei (1996). Convergence to the law of one price without trade barriers or currency fluctuations. *Quarterly Journal of Economics 111 (4)*, 1211–1236.

Ritola, M. (2008). Price convergence and geographic patterns of market integration: evidence from china. *BOFIT Discussion Papers 13*.

Shimotsu, K. (2010). Exact local whittle estimation of fractional integration with unknown mean and time trend. *Econometric Theory 26*, 501–540.

Shimotsu, K. and P. Phillips (2005). Exact local whittle estimation of fractional integration. *Annals of Statistics 33*, 1890–1933.

Shimotsu, K. and P. Phillips (2006). Local whittle estimation of fractional integration and some of its variants. *Journal of Econometrics 130*, 209–233.

Stengos, T. and M. E. Yazgan (2014a). Persistence in convergence. *Macroeconomic Dynamics*, Forthcoming.

Stengos, T. and M. E. Yazgan (2014b). Persistence in real exchange rate convergence. *Studies in Nonlinear Dynamics and Econometrics*, Forthcoming.

Wimanda, R. E. (2009). Price variability and price convergence: Evidence from indonesia. *Journal of Asian Economics 20*(4), 427–442.

Wolszczak-Derlacz, J. and R. De Blander (2009). Price convergence in the european union and in the new member states. *Bank i Kredyt, National Bank of Poland 40(2)*, 37–59.

Yazgan, M. E. and H. Yilmazkuday (2011). Price-level convergence: New evidence from us cities. *Economics Letters 110*(2), 76–78.

Appendix 1: Additional Tables

Table A.1.1 – DESCRIPTIVE STATISTICS FOR GOODS Michael Kumhof

	Total	Traded	Nontraded	Traded (%)	Mean Inflation (%)	CV Inflation (%)
1994M1-2001M12 (High Inflation)						
Pooled Sample	128	115	13	90	55	2
Traded Goods	115	115	0	90	55	2
Nontraded Goods	13	0	13	90	55	2
Clothing and Footwear	14	13	1	93	55	2
Food, Beverage and Tobacco	70	70	0	100	55	2
Furniture and Furnishings	14	14	0	100	54	2
Health	2	1	1	50	50	2
Hotels, Cafes and Restaurants	3	0	3	0	53	2
Housing and Rent	2	1	1	50	61	1
Leisure, Entertainment and Culture Expenditures	6	4	2	67	56	2
Miscellaneous Goods and Services	10	9	1	90	56	2
Transport	7	3	4	43	58	2
2003M1-2010M12 (Low Inflation, IT)						
Pooled Sample	128	115	13	90	8	11
Traded Goods	115	115	0	90	8	11
Nontraded Goods	13	0	13	90	7	7
Clothing and Footwear	14	13	1	93	5	16
Food, Beverage and Tobacco	70	70	0	100	9	10
Furniture and Furnishings	14	14	0	100	6	8
Health	2	1	1	50	5	21
Hotels, Cafes and Restaurants	3	0	3	0	13	2
Housing and Rent	2	1	1	50	10	3
Leisure, Entertainment and Culture Expenditures	6	4	2	67	16	15
Miscellaneous Goods and Services	10	9	1	90	7	7
Transport	7	3	4	43	11	4

Notes: Mean Inflation (%) is the average inflation across goods and cities within each group. CV Inflation (%) is the coefficient of variation (defined as the standard deviation over the average of) of inflation across goods and cities within each group.

Table A.1.2 – Descriptive Statistics for Cities

	1994M1-2001M12 (High Inflation)				2003M1-2010M12 (Low Inflation)	
City/Region	Mean Inflation (%)	CV Inflation (%)		City/Region	Mean Inflation (%)	CV Inflation (%)
Adana	55	2		Adana	8	11
Ankara	56	2		Ankara	8	12
Antalya	45	3		Antalya	8	12
Balıkesir	55	2		Balıkesir	9	10
Bursa	56	2		Bursa	9	10
Denizli	56	2		Denizli	10	10
İstanbul	56	2		İstanbul	8	10
İzmir	56	2		İzmir	8	12
Kayseri	56	2		Kayseri	8	11
Kocaeli	56	2		Kocaeli	9	10
Konya	57	2		Konya	8	12
Manisa	56	2		Manisa	8	11
Samsum	57	2		Samsum	8	12

Notes: Mean Inflation (%) is the average inflation across goods within each city. CV Inflation (%) is the coefficient of variation (defined as the standard deviation over the average of) of inflation across goods within each city.

Appendix 2: Further Tests

The empirical results presented suggested that the inflation regime influenced convergence characteristics. The evidence suggests that persistence in relative prices is higher during the low-inflation period. In this section, we elaborate on this evidence and test the statistical significance of the difference between the average ds of both periods. Hence our hypothesis is described as follows:

$$
\begin{aligned}
H_0 & : \quad \mu_d^{low} - \mu_d^{high} = 0 \\
H_1 & : \quad \mu_d^{low} - \mu_d^{high} \neq 0,
\end{aligned}
$$

where μ_d^{low} and μ_d^{high} refer to the averages of persistence parameter of d of low- and high-inflation regimes. There are 2 alternative ways of considering this average: either over city pairs (rg) for each goods or over the goods (g) for each city pairs. In the former case, the average represents the average d for 78 city pairs. Therefore, we obtain 78 observations as the number of city pairs for each of 128 goods. For the latter, the average refers to the average d of 128 goods for each city pair.

The following equation has been previously described (see Shimotsu (2010) for example):

$$
\sqrt{\upsilon}\left(\hat{d} - d\right) \underset{asy}{\sim} N\left(0, \frac{1}{4}\right)
$$

As indicated above, following Shimotsu (2010), υ is set to $T^{0.6}$ and T is the length of the series used in the estimation of ds Then,

$$
\sqrt{\upsilon n}\left(\overline{\hat{d}} - \mu_d\right) \underset{asy}{\sim} N\left(0, \frac{1}{4}\right)
$$

where n is the number of observations (number of estimated ds, i.e., either 78 or 128) and $\overline{\hat{d}}$ is the sample average of estimated ds. Let $\overline{\hat{d}}_{low}$ and $\overline{\hat{d}}_{high}$ represent estimated ds in low- and high-inflation regimes, respectively. Assuming they are independently distributed, we obtain the following equation:

$$
\sqrt{\upsilon n}\left[\left(\overline{\hat{d}}_{low} - \overline{\hat{d}}_{high}\right) - \left(\mu_d^{low} - \mu_d^{high}\right)\right] \underset{asy}{\sim} N\left(0, \frac{1}{2}\right)
$$

Then, to test the above hypothesis, we use the following z-test statistics.

$$z = \frac{\left(\bar{\hat{d}}_{low} - \bar{\hat{d}}_{high}\right)}{\sqrt{\frac{1}{2vn}}}$$

Table A1 presents the results for each good. For 117 of 128 goods, we observe p-values smaller than 5 percent, which indicate the differences in persistence parameters during the two periods. However, for 95 of these 117 goods, the estimated difference between the persistence parameters (d) is positive, which indicates that persistence is higher during the low-inflation period. Only for 22 of 117 goods does the evidence indicate that the difference in d is significant and negative, which implies higher persistence during high inflation. For 75 percent of the goods under consideration (95 out of 128), the evidence suggests that the levels of inflation and persistence are negatively related, while for only 17 percent of goods does the relationship appear to be the reverse (22 out of 128).

Table A2 presents the results for each city pair. In 76 of 78 city pairs, the p-value of the test is smaller than 5 percent, which provides evidence of the difference in persistence parameters during the two inflationary episodes. Moreover, for 66 of 76 city pairs, or 85 percent of all city pairs (66 out of 78), the estimated difference between persistence parameters (d) is positive, which indicates that persistence is higher during the low-inflation period. Therefore, there are 12 city pairs for which the evidence is not consistent with the high persistence hypothesis during the low-inflation regime. Consistent with our previous findings, all of these city pairs include the city of Antalya.

Table A.2.1: estimates for each commodity group across all city pairs.

Commodities	$\bar{d}_l$	$\bar{d}_h$	$\bar{d}_l - \bar{d}_h$	$p-$value	Commodities	$\bar{d}_l$	$\bar{d}_h$	$\bar{d}_l - \bar{d}_h$	$p-$value
Baby food	1.086	0.729	0.357	0.000	Toiletsoaps	0.795	0.483	0.312	0.000
Beer	0.776	0.498	0.279	0.000	Towel	0.946	0.828	0.118	0.000
Biscuits for babies	0.766	0.663	0.103	0.000	Tube gas	0.870	0.573	0.297	0.000
Blanket	0.979	0.809	0.170	0.000	Tulle	0.927	0.778	0.150	0.000
Box of coloured pencils	1.096	0.810	0.286	0.000	White bread	0.797	0.398	0.399	0.000
Broiled meat	0.962	0.750	0.212	0.000	Footwear rep.	0.865	0.741	0.124	0.000
Bus fare	0.846	0.674	0.172	0.000	Women's Hairdressing	0.926	0.639	0.288	0.000
Cake	0.684	0.583	0.100	0.000	Woolen fabrics	0.901	0.780	0.120	0.000
Canned vegetables	0.813	0.687	0.126	0.000	X-ray fees	0.995	0.669	0.326	0.000
Carbonated beverages	0.935	0.652	0.283	0.000	**Potatoes**	**0.140**	**0.404**	**-0.265**	**0.000**
Carpet	0.867	0.748	0.119	0.000	**Yoghurts**	**0.621**	**0.831**	**-0.210**	**0.000**
Cd	0.974	0.750	0.224	0.000	**Diesel oil**	**0.286**	**0.490**	**-0.203**	**0.000**
Chocolate	0.967	0.680	0.286	0.000	**Corn oil**	**0.568**	**0.754**	**-0.186**	**0.000**
Cinema	0.874	0.595	0.279	0.000	**Tomato sauce**	**0.562**	**0.745**	**-0.183**	**0.000**
City bus fare	0.866	0.437	0.429	0.000	**Wermicelli**	**0.564**	**0.707**	**-0.142**	**0.000**
Coke	0.915	0.680	0.235	0.000	**Detergents**	**0.687**	**0.823**	**-0.136**	**0.000**
Cologne	0.902	0.732	0.170	0.000	**Milk**	**0.506**	**0.633**	**-0.127**	**0.000**
Condimend-spices	1.061	0.620	0.442	0.000	Fruit Juices	0.862	0.774	0.088	0.000
Confectionery	0.883	0.617	0.267	0.000	**Veal**	**0.620**	**0.744**	**-0.124**	**0.000**
Cotton cloth	0.885	0.757	0.128	0.000	Boiled wheat	0.786	0.700	0.085	0.000
Desserts	0.847	0.630	0.217	0.000	Belts	0.851	0.766	0.085	0.000
Dishwasher detergents	0.987	0.683	0.304	0.000	Lace-Thread	0.908	0.827	0.081	0.000
Driver course fare	1.040	0.847	0.194	0.000	Lentils	0.719	0.639	0.080	0.000
Purchase of glass	0.931	0.681	0.251	0.000	Deodorant	0.732	0.653	0.079	0.000
Film development	0.947	0.589	0.358	0.000	Apples	0.393	0.315	0.078	0.000
Flat bread	0.984	0.714	0.270	0.000	Wine	0.747	0.673	0.073	0.000
Garlic-flavored sausage	0.886	0.724	0.162	0.000	Nescafe	0.965	0.892	0.072	0.000
Glass household utentsils	1.009	0.721	0.288	0.000	Mutton	0.719	0.648	0.071	0.000
Green onions	0.453	0.309	0.144	0.000	**Honey**	**0.695**	**0.792**	**-0.097**	**0.000**
Hamburger	0.881	0.735	0.147	0.000	Curtain	0.925	0.857	0.068	0.000
Hazelnuts	0.699	0.467	0.231	0.000	Children's footwear	0.723	0.661	0.061	0.000
Helva	0.802	0.666	0.136	0.000	**Jewellery**	**0.382**	**0.468**	**-0.086**	**0.000**
Injector	0.982	0.760	0.222	0.000	Water	0.888	0.832	0.056	0.000
Iron	0.932	0.772	0.161	0.000	**Kosher cheese**	**0.693**	**0.767**	**-0.074**	**0.000**
Knitting wool	1.038	0.669	0.369	0.000	**Overall for baby**	**0.836**	**0.909**	**-0.073**	**0.000**
Lemons	0.392	0.196	0.196	0.000	Parsley	0.579	0.532	0.047	0.000
Lump sugar	0.751	0.616	0.135	0.000	**Onions**	**0.321**	**0.381**	**-0.060**	**0.000**
Men's footwear repair	0.910	0.757	0.153	0.000	Egg	0.415	0.373	0.042	0.000
Men's Hairdressing	0.957	0.670	0.287	0.000	**Sun-flower oil**	**0.624**	**0.682**	**-0.058**	**0.000**
Mini bus fare	0.845	0.429	0.415	0.000	**Dry beans**	**0.703**	**0.761**	**-0.058**	**0.000**
Motor oil	0.983	0.886	0.097	0.000	**Bananas**	**0.333**	**0.390**	**-0.057**	**0.000**
Notebook	1.078	0.826	0.252	0.000	Pijamas	0.912	0.872	0.040	0.000
Olive	0.937	0.828	0.109	0.000	White cheese	0.893	0.853	0.039	0.000
Olive oil	0.756	0.596	0.160	0.000	Packaged soup	0.641	0.603	0.039	0.000
Plastic household utentils	0.983	0.772	0.212	0.000	Lettuce	0.281	0.243	0.038	0.000
Poultry	0.547	0.421	0.126	0.000	**Jam**	**0.708**	**0.761**	**-0.053**	**0.000**
Powdered sugar	0.703	0.504	0.199	0.000	**Chickpeas**	**0.656**	**0.708**	**-0.052**	**0.001**
Raisins	0.706	0.539	0.166	0.000	**Butter**	**0.676**	**0.726**	**-0.050**	**0.001**
Rice	0.810	0.564	0.247	0.000	Hair dryer	0.928	0.899	0.028	0.006
Rice flour	0.916	0.690	0.226	0.000	Pumpkin seeds	0.834	0.807	0.027	0.009
Roasted chick-peas	0.748	0.645	0.104	0.000	Peanuts	0.768	0.742	0.026	0.010
Salami	0.912	0.719	0.193	0.000	**Women's footwear**	**0.709**	**0.739**	**-0.030**	**0.028**
Salt	0.775	0.617	0.158	0.000	**Baby's pijamas**	**0.879**	**0.909**	**-0.030**	**0.030**
Sausage	0.906	0.758	0.147	0.000	**Margarine**	**0.460**	**0.442**	**0.018**	**0.052**
Sewing-Thread	0.850	0.667	0.183	0.000	**Tomatoes**	**0.321**	**0.306**	**0.015**	**0.084**
Sponge for dish washing	0.841	0.654	0.187	0.000	**Pistachio**	**0.649**	**0.636**	**0.013**	**0.120**
Stationery	0.903	0.752	0.151	0.000	**Cacao**	**0.901**	**0.918**	**-0.017**	**0.143**
Steel kitchen utentils	1.039	0.777	0.262	0.000	**Men's footwear**	**0.740**	**0.757**	**-0.017**	**0.147**
Stove pipe	0.947	0.703	0.244	0.000	**Cotton wool**	**0.763**	**0.755**	**0.008**	**0.226**
Sun flower seeds	0.821	0.695	0.126	0.000	**Coffee**	**0.725**	**0.717**	**0.008**	**0.228**
Taxi fare	0.862	0.628	0.234	0.000	**Travel goods**	**0.846**	**0.840**	**0.006**	**0.298**
Teflon household utentils	1.062	0.829	0.233	0.000	**Garlic**	**0.462**	**0.468**	**-0.005**	**0.369**
Thin dough	0.791	0.669	0.122	0.000	**Macaroni**	**0.562**	**0.560**	**0.002**	**0.444**
Toilet paper	0.883	0.719	0.164	0.000	**Mineral water**	**0.693**	**0.695**	**-0.002**	**0.445**

Table A.2.2: $p-$values of the null hypothesis $d_{1994} = d_{2003}$ on the basis of d estimates for each city pair across all commodities.

City pairs	$\bar{d}_l$	$\bar{d}_h$	$\bar{d}_l - \bar{d}_h$	$p-$value	City pairs	$\bar{d}_l$	$\bar{d}_h$	$\bar{d}_l - \bar{d}_h$	$p-$value
Ada-Ank	0.751	0.640	0.111	0.000	Den-Man	0.778	0.604	0.174	0.000
Ada-Bal	0.808	0.648	0.161	0.000	Den-Sam	0.778	0.640	0.138	0.000
Ada-Bur	0.796	0.643	0.153	0.000	Ist-Kay	0.811	0.653	0.159	0.000
Ada-Den	0.792	0.617	0.175	0.000	Ist-Koc	0.768	0.610	0.157	0.000
Ada-Ist	0.795	0.662	0.133	0.000	Ist-Kon	0.793	0.660	0.133	0.000
Ada-Kay	0.791	0.667	0.123	0.000	Ist-Man	0.820	0.684	0.136	0.000
Ada-Koc	0.780	0.653	0.127	0.000	Ist-Sam	0.819	0.660	0.159	0.000
Ada-Kon	0.772	0.613	0.159	0.000	Izm-Kay	0.809	0.667	0.142	0.000
Ada-Man	0.780	0.646	0.134	0.000	Izm-Koc	0.778	0.656	0.122	0.000
Ada-Sam	0.795	0.625	0.170	0.000	Izm-Kon	0.789	0.671	0.119	0.000
Ank-Bal	0.767	0.666	0.101	0.000	Izm-Man	0.776	0.612	0.164	0.000
Ank-Den	0.758	0.648	0.110	0.000	Izm-Sam	0.787	0.636	0.150	0.000
Ank-Ist	0.756	0.650	0.106	0.000	Kay-Koc	0.816	0.609	0.206	0.000
Ank-Kay	0.780	0.635	0.146	0.000	Kay-Kon	0.813	0.637	0.176	0.000
Ank-Koc	0.769	0.629	0.139	0.000	Kay-Man	0.832	0.640	0.192	0.000
Ank-Kon	0.765	0.641	0.125	0.000	Kay-Sam	0.795	0.639	0.156	0.000
Ank-Man	0.781	0.634	0.147	0.000	Koc-Kon	0.801	0.669	0.133	0.000
Ank-Sam	0.749	0.636	0.113	0.000	Koc-Man	0.824	0.653	0.171	0.000
Bal-Bur	0.800	0.643	0.157	0.000	Koc-Sam	0.803	0.635	0.168	0.000
Bal-Den	0.805	0.637	0.168	0.000	Kon-Man	0.804	0.632	0.172	0.000
Bal-Ist	0.812	0.655	0.157	0.000	Kon-Sam	0.797	0.635	0.162	0.000
Bal-Izm	0.774	0.674	0.100	0.000	Man-Sam	0.827	0.652	0.175	0.000
Bal-Kay	0.814	0.667	0.147	0.000	**Ant-Izm**	**0.734**	**0.874**	**-0.140**	**0.000**
Bal-Koc	0.818	0.596	0.222	0.000	Ank-Bur	0.738	0.646	0.091	0.000
Bal-Kon	0.802	0.636	0.166	0.000	**Ank-Ant**	**0.721**	**0.830**	**-0.109**	**0.000**
Bal-Man	0.812	0.664	0.148	0.000	Ank-Izm	0.732	0.657	0.075	0.000
Bal-Sam	0.814	0.660	0.155	0.000	Ist-Izm	0.765	0.701	0.064	0.000
Bur-Den	0.788	0.609	0.179	0.000	Bur-Izm	0.739	0.677	0.061	0.000
Bur-Ist	0.779	0.594	0.185	0.000	Ada-Izm	0.760	0.699	0.061	0.000
Bur-Kay	0.809	0.632	0.177	0.000	**Ant-Bur**	**0.771**	**0.852**	**-0.081**	**0.000**
Bur-Koc	0.773	0.614	0.158	0.000	**Ant-Ist**	**0.790**	**0.857**	**-0.067**	**0.000**
Bur-Kon	0.796	0.624	0.172	0.000	**Ant-Den**	**0.786**	**0.839**	**-0.053**	**0.000**
Bur-Man	0.808	0.637	0.172	0.000	**Ant-Sam**	**0.776**	**0.828**	**-0.052**	**0.001**
Bur-Sam	0.781	0.643	0.138	0.000	**Ant-Man**	**0.785**	**0.827**	**-0.042**	**0.004**
Den-Ist	0.773	0.636	0.137	0.000	**Ada-Ant**	**0.770**	**0.812**	**-0.042**	**0.004**
Den-Izm	0.780	0.607	0.174	0.000	**Ant-Bal**	**0.781**	**0.817**	**-0.035**	**0.013**
Den-Kay	0.792	0.636	0.157	0.000	**Ant-Kon**	**0.771**	**0.804**	**-0.033**	**0.020**
Den-Koc	0.791	0.594	0.197	0.000	**Ant-Kay**	**0.784**	**0.801**	**-0.017**	**0.140**
Den-Kon	0.783	0.645	0.138	0.000	**Ant-Koc**	**0.765**	**0.773**	**-0.008**	**0.300**