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 that was successful in lowering and maintaining inflation at acceptable levels. During this low-inflation IT regime, it is also shown that inflation convergence across regions appears to occur more quickly and may be responsible for the slower pace of convergence in price levels.

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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 indices, 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). Although, the results of this body of research indicate that the rate of convergence is shorter, conflicting results are also present in the literature.[3]

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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)).

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)[2]

[3]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. Dreger and Kosfeld (2010) reported evidence on price non-convergence using regional data for 439 German districts.

PPP studies, using aggregate price data, have also investigated the relationship between inflation and price convergence. Cross country studies, such as Cheung and Lai (2000) and McNown and S Wallace (1989) have shown that inflation should foster the process of price convergence. This literature implies that when the inflation differential between countries is high, nominal exchange rates are more likely to evolve according to this inflation differential. The main explanation of this fact is that in high inflation countries, large monetary growth would overshadow real factors causing deviation from PPP. Therefore PPP is more likely to hold in those countries.

This paper compares the behavior of price-level convergence across regions under two different inflation regimes by using disaggregated prices, which, to the best of our knowledge, has not been investigated in earlier studies. By doing so, we depart from the above PPP studies, by eliminating the exchange rate factor, which seems to absorb the bulk of adjustment to PPP. Then, we analyze whether inflation can foster the convergence of individual prices across locations within a country, as in the case of PPP studies, when insulated from the exchange rate effect.[4]

In particular, we investigate the regional price-level convergence properties of individual goods in an emerging market economy, Turkey, which provides a unique data set 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 slower convergence of price levels during that period.

[4]Bergin et al. (2013) provide an explanation of why prices adjust much slower when aggregated into indices compared to individual goods. They find that individual prices respond to idiosyncratic shocks (i.e. industry-specific shocks). While the aggregate indices adjust mainly via the nominal exchange rates regardless of the type of shock.

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 data set. 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/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.[5] 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.[6]

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

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

[6]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.

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.[7] 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 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.

Before moving to the details of the empirical investigation, the price dispersion across cities (defined as the absolute value of the difference of log-prices for each good across cities) are also depicted in Appendix Figures A.1 and Figures A.2. One important detail is that city pairs including the city of Antalya have experienced relatively higher reductions in their price dispersion (on average across goods) from high- to low-inflation periods; similarly, nontraded goods have experienced relatively higher reductions in their price dispersion (on average across cities). We will refer

[7]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.

to these size differences (of price dispersion) and their implications while explaining the results of the empirical investigation, below.

3 Methodology

Most of the empirical work so far assumes that the empirical analysis of price convergence can be carried out within a $I(0)$ or $I(1)$ framework by employing unit root tests. However, long memory framework may provide richer convergence classifications than that can be captured by simple $I(1)/I(0)$ dichotomy. Although, as is shown below, results based on fractionally integration can be effectively used to obtain various convergence classifications, $I(1)/I(0)$ framework can only produce a simple absolute divergence and rapid convergence dichotomy.

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

$$q^g_{rk,t} = p^g_{r,t} - p^g_{k,t}; \quad g = 1, ..., G, \quad r = 1, ..., R \quad (r \neq k), \quad t = 1, ..., T, \tag{1}$$

where $p^g_{r,t}$ 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, $q^g_{rk,t}$ across all region pairs $rk = 1, 2, ..., R(R-1)/2$.

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

$$q^g_{rk,t} \backsim I(d), \tag{2}$$

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 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 Whittle estimators that are valid under non-stationarity. Let $I_z(\omega_j)$ denote the periodogram of a series z_t based on a discrete Fourier transform $W_z(\omega_j)$ at frequency $\omega_j = \frac{2\pi j}{T}$ for $j = 0, ...T-1$, such that $I_z(\omega_j) = W_Z(\omega_j)W_z^*(\omega_j)$ with $W_z^*(\omega_j)$ being the complex conjugate of $W_z(\omega_j)$ defined as

$$W_z(\omega_j) = \frac{1}{\sqrt{2\pi T}} \left| \sum_{t=1}^{T} z_t e^{it\omega_j} \right|^2 \quad (3)$$

The discrete Fourier transform $W_z(\omega_j)$ can be used to define a Whittle estimator of d obtained by minimizing the objective function below with respect to d:

$$WH(G,d) = \frac{1}{\upsilon} \sum_{j=1}^{\upsilon} \left(\ln(G\omega_j^{-2d}) + \frac{I_z(\omega_j)\omega_j^{2d}}{G} \right), \; G \in (0, \infty) \quad (4)$$

where υ is the number of frequencies used in the estimation. The most well known Whittle estimator that is valid under non-stationarity is Exact Local Whittle (ELW) estimator of Shimotsu and Phillips (2005, 2006). Shimotsu (2010) indicates that the ELW estimator has some undesirable properties. He modifies the ELW objective function to derive 2 Stage Feasible Exact Local Whittle (2FELW) estimator and shows that this new Whittle estimator does not inherit these undesirable characteristics of the ELW. Another alternative Whittle estimator valid for non-stationarity is the fully extended local Whittle estimator (FELW) of Abadir et al. (2007).[8,9] 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.[10] 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 estimators.

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

[8]The 2FELW and FELW estimators can also be calculated by prior de-trending. The estimators with de-trending 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.

[9]The 2FELW and FELW estimators can be regarded as being complementary to each other for a variety of reasons. The FELW estimator has the advantage over the 2FELW estimator in that it covers a wider range of d, and it does not require estimating the mean. However, the FELW estimator excludes the values of $d = \frac{1}{2}, \frac{3}{2}, ...$, which results in "holes" in the confidence intervals at these points, whereas the two-step approach does not.

[10]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.

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 the convergence rate across regions is slower during the low-inflation period for most good prices. Regarding the region pairs including the region of Antalya, recall that they had experienced relatively higher reductions in their price dispersion (on average across goods) from high- to low-inflation periods according to Figure A.1; hence, the size of the price dispersion has been effective in explaining the speed of convergence between the two periods.

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. Figure 3 also distinguishes between traded and nontraded goods, where it is evident that nontraded goods have more cases of non-convergence during the low-inflation period. Since nontraded goods had experienced more reduction in their price dispersion across cities (according to Figure A.2), the size of the price dispersion has again been effective in explaining the convergence patterns between the two periods.

A formal test for the difference between the mean ds in both regimes is provided in the Appendix. In particular, when 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 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 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.[11]

A number of papers have already analyzed the link between convergence in prices and convergence in inflation rates. Rogers et al. (2001) and Rogers (2007) provided evidence on price level convergence in Europe by documenting a striking decline in dispersion for traded goods prices in Europe.[12] An important implication of this convergence is that, with prices initially different across countries, convergence to a common level of prices accomplished through higher inflation in countries where

[11] It is important to emphasize that convergence in inflation rates is a sufficient (but not necessary) condition for divergence in price levels.

[12] Interestingly, most of this decline took place prior to the launch of the euro

prices are initially low. In other words, convergence is achieved through divergence in inflation rates. Égert (2007) examined the relation price level convergence and inflation differentials in Europe and argued that price level convergence should not necessary imply divergence in inflation rates. The occurrence of this depends on the strength of the exchange rate pass-through as explained by Égert (2007). Berk and Swank (2011) reports that regional inflation rates adjust to eliminate PPP deviations in the US as well as in the euro area.

We represent relative inflation rates as below,

$$\Delta q^g_{rk,t} = \Delta p^g_{r,t} - \Delta p^g_{k,t}; \quad g = 1, ..., G, \quad r = 1, ..., R \quad (r \neq k), \quad t = 1, ..., T, \qquad (5)$$

where $\Delta p^g_{r,t} = p^g_{r,t} - p^g_{r,(t-1)}$ is the inflation rate of good g in the region r at time t. As in the case of price levels, 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 inflation gaps, $\Delta q^g_{rk,t}$ across all region pairs $rk = 1, 2, ..., R(R-1)/2$.

The results are depicted 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[13], while stationary convergence (i.e., $0 < d \leq 0.5$) is relatively rare across regions.[14] 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 inflation regimes 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.

[13]These results are consistent with those reported in Lutz(2004) and Golberg and Verboven (2004). They both test the relative and absolute versions of the LOP and find that the speed of convergence is higher when testing relative compared to absolute LOP.

[14]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.

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 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.

The results of the paper also have implications for future theoretical studies. For instance, Levin and Yun (2007) suggest that the frequency of price adjustment increases with the steady-state level of inflation when the contract duration (i.e., the Calvo parameter) is determined endogenously in the model. Such a theoretical implication is consistent with the empirical results of this paper, since good-level price convergence across regions is slower during the low-inflation, presumably due to lower frequency of price adjustment in the world of Levin and Yun (2007). However, when the contract duration is exogenous (i.e., the standard Calvo price setting behavior), there would be no relation between the steady-level inflation and the elimination of price dispersion. Hence, endogenously determined contract duration seems to be the key in explaining the results in this paper from the theoretical perspective.

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Appendix: 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 two alternative ways of considering this average: either over city pairs (rk) for each good 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):

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

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,

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

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

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

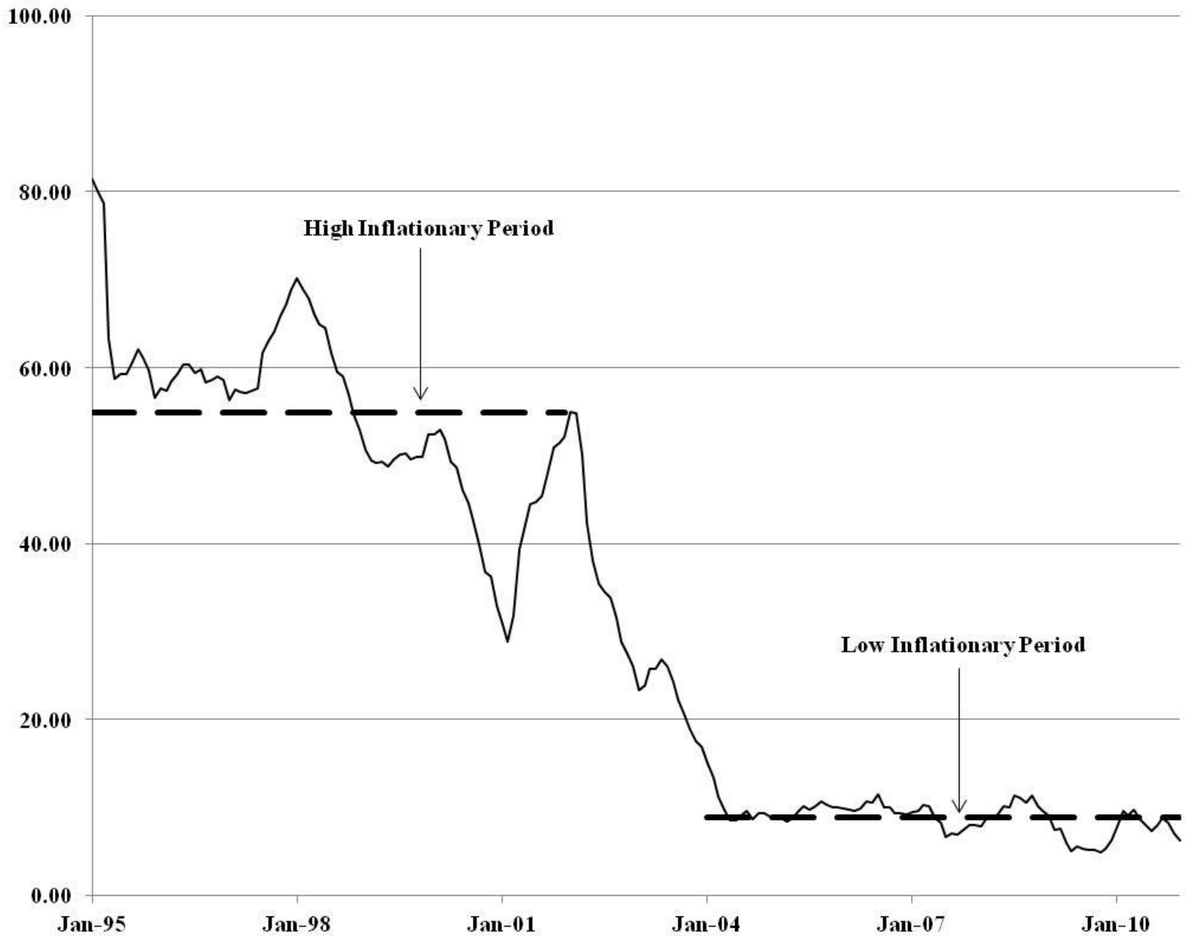
Then, to test the above hypothesis, we use the following z-test statistics.

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

Table A.2.1 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).

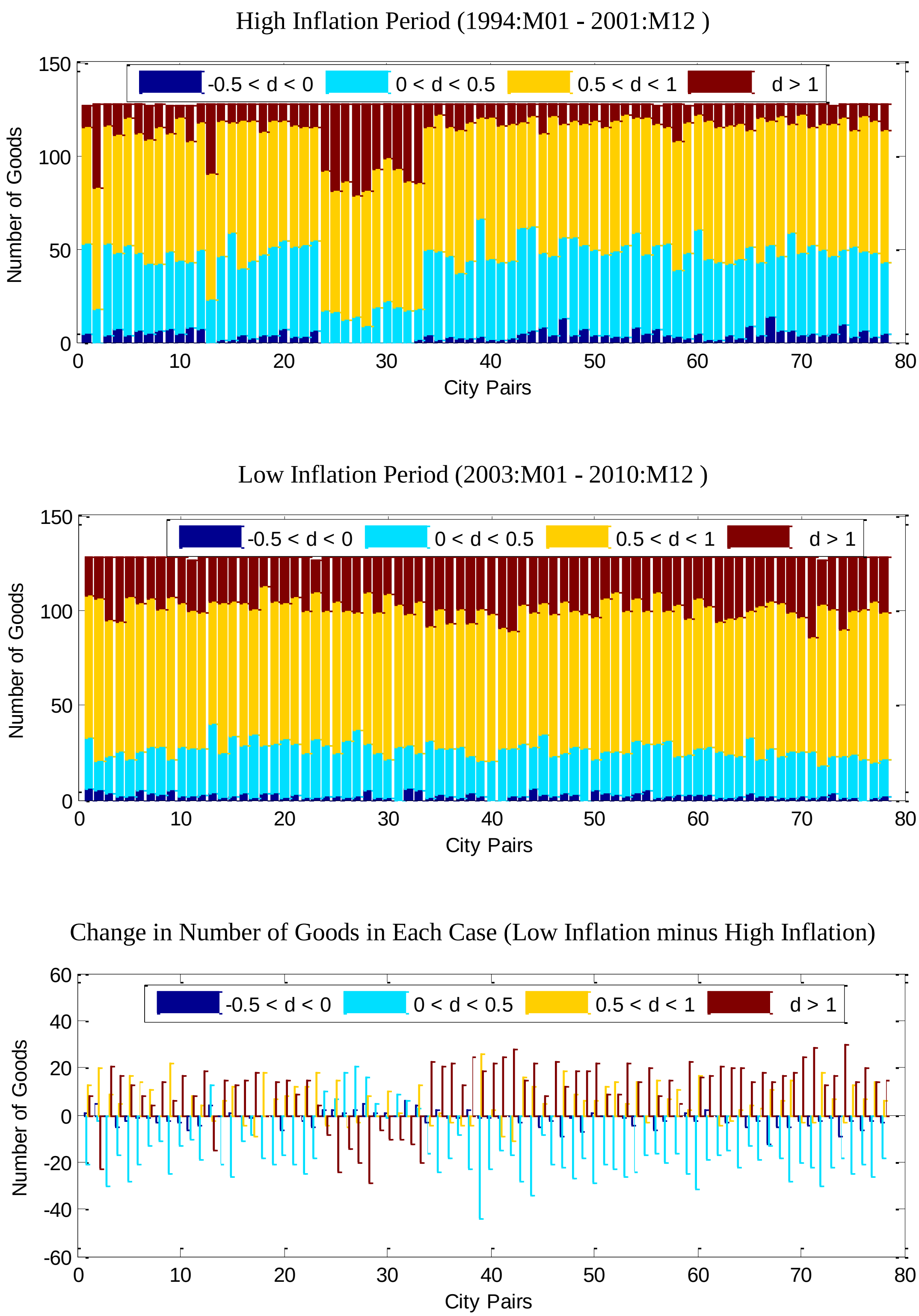
Table A.2.2 presents the results for each city pair. In 76 of 78 city pairs, the p-value of the test is smaller than 5 percent, which provides evidence of the difference in persistence parameters during the two inflationary episodes. Moreover, for 66 of 76 city pairs, or 85 percent of all city pairs (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.

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.

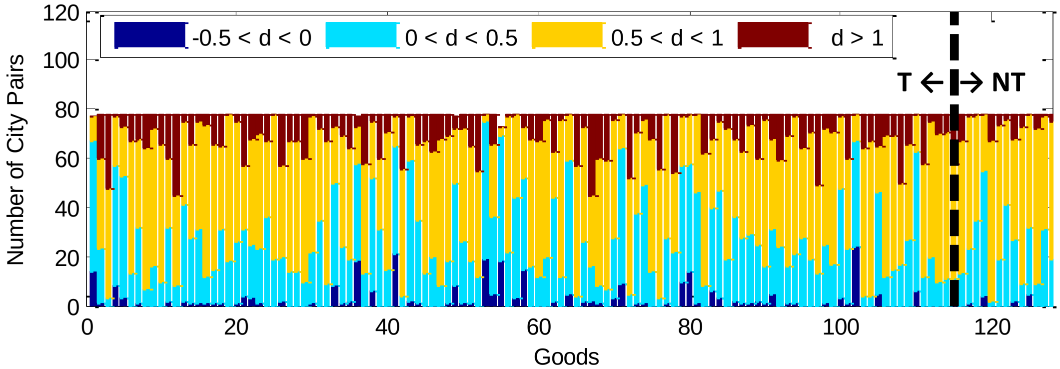
Figure 2 - Convergence Results for Price Levels based on City-Pairs



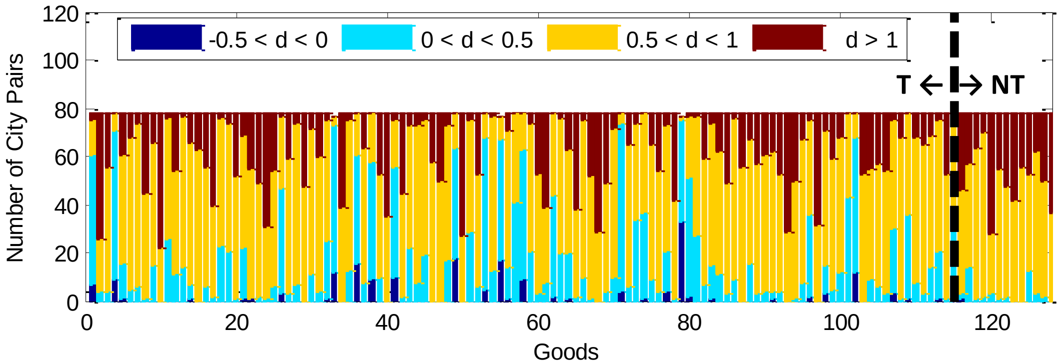
Notes: Each city pair in the bottom graph has four bars, each representing the change in the number of goods for different intervals of *d* estimates. The information in the bottom graph is also given in Table 1.

Figure 3 - Convergence Results for Price Levels based on Goods

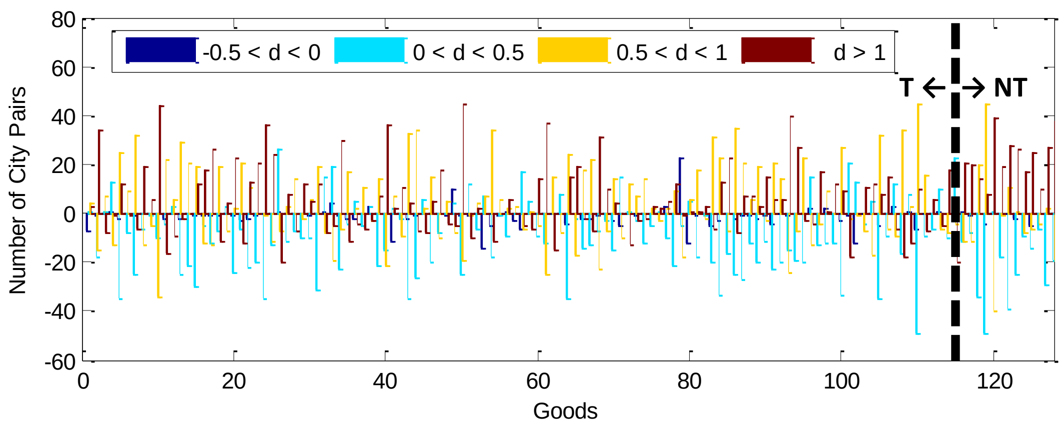
High Inflation Period (1994:M01 - 2001:M12)



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

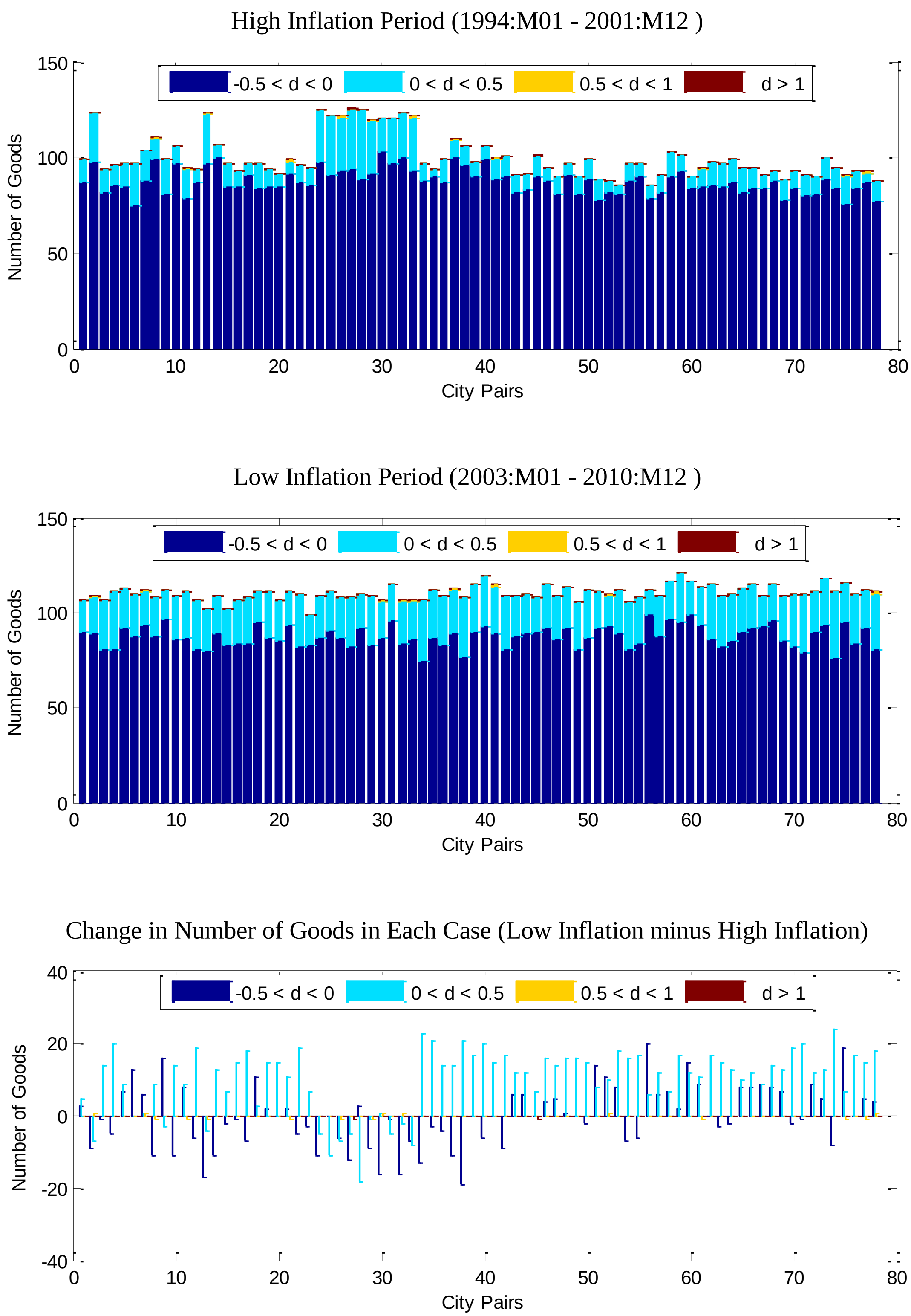


Change in Number of City-Pairs in Each Case (Low Inflation minus High Inflation)



Notes: T stands for traded goods, while NT stands for nontraded goods. 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.

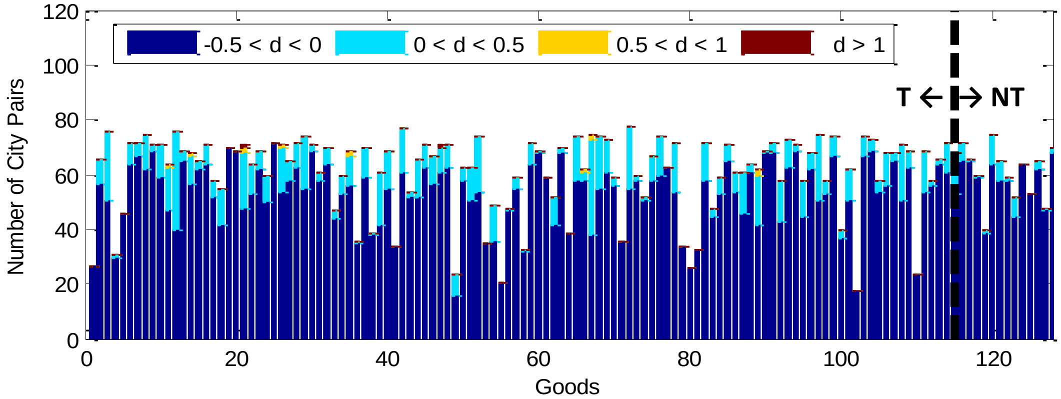
Figure 4 - Convergence Results for Inflation Rates based on City-Pairs



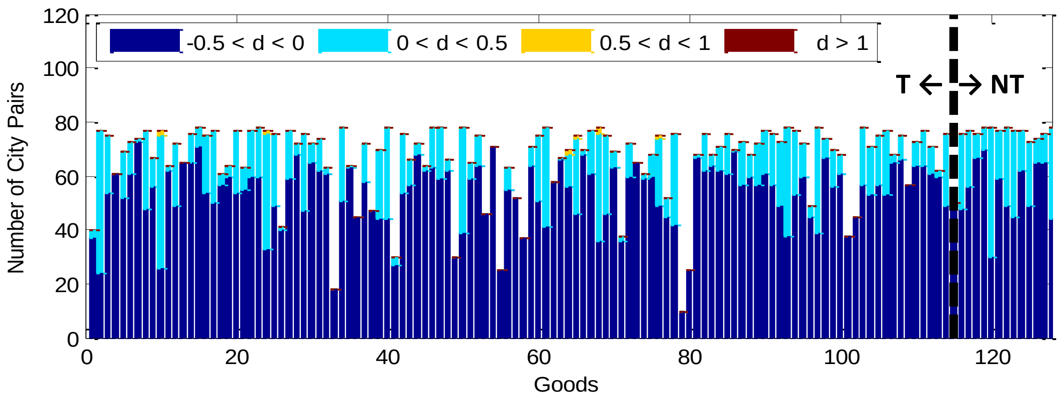
Notes: Each city pair in the bottom graph has four bars, each representing the change in the number of goods for different intervals of *d* estimates. The information in the bottom graph is also given in Table 3.

Figure 5 - Convergence Results for Inflation Rates based on Goods

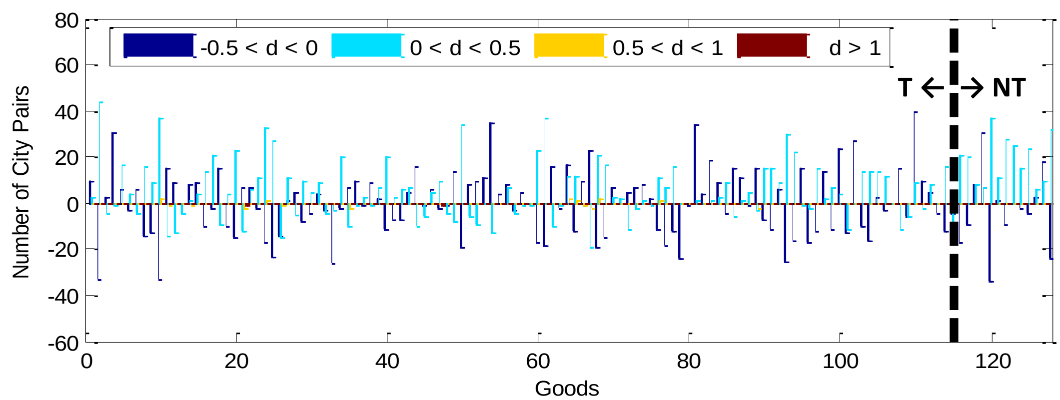
High Inflation Period (1994:M01 - 2001:M12)



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



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



Notes: T stands for traded goods, while NT stands for nontraded goods. 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) for Price-Level Convergence

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
Apples	-7	1	4	3
Baby food	-1	-18	-15	34
Baby's pijamas	0	1	7	-8
Bananas	1	13	-13	-1
Beer	-2	-35	25	12
Belts	0	-8	9	-1
Biscuits for babies	-1	-25	32	-6
Blanket	0	-6	-13	19
Boiled and pounded wheat	0	-1	-5	6
Box of coloured pencils	0	-10	-34	44
Broiled meat	1	-11	-11	21
Bus fare	-1	-8	-11	20
Butter	-2	-4	22	-16
Cacao	0	3	6	-9
Cake	-2	-25	29	-2
Canned vegetables	0	-21	21	0
Carbonated frutiy beverages	-1	-30	19	12
Carpet	-1	-5	-12	18
Cd	-1	-12	-13	26
Chickpeas	-1	-7	19	-11
Children's footwear	0	3	-7	4
Chocolate	-1	-24	2	23
Cinema	0	-34	20	14
City bus fare	-4	-49	45	8
Coffee	-3	-6	21	-12
Coke	-2	-22	11	13
Cologne	-1	-20	0	21
Condimend-spices	0	-35	-1	36
Confectionery	0	-13	-11	24
Corn oil	1	26	-7	-20
Cotton cloth	0	-11	3	8
Cotton wool	0	-7	14	-7
Curtain	0	-10	-2	12
Deodorant for women	-1	-10	6	5
Desserts	0	-31	19	12
Detergents	1	15	-8	-8
Diesel oil	4	19	-19	-5
Dishwasher detergents	-1	-23	-6	30
Driver course fare	0	1	-40	39
Dry beans	-2	-4	17	-11
Egg	-2	5	2	-4
Expenditure on the purchase of glass	0	-18	-1	19
Film development	0	-39	11	28
Flat bread	-2	-25	1	26
Fruit Juices	0	-5	11	-6
Garlic	3	3	-3	-3
Garlic-flavored sausage	0	-21	14	7
Glass household utentsils	0	-15	-21	36
Green onions	-11	2	7	2
Hair dryer	0	-2	-9	11
Hamburger	0	-9	-8	17
Hazelnuts	-2	-35	33	4
Helva	-1	-26	34	-7
Honey	0	6	2	-8
Injector	0	-20	15	5
Iron	0	-8	-10	18
Jam	-1	0	5	-4
Jewellery	10	4	-8	-5
Knitting wool	-1	-25	-19	45
Kosher cheese	-1	12	-1	-10
Lace-Thread	0	-6	4	2
Lemons	-14	7	7	0
Lentils	-5	-18	34	-11
Lettuce	-1	-1	6	0
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

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
Lump sugar	1	-9	2	6
Macaroni	-3	0	3	0
Margarine	-6	17	-6	-5
Men's footwear	0	5	1	-6
Men's footwear repair	0	-9	-5	14
Men's Hairdressing	0	-12	-25	37
Milk	0	0	15	-15
Mineral water	0	8	-8	0
Mini bus fare	-4	-35	24	15
Motor oil	0	-2	-17	19
Mutton	-2	-14	18	-2
Nescafe	-2	-13	22	-7
Notebook	-1	-7	-23	31
Olive	0	-3	-7	10
Olive oil	-3	-15	14	4
Onions	-5	15	-10	0
Overall for baby	0	1	12	-13
Packaged soup	-1	-3	7	-3
Parsley	0	-12	14	-2
Peanuts	0	-5	2	3
Pijamas	0	1	-3	2
Pistachio	3	-10	2	5
Plastic household utentils	0	-21	9	12
Potatoes	23	-5	-18	-1
Poultry	-12	5	6	1
Powdered sugar	-1	-18	18	1
Pumpkin seeds	0	-1	-2	3
Raisins	-5	-20	31	-6
Rice	-3	-33	23	13
Rice flour	0	-16	-7	23
Roasted chick-peas	-2	-25	35	-8
Salami	-1	-27	21	7
Salt	-1	-12	6	7
Sausage	-2	-20	19	3
Sewing-Thread	-1	-11	-3	15
Sponge for dish washing	-4	-23	21	6
Stationery	0	-20	14	6
Steel kitchen utentils	-1	-15	-24	40
Stove pipe	-1	-19	-7	27
Sun flower seeds	0	-20	23	-3
Sun-flower oil	2	15	-13	-4
Taxi fare	-5	-14	-6	25
Teflon household utentils	0	-13	-4	17
Thin dough	2	-12	9	1
Toilet paper	0	-12	0	12
Toiletsoaps	-3	-33	27	9
Tomato sauce	-1	21	-2	-18
Tomatoes	-12	13	-1	0
Towel	0	-4	-7	11
Travel goods	0	5	-17	12
Tube gas	-5	-35	32	8
Tulle	0	-9	-6	15
Veal	3	12	-9	-6
Water	0	-16	34	-18
Wermicelli	1	8	3	-12
White bread	-6	-49	45	10
White cheese	0	-9	16	-7
Wine	0	-6	0	6
Women's footwear	1	10	-6	-5
Women's footwear repair	0	-6	-4	10
Women's Hairdressing	0	-29	2	27
Woolen fabrics	0	-10	-8	18
X-ray fees	0	-19	-19	38
Yoghurts	1	23	-4	-20

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

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
Adana - Ankara	1	-21	13	8
Adana - Antalya	5	-2	20	-23
Adana - Balıkesir	0	-30	9	21
Adana - Bursa	-5	-17	5	17
Adana - Denizli	-2	-28	17	13
Adana - İstanbul	-1	-21	14	8
Adana - İzmir	-1	-13	11	4
Adana - Kayseri	-3	-11	0	14
Adana - Kocaeli	-2	-25	22	6
Adana - Konya	-3	-13	0	17
Adana - Manisa	-6	-10	8	8
Adana - Samsun	-4	-19	4	19
Ankara - Antalya	4	13	-2	-15
Ankara - Balıkesir	0	-21	6	15
Ankara - Bursa	1	-26	12	13
Ankara - Denizli	0	-11	-4	15
Ankara - İstanbul	-1	-8	-9	18
Ankara - İzmir	0	-18	18	0
Ankara - Kayseri	0	-21	7	14
Ankara - Kocaeli	-6	-17	8	15
Ankara - Konya	0	-21	12	9
Ankara - Manisa	-2	-25	12	15
Ankara - Samsun	-5	-18	18	4
Antalya - Balıkesir	2	10	-4	-8
Antalya - Bursa	2	7	15	-24
Antalya - Denizli	1	18	-5	-14
Antalya - İstanbul	2	21	-3	-20
Antalya - İzmir	5	16	8	-29
Antalya - Kayseri	1	5	0	-6
Antalya - Kocaeli	1	-1	10	-10
Antalya - Konya	0	9	1	-10
Antalya - Manisa	6	6	0	-12
Antalya - Samsun	4	3	13	-20
Balıkesir - Bursa	-3	-16	-4	23
Balıkesir - Denizli	2	-24	1	21
Balıkesir - İstanbul	-1	-18	-3	22
Balıkesir - İzmir	-1	-8	-4	13
Balıkesir - Kayseri	2	-23	-4	25
Balıkesir - Kocaeli	-1	-44	26	19
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

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
Balıkesir - Konya	-1	-23	2	22
Balıkesir - Manisa	-1	-15	-9	25
Balıkesir - Samsun	0	-17	-11	28
Bursa - Denizli	-3	-28	16	15
Bursa - İstanbul	0	-34	12	22
Bursa - İzmir	-5	-8	5	8
Bursa - Kayseri	-2	-21	0	23
Bursa - Kocaeli	-9	-22	19	12
Bursa - Konya	-1	-27	9	19
Bursa - Manisa	-7	-18	6	19
Bursa - Samsun	1	-29	6	22
Denizli - İstanbul	0	-21	12	9
Denizli - İzmir	0	-23	14	9
Denizli - Kayseri	-1	-26	5	22
Denizli - Kocaeli	-4	-24	14	14
Denizli - Konya	0	-17	-3	20
Denizli - Manisa	-6	-16	15	8
Denizli - Samsun	-2	-20	7	15
İstanbul - İzmir	0	-16	11	5
İstanbul - Kayseri	1	-25	2	23
İstanbul - Kocaeli	-2	-31	17	16
İstanbul - Konya	2	-19	0	17
İstanbul - Manisa	0	-17	-4	21
İstanbul - Samsun	-3	-15	-2	20
İzmir - Kayseri	0	-22	2	20
İzmir - Kocaeli	-5	-13	4	14
İzmir - Konya	-2	-19	3	18
İzmir - Manisa	-12	-13	11	14
İzmir - Samsun	-5	-18	6	17
Kayseri - Kocaeli	-5	-28	15	18
Kayseri - Konya	-2	-20	-3	25
Kayseri - Manisa	-4	-22	-3	29
Kayseri - Samsun	-2	-30	18	13
Kocaeli - Konya	-1	-22	7	17
Kocaeli - Manisa	-9	-18	-3	30
Kocaeli - Samsun	-2	-25	13	14
Konya - Manisa	-6	-21	7	20
Konya - Samsun	-2	-26	14	14
Manisa - Samsun	-3	-18	6	15

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

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

Table A.1.1 – Descriptive Statistics for Goods

1994M1-2001M12 (High Inflation)						
	Total	Traded	Nontraded	Traded (%)	Mean Inflation (%)	CV 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)						
	Total	Traded	Nontraded	Traded (%)	Mean Inflation (%)	CV Inflation (%)
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.

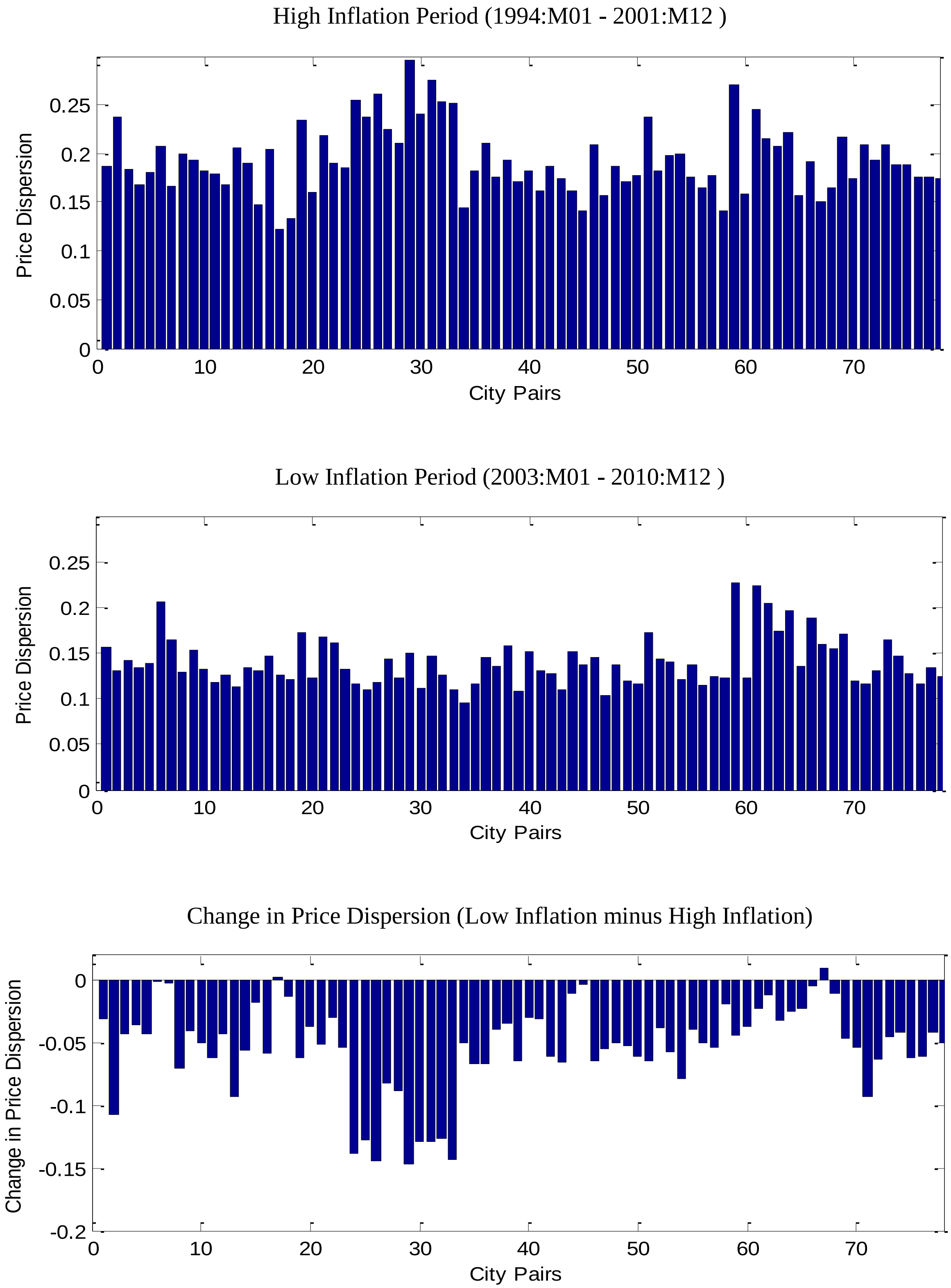
Table A.2.1: estimates for each commodity group across all city pairs.

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.

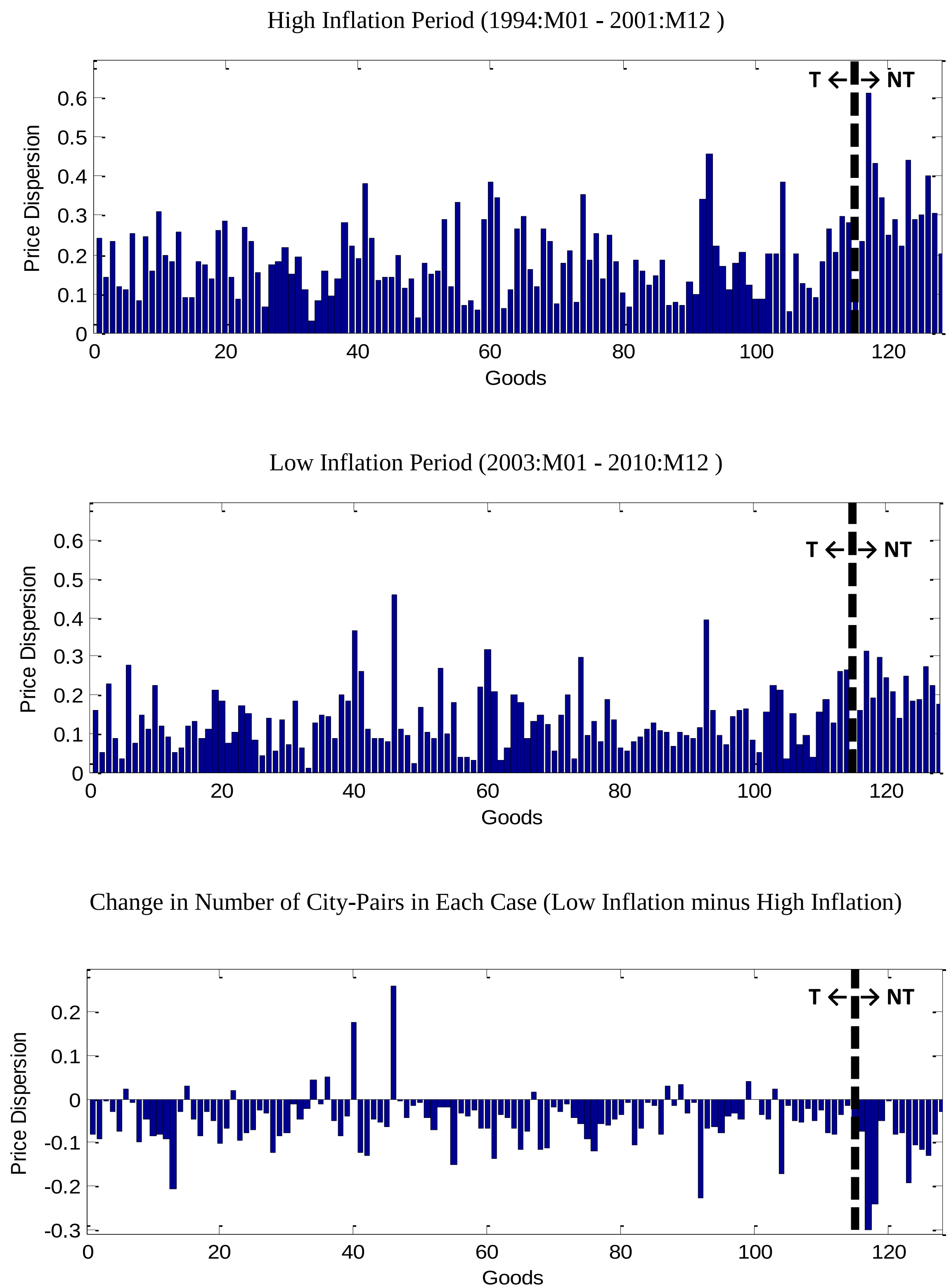
City pairs	$\bar{d}_l$	$\bar{d}_h$	$\bar{d}_l - \bar{d}_h$	$p-$value	City pairs	$\bar{d}_l$	$\bar{d}_h$	$\bar{d}_l - \bar{d}_h$	$p-$value
Ada-Ank	0.751	0.640	0.111	0.000	Den-Man	0.778	0.604	0.174	0.000
Ada-Bal	0.808	0.648	0.161	0.000	Den-Sam	0.778	0.640	0.138	0.000
Ada-Bur	0.796	0.643	0.153	0.000	Ist-Kay	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**

Figure A.1 – Price Dispersion across Cities (Average across Goods)



Notes: Price dispersion has been defined as the absolute value of the difference of log-prices for each good across cities. The figures show the average price dispersion across goods.

Figure A.2 – Price Dispersion across Cities (Average across City Pairs)



Notes: T stands for traded goods, while NT stands for nontraded goods. Price dispersion has been defined as the absolute value of the difference of log-prices for each good across cities. The figures show the average price dispersion across city pairs.