Relative Price Variability and Inflation: New evidence from Turkey*

Mustafa Caglayan†
University of Liverpool

Alpay Filiztekin‡
Sabanci University

July 25, 2001
This Revision

Abstract

Using a half-a-century long disaggregated data, we investigate the link between inflation and relative price variability, and the impact of structural changes in the behavior of inflation. We also investigate the underlying reasons driving the link between inflation and price variability. Using panel data techniques to control for aggregate shocks, we show that: 1) the effect of inflation is non-neutral: relative price variability has increased in inflationary as well as deflationary periods, 2) the effect of inflation is lower in magnitude during the high inflationary period as Danziger (1987) suggests, 3) we find strong support for menu cost models, but none for signal extraction models.

Key Words: inflation, price variability, intra- and inter-market, disaggregated panel data
JEL Code: E31, C33

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* We thank C. F. Baum and N. Ozkan for productive conversations on these issues. The usual disclaimer applies.
† Corresponding Author: Department of Economics and Accounting, University of Liverpool, Eleanor Rathbone Building, Bedford Street South, Liverpool L69 7ZA, UK, tel: +44(0)151 794 3060, fax: +44(0)151 794 3028, e-mail: caglayan@liverpool.ac.uk
‡ Faculty of Arts and Social Sciences, Sabanci University Campus, Orhanli, 81474 Tuzla, Istanbul, Turkey, tel: +90 (1) 216 483 92 64, fax: +90 (1) 216 483 9250, e-mail: alpayf@sabanciuniv.edu

1. Introduction

A substantial body of theoretical and empirical literature has investigated the link between inflation and relative price variability as this information contributes to our understanding of the transmission mechanism of inflation, responses of different markets to inflationary shocks and the welfare costs of inflation. One of the earlier empirical studies providing a link between inflation and relative price variability is Mills' (1927) analysis of the U.S. price system. Since then, researchers have utilized aggregated and disaggregated data to understand the relationship between inflation and relative price variability. The general consensus is that there is a positive association between inflation and inflation variability. [1]

Considering these recent developments and the general criticism[2] raised in the literature, we use a half-a-century long disaggregated annual data set**,** which contains 22 food product prices for the largest 19 provinces in Turkey over the 1948-1997 period, to investigate the link between inflation and relative price variability.[3] As Beaulieu and Mattey (1999) argue, data sets that have both cross-sectional and time series variability allow researchers to measure distribution of prices and identify the variation in inflation rates more accurately. From this point of view, our data set provides a unique opportunity. Furthermore,

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[1] Among many others, see for example Vining and Elwertowski (1976), Parks (1978), Fisher (1981), Reinsdorf (1994), Parsley (1996), Debelle and Lamont (1997) and Jaramillo (1999) for the US. Also see Hercowitz (1981) for West Germany, Van Hoomissen (1988) and Lach and Tsiddon (1992, 1993) for Israel, Tommasi (1993) and Dabus (2000) for Argentina and Domberger (1987) for the UK.

[2] For general criticism see the following: Danziger, (1987) has argued that the use of aggregate price indices may smooth the variability in the data and mask the relationship. Parsley (1996) has suggested that any change in the quality of goods in the basket on which the indices are based may create higher variability than actually exists. Fischer (1981) has reported that the existing positive relationship between inflation and relative price variability is driven by certain products, such as energy and food. Drifill, Mizon and Ulph (1990) along with Bomberger and Makinen (1993) have claimed that some influential observations could yield a positive link between inflation and relative price variability. Hartman (1991) has argued that the observed positive relationship could be a definitional artifact.

[3] Karasulu (1997) has only investigated the link between inflation and its variability using a panel of 3 cities over 1991-1996. However, her study is subject to the criticisms previously raised in the literature. Also due to data restrictions her study is not as comprehensive as ours.

over the sample period, Turkey experienced two distinct episodes with varying degrees of inflation. Between 1948 and 1976 inflation rate was relatively low, around 8.5%, compared to the period between 1976 and 1997 during which inflation rate averaged around 46%.[4] Therefore, different from the literature, we can also consider the impact of structural changes in the behavior of inflation on price variability.[5] Our second goal is to uncover the underlying reasons driving the link between inflation and price variability by investigating the effect of expected and unexpected inflation on price variability. While carrying out our analysis, we also test for an asymmetrical response of relative prices to negative inflation, similar to Jaramillo (1999), which could be interpreted as a robustness check of our findings.

While pursuing our goals, we base our empirical analysis on panel data techniques to control for aggregate shocks, which may affect both inflation and relative price variability. Different from most of the studies in the literature, we use two sets of price variability- variability relative to product average (intra-market variability) or relative to an average of the cities (inter-market variability)- and for each measure we compute both relative price variability and relative (price-change) inflation variability.[6] Our analysis indicates that the effect of inflation is non-neutral: there is a positive association between inflation and inflation variability (for both inter- and intra-market). Furthermore, structural changes in the behavior of inflation have an important impact on the relationship: in particular the effect of inflation on intra market inflation variability is lower in magnitude during high inflationary periods as Danziger (1987) suggests. However, the link between inflation and relative price variability is

[4] A severe balance of payments crisis, as a consequence of a long lasting import-substituting industrialization experience, was the main reason for rising inflation after 1976. Interestingly, over the years, inflation increased rather smoothly without significant jumps.
[5] Dabus (2000) has investigated the link between inflation and price variability as he categorized inflation into four compartments. However, he did not investigate the impact of different inflation regimes on intra- and inter- market variability.

mixed. Similar to the above case we find that intra-market relative price variability follows a non-linear relationship: during high inflationary periods relative price volatility is considerably lower than that of low inflationary periods. Similarly the relationship between expected inflation and price variability is positive at low inflationary regime and becomes negative when inflation is high and prolonged. However, when we analyze inter-market relative price variability, we find a negative yet weak relationship between inter-market relative price variability and inflation. Our analysis show that there is strong evidence in favor of menu cost models, yet none for signal extraction models.

The outline for the remainder of the paper is as follows. The next section briefly provides the theoretical background linking inflation rate to relative price variability. Section 3 describes the data and present some summary information. Section 4 lays out measures of relative price variability. Section 5 presents the empirical evidence. Finally, section 6 concludes the paper.

2. Theoretical Background

In this section, as one of the aims of the paper is to shed some light on the mechanism(s) driving the relationship between inflation and price variability, we briefly discuss menu cost and signal extraction models as well as search models for completeness.

Menu cost models predict that due to costs associated with changing the price of a product, monopolistically competitive firms will set prices as close as possible to a chosen target level while making infrequent adjustments. Sheshinski and Weiss (1977, 1983) and more recently Ball and Romer (1993) propose that firms follow one-sided (*S*,*s*) pricing rules

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[6] Most of the earlier research has concentrated on the association between inflation and its variability due to lack of data, while (to our best knowledge) Parsley (1996) and Reinsdorf (1994) constitute two

when faced with inflation. According to this approach, firms keep nominal price of their product unchanged until the real price hits the lower bound *s*. Thereafter, firms increase the real price of the product to the upper bound *S*. The model predict that the optimal *(S, s)* band widens with the expected inflation leading to a greater dispersion of prices provided that firms do not adjust prices synchronously.

Barro's (1976) signal extraction model, based on Lucas (1973), shows that relative price variability should rise in an inflationary environment as unexpected inflation creates misperceptions on absolute and real price changes. Since firms cannot differentiate between real and nominal shocks in these models, individual firms adjust prices more often than output levels in response to all shocks, including real demand shocks. Hence, as inflation uncertainty rises the dispersion of prices becomes wider. Moreover, given this basic signal extraction framework, trend inflation will have no impact on relative prices.

While menu cost and signal extraction models claim similar predictions for the link between inflation and relative price variability, signal extraction models emphasize the positive effect of unexpected inflation on relative price variability and menu-cost models underlies the positive effect of expected inflation. Furthermore, signal extraction models are more relevant for the variability of prices of different goods around an aggregate price level, which is referred as the inter-market variability. In contrast, menu-cost models address the price setting behavior of different sellers of the same good, and their predictions are more about intra-market variability.[7]

Finally, costly search models provide a link between price dispersion and inflation based on the premise that consumers accumulate information only on a subset of all existing

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exceptions.

[7] See Lach and Tsiddon (1992) for more discussion in these lines.

prices. As Stigler and Kindahl (1970) propose, due to deterioration of consumers' price information during inflationary periods, elimination of price dispersion will be nullified. In this context, Van Hoomissen (1988) points out that the model does not necessarily predict less search during inflationary episodes. However, as "the stock of information a person holds" declines, the dispersion of prices widens. In contrast, Benabou and Gertner (1993) show that in a search model with learning, inflationary noise can induce more search and, consequently, a reduction in price dispersion depending on the size of information costs.

3. The Data Set

3A. The Data Set and Basic Statistics

We carry out our analysis using annual disaggregated price data obtained from the Retail Price Statistics published by the State Institute of Statistics (SIS) of Turkey between 1948-1997. The Institute collects retail prices of several products from at least three different stores in various province centers. Agents of the Institute visit the same stores, unless a store has gone out of business, and collect unit prices of goods along with detailed product information. This approach ensures the consistency of the data between and within province centers. Unfortunately, the data are publicly available only as the average of annual price quotations.

Although the original data set contains retail price of hundreds of products, we restrict our attention to a smaller subset. First, we exclude products from the data set whose prices were directly controlled by the government (e.g., tea).[8] Second, we eliminate products from our data set for which quotations were not available in the early years or whose quality has changed over time. Third, we rule out products which show considerable cyclicality over

[8] Mizon, Safford and Thomas (1990) using UK data showed that government intervention in product markets could lead to spurious correlation between inflation and relative price variability.

the years due to weather conditions (severe draughts or adequate rain can alter the amount and the quality of agricultural products such as onions, potatoes etc. brought to market). Hence, the final data set contains 22 food products across the largest 19 provinces in Turkey over the period 1948-1997.[9] Except for a few cases, each commodity contributes observations for the full sample period for each of the provinces. Had there been sufficient quotes to use every province in every year, there would have been 20900 observations (22 products x 19 provinces x 50 years), but the actual number of observations used in the analysis is 20,389 due to missing data.[10]

During the sample period, as depicted in Figure 1, there has been a substantial change in the pattern of inflation in Turkey. The figure, in solid line, presents inflation computed as unweighted average price changes using price quotations from our data set and, in dotted line, aggregate inflation published by the SIS.[11] Between 1948-1976 the inflation rate in Turkey was relatively low (though high in international standards), yet it increased substantially over 1976-1997. Surprisingly, despite the prolonged high inflationary experience, Turkey has never had any period of hyperinflation as recently experienced by many Latin American countries or Israel.

Table 1 provides basic summary statistics. Panel A displays information on price changes for each product across provinces (intra-market) while panel B presents similar information on price changes in each province across products (inter-market). The first

[9] These 19 cities in our data set not only have the largest population in the country but also they are geographically widely dispersed. Furthermore, these provinces are specifically chosen by the SIS as regional centers to conduct several other surveys, such as Survey of Income Distribution, Household Employment Survey, etc.
[10] Most notably no price data have been collected for Malatya between 1976-1979, and for Gaziantep between 1978-1980 and 1983-1984.
[11] Several authors who have used weighted and unweighted measures to investigate the relationship between inflation and price variability found identical or very similar results. Given that the correlation

column of panel A provides the number of retail price quotations for each product. The next three columns show the proportion of direction of changes in nominal price levels by product. The bottom line shows that the total number of nominal price increases constitute 83.4% of all price movements in contrast to a mere 11.3% price reductions throughout the entire sample period. Especially after 1976, when inflation rate increased to an average of above 45%, there are very few reductions in nominal prices: only in 91 cases prices have declined constituting 4% of reductions in the entire sample and around 1% of all observations after 1976.

It should be noted that not only did the prices predominantly increased throughout the last 50 years in Turkey, the magnitude of price increases were also considerably higher than that of price reductions. During the sample period, the average magnitude of nominal price increase is 31.3% as opposed to an average magnitude of 8.6% on nominal price reductions.[12] Contrarily, when we consider movements in real terms, defined as the change in price of good *i* in province *j* relative to change in average price of all goods in all provinces in a particular year, there has been considerable price reductions. Indeed, except for some products (mutton, beef, eggs, olives, kasseri and yogurt), the number of real price reductions is higher than increases. Nevertheless, the magnitude of the real price increases on average was higher than that of price reductions. Similarly, the intertemporal variation of price increases is higher in comparison to variation of price reductions. The only exception to the last two statements is the behavior of egg prices.

Similar patterns hold for inter-market price dynamics as presented in panel B. The number of nominal price increases dominates the distribution**,** as price increases constitute over 80% of all price changes for all provinces. However, we observe a significant number of

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between the unweighted inflation measure computed using our data set and the weighted measure provided by SIS is around 99%, we do not utilize the weighted measures in this study.

price reductions in real terms and both the average magnitude and the volatility of price increases are significantly greater than price reductions.

3B. Inter-Market and Intra-Market Dynamics in Turkey

Before we present our measures of price variability, it would be useful to look at inter-market and intra-market variation using a decomposition of price variability analogous to the one in Domberger (1987). Letting P_{ijt} to define the price of product *i* sold at province *j* at time *t*, and the average product price across the *n* non-missing cities as $\overline{P}_{it} = 1/n \sum_{j=1}^{n} P_{ijt}$, the shares of within- and between-market variability can be obtained by expressing total relative price variability as:

$$\sum_{i=1}^{m}\sum_{j=1}^{n}(P_{ijt} - P_t)^2 = \sum_{i=1}^{m}\sum_{j=1}^{n}(P_{ijt} - \overline{P}_{it})^2 + \sum_{i=1}^{m}(P_{it} - P_t)^2 \qquad (1)$$

where $P_t = 1/m \sum_{i=1}^{m} \overline{P}_{it}$ is the overall price level and *m* is non-missing observations on commodities. The first term on the right hand side of Equation (1) is the variance within product (intra-market), and the second is variance between goods in provinces (inter-market). The same decomposition can be obtained for the variance of rates of changes by replacing prices with changes of prices in Equation (1). Using the above decomposition we show in Figure 2 that the intra-market inflation variability of price changes is on average 49% and can be as high as 84% and as low as 8% over the sample period. However, the intra-market price level variability constitutes a very small portion of total variation in our sample, which is around 4% of total variance.

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[12] Nominal price changes are not reported in the table, however, they are available from the authors upon request.

4. Measures of Relative Price Variability

Below we define four measures of relative price variability that we use in this paper.[13] Our first dispersion measure, V_{1it}, captures intra-market dispersion of price levels which is the square root of the sum of squared deviations of relative prices, $\mathrm{R}_{\mathrm{ijt}}$, around the cross-sectional average relative price for product ***i*****,** $\overline{\mathrm{R}}_{\mathrm{it}}$**.**

$$V_{1it} = \left[\frac{1}{n-1} \sum_{j=1}^{n} (R_{ijt} - \overline{R}_{it})^2 \right]^{0.5} \tag{2}$$

The relative product price is computed as $\mathrm{R}_{\mathrm{ijt}} = \ln(P_{ijt} / \overline{P}_{it})$ and the cross sectional average relative price for product *i* is $\overline{\mathrm{R}}_{\mathrm{it}} = 1/n \sum_{j=1}^{N} R_{ijt}$, where *n* refers to non-missing number of cross sections, cities. The second dispersion measure, V_{2jt}, takes the square root of the sum of squared deviations of relative prices from city averages over *m* non-missing observations, commodities providing us a measure of inter-market dispersion of relative prices.

$$V_{2jt} = \left[\frac{1}{m-1} \sum_{i=1}^{m} (R_{ijt} - \overline{R}_{jt})^2 \right]^{0.5} \tag{3}$$

where $\overline{R}_{jt} = 1/m \sum_{i=1}^{m} R_{ijt}$.

The other two dispersion measures have been widely used in the literature. Intra-market variability of relative inflation, V_{3it}, is obtained by computing the dispersion of the inflation rate around all non-missing cities.

[13] Also see Parsley (1996).

$$V_{3it} = \left[\frac{1}{n-1} \sum_{j=1}^{n} (\pi_{ijt} - \bar{\pi}_{it})^2 \right]^{0.5} \tag{4}$$

We denote π_{ijt} as the rate of change in the price of the *i*th product in city *j* at time *t*, and $\bar{\pi}_{it}$ is the average rate of change in product *i*'s price over all non-missing cities. Finally, the fourth measure, dispersion of product-level inflation rates, V_{4jt}, is computed as the square root of the sum of the squared deviations of inflation around the average product inflation for the city.

$$V_{4jt} = \left[\frac{1}{m-1} \sum_{i=1}^{m} (\pi_{ijt} - \bar{\pi}_{jt})^2 \right]^{0.5} \tag{5}$$

where $\bar{\pi}_{jt}$ is the average inflation rate within a city.

Table 2 provides summary statistics for inflation and dispersion measures where these series are calculated across provinces and across commodity groups. Comparison of panel A with panel B reveals that average intra- and inter-market dispersion measure for relative price levels are very close, however intra-market dispersion is wider in comparison to inter-market dispersion. The mean of the dispersion measure for inter-market price changes, as presented in panel B, is 50% higher than that of intra-market inflation changes while the variances of both measures are almost identical. The mean value of inflation whether measured for each product across provinces or for each province across products is around 24% with a coefficient of variation close to one regardless whether inflation is measured for a specific commodity or for a particular province.

5. Empirical Analysis

5A. The Link Between Inflation And Relative Prices

Using those four dispersion measures discussed in Section 4, we estimate two sets of fixed effect regression models which provide unbiased and consistent parameter estimates by allowing us to control for the effects that are specific to commodities, cities or years. Our first model, equation (6) below, regresses variability measures onto absolute value of inflation and as such allows us to investigate whether deflationary periods are also associated with high relative price variability along with inflationary periods, as previously documented for the US and Argentina, see for example Parks (1978) and Tommasi (1991), respectively. Theoretical explanation for this relationship between relative price variability and inflation relies on the assumption of relative shocks and related adjustment processes of different provinces. For example, whenever a city is affected by a negative demand shock with respect to the rest of the nation, we expect to see the relative prices of all goods in that city to fall leading to higher intra-market price variability. Furthermore, since the relative price of different goods in that city will adjust at different rates, we should observe higher inter-market inflation variability, as well. Therefore, replacing average inflation with its absolute value, we can control for the downward bias due to symmetric effects of negative inflation as shown below.

$$V_t = \sum_{i=1}^{\kappa} \lambda_i + \sum_{t=1}^{T} \tau_t + \beta abs\left(\overline{\Pi}_t\right) + u_t \tag{6}$$

However, this approach does not capture a different response of relative price variability to negative and positive inflation. In particular, Jaramillo (1999) has shown that Parks' finding of positive relationship between inflation and relative price variability is robust to influential observations, such as the years of oil shocks, once the asymmetry is controlled for. Therefore, introducing a product term ($DUM_t * abs(\overline{\Pi}_t)$) where DUM_t takes the value of 1 when inflation is negative along with the absolute value of average inflation

($abs(\overline{\Pi}_t)$), we can test whether the impact of inflation and deflation on price variability is asymmetrical in fixed effects context:

$$V_t = \sum_{i=1}^{\kappa} \lambda_i + \sum_{t=1}^{T} \tau_t + \beta\left[abs\left(\overline{\Pi}_t\right)\right] + \gamma\left[DUM * abs\left(\overline{\Pi}_t\right)\right] + u_t \qquad (7)$$

If the data were to support asymmetry, then γ would be significantly different from zero.

Table 3a presents coefficient estimates for each of the models discussed above using intra-market price dispersion measure as the dependent variable. The first two columns of the table shows that inflation does not impact relative price variability, V_{1it}, except that during deflationary periods there is some weak positive impact of inflation on relative price dispersion as shown in column 2. Contrarily, columns 3 and 4 provide a strong support for a positive link between inflation and relative inflation variability, V_{3it}. There is also evidence in support for an asymmetric relationship between inflation and relative inflation variability. Overall, Table 3a provides evidence that inflation is non-neutral: in particular intra-market inflation variability increases with inflation. Deflationary episodes produce similar but stronger effects.

Table 3b exhibits coefficient estimates when we use measures of inter-market relative price dispersion as the dependent variable. Different from Table3a, coefficient estimates for inter market relative price variability reported in columns 1 and 2 have the wrong sign. In particular, when we incorporate the asymmetric effects of inflation, we obtain weakly significant negative impact of inflation, however, a positive impact of deflation. There is only one case in the empirical literature where inflation and price variability is found to be negatively related. Reinsdorf (1994) has reported a negative relationship between the two variables, however, his variability measure was intra-market price variability. He attempted to explain his finding as it “may reflect short-run effects of incomplete adjustment of expectations after a sudden change in inflation" (Reinsdorf, 1994, p.725). He has also stated that his findings could be a result of using data from the Volcker disinflation period. While similar arguments cannot be made for our results, this negative relationship is an interesting feature of our data. Finally, columns 3 and 4 of the same table show that, similar to those reported in the literature, inflation has a positive impact on inter market relative inflation variability, V_{4jt}, with no asymmetry in the relationship.

5B. The Impact of Different Inflationary Episodes

Since Turkey has been through two distinct inflationary periods throughout the post-war era, one can argue that our findings could be driven by the behaviour of inflation rate. Therefore, to test if a structural change in the behaviour of inflation is behind the results that we have reported so far, we allow for a break in the estimated slope coefficients and reestimate the relationship between inflation and relative price variability. We choose 1976 as the break point for our analysis, for Turkey has experienced a payments crisis which lead to an increasing inflation since then as a consequence of the collapse of import-substituting industrialization strategy. To find out the effect of the change in the magnitude of inflation on our findings, we introduce a new term ($PDUM_t$) to our basic model, which takes the value 1 after 1976 and 0 otherwise and interact it with the slope coefficient. Tables 4a and 4b report the coefficient estimates for our modified models.

Interestingly the results show a very strong distinction between low and high inflation periods. Table 4a shows that inflation has a very strong and significant positive impact on intra-market relative price variability, V_{1it}, during the first sub-period, and the effect is completely eliminated during the second sub-period during when average inflation was around 46%. Thus previous finding of no significant relationship is due to the not accounted non-linearity in the relationship. This finding confirms the variant of menu cost models by

Danziger (1987) who shows that the relationship between price variability and inflation may reverse when inflation is increasing rapidly. The same type of a relationship is provided for intra market inflation variability, V_{3it} , as presented in columns 3 and 4 of the same table: while the overall relationship is positive, the size of the effect of inflation on relative inflation variability is considerably smaller when inflation is high enough. Finally, there is strong evidence for asymmetric relationship between relative inflation variability and inflation, similar to evidence provided in Table 3a, column 4.

Table 4b presents the association between inflation and inter-market price variability after allowing for a structural change in the behaviour of inflation. The overall results are not much different from first two columns in Table 3b: there is still evidence for a negative effect of inflation on inter-market relative price variability and a positive association between inflation and relative inflation variability similar to the existing literature. Furthermore the non-linearity found in the previous analysis disappears.

5C. The Expected and Unexpected Inflation

In this section we explore the impact of expected and unexpected inflation on price dispersion. As previously discussed, menu-cost models and signal extraction models have distinct propositions as to how inflation may affect relative price variability, yet both models predict a positive link. On one hand menu-cost models imply that expected inflation increases the band within which sellers set their prices. On the other, signal extraction models emphasize the importance of surprise factor in inflation. Thus, decomposing inflation into expected and unexpected components, we reestimate regressions between price variability measures on expected and unexpected components of inflation to discover which of the two models is more favorable to interpret our data set.

Partitioning inflation into a permanent (expected) and transitory (unexpected) component is a formidable task by itself. While several other methods are equally acceptable, we follow a decomposition procedure also used by Lach and Tsiddon (1992) and Reinsdorf (1994). In that respect, we model the product price as a random walk that incorporates both permanent and transitory components. Then, we regress inflation series for each product (or city) on its own lags, lags of aggregate inflation and a time variable. Finally, we compute expected and unexpected inflation series ensuring that the latter is white noise.[14]

Table 5a and 5b present regression results between price variability measures and the expected and unexpected inflation. As before, there is no effect of neither expected or unexpected inflation on intra-market price variability for the whole sample. When we split the sample into two distinct inflationary regimes, we regain the same non-linear relationship between expected inflation and relative price variability as shown in columns 3 and 4. The remaining four columns show the relationship between expected and unexpected inflation and relative inflation variability. While there is significant positive relationship for the entire sample as the theory predicts, the estimation that takes into account the regime shift reveals once again significant non-linearity.

In the case for inter-market relative price variability the coefficient of unexpected inflation is positive and significant at the 5% level, as presented in Table 5b column 1. However, the significance of the relationship vanishes once different inflationary regimes are accounted for. Thus, our results contradicting the signal extraction models are still intact. Finally, we find no effect of expected or unexpected inflation on inter-market inflation variability as shown in the last 4 columns of the same table. It is possible that the reason why

[14] The inflation rate for every product i (province j) is modeled as an ARMAX process where the x-variable is aggregate inflation series. The model also incorporates a trend or a broken trend term when proved to be significant. Detailed estimation results are available from authors upon request.

we can not provide strong evidence to reveal the type of mechanism driving the link between inflation and price variability in Turkey is linked with the fact that we have only access to annual data. Possibly, using monthly data one could shed some light on this aspect of the issue.

5D. Further Explorations

To further test for the robustness of our findings, we experimented with different break dates to capture changes in the behavior of inflation, as our choice for the break date could be seen arbitrary. Furthermore, we experimented with multiple break dates to capture finer changes in the inflation regime or changes in the economic policy that could impact the progression of inflation rate. All our experiments rendered qualitatively no or insignificant impact on our results.[15]

6. Conclusion

In this paper, we use a half-a-century long disaggregated annual data set containing 22 food prices for the largest 19 provinces in Turkey over 1948-1997, to investigate the link between inflation and relative price variability. Using panel data techniques to control for aggregate shocks, which may affect both inflation and relative price variability, we show that the effect of inflation is non-neutral: relative price variability has increased in inflationary as well as deflationary periods. We also consider the impact of structural changes in the behavior of inflation on price variability as Turkey has initially experienced low followed by high inflationary periods. We also show that the effect of inflation on relative inflation variability is lower in magnitude during the high inflationary period as Danziger (1987) suggests. Our results verify that the effect of inflation is non-neutral and that there is a considerable non-linear impact of inflation on price variability. Finally, decomposing inflation into expected and unexpected components, our analysis provides strong support for Danziger-type menu cost models where the relationship between price variability and inflation is non-linear.

We fail to find evidence in favor of Lucas-type signal extraction models. In fact, in most cases we found reverse sign for the effect of inflation. Our attempt to control for various effects, aggregate shocks, differences in inflationary regime, and various break dates have not changed our finding.

[15] For space considerations, these results are not provided but are available from authors upon request.

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Table 1: Summary Statistics

Panel A) Intra-Market; Across Provinces, 1948-1995

Good	No. of Price Obs	Changes in Nominal Prices Positive	Zero	Negative	Changes in Real Prices Positive	Negative	Avg. Price Increases	Avg. Price Decreases	Std.Dev. of Price Inc.	Std.Dev. of Price Dec.
Bread	940	88.4	6.7	4.9	48.3	51.7	7.6	-6.2	7.4	5.4
Flour	941	84.2	5.2	10.6	43.5	56.5	10.2	-8.8	10.7	7.6
Rice	940	78.2	1.7	20.1	39.8	60.2	19.8	-15.2	20.4	13.5
Cr'd Wheat	941	84.8	4.4	10.9	45.4	54.6	9.8	-9.0	10.6	9.9
Pasta	940	82.0	4.3	13.7	40.0	60.0	10.9	-8.6	11.1	7.8
Beans	941	79.7	1.0	19.4	45.8	54.2	22.1	-18.6	23.9	19.6
Chick Peas	941	84.5	2.5	12.9	47.0	53.0	18.6	-16.1	17.7	15.8
Sugar Cubes	939	74.9	15.8	9.3	32.4	67.6	12.3	-8.8	15.0	9.5
Gran. Sugar	940	73.3	17.3	9.4	33.6	66.4	11.4	-8.6	13.1	9.4
Salt	934	67.0	23.5	9.5	42.1	57.9	20.2	-13.3	21.0	12.6
Mutton	941	90.9	1.0	8.2	51.6	48.4	10.4	-9.2	9.9	8.4
Beef	875	91.5	0.2	8.3	52.2	47.8	11.9	-9.7	10.9	9.5
Poultry	940	86.0	0.9	13.1	48.2	51.8	11.3	-11.7	15.3	14.4
Eggs	941	86.2	9.7	4.1	50.4	49.6	8.3	-9.9	8.6	9.7
Olives	941	86.3	1.4	12.3	50.2	49.8	10.9	-9.3	10.1	7.9
Olive Oil	941	82.8	1.7	15.5	43.3	56.7	15.1	-11.4	17.5	12.3
Margarine	842	82.6	4.0	13.5	35.8	64.2	12.7	-9.6	13.8	8.9
Milk	941	84.9	6.4	8.7	48.1	51.9	9.8	-7.9	12.6	7.3
Butter	830	87.5	0.4	12.1	44.3	55.7	10.8	-8.9	10.1	8.1
Kasseri	933	88.9	0.7	10.5	51.3	48.7	9.3	-8.5	9.1	8.3
Feta Cheese	926	87.5	1.6	10.9	47.8	52.2	7.8	-7.5	8.0	7.2
Yogurt	941	84.0	4.2	11.8	50.3	49.7	10.4	-9.1	11.4	9.2
All Goods	20,389	83.4	5.3	11.3	45.1	54.9	12.2	-10.3	13.7	10.7

Notes: All figures presented in columns 2-9 are in percentages.

Panel B) Inter-Market; Across Goods, 1948-1995

Province	**No. of Price Obs**	**Changes in Nominal Prices**			**Changes in Real Prices**		**Avg. Price Increases**	**Avg. Price Decreases**	**Std.Dev. of Price Inc.**	**Std.Dev. of Price Dec.**
		Positive	**Zero**	**Negative**	**Positive**	**Negative**				
Adana	1,032	83.3	6.7	10.0	45.5	54.5	12.3	-10.4	13.5	9.7
Ankara	1,054	85.2	6.0	8.7	44.8	55.2	11.1	-9.1	11.0	8.4
Antalya	1,023	83.7	4.3	12.0	46.4	53.6	12.2	-10.2	12.2	8.7
Bursa	1,042	83.2	5.5	11.4	44.3	55.7	12.6	-10.3	11.7	9.5
Denizli	1,024	82.8	3.9	13.2	45.8	54.2	12.7	-10.8	12.9	10.1
Diyarbakir	1,041	82.5	6.4	11.0	43.8	56.2	12.3	-9.7	10.7	7.9
Erzurum	1,047	83.1	7.0	9.8	46.3	53.7	11.6	-10.2	11.2	8.8
Eskisehir	1,052	85.4	4.6	10.0	46.6	53.4	11.5	-10.0	11.5	9.5
Gaziantep[a]	996	80.6	4.5	14.8	48.0	52.0	12.9	-10.5	13.6	10.2
Icel	972	83.4	3.9	12.7	47.0	53.0	12.9	-11.8	16.5	14.7
Istanbul	1,049	85.1	4.8	10.2	45.2	54.8	11.1	-9.3	11.2	8.0
Izmir	1,053	83.9	6.1	10.1	46.4	53.6	10.8	-9.4	10.7	8.6
Kayseri	1,048	83.4	4.7	11.9	45.5	54.5	12.9	-10.6	12.3	10.1
Kocaeli	1,050	83.8	4.5	11.7	45.4	54.6	12.0	-10.4	12.3	9.6
Konya	1,030	83.7	4.8	11.5	46.5	53.5	12.5	-10.8	13.2	10.2
Malatya[b]	1,034	81.0	6.6	12.4	44.6	55.4	12.9	-10.4	12.7	10.6
Samsun	950	84.7	4.6	10.7	45.3	54.7	12.3	-10.2	12.2	9.0
Trabzon	1,030	82.6	5.9	11.5	45.6	54.4	13.3	-10.8	14.2	10.8
Zonguldak	1,032	82.5	5.0	12.5	45.8	54.2	12.1	-10.6	12.9	10.1
All Cities	20,389	83.4	5.3	11.3	45.7	54.3	12.2	-10.3	12.5	9.8

Notes: All figures presented in columns 2-9 are in percentages.

Table 2: Summary Statistics on Relative Price and Relative Inflation Variability

Panel A) Intra Market Volatility--Across Provinces, 1948-1995

	V1		V3		Inflation	
Good	**Mean**	**Stdev**	**Mean**	**Stdev**	**Mean**	**Stdev**
Bread	0.084	0.027	0.064	0.030	25.6	24.1
Flour	0.131	0.045	0.095	0.042	24.7	24.3
Rice	0.093	0.022	0.080	0.034	23.9	29.9
Cracked Wheat	0.150	0.057	0.105	0.061	24.7	23.5
Pasta	0.115	0.044	0.085	0.044	24.4	25.3
Beans	0.141	0.048	0.100	0.051	25.2	31.0
Chick Peas	0.192	0.068	0.112	0.037	25.4	27.3
Sugar Cubes	0.043	0.035	0.039	0.053	23.3	27.4
Granulated Sugar	0.034	0.030	0.036	0.037	23.3	27.4
Salt	0.264	0.101	0.181	0.085	26.1	27.4
Mutton	0.120	0.026	0.068	0.025	26.1	22.4
Beef	0.135	0.026	0.076	0.026	26.7	22.9
Poultry	0.190	0.097	0.138	0.094	24.6	21.9
Eggs	0.106	0.035	0.066	0.023	24.4	21.7
Olives	0.170	0.045	0.109	0.032	26.1	23.4
Olive Oil	0.067	0.027	0.065	0.026	25.3	31.0
Margarine	0.084	0.053	0.079	0.053	23.5	27.6
Milk	0.185	0.080	0.106	0.068	25.8	22.9
Butter	0.147	0.085	0.093	0.033	25.1	24.3
Kasseri	0.123	0.038	0.093	0.044	25.8	21.7
Feta Cheese	0.124	0.029	0.085	0.033	25.1	21.8
Yogurt	0.271	0.067	0.122	0.055	25.9	23.3
All Goods	0.135	0.080	0.091	0.057	25.1	25.1

Panel B) Inter Market Volatility--Across Goods, 1948-1995

Provinces	**V2**		V4		**Inflation**	
	Mean	**Stdev**	**Mean**	**Stdev**	**Mean**	**Stdev**
Adana	0.114	0.038	0.153	0.056	23.6	21.9
Ankara	0.118	0.026	0.131	0.043	22.9	20.0
Antalya	0.116	0.030	0.148	0.048	24.0	22.1
Bursa	0.129	0.039	0.146	0.050	24.1	22.7
Denizli	0.149	0.042	0.146	0.046	23.7	22.1
Diyarbakir	0.141	0.033	0.148	0.053	24.8	22.9
Erzurum	0.135	0.032	0.135	0.045	24.4	22.7
Eskisehir	0.103	0.024	0.140	0.055	24.9	22.6
Gaziantep[a]	0.132	0.042	0.152	0.042	23.5	21.9
Icel	0.134	0.055	0.154	0.050	22.6	22.8
Istanbul	0.155	0.057	0.161	0.105	25.3	23.3
Izmir	0.131	0.032	0.133	0.040	25.1	22.5
Kayseri	0.135	0.054	0.150	0.047	25.7	22.6
Kocaeli	0.118	0.027	0.141	0.054	25.3	22.8
Konya	0.152	0.072	0.154	0.054	25.9	22.8
Malatya[b]	0.171	0.051	0.158	0.050	25.6	22.3
Samsun	0.141	0.042	0.155	0.046	24.6	22.2
Trabzon	0.151	0.051	0.152	0.046	25.9	22.4
Zonguldak	0.149	0.042	0.159	0.069	25.9	22.6
All Cities	0.136	0.046	0.148	0.055	23.7	22.2

Table 3a- Inflation and Intra-market Price Variability, 1948-1995

	Dispersion Measure			
	V_{1it}	V_{1it}	V_{3it}	V_{3it}
abs(Π_t)	0.019	0.017	0.065*	0.064*
	(0.014)	(0.014)	(0.015)	(0.015)
DUM_t* abs(Π_t)	-	0.122**	-	0.164*
		(0.066)		(0.062)
City Dummies	No	No	No	No
Product Dummies	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes
Adjusted R-Squared	0.639	0.640	0.469	0.472
Std Error of Regr.	0.050	0.050	0.043	0.043
No of Cross-Sections	22	22	22	22
No. of Observations	1,078	1,078	1,078	1,078

Notes: V_{1it} and V_{3it} denotes intra market relative price and inflation variability, respectively. $_t$ denotes inflation. DUM_t takes the value of 1 when inflation is negative and 0 otherwise. Heteroskedasticity consistent standard errors are in parentheses. * and ** denote significance at 5 and 10% significance levels, respectively.

Table 3b- Inflation and Inter-market Price Variability, 1948-1995

	Dispersion Measure			
	V_{2jt}	V_{2jt}	V_{4jt}	V_{4jt}
abs(Π_t)	-0.117	-0.125**	0.274*	0.276*
	(0.071)	(0.072)	(0.083)	(0.085)
DUM_t* abs(Π_t)	-	0.347*	-	-0.070
		(0.174)		(0.207)
City Dummies	Yes	Yes	Yes	Yes
Product Dummies	No	No	No	No
Time Dummies	Yes	Yes	Yes	Yes
Adjusted R-Squared	0.343	0.342	0.567	0.568
Std Error of Regr.	0.034	0.034	0.034	0.034
No of Cross-Sections	19	19	19	19
No. of Observations	919	919	919	919

Notes: V_{2jt} and V_{4jt} denotes intra market relative price and inflation variability, respectively. Π_t denotes inflation. DUM_t takes the value of 1 when inflation is negative and 0 otherwise. Heteroskedasticity consistent standard errors are in parentheses. * and ** denote significance at 5 and 10% significance levels, respectively.

Table 4a- Testing the Break in the Relationship Between Inflation and Intra-market Price Variability, 1948-1995

	Dispersion Measure			
	V_{1it}	V_{1it}	V_{3it}	V_{3it}
abs(Π_t)	0.060*	0.055*	0.131*	0.125*
	(0.023)	(0.023)	(0.024)	(0.024)
$PDUM_t$*abs(Π_t)	-0.058*	-0.054*	-0.093*	-0.087*
	(0.029)	(0.029)	(0.031)	(0.031)
DUM_t*abs(Π_t) [≡X]		0.103		0.139*
		(0.068)		(0.064)
$PDUM_t$*X	-	0.137	-	-0.297*
		(0.200)		(0.156)
City Dummies	No	No	No	No
Product Dummies	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes
Adjusted R-Squared	0.639	0.639	0.474	0.476
Std Error of Regr.	0.050	0.050	0.043	0.043
No of Cross-Sections	22	22	22	22
No. of Observations	1,078	1,078	1,078	1,078

Notes: See notes to Table 3a. DUM_t takes the value of 1 when inflation is negative and 0 otherwise. $PDUM_t$ takes the value 1 after 1976 and 0 otherwise.

Table 4b- Testing the Break in the Relationship Between Inflation and Inter-market Price Variability, 1948-1995

	Dispersion Measure			
	V_{2jt}	V_{2jt}	V_{4jt}	V_{4jt}
abs(Π_t)	-0.118**	-0.137*	0.359*	0.366*
	(0.061)	(0.06)	(0.061)	(0.063)
$PDUM_t$*abs(Π_t)	0.003	0.022	-0.156	-0.163
	(0.134)	(0.136)	(0.156)	(0.157)
DUM_t*abs(Π_t) [≡X]	-	0.356*	-	-0.138
		(0.178)		(0.205)
$PDUM_t$*X	-	NA	-	NA
City Dummies	Yes	Yes	Yes	Yes
Product Dummies	No	No	No	No
Time Dummies	Yes	Yes	Yes	Yes
Adjusted R-Squared	0.342	0.342	0.569	0.570
Std Error of Regr.	0.034	0.034	0.033	0.0343
No of Cross-Sections	19	19	19	19
No. of Observations	919	919	919	919

Notes: See notes to Table 3b. DUM_t takes the value of 1 when inflation is negative and 0 otherwise. $PDUM_t$ takes the value 1 after 1976 and 0 otherwise. Negative inflation rate for a province is not observed after 1976, therefore there is no variation in $PDUM_t$*X.

Table 5a- The Effects of Expected and Unexpected Inflation on Intra-market Relative Price Variability, 1948-1995

	Dispersion Measure					
	V_{1it}	V_{1it}	V_{1it}	V_{3it}	V_{3it}	V_{3it}
abs(E(Π_t))	0.021	0.026	0.084*	0.058*	0.064*	0.139*
	(0.019)	(0.019)	(0.035)	(0.017)	(0.017)	(0.032)
abs(UE(Π_t))	0.044	-0.144	0.102*	0.034	0.026	0.064
	(0.035)	(0.141)	(0.042)	(0.032)	(0.033)	(0.040)
DUM_t* abs(E(Π_t))	-	0.036	-	-	-0.164	-
		(0.035)			(0.168)	
DUM_t* abs(UE(Π_t))	-	0.241**	-	-	0.282**	-
		(0.137)			(0.146)	
$PDUM_t$*abs(E(Π_t))	-	-	-0.088*	-	-	-0.113*
			(0.042)			(0.038)
$PDUM_t$*abs(UE(Π_t))	-	-	-0.083	-	-	-0.043
			(0.055)			(0.052)
City Dummies	No	No	No	No	No	No
Product Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-Squared	0.634	0.634	0.563	0.473	0.474	0.363
Std Error of Regr.	0.050	0.050	0.053	0.044	0.043	0.047
No of Cross-Sections	22	22	22	22	22	22
No. of Observations	1,011	1,011	1,011	1,011	1,011	1,011

Notes: See notes to Table 3a. DUM_t takes the value of 1 when inflation is negative and 0 otherwise. E(Π_t) and UE(Π_t) denote for expected and unexpected components of inflation, respectively.

Table 5b- The Effects of Expected and Unexpected Inflation on Inter-market Relative Price Variability, 1948-1995

	Dispersion Measure					
	V_{2jt}	V_{2jt}	V_{2jt}	V_{4jt}	V_{4jt}	V_{4jt}
abs(E(Π_t))	-0.046	-0.048	0.005	0.039	0.039	0.080**
	(0.038)	(0.039)	(0.041)	(0.049)	(0.050)	(0.048)
abs(UE(Π_t))	0.063*	0.057**	0.084	0.038	0.033	0.002
	(0.032)	(0.032)	(0.058)	(0.035)	(0.035)	(0.063)
DUM_t* abs(E(Π_t))	-	0.409	-	-	-0.342	-
		(0.249)			(0.389)	
DUM_t* abs(UE(Π_t))	-	-0.178	-	-	0.452	-
		(0.235)			(0.365)	
$PDUM_t$*abs(E(Π_t))	-	-	-0.076	-	-	-0.064
			(0.076)			(0.092)
$PDUM_t$*abs(UE(Π_t))	-	-	-0.026	-	-	0.056
			(0.071)			(0.075)
City Dummies	Yes	Yes	No	Yes	Yes	No
Product Dummies	No	No	Yes	No	No	Yes
Time Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R-Squared	0.342	0.342	0.367	0.569	0.570	0.542
Std Error of Regr.	0.034	0.034	0.036	0.033	0.034	0.037
No of Cross-Sections	19	19	22	19	19	22
No. of Observations	865	865	1,011	865	865	1,011

Notes: See notes to Table 3b. DUM_t takes the value of 1 when inflation is negative and 0 otherwise. E(Π_t) and UE(Π_t) denote for expected and unexpected components of inflation, respectively.

Figure 1: The course of Inflation in Turkey, 1948-1995

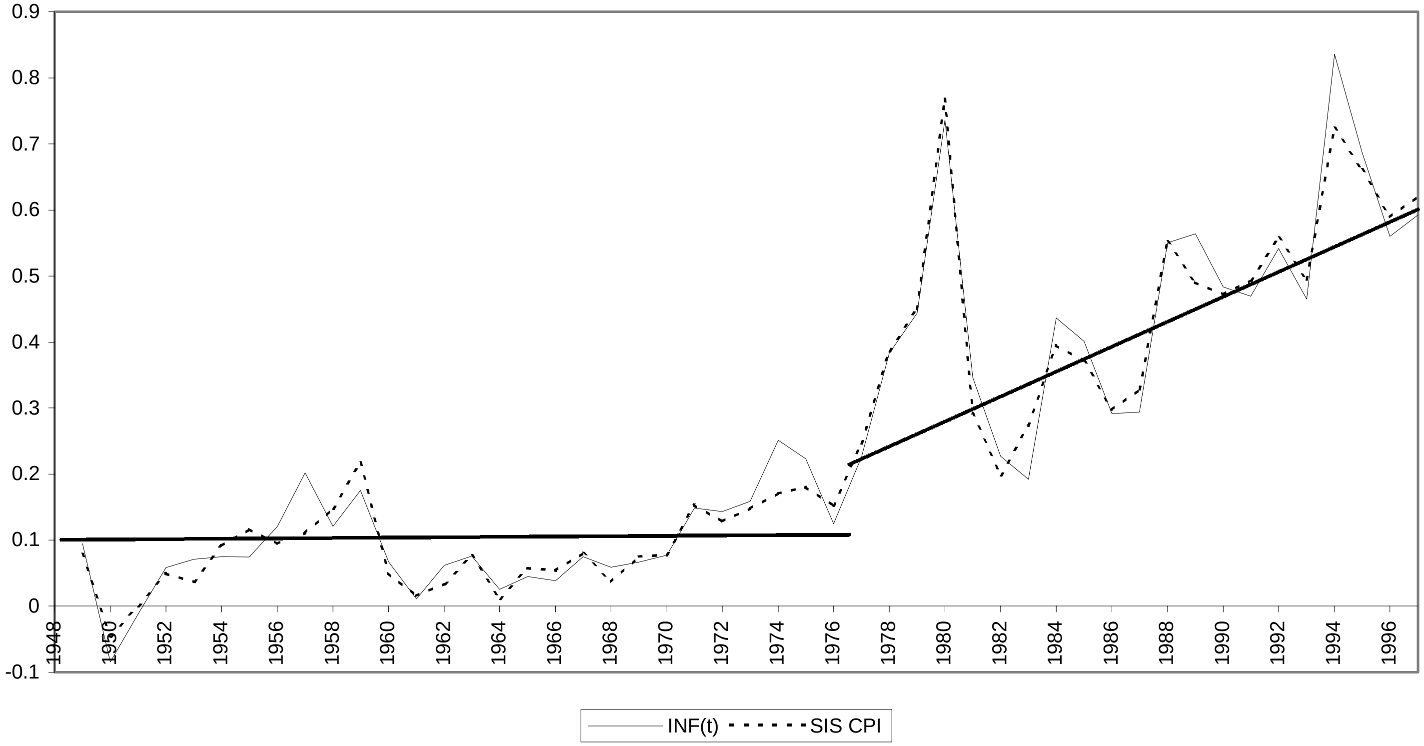

Figure 2: The Share of Intra-Market Price Variability In Total