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Nonlinear impact of inflation on relative price variability

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Abstract

Using a half-a-century long disaggregated price data for 22 food products collected from 19 cities, we show that the association between inflation and price variability is nonlinear with respect to changes in inflation rate. We obtain similar results for expected and unexpected inflation.

Keywords: Inflation; Price variability; Nonlinearity; Panel data

JEL classification: E31; C23

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. The general consensus of empirical research is that there is a positive association between inflation and inflation variability.[2]

Despite wide evidence in favor of positive relationship between relative price variability and inflation, researchers have not tested if a structural change in inflation rate could affect this relationship. Hence, using a half-a-century long disaggregated annual price data for 22 food products

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[2]Among many others, see for example Vining and Elwertowski (1976), Parks (1978), Lach and Tsiddon (1992), Debelle and Lamont (1997).

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collected from the largest 19 provinces in Turkey over the period 1948–1997, we consider the impact of a structural change in the behavior of inflation on the link between inflation and price variability.[3] We show that the effect of inflation on relative price variability significantly declines as inflation increases and stays high. This finding strongly suggests for nonlinearities in the relationship. Similar observations apply for expected and unexpected inflation.

The next section briefly describes the data, lays out price variability measures and presents the empirical evidence. Section 3 concludes the paper.

2. Empirical findings

2.1. The data and measures of variability

We use a disaggregated panel data set made available by the State Institute of Statistics (SIS) of Turkey over the period 1948–1997. The Institute collects unit prices of several products along with detailed product information from the same set of stores, unless a store goes out of business, from various province centers while ensuring the consistency of the data between and within province centers. The data are then published for store averages at an annual frequency by the Institute. We base our analysis on 22 food products collected from the largest 19 centers after eliminating some products if: (i) prices were directly controlled by the government, (ii) product quality has changed over time. Except for a few cases, each commodity in our data set contributes observations for the full sample period for each of the provinces.

We measure relative price variability for product i, $V_{1,it}$, as

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

where R_{ijt} and $\bar{R}_{it}$ denote for the relative price of product i in province j and the cross-sectional average relative price for product i, respectively. Our second measure, inflation variability, is extensively used in the literature and can be easily constructed as follows:[4]

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

where π_{ijt} and $\bar{\pi}_{it}$ denote product inflation in province j and the average inflation rate for product i over all non-missing cities, respectively.

[3] Beaulieu and Mattey (1999) argue that a data set having both cross-sectional and time series variability allows one to measure distribution of prices and identify the variation in inflation rates more accurately. From this point of view, our data set is unique.

[4] Researchers have frequently used inflation variability as a measure of volatility due to lack of actual price data.

2.2. Nonlinear effects of inflation on relative price variability

We use panel data techniques to obtain unbiased and consistent parameter estimates controlling for the shocks that are specific to commodities (λ) and years (τ). In model (3) below, we regress relative price variability on absolute value of inflation, $|\pi_{it}|$, to investigate whether deflationary periods along with inflationary periods are associated with high relative price variability, as previously documented for the US and Argentina (e.g., Parks (1978) and Tommasi (1993), respectively):[5]

$$V_{it} = \sum_{i=1}^{\kappa} \lambda_i + \sum_{t=1}^{T} \tau_t + \beta|\pi_{it}| + u_t. \tag{3}$$

Next, we incorporate the observation that Turkey has been through two distinct inflationary periods during the post-war era into our model to investigate the impact of a structural change in the behavior of inflation on price variability. Specifically, we investigate the effects of absolute inflation before and after 1976. Fig. 1 depicts the substantial change in the pattern of inflation in Turkey during the sample

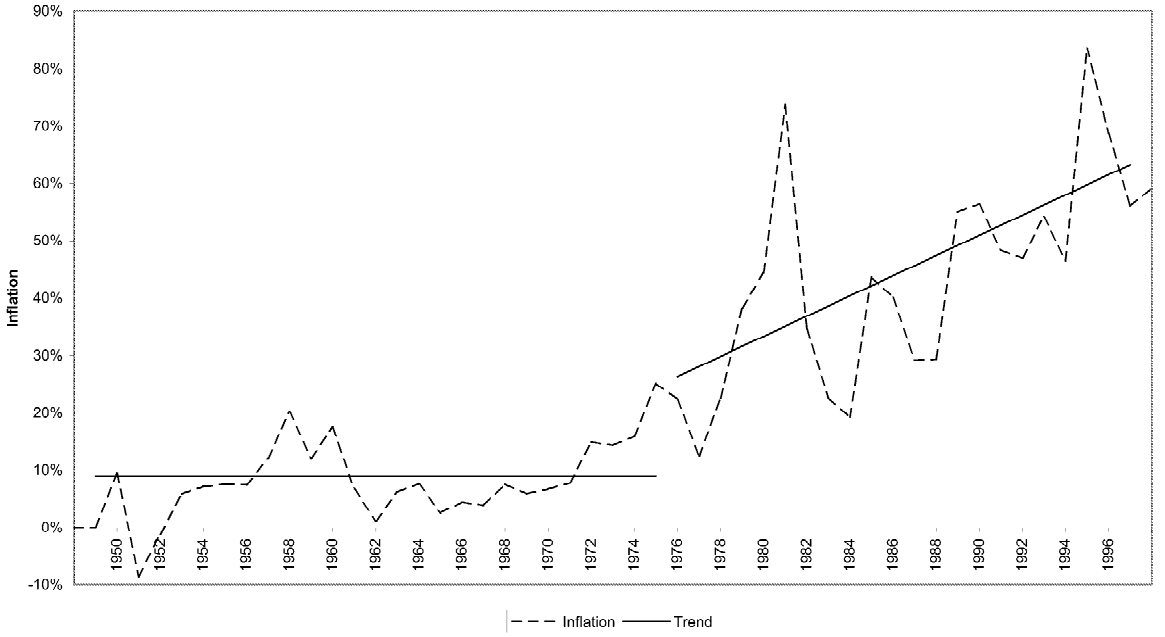

Fig. 1. The course of inflation and its trend in Turkey, 1948–1997. Note: aggregate inflation is calculated as unweighted average changes of all prices.

[5]We considered the possibility of asymmetrical response to negative and positive inflation in our analysis. However, this approach did not render any significant impact.

period.[6] The break in 1976 corresponds to a payments crisis in Turkey, which led to increases in inflation and collapse of import-substituting industrialization strategy. Despite several attempts including massive trade and financial liberalization, inflation rate could not be reduced. This structural change in the behavior of inflation might have a substantial impact on the link between inflation and relative price variability as captured by the interaction terms in the following model:

$$V_{it} = \sum_{i=1}^{\kappa} \lambda_i + \sum_{t=1}^{T} t_\tau + \beta_1 |\pi_{it}| \cdot D4875 + \beta_2 |\pi_{it}| \cdot D7697 + u_t, \quad (4)$$

where dummy variables $D4875$ and $D7697$ are set to 1 during the indicated years, and 0 otherwise.

Parameter estimates for these two models are presented in Table 1. Incidentally, our results show a significant difference between low and high inflationary periods. Column 1 presents evidence that there is no significant link between relative price variability, $V_{1,it}$, and inflation. Yet, allowing for a structural break in the inflation series changes the conclusion drastically as presented in column 2. During low inflationary periods, inflation positively affects relative price variability. However, this relationship disappears during high inflationary periods indicating a nonlinear relationship. A comparable pattern emerges when we investigate the link between inflation variability, $V_{2,it}$, and inflation. Similar to the general consensus in the literature, column 3 presents evidence for existence of a positive link between the variables. Column 4 lays out the nonlinear relationship; during high inflationary episodes the association between inflation and inflation variability is significantly lower, yet positive.

Table 1
Impact of inflation on price variability

	(1) V1	(2) V1	(3) V2	(4) V2
$\lvert\pi_{it}\rvert$	0.019		0.066	
	[0.014]		[0.012]**	
$\lvert\pi_{it}\rvert \cdot D4875$		0.060		0.131
		[0.026]*		[0.023]**
$\lvert\pi_{it}\rvert \cdot D7697$		0.001		0.038
		[0.017]		[0.015]**
Observations	1078	1078	1078	1078
No. of products	22	22	22	22
R^2	0.11	0.11	0.14	0.15

Standard errors in brackets.
*Significant at 5%; **significant at 1%.
Time and product dummies are included in all regressions.
$D4875$ is set to 1 if $1948 \leq \text{year} \geq 1975$ or zero.
$D7697$ is set to 1 if $1976 \leq \text{year} \geq 1997$ or zero.

[6] The figure plots inflation series computed as unweighted average price changes using price quotations from our data set. Note that the correlation coefficient between this series and the aggregate inflation series published by the SIS is 99%.

2.2.1. The effects of expected and unexpected inflation

In this section we explore effects of expected and unexpected inflation on price dispersion considering the effect of a structural change in the behavior of inflation. While menu cost models predict a positive impact of anticipated inflation on relative price variability, in Lucas-type confusion models (Lucas, 1973) dispersion increases due to unexpected inflation. For our analysis, we follow a common decomposition procedure, also used by Lach and Tsiddon (1992), and partition inflation into its permanent (expected) and transitory (unexpected) components ensuring that the latter is white noise.

The next two models we estimate are similar to Eqs. (3) and (4) except that we use absolute value of expected inflation, $|E\pi_{it}|$, and unexpected inflation, $|U\pi_{it}|$, instead of absolute inflation. Table 2 presents our results. Column 1 shows that neither expected nor unexpected inflation have a significant impact on relative price variability over the full sample. After splitting the sample into two distinct inflationary regimes, we obtain a nonlinear association between expected inflation and relative price variability as shown in Column 2. We also find evidence that unexpected inflation has a positive impact on relative price variability during the low inflationary period. Nevertheless, as inflation rate increases, the association disappears.

We obtain sharper results than the previous case when we investigate inflation variability. Columns 3 and 4 present evidence for nonlinearity between inflation and its variability. The impact of expected inflation is positive and significant during the low inflationary period, but there is none during the high inflationary period. Unexpected inflation appears to have no effect in either periods.

Table 2
Impact of expected and unexpected inflation on price variability

	(1) V1	(2) V1	(3) V2	(4) V2
$\|E\pi_{it}\|$	0.021		0.058	
	[0.019]		[0.017]**	
$\|U\pi_{it}\|$	0.044		0.034	
	[0.028]		[0.025]	
$\|E\pi_{it}\| \cdot D4875$		0.084		0.139
		[0.038]*		[0.033]**
$\|U\pi_{it}\| \cdot D4875$		0.102		0.065
		[0.050]*		[0.044]
$\|E\pi_{it}\| \cdot D7697$		−0.004		0.026
		[0.023]		[0.020]
$\|U\pi_{it}\| \cdot D7697$		0.019		0.021
		[0.033]		[0.029]
Observations	1010	1010	1010	1010
No. of products	22	22	22	22
R^2	0.11	0.12	0.13	0.14

Standard errors in brackets.
*Significant at 5%; **significant at 1%.
Time and product dummies are included in all regressions.
$D4875$ is set to 1 if $1948 \leq \text{year} \geq 1975$ or zero.
$D7697$ is set to 1 if $1976 \leq \text{year} \geq 1997$ or zero.

3. Conclusions

Using a half-a-century long disaggregated annual data set, we investigate the effect of a structural change in inflation on the link between inflation and price variability. We show that the relationship between inflation and price variability is nonlinear. Similar observations are valid for the effect of expected and unexpected inflation. Although we find support for menu cost models and weak support for confusion models during the low inflationary period, both models fail during high inflationary periods. Our attempts to control for aggregate shocks or various break dates have not changed our findings. Our results show that failure to control for structural changes in the inflation series will lead to biased results and misleading conclusions. They also suggest that the welfare effects of inflation can change substantially in countries where inflation changes over time.

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