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Inflation and Relative Price Dispersion: Evidence for Iran

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Abstract

The recent literature on the welfare cost of inflation emphasizes inflation's effects on the dispersion of relative prices. This paper tests three models that predict a relationship between the Relative Price Dispersion (RPD) and facets of inflation such as expected inflation, unexpected inflation, and inflation uncertainty. These are, correspondingly, the Sheshinski-Weiss menu cost model, the Lucas-Barro signal-extraction model, and the Hercowitz-Cukierman extension of the signal extraction model. The results verify the signal extraction model and its extension in Iran. However, there is no evidence of menu cost model.

Keywords: Efficiency, Risk, Risk and Efficiency Correlation, MEA Multi-Way Analysis, SFA Stochastic Frontier Analysis.

1- Introduction

The relationship between variability of relative prices and inflation has been the case of research in recent years. Relative price variability is generally believed as a measure of the welfare cost of inflation. The early descriptive studies of the behavior of prices by Mills (1927) and Graham (1930) both found that inflation raises the variability of relative prices. Recent literature beginning with Vining and Elwertowski (1976) and Parks (1978) searched for the particular aspect of inflation that is most closely

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associated with Relative Price Dispersion. Damjanovic and Nolan (2010) test macroeconomic implications of RPD as a major cost of inflation. They conclude that the impact of price dispersion on welfare is substantial and it made the economy evolve in a more sluggish manner than with no price dispersion.

Most of studies on this subject are done for the United States and very few for other countries like Germany, Argentina, and Turkey. The only paper investigates the relation between inflation and RPD in Iran, is Gholibagloo (1387) using quarterly data of Iran's 8 main CPI[1] groups for 25 years from 1360 till 1385.

In this paper we examine and test the effects of different factors (based on signal extraction and menu cost models) on the dispersion of relative prices in Iran's economy with monthly data for 19 subgroups of Iran's CPI. We test three main theories associated with inflation and RPD in Iran's economy, and verify the consistency of results.

2- Theories linking inflation and RPD

The welfare cost of inflation is explained through its influence on relative price changes, based on three theories of menu cost, signal extraction and extended signal extraction. All of them state that inflation increases relative price dispersion, therefore, obstructs the efficient allocation of resources. While the signal extraction model of Lucas (1973) and Barro (1976) emphasizes the variability of relative prices is related to unexpected component of inflation, Sheshinski and Weiss (1977) menu cost model insists on the effect of expected inflation as well as unexpected inflation. Hercowitz (1981) and Cukierman (1983) extended signal extraction model deals with symmetric effect of positive and negative unexpected inflation. Other determinants like inflation uncertainty and inflation volatility are also considered by many investigations.

Ascari (2004) states that steady state output would be lower, when inflation has an increasing trend, in the New Keynesian model (with Calvo contracts). Schmitt-Grohe and Uribe (2005) also discussed the distortive effects of the price dispersion by the link between trend inflation and the

1- Consumer Price Index.

importance of price dispersion. Amano, Ambler and Rebei (2007) insist on the cost of price dispersion, by numerical simulations. Damjanovic and Nolan (2010) pursue the question of why price dispersion is costly in the Calvo-Yun type framework, analytically and provide detailed analyses of the welfare impact of price dispersion, which conclude it is substantial. They say in an economy facing RPD, consumption would not reach its maximum level, and more labor is employed in the industries with higher prices, which in turn decreases labor productivity and increases labor-output ratio at the macro-level. In this condition, RPD raises wage rate and cost of production relative to an economy without RPD. They also indicate that the effect of RPD and low productivity are similar, that is, the economy employs more labor for the same level of output. They show that RPD is itself sensitive to the lower level of inflation and increases sharply with the level of inflation, but the effect of RPD, unlike productivity is not exogenous and has some impacts on optimal monetary policy; i.e. disinflation is an optimal monetary policy when a country is experimenting RPD. Besides, the effect of RPD usually is not felt fully in the following period, rather it drags on for some time (it is a persistent process). Also the higher level of labor employment reduces the leisure time of consumers, which increases RPD. They conclude that "any shock which decreases RPD will impart upward momentum to output and downward momentum to inflation", and there is "a close similarity to a preference shift into leisure".

Becker (2011) states that in the "classic menu-cost or Lucas-type models, inflation increases RPD, distorts the information content of prices, and, thereby, impedes efficient allocation of resources. Both types of models imply a monotonic inflation-RPV relationship in which inflation always lowers welfare. This is in contrast with recent monetary search (Head and Kumar, 2005) and Calvo-type (Choi, 2010) models that predict the relationship to be non-linearly U-shaped, with an optimal rate of inflation above zero". Nakamura and Steinsson (2008b) "show that the frequency of RPD is strongly related to the rate of inflation". As Choi (2010) indicates in a Calvo-type model with sectoral non-homogeneity, firms with more relative flexible prices, "respond more to an external shock than do relatively sticky prices". He also states that the link between RPD and inflation is not always u-shaped, for example in the higher inflation conditions. Kiley (2000) in a saple of 43 countries, finds that higher inflation rates cause greater price flexibility.

Although the significant effect of positive unexpected inflation on RPD is verified in most papers, the effects of expected inflation and negative unexpected inflation is in debate. In the following, we test whether each of these components of inflation has any influences on the dispersion of relative prices in Iran.

3- Data and Variables

The data used is monthly consumer price index (CPI) of Iran from 1374.1-1387.12 (1995:3-2009:2) for its 19 major subgroups reported by Central Bank of the Islamic republic of Iran (CBI). The weights of these subgroups changed two times during the surveyed period. We use corresponding weights for each year and define aggregate inflation rates based on Parks (1978) as the average growth rates of subgroups. (W_{it} is the relative household's expenditure on i^{th} category in period t):

$$DP_t = \sum_{i=1}^{n} W_{it}(DP_{it}) \tag{1}$$

Where DP_{it} is the inflation rate of category *I* in period *t*, measured by log differences of all CPI subgroups between two consecutive periods of t and t – 1:

$$DP_{it} = \ln P_{it} - \ln P_{it-1} \tag{2}$$

The two mostly used measurements of Relative Price Dispersion (RPD) are presented by Parks (1978) and by Blejer (1983). Although most researchers have used the former, we use the latter because it shows the dispersion of relative prices in a more detailed way, independent of aggregated inflation.

The RPD variable introduced by Parks (1978) is the weighted variance of subgroups' inflation for each month, that is:

$$RPV_t = \sum_{i=1}^{n} W_i(DP_{it} - DP_t)^2 \tag{3}$$

The other measurement introduced by Blejer (1983), is the weighted average of the absolute values of all possible differences between pairs of observations. It is shown that it is also a weighted variation of the Gini mean difference index and independent of the central values of the distribution. Besides that, it is shown by Fama (1971) that in non normal table distributions, the sample standard deviation is unstable and dose not converge by increases in sample size. We use the latter, since there are potential problems with the second moment of some non normal distributions:

$$WB_t = \frac{1}{n-1}\sum_{i=1}^{n-1}\sum_{j=i+1}^{n}\left(w_{it}+w_{jt}\right)\left|DP_{it}-DP_{jt}\right| \tag{4}$$

Figure 1 and figure 2 depict the aggregated inflation and relative price dispersion in Iran during the sample period. Both series are stationary at 1% based on ADF unit root test in level with the maximum lag selected by AIC.

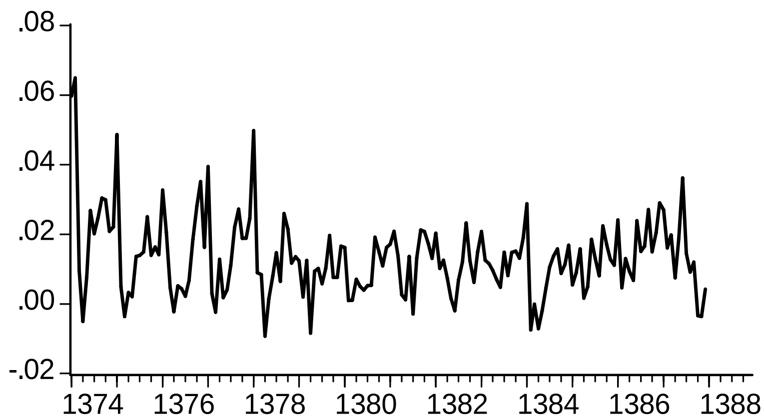

Figure1. Monthly inflation rates (DP_t), Iran's CPI 1374.1-1387.12

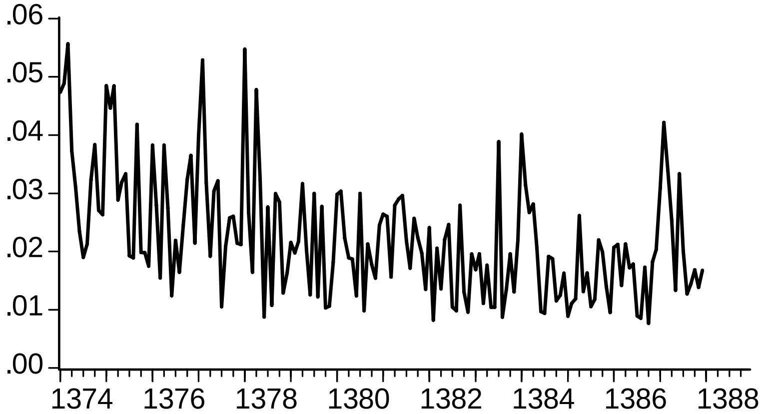

Figure2. Monthly relative price dispersion (WB_t), 1374.1-1387.12

Inflation has been decomposed into expected inflation, unexpected inflation and uncertainty. The inflation model is an Autoregressive GARCH[1] model. Expected inflation (*EIN*) is the rate forecasted by economic agents (for the current period), unexpected inflation (*UIN*) is the difference between observed (IN) and expected inflation (*UIN* = *IN* – *EIN*). An inflation model presents uncertainty when the forecast errors are heteroskedastic. The conditional variance generated by GARCH model is used as inflation uncertainty. By the simultaneous estimate of the inflation model and GARCH equation, the following inflation model is obtained in which the forecast errors are homoskedastic:

$$DP_t = \alpha_0 + \alpha_1 DP_{t-1} + \alpha_2 DP_{t-2} + \alpha_3 DP_{t-4} + \alpha_4 DP_{t-5} + \alpha_5 DP_{t-7} + \alpha_6 DP_{t-11} + \alpha_7 DP_{t-12} + \alpha_8 S_4 + \varepsilon \quad (5)$$

$$\sigma^2_t = \beta_0 + \beta_1 \varepsilon^2_{t-1} + \beta_2 \sigma^2_{t-1} + \beta_3 \sigma^2_{t-2} + \varepsilon \quad (6)$$

[1]Generalized Auto-Regressive Conditional Heteroskedasticity

Table1: Estimated Coefficients and T-Statistics of the Equation 5

Coefficient	α_0	α_1	α_2	α_3	α_4	α_5	α_6	α_7	α_8
Value	0.0099	0.183	0.115	-0.125	-0.123	-0.137	0.1	0.255	-0.0034
t-statistics	4.05	2.32	-1.83	-1.65	-1.92	-1.92	1.50	5.2	-2.2

Coefficient	β_0	β_1	β_2	β_3
Value	0.000029	0.308	-0.236	0.478
t-statistics	1.818	2.104	-1.844	2.95

We use one period ahead forecast of DP_t in equation 5 as expected inflation, the difference between observed inflation and expected inflation as unexpected inflation, and $\sigma^2{}_t$ as inflation uncertainty.

4- Empirical Results

First, we estimate the dispersion of relative prices with the rate of inflation. Then the effects of expected and unexpected inflation are analyzed. As most investigations we assume the nonlinear effect of inflation on Relative Price Dispersion, so, the squared form of inflation is used. We

$$WB_t = \gamma_0 + \gamma_1 DP_t^2 + \varepsilon_t$$

Table2. Estimated Coefficients and T-Statistics of the Equation 6

Coefficient	γ_0	γ_1
Value	0.0198	9.19
t-statistics	24.013	6.857

The least squares estimate of the coefficient of squared inflation (γ_1), has a plausible sign and is highly significant. Then we added lagged squared variables based on minimized AIC to examine if the effect is coeval.

$$WB_t = \delta_0 + \delta_1 DP^2{}_t + \delta_2 DP^2{}_{t-1} + \delta_3 DP^2{}_{t-3} + \delta_4 DP^2{}_{t-4} + \delta_5 DP^2{}_{t-8} + \varepsilon_t \quad (8)$$

Table 3: Estimated Coefficients and T-Statistics of the Equation 7

Coefficient	δ_0	δ_1	δ_2	δ_3	δ_4	δ_5
Value	0.014	10.072	4.6	6.417	6.821	2.26
t-statistics	13.83	5.833	2.69	3.766	4.01	1.983

The results indicate that the simultaneous effect of inflation on relative price dispersion is highly significant, while some evidence of weaker impacts of previous months can be seen. At this point it is appropriate to focus on the simultaneous effect of inflation on relative prices by dividing inflation into expected and unexpected components. For corresponding variables, we use squared forms[1]. Thus, we estimate the following equation:

$$WB_t = \theta_0 + \theta_1 EI_t^2 + \theta_2 UI_t^2 + \varepsilon_t \tag{9}$$

Table 4: Estimated Coefficients and T-Statistics of the Equation 8

Coefficient	θ_0	θ_1	θ_2
Value	0.0176	7.004	44.337
t-statistics	16.809	1.393	7.507

Despite of the prominent and positive effect of unexpected inflation, the effect of expected inflation is statistically insignificant. In order to verify the symmetric effect of positive and negative unexpected inflation, we generate positive and negative series of unexpected inflation based on the following formulas:

$$UIP_t = (UI_t > 0) * UI_t \tag{10}$$

$$UIN_t = (UI_t < 0) * UI_t \tag{11}$$

1- Based on the economic theories, we expect positive signs for the variables. The squared forms are included to show the nonlinearity effects of the explanatory variables.

Then these two new variables (the positive and negative unexpected inflation series), are used as two different explanatory variables and define the following equation (13). After estimating it, we get the following results

$$WB_t = \vartheta_0 + \vartheta_1 UIP_t^2 + \vartheta_2 UIN_t^2 + \varepsilon_t \tag{12}$$

$\bar{R}^2$ =0.356, F ($\vartheta_1 = \vartheta_2$) =0.05

Table 5: Estimated coefficients and t-statistics of the equation 10

Coefficient	ϑ_0	ϑ_1	ϑ_2
Value	0.0186	46.462	48.704
t-statistics	24.684	7.016	5.747

We use a wald test In order to test for the symmetric effect of unexpected inflation. The results of the test indicate that we cannot reject the hypothesis of equality between positive and negative coefficients of unexpected inflation at the 10% level. Therefore, the symmetric effect of unexpected inflation on Relative Price Dispersion can be accepted.

At the final part of empirical step, we estimate the equation introduced by Aarstol (1999) as the general model (equation 13), in which WB_t is regressed on expected inflation ($EINF_t$), positive unexpected inflation (UIP_t), negative unexpected inflation (UIN_t), and the conditional variance of inflation uncertainty (σ_t^2), all of which are generated by the inflation model (equations 5).

$$WB_t = \gamma_0 + \gamma_1 EI_t^2 + \gamma_2 UIP_t^2 + \gamma_3 UIN_t^2 + \gamma_4 \sigma_t^2 \tag{13}$$

$\bar{R}^2$ =0.39, F ($\gamma_2 = \gamma_3$) =0.687

Table 6: Estimated Coefficients and T-Statistics of the Equation 11

Coefficient	γ_0	γ_1	γ_2	γ_3	γ_4
Value	0.0137	5.46	40.507	32.437	69.955
t-statistics	10.255	1.142	6.145	3.69	4.348

The results of general model (equation 13) are consistent with the results of specific and separated models (equations 9 and 12). Expected inflation is insignificant in equation 13 as well as in equation 9 and, the hypothesis of equality between positive and negative portions of unexpected inflation cannot be rejected at the 10% level in equations 12 and 13.

5- Conclusion

This paper explores the distorting effect of inflation on the information content of nominal prices in Iran's economy. Expected inflation, realized unexpected inflation, and inflation uncertainty have all been proposed to increase Relative Price Dispersion and to obstruct the efficient allocation of resources.

The results of the paper can be summarized as followings. In agreement with the evidence found by Gholibagloo (1387), our results verify significant effect of unexpected inflation on RPD in Iran. But we did not find any evidence for the effectiveness of expected inflation on Iran's RPD, in contrast with Gholibagloo's findings. Finally, the symmetric effect of positive and negative unexpected inflation on Iran's RPD cannot be rejected at the 10% level. Thus, the relation between inflation and relative price dispersion in Iran can be explained by both versions of signal extraction models. However, there is no evidence of menu cost models in Iran's economy.

Our results indicate that a stabilized inflation rate regardless of its degree do not affect the dispersion of relative prices. However, capricious inflation rates resulting in high levels of unexpected inflation and uncertainty increase RPD. Thus, in order to prevent relative price changes rising, stabilizing policies are more effective than policies which abruptly lower inflation rate.

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