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Inflation and Relative Price Variability: Further Evidence from Malaysia

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ABSTRACT

There are different theories which relate inflation to relative price variability (RPV). While menu cost model relates RPV to expected inflation, signal extraction model and extension of signal extraction relate RPV to inflation uncertainty and unexpected inflation. Using Malaysian data from 1994-2011, this study further investigates the relationship between inflation and the RPV while taking into account some other aspects of inflation which are inflation uncertainty, expected inflation and unexpected inflation. These aspects of inflation are not often discussed by previous studies in Malaysia. An autoregressive GARCH model is employed to decompose inflation to expected and unexpected elements while the conditional variance of the GARCH model is used as a proxy for inflation uncertainty. The results are consistent with menu cost model as they show that expected inflation increases RPV. However, unexpected inflation is also positively and significantly correlated with RPV and the equality test on coefficients shows that the sign of unexpected inflation is irrelevant and only its magnitude matters as predicted by extension of signal extraction model. Based on these results the study concludes that while empirical evidences support both menu cost and extension of signal extraction, none of the theories on its own can completely explain the determinants of RPV.

Keywords: Relative Price Variability, Inflation, Malaysia

INTRODUCTION

To many governments, reducing and stabilizing inflation rate is a very important objective, since inflation is one of the most important variables in the economy. Not only inflation has several direct and indirect effects on real economic variables, but also agents in economy are very sensitive to changes in inflation rate. The importance of the issue has motivated many researchers in the field of economy to investigate different aspects of inflation and their effect on economy all around the world; Malaysia is not an exception. Many researches in Malaysia have investigated the main causes of inflation in the country as well as major and minor influences of Malaysian inflation rate on economic variables such as output and growth (e.g. Tan and Baharumshah, 1999; Cheng and Tan, 2002; Abdul Karim et al, 2009).

One important aspect of inflation that has attracted many researchers especially in recent years is its relationship with relative price variability (RPV). Aarstol (1999) in his seminal paper defines RPV as "sum of the squared deviations of rates of change of various price sub-indexes from the rate of change of an overall price index in period t". Sub-indexes represent prices of groups of commodities with which inflation is defined. Inflation will not increase RPV if these sub-groups' price move along with inflation as inflation changes. However in practice, commodity prices do not show the same pattern of change as inflation does, e.g. when inflation rise sharply they may increase slower or faster than core inflation rate. Hence, empirically it is observed that higher rates of inflation and deflation are correlated with higher level of RPV. This empirical findings starts with Mills (1927) who found the absolute value of inflation is correlated with price dispersion. Years after, study byVining and Elwertowski (1976) verified the initial findings of Mills and it was the beginning of empirical researches on RPV-inflation nexus, along with its underpinning theories.

For the case of Malaysia, previous studies by Zaidi et.al (2005) and Abdul Karim et. al (2008) are of concern. The former study looks at the relationship between inflation and the RPV which

measures price dispersion among the economic regions, namely the Peninsular Malaysia, Sabah and Sarawak. The later study further investigates the relationship between inflation and the RPV, but the RPV in that case measures price dispersion among subgroup prices for each of the three regions. After all, both overall results support the menu cost theory. The two studies, however do not take into account further aspects of inflation such as the inflation uncertainty, expected inflation and unexpected inflation. This study, thus attempts to fill the research gap by investigating the effect of different aspects of inflation on RPV using the latest available data.

The rest of this paper is organized as follows. Next section shortly reviews theories which relate RPV to inflation and discusses some empirical evidences both globally and locally. The methodology and data used are introduced in the section that follows. The next section after that discusses the results and findings while the last section concludes with suggestions for further researches.

THEORETICAL BACKGROUND AND EMPRICAL EVIDENCES

There are different theories to explain how inflation is related to RPV. These theories assume dissimilar theoretical link between inflation and RPV and therefore they suggest different aspects of inflation to affect RPV. These aspects are namely expected inflation, unexpected inflation and inflation uncertainty. We review only three most important approaches to this link, however there may exist other justification to the issue.

Menu cost theory is probably the mostly well-known theory to relate inflation to RPV. In this theory which was developed mainly by Sheshinsky and Weiss (1977) and also Rotemberg (1983), RPV is attributed to expected inflation as in short run firms do not adjust their prices identically due to noticeable cost of change in prices. Therefore it is suggested that there exist a (S, s) strategy which firms follow when they need to adjust their prices due to change in general level of prices. When the real price of their commodities reaches the lower bond of s, they adjust their nominal price of that commodity so that it upholds the real price of S. The interval between S and s increases when there is a rise in expected inflation level. Therefore, when expected inflation increase, firms with different prices strategies will not adjust their prices simultaneously and that leads to higher variability in relative prices.

Secondly, signal extraction theory which is attributed to Lucas (1973) and Barro (1976) has different assumption about the relationship between inflation and RPV. In this theory the inflation level has no effect on RPV, but it is *ex ante* inflation uncertainty that increase RPV. The reason is that when uncertainty increases firms misinterpret nominal shocks as aggregate shocks and therefore they adjust the price of commodities instead of their supply quantity. However their reaction to expected shocks is the same and therefore it cannot have any effect on RPV.

The third model is extension of signal extraction. Herkowitz (1981) and Cukierman (1983) extended the signal extraction model and made a different conclusion about the effect of unexpected inflation. Their theory predicts that due to assumption of different elasticity of supply, the adjustment of prices would not be the same for all firms; those which have higher elasticity of supply adjust prices less than the others. Therefor the more unexpected shock is, the more RPV will be. In this model, the sign of shocks is irrelevant and only magnitude of unexpected inflation that matters.

Empirical works studied evidences on this relationship in many economic contexts and made different conclusions to support each of above mentioned theories. Early studies in this field have been devoted to US economy. Mills (1927) was one of the first researchers to notice this relationship. He found that the variability of relative prices has increased when inflation rate were higher, however he was not very successful to explain this relationship from theoretical point of view. In contrast Vining and Elwertowski (1976), after reviewing the existence of this relationship in US economy tried to explain the theoretical reasons behind it.

While early researchers only used illustrations to show the probable relation between inflation and RPV, Parks (1978) went a step forward and proved the existence of link between inflation and absolute value of inflation using econometrics methodology. His research showed that unexpected inflation has a determining role in producing RPV. Blejer (1981) investigated the same issue for Argentina's inflation data and verified Parks' finding about the role of unexpected inflation in increases RPV. However, the study of Grier and Perry (1996), once again in US, showed that inflation uncertainty is determinant of RPV. In addition, Binette and Martel (2005) on Canadian price data found expected inflation to be the main cause of RPV. Therefore, the empirical works showed that not only in theory, but also in practice it is not easy to make an agreement about this economic phenomenon.

More recently, many studies tried to distinguish which aspect of inflation is the real cause of RPV. However, they also found mixed results which do not exclusively support one of the theories. Working on a long period price data of US, Aarstol (1999) found that expected inflation, positive unexpected inflation and inflation uncertainty are significantly correlated with RPV. In a different economical contexts Tang and Wang (1993) studied Chinese hyperinflation and found both expected inflation and absolute value of unexpected inflation to be determinants of RPV. In one of the most recent works, Valdovinos and Gerling (2011) focused on the data of WAEMU countries in Africa and found that unexpected inflation is almost always significantly related to RPV, while expected inflation is also significant for some of those countries.

In Malaysia there exists two studies that consider the effects of inflation on RPV; Zaidi et. al (2002) and Abdul Karim et al (2008). The former study looks at the relationship between inflation and the RPV which measures price dispersion among the economic regions, namely the Peninsular Malaysia, Sabah and Sarawak. The later study further investigates the relationship between inflation and the RPV, but the RPV in that case measures price dispersion among subgroup prices for each of the three regions. Both studies find that inflation has a positive and significant effect on RPV, which further supports the menu cost theory. However, in contrast to other researchers, both studies do not measure the effect of different aspects of inflation on RPV. They only relate RPV to inflation rate and change in inflation rate. Specifically, they investigate if these variables and their squared values are correlated with RPV. Realizing the lack of study on this issue in Malaysian case, this study attempts to shed some lights on the issues.

METHODOLOGY AND DATA

To calculate inflation and variability of relative price this study uses monthly consumer price index (CPI) of Malaysia for period of 1994 to 2011. During this period of time there have been changes in both groups of commodities and also the base year to calculate CPI. Therefore, we use corresponding groups and weights for each period of time. Inflation in each group of commodities is defined as log-difference of the index for one period of time. The overall inflation rate is the weighted average of inflation in sub-indexes.

$$\pi_{it} = ln(P_{it}) - ln(P_{it-1}) \quad (1)$$

$$\pi_t = \sum_{i=1}^{n} w_i \pi_{it} \quad (2)$$

RPV is defined as the variance of the sub-indexes inflation rates around the overall inflation rate. In the literature some studies such as Aarstol (1999) and Tang and Wang (1993) used an unweighted measure of RPV[1]. However when weightings are available it would be more appropriate to measure weighted RPV, because some groups of product have relatively higher weights which reflect the importance of those group in comparison to others and therefore ignoring these weights neglects the "huge differences in the relative importance of goods" (Becker and Nautz, 2009). In this study we use both weighted and unweighted measure of RPV to compare the results estimated for each.

$$RPV_t^w = \sum_{i=1}^{n} w_i(\pi_t - \pi_{it})^2 \quad (3)$$

$$RPV_t^u = \frac{1}{n}\sum_{i=1}^{n}(\pi_t - \pi_{it})^2 \quad (4)$$

where w_i is the corresponding weight of each component and summation of all weights is equal to one. To measure the effect of different aspects of inflation we decompose inflation to expected and unexpected inflation. Following Aarstol (1999) and Becker and Nautz (2009) a Autoregressive moving average (ARMA) process with low order GARCH (p, q) error is used to model inflation which allow us to use its conditional variance as a proxy for inflation uncertainty. We use a Maximum-Likelihood estimation which minimize AIC to find the best lag structure. One period forecast of this ARMA model of inflation would be the expected rate of inflation, while the forecast error is supposed as inflation surprise or unexpected inflation.

$$UI_t = \pi_t - EI_t \quad (5)$$

[1]Aarstol (1999) ignores the weight but he mentioned the reason that weights were not available.

where UI_t and EI_t are unexpected and expected inflation in time t. To test for symmetric effect of unexpected inflation on RPV, as predicted by extension of signal extraction model, we use two auxiliary variables of positive expected inflation (UIP) and negative unexpected inflation (UIN). UIP is equal to UI, whenever UI≥0; otherwise it takes zero. Accordingly, UIN is equal to UI value when UI<0 and otherwise it is equal to zero.

RESULTS AND DISCUSSIONS

The inflation model which minimize AIC and at the same time makes significant coefficients for all lagged values, moving average terms and ARCH and GARCH terms is as below:

$$\begin{array}{l}\pi_t = \underset{(0.00)}{0.17} + \underset{(0.00)}{0.25}\,\pi_{t-1} - \underset{(0.00)}{0.13}\,\pi_{t-5} + \underset{(0.00)}{D0806} + \underset{(0.04)}{0.12}\,v_{t-7} + \underset{(0.01)}{0.13}\,v_{t-12} + v_t \\ \sigma^2_{v.t} = \underset{(0.00)}{0.02} + \underset{(0.00)}{0.27}\,v_{t-1} - \underset{(0.02)}{0.11}\,\sigma^2_{v.t-1} - \underset{(0.01)}{0.15}\,\sigma^2_{v.t-2} - \underset{(0.00)}{0.52}\,\sigma^2_{v.t-3}\end{array}$$

(Adjuster $R^2 = 0.43$)[2] (6)

D0806 represents the dummy variable to adjust Jun-2008 sharp increase[3] in fuel prices by government of Malaysia, which takes value of unit for this month and zero for other times. One period forecast of the above model is used as expected inflation and the forecast error created the unexpected inflation series. The conditional variance (CVAR) of the GARCH model is used to proxy for inflation uncertainty.

$$RPV_t = \alpha_0 + \alpha_1 EI_t + \alpha_2 UI_t + \alpha_3 CVAR_t \quad (7)$$

In next estimation, to test the symmetric effect of positive and negative inflation we substitute UI by UIP and UIN.

$$RPV_t = \beta_0 + \beta_1 EI_t + \beta_2 UIP_t + \beta_3 UIN_t + \beta_4 CVAR_t \quad (8)$$

Augmented Dickey–Fuller (ADF) test verified all variables to be stationary in any conventional level of confidence; the test results are available in table 1.For two measures of RPV, the estimation results of both equations8 and 9 are presented in Table 2. The results show that weighted RPV measures for both equations noticeably make higher R-squares, 0.90 versus 0.64. Our findings do not support the relationship between conditional variance of inflation equation with RPV. Yet, both expected and unexpected inflation significantly increase RPV. Using Wald test for equality of coefficients of expected and unexpected inflation, we cannot reject symmetric effect of expected and unexpected inflation in any conventional level of confidence. Although our finding partially supports extension of signal extraction, all of four equations support the significant effect of expected inflation for 1% level of confidence which means Menu Cost model is also supported by the results.

We believe our findings are consistent with those of Abdul Karim et at (2008) for Malaysian inflation-RPV nexus. They found that inflation, square of inflation as well as change in rate of inflation and its square value are all positively correlated to RPV. Therefore, they conclude that Menu Cost is supported with their findings. However, we believe change in the inflation rate is a proxy for unexpected inflation. Fischer (1981) states that "in practice unanticipated inflation is not easily distinguishable from the change in the inflation rate". He used a fourth order AR model to decompose inflation to expected and unexpected parts. His empirical finding verified his assumption about unexpected inflation and change in inflation rate, when he examined both change in inflation rate and unexpected inflation to affect RPV. We also found that, in the period of our study for Malaysia change of inflation rate is correlated to unexpected inflation with the rate of 0.63; therefore it can imply that Abdul Karim et al (2008) findings about the correlation between RPV and change of inflation is

[2]The same ARMA model ([1, 5], [7, 12]) minimize the AIC using OLS method; the results of using that model is consistent with following findings of the paper; however the OLS model suffer from autocorrelation and heteroscedasticity in error terms. For simple ARMA model the ARCH test reject the null hypothesis of no heteroscedasticity for 5% level of incidence; conversely, after applying the GARCH error term it cannot reject homoscedasticity for none of the conventional confidence levels.

[3]While inflation average rate for first 5 month of year 2008 is 0.3 percent, it sharply increases to 3.2 for month July due to more than 150% increase in fuel prices and decrease slowly in months later that to go fall back it past level. Removing this dummy will not change the findings of this paper while it decreases the R-square to less than 5 percent because of high error term for that specific month.

originally resulted from the effect of unexpected inflation on RPV. Therefore our finding which show unexpected inflation is correlated to RPV is somehow in consistence with their findings about change in inflation rate and RPV.

CONCLUSION

We believe finding of this study is not in contrast to recent related works in Malaysia, but this study completes those past studies and therefore it can contribute to our knowledge about this relationship. There are three main conclusion we can infer from the findings of this study.

First, the role of inflation in determining RPV is significant. However decomposing inflation to two different parts of expected and unexpected could help us to better explain this relationship. Our empirical findings show that both expected and unexpected inflation can contribute to RPV, while inflation uncertainty has no significant effect on RPV. That means menu cost theory and expansion of signal extraction are more successful in explaining this relationship than signal extraction theory.

Second conclusion is that the similar role of positive and negative unexpected inflation is under question. Although the Wald test could not reject the equality of two coefficients, we cannot assure that both positive and negative unexpected inflation have the same effect on RPV as sometimes, negative unexpected inflation shows insignificant effects. This conclusion is in harmony with those of Aarstol (1999) who found that negative unexpected inflation is not significantly related to RPV. Therefore, more researches about the asymmetric effect of positive and negative unexpected inflation are suggested for future researchers.

Thirdly we found that it is important if we could consider weighted measure for RPV instead of unweighted measure. The reason is that some groups of commodities are more important for consumers as they include a larger share of consumption according to surveys done by Malaysian Statistic Department. We also found that in practice using weighted data shows higher r-square in regressions. In addition the significance of coefficients is not the same when we compare two measures of RPV. This finding supports those of Becker and Nautz (2009) as they also found that using weighted measure of RPV is more useful to study the link between inflation and RPV.

We also believe that this study can contribute to government macroeconomic policies as it reveals some new aspects of relationship between inflation and RPV in Malaysia. According to many researchers such as Fischer (1981, 1982) and Longworth (2002), RPV can affect real macroeconomic variables as it distorts efficiency of resource allocation and consequently decreases output and welfare. One important policy implication is that according to findings of this study, a low and stable rate of inflation can significantly decrease RPV and help to minimize its negative effects on economy. Besides, we can infer that expected inflation is preferred to unexpected inflation as we found that the expected inflation has less influence on increasing RPV. Therefore, clarifying monetary policies and more transparency about prices would result to less uncertainty about movement in prices (i.e. inflation rate) and can decrease RPV.

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TABLE 1: ADF stationary test results

	t-Statistic	Probability
RPV^{UW}	-14.26	0.00
RPV^{W}	-13.88	0.00
EI	-11.17	0.00
UI	-15.52	0.00
UIP	-14.39	0.00
UIN	-13.70	0.00
CVAR	-5.48	0.00

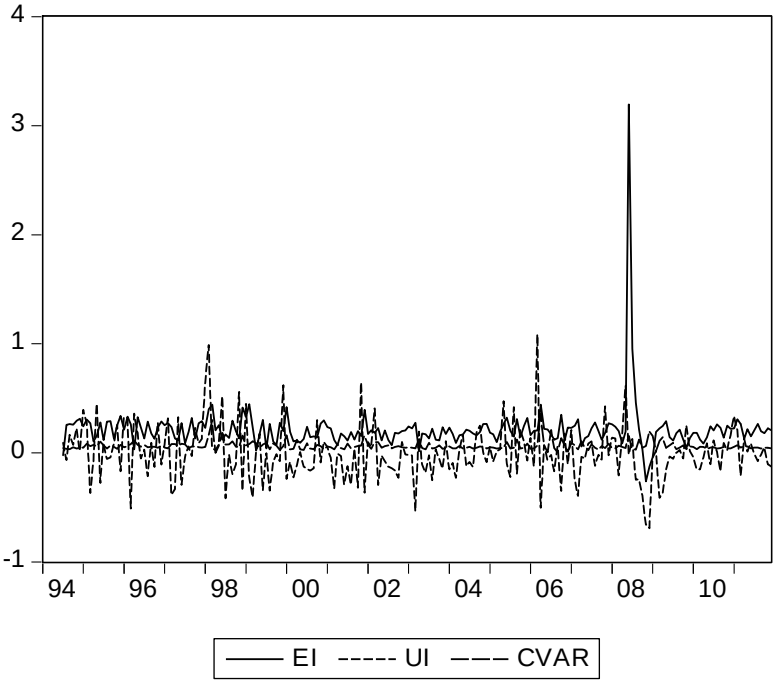
TABLE 2: OLS estimation for equations (8) and (9)

Equation (8)					
	α_0	α_1	α_2	α_3	
Weighted RPV	-0.04	3.46***	5.14***	-2.13	
	(0.72)	(0.00)	(0.01)	(0.31)	
Unweighted RPV	0.22	2.32***	3.37***	-1.84	
	(0.12)	(0.00)	(0.01)	(0.32)	
Equation (9)					
	β_0	β_1	β_2	β_3	β_4
Weighted RPV	-0.03	3.47***	4.94**	6.29*	-2.68
	(0.77)	(0.00)	(0.02)	(0.06)	(0.13)
Unweighted RPV	0.22	2.32***	3.41**	3.12	-1.72
	(0.11)	(0.00)	(0.01)	(0.15)	(0.25)

Note: numbers in parenthesis are P-value (Newey-West heteroscedasticity and autocorrelation consistent standard errors and covariance); ***, ** and * indicates significance in 1%,5% and 10%. R-square for weighted models is 0.90 while for unweighted models is 0.64 for both equations.

TABLE 3: Consumer Price Index Subcategories - Source: Department of Statistics

No	Group Name	Weights
0	Food and Non-alcoholic Beverages	30.3
1	Alcoholic Beverages and Tobacco	2.2
2	Clothing and Footwear	3.4
3	Housing, Water, Electricity, Gas and Other Fuels	22.6
4	Furnishings, Household Equip. & Routine household Maintenance	4.1
5	Health	1.3
6	Transport	14.9
7	Communication	5.7
8	Recreation Services & Culture	4.6
9	Education	1.4
10	Restaurants & Hotels	3.2
11	Misc. Goods & Services	6.3



GRAPH 1: Expected Inflation (EI), Unexpected Inflation (UI) and Inflation Uncertainty (CVAR)