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Inflation and relative price variability: short-run vs. long-run

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Abstract

This paper uses recent developments in measuring correlation to examine the relationship between inflation and relative price variability (RPV). The results suggest that the positive correlation holds not only in the short run but also in the long run. This finding has important implications for theoretical models that purport to explain this relationship: such models must incorporate features that generate positive relationships that hold even in the long run.

Keywords: Relative price variability; Correlation coefficients of VAR forecast errors

JEL classification: E31; E32

1. Introduction

The positive correlation between inflation and relative price variability[1] (RPV hereafter) is a well-documented empirical regularity. Whereas the existing literature has mainly focused on this relationship in the short run, whether it holds in the long run is controversial. However, this issue is important for developing theoretical models to explain this relationship. Most models developed during the last three decades seem to be based on the implicit assumption that this is a short-run phenomenon. For example, in the models developed by Lucas (1973) and Barro (1976), and extended

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[1] In most empirical work, since price indices are used instead of actual prices, the dispersion of price changes across commodity groups are used as a measure of RPV, although from a theoretical standpoint, it is desirable to use the dispersion of prices, and not price changes.

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by Parks (1978) and Hercowitz (1981), the misperceptions of absolute and relative price changes, caused by unanticipated happenings lead to increases in the dispersion of the relative price changes. More recently, Ball and Mankiw (1995) argue that the existence of menu costs faced by firms in adjusting prices gives rise to relative price changes, which in turn leads to aggregate inflation. These models seem to imply that the significant positive relationship between inflation and RPV would be short-lived. Balke and Wynne (2000), on the other hand, argue that the existence of similar positive relationships between the mean and the standard deviation, and even higher order moments of the distribution of technology shocks may be indicative of the changes in relative prices being driven by these technology shocks. One distinct implication of their model is that the relationship could hold even in the long run.[2]

Recently, two empirical studies have investigated the short-run and long-run relationships between inflation and RPV, and arrived at contradictory conclusions. Using actual price data for 32 commodities in 48 US cities for a period from 1975 through 1992, Parsley (1996) finds that the inflation–RPV correlation holds only in the short run, and therefore holds it to be evidence in support of misperceptions or menu cost models. He uses two different methods to examine whether the relationship holds in the long run. First, he examines the persistence characteristics of the univariate time series RPV measures, and of the residuals obtained from a regression of RPV on inflation. That the unit root null hypotheses are rejected for both series leads him to conclude that RPV is stationary, and therefore no long run relationship exists between inflation and RPV; that is, the two series are not cointegrated. Second, Parsley examines the impulse responses of RPV to a one-time inflation shock, obtained from a bivariate VAR, and finds that ‘once the mutual interdependence of inflation and RPV are accounted for, a one-time shock to inflation is dissipated fairly quickly’ reinforcing his earlier conclusion that inflation–RPV relationship is short-run. Debelle and Lamont (1997), on the other hand, use annual CPI data for 14 categories of goods and services in 19 US cities for a period from 1954 through 1986 and find substantial correlation even at longer time horizons, and therefore consider it to be evidence against misperceptions or menu cost models. In order to investigate long-run relationship, they re-compute inflation and RPV using price changes over 5-year intervals and re-estimate regressions of RPV on inflation.

In this paper, we re-examine the Inflation–RPV relationship in the short run as well as in the long run using aggregate price data for the US. This relationship is described from a dynamic perspective using the correlation coefficients of VAR forecast errors at different forecast horizons, recently proposed by den Haan (2000). This method encompasses a range of dynamic characteristics of the series under consideration in a very efficient manner. Moreover, the statistics are intuitive and easy to interpret. The results suggest that significant positive correlation between inflation and RPV holds even in the long run.[3] Thus, it implies that a model that is intended to explain this

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[2] Commenting on the implications of the Balke and Wynne model for relationship between various moments of the distribution of relative price changes, Bryan and Cecchetti (1999) write, “. . .the effects need not die out in the long run. In fact, if the effect is predominantly a real one, it might become more pronounced over time.”

[3] It is important to note that the procedure used in this paper, unlike that of Parsley, does not rely on an arbitrary set of identifying assumptions. In particular, the den Haan procedure is robust to the order of shocks to the model. For details, see den Haan (2000).

Table 1
Characteristics of the estimated VARs

Sample period	Unit root imposed	No. of variables	No. of lags	Linear trend	Quadratic trend
Monthly data					
1947:02–2000:10	No	2	13	Yes	Yes
1948:01–2000:01	No	4	5	Yes	Yes
1947:02–2000:10	Yes	2	10	No	No
1948:01–2000:01	Yes	4	10	No	No
Quarterly data					
1947:02–2000:03	No	2	1	Yes	Yes
1948:01–1999:04	No	4	2	Yes	Yes
1947:02–2000:03	Yes	2	12	No	No
1948:01–1999:04	Yes	4	2	No	No

relationship has to build in features that generate long-run positive relationship between inflation and RPV.

The rest of the paper is organized as follows. The second section discusses data and methodology. In the third section, we present and discuss the results. The next section concludes.

2. Data and methodology

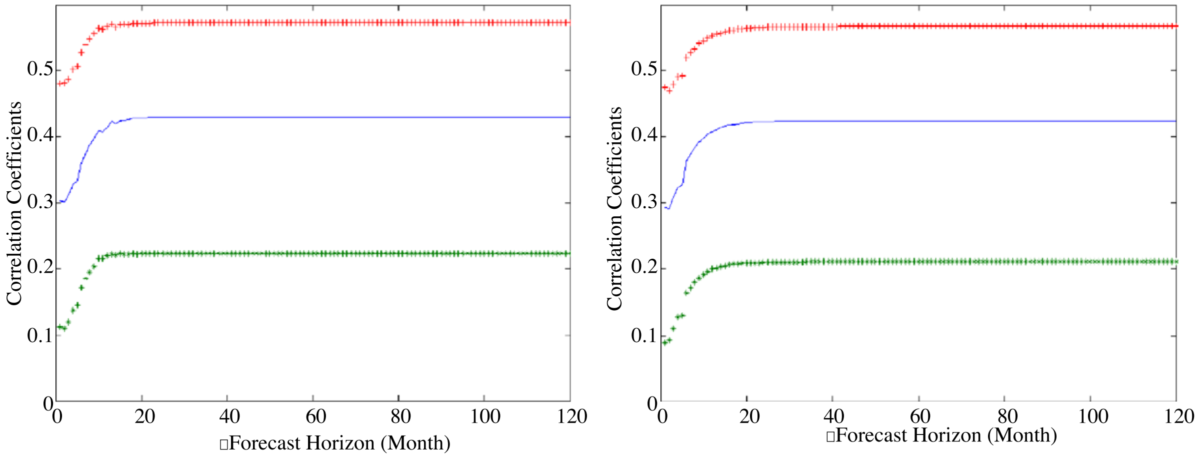
We use monthly and quarterly Producer Price Index (PPI hereafter) for 15 major commodity groups. The monthly data cover a period from January 1947 to October 2000 and the quarterly data cover a period from the first quarter of 1947 to the third quarter of 2000. These are two-digit commodity groups covering agriculture, forestry, mining and manufacturing—as defined by the Bureau of Labor Statistics (BLS). We also use monthly and quarterly data on monetary base and unemployment rate for the corresponding periods, obtained from the Monetary Trends published by the Federal Reserve Bank of St. Louis and the BLS, respectively.

We use these data sets to construct data on the variables required for this study. We first define the following variables. Let P_t be the PPI of all commodities in period t. Then the inflation in period t is defined as

$$\pi_t = \ln P_t - \ln P_{t-1} \tag{1}$$

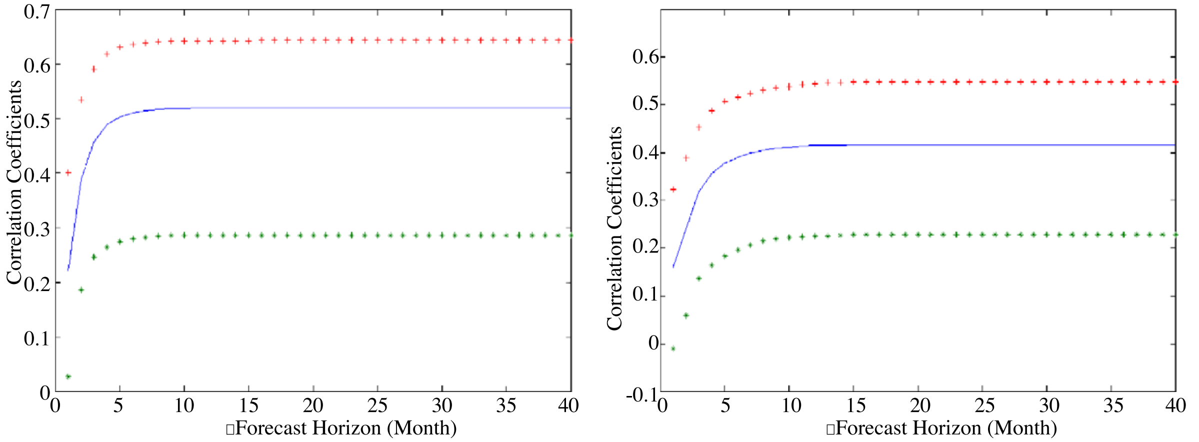
Relative price variability (RPV) in period t is defined as

$$V_t = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(\pi_{i,t} - \overline{\pi}_t)^2} \tag{2}$$



(A) Bivariate VAR; Monthly Data: 1947:2-2000:10

(B) Multivariate VAR; Monthly Data: 1948:2-2000:1



(C) Bivariate VAR; Quarterly Data: 1948:2-2000:2

(D) Multivariate VAR; Quarterly Data: 1948:2-1999:4

Fig. 1. Correlation between inflation and relative price variability. No unit root imposed in the estimation of VAR.

where $\bar{\pi}_t = \frac{1}{n}\sum_{i=1}^{n} \pi_{i,t}$ is the mean price changes (averaged across commodities)[4] in period t. Also, note that i indexes commodities and n is the number of commodities.

Following den Haan (2000), we calculate correlation coefficients of forecast errors at different forecast horizons, obtained from estimation of various specifications of the following VAR model:

$$Y_t = A + Bt + Ct^2 + \sum_{j=1}^{p} D_j Y_{t-j} + \varepsilon_t \tag{3}$$

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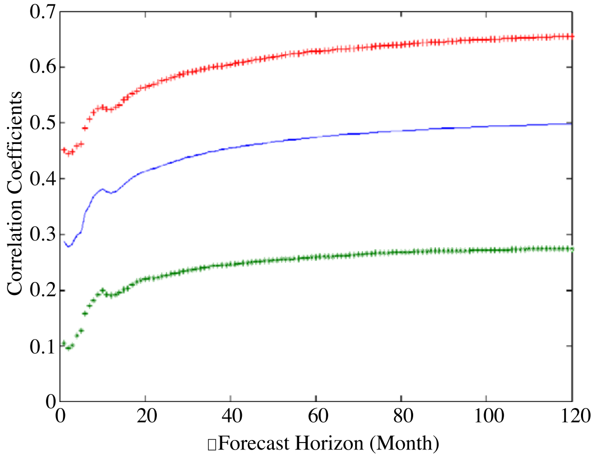
[4] Note that P_t is constructed as a weighted index of all underlying prices and therefore it is desirable that both V_t and $\bar{\pi}_t$ are calculated as weighted standard deviation and mean, respectively. However, we find that the results do not change. Moreover, some prominent studies (e.g., Vining and Elwertowski, 1976; Debelle and Lamont, 1997) use unweighted measures.

where Y_t is an $m \times 1$ vector that includes inflation, π_t, and relative price variability, V_t; A, B and C are $m \times 1$ vectors of constants; D_j is an $m \times m$ matrix of auto-regressive coefficients at lag j. ε_t is an $m \times 1$ vector of innovations that are assumed to be serially uncorrelated but can be correlated with each other. We define the K-period ahead forecast errors for inflation and RPV from this VAR as follows:

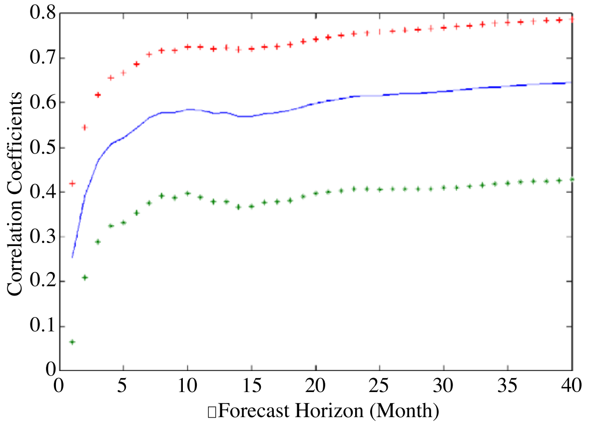
$$e^{\pi}_{t+K,t} = \pi_{t+K} - E_t \pi_{t+K} \tag{4}$$

$$e^{V}_{t+K,t} = V_{t+K} - E_t V_{t+K} \tag{5}$$

Then, we calculate the correlation between $e^{\pi}_{t+K,t}$ and $e^{V}_{t+K,t}$ and denote it by Corr (K). As we can see from the general formulation of the estimation Eq. (3), this model allows for a number of



(A) Bivariate VAR; Monthly Data: 1947:2-2000:10 (B) Multivariate VAR; Monthly Data: 1948:2-2000:1



(C) Bivariate VAR; Quarterly Data: 1948:2-2000:2 (D) Multivariate VAR; Quarterly Data: 1948:2-1999:4

Fig. 2. Correlation between inflation and relative price variability. Unit root imposed in the estimation of VAR.

dynamic characteristics, including trend and/or quadratic trend, of the series that are being modeled.

3. Results

We first estimate a bivariate VAR that includes inflation and RPV, and then estimate a multivariate VAR that includes growth of monetary base and unemployment as additional variables. Since these two variables have been shown to be important for long-run and short-run behavior of inflation we thought it would be appropriate to see if they affect the inflation–RPV relationship. The characteristics of the models that we have estimated are summarized in Table 1. The lag lengths and inclusion of linear and quadratic trends are based on the Akaike information criterion. 90% confidence intervals are calculated using bootstrap methods.

The correlation coefficients for the monthly and quarterly data along with their 90% confidence intervals are plotted in Figs. 1 and 2 under two scenarios. Fig. 1 plots these coefficients at different time horizons when no unit root is imposed in the estimation of the VAR, and Fig. 2 plots them when a unit root is imposed.[5] As we can see from the figures, under both scenarios, the coefficients are significantly positive at all horizons. However, in Fig. 1, with no unit root imposed, convergence to a constant positive correlation is rapid, occurring in about 2 years. On the other hand, under the second scenario convergence is slower, as the coefficients increase throughout the forecast horizon. The correlation coefficients of forecast errors from both bivariate and multivariate VAR are qualitatively the same.

Given the widespread view that relative price changes are caused by temporary disturbances in the individual markets and therefore the positive relationship between inflation and RPV would at best be short-lived, this result is interesting and has far-reaching implications for theories that are needed to explain such relationship.

4. Conclusion

In this paper, the correlation coefficients of VAR forecast errors at different forecast horizons are used to examine the relationship between inflation and relative price variability. The results suggest that the positive correlation holds not only in the short run but also in the long run. This has important implications for the models intended to explain this relationship: such models must incorporate features that generate positive relationship that holds even in the long run.

Acknowledgements

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[5] Both Augmented Dickey–Fuller Test and Phillips–Perron Test reject the unit root null hypothesis for inflation, RPV and money growth. On the other hand, unemployment rate is found to be a unit root process. These test results for inflation and unemployment are, however, controversial.

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