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Differential Inflationary Expectations: Evidence From A High Inflation Economy

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INTRODUCTION

The theoretical relationship between the variance of inflationary expectations across markets, the variance of aggregate demand, inflation uncertainty and the variance of inflation has been analyzed by Cukierman and Wachtel (CW, hereafter) in a couple (of studies (CW, 1979, 1982). Using a multigood adaptation of Lucas' (1973) multimarket equilibrium model, CW show that holding the variability of market; specific shocks constant ii positive relationship exists between -the above mentioned variables. Taylor (1981), using a different theoretical framework, predicts the same relationship between the variability of inflationary forecasts across markets and the variance of inflation.

Empirical tests of the CW propositions require data cd inflationary expectations across markets. Such data can be found in surveys of inflationary expectations of individuals, since the survey's respondents come frmni different markets which they are assumed to represent. The two most famous and commonly used sources for inflationary expectations iri the LLS. (Livingston's and The Universitli of Michigan SRC survey) have been used for the empirical analysis in CW (1979, 1982).[1] While CW provide empirical support for their propositions, their results have been questioned by Mitchell and Taylor (1982). No further attempts at testing the empirical validity of the CW model have been made since. This surprising fact is attributed to the lack of survey data, regarding inflationary expectations, for countries outside the U.S.[2] This paper attempts to fill this gap, by using new survey data for Israel. It thus provides an opportunity to test, for the first time, the validity of the CW propositions for a country other than the U.S. and in high inflation economy.

CW's propositions have important policy implications. If high and variable inflation leads to more inflation uncertainty and higher dispersion of inflationary expectations across markets, then it clearly has an adverse effect on economic activity and allocation of resources. In that case a stable government economic policy is called for.

THE THEORETICAL PROPOSITIONS AND PREVIOUS EMPIRICAL EVIDENCE

CW (1979, 1982) advance the following propositions:

a)The %variance of inflationary expectations across markets, $V(\pi^e)$ increases when the variance of the aggregate demand shock, V(y), increases.

b)There is a positive relationship between $V(\pi^e)$ and the variance of actual inflation $V(\pi)$. The intuition of proposition (b) is that mmen the behavior of inflation becomes more erratic there is more disagreement about the future course of inflation.[3]

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c)There is ii positive relationship between inflation uncertainty (denoted by V(FE) and defined precisely in section 3) and V(y).

d)There is a positive relationship between V(FE) and $V(\pi^e)$

e)There is a positive relationship between V(FE) and $V(\pi)$.

Allpropositions are valid only if the variance of relative demand shocks is constant over time as is proved by CW (1982).

To test proposition (a) CW (1979) regress $V(\pi^e)$ on a moving variance of nominal GNP change, V(y), and on nominal personal income change, V(PI). For the Livingston data both V(PI) and V(y) have a positive and significant effect on $V(\pi^e)$ as suggested by the model . For the SRC data only V(y) is significant.

CW test proposition (b) by regressing $V(\pi^e)$ on $V(\pi)$ where the latter is measured for the consumer price index, V(CPI), and for the GNP deflator, V(PGNP). For both measures of V(n) and for both sources of data (livingston and SRC), the results support proposition (b). Mitchell and Taylor (1982), show that the error terms in CW's regressions for the Livingston data are serially correlated. Reestimating the equations using the Cochrane-Orcutt procedure (CORC), proposition (b) does not hold: $V(\pi)$ is not significantly associated With $V(\pi^e)$. The results for proposition (a) are mixed: V(y) has a significant negative effect on $V(\pi^e)$ contrary to proposition (a), while V(PI) has the expected significant positive effect. In a later paper CW (1982) try to overcome the problem of serial correlation by breaking the sample into four sub-samples. In all of their regressions, the coefficients of V(y), V(PI), V(CPI) and V(PGNP) are significant and positive as predicted by propositions (a) and (b). However, while their procedure significantly reduces the degree of serial correlation, in half of the regressions for the $V(\pi)$ variables the hypothesis of no serial correlation cannot be accepted (at the 5% significance level).

Preliminary empirical support for propositions (c), (d) and (e) is provided by CW (1982). They calculate the simple coefficients of correlation between V(FE), $V(\pi)$, $V(\pi^e)$ and V(y) and find all of them to be positive as expected.

THE EMPIRICAL TESTS

The Data

The data for inflationary forecasts is based on a survey conducted by the authors. The survey is carried out every quarter starting in 1980; consequently, this limits the sample to the post-1980 period. The survey is conducted through questionnaires mailed to economists and executives (chief financial officers, general managers, chairmen) in the industrial, commercial and banking sectors in Israel. The survey participants are asked to report their expected rate of inflation for one, two, three and four quarters ahead. The empirical analysis is based on the one-quarter ahead forecasts. On the average 76 respondents returned their questionnaires in time to be included in the sample [4]. The response rate, which was measured since 1985, was quite high: it varied between 43% and 60%, averaging 50%. Some of the participants in the survey are the same individuals throughout most or the entire sample period. Others were added to the mailing list as it was expanded, or when they took over a position held by another survey's participant. Those who changed jobs continued to be included in the sample if they could be traced. individuals who did not respond at several consecutive samples were not approached anymore. [5]

As was mentioned earlier, this paper concentrates on the empirical aspects of the CW propositions. Thus more care was exercised in constructing the various measures for the moving variances (MV). This enables us to examine whether the results are sensitive to the particular measure chosen. The empirical analysis of CW (1979, 1982) and Mitchell and Taylor (1982) is extended in two directions. First, two methods of constructing the MV measures are used. The first (similar to CW), is a centered MV (CMV). Mitchell (1981) argues that the CMV measure is theoretically inferior since it assumes that forecasters are aware of the variability in the future months. Thus, a second method is used here - an end of period MV (EMV) . In this measure only past and current variability is used.

$$(1)\quad CMV_t = \sum_{t-a}^{t+a}(X_i - \bar{X}_t)^2/(2a+1) \quad \bar{X}_t = \sum_{t-1}^{t+a} x_i/(2a+1)$$

$$(2)\quad EMV_t = \sum_{t-b}^{t}(X_i - \bar{X}_t)^2/(1+b) \quad \bar{X}_t = \sum_{t-b}^{t} X_i/(1+b)$$

Secondly, rather than fixing the value of equations (1) and (2) (e.g. at 9 quarters as in CW), we experimented with different values of a and b, and the optimal value -a and b - were chosen on the basis of the highest R^2 for the regression equation. For variables where data is available both monthly andquarterly, MV was calculated for both frequencies.

To test the CW propositions the following regressions were estimated.

(3) $V(\pi^e) = a_0 + a_1 MV(y)$
(4) $V(\pi^e) = b_0 + b_1 MV(\pi)$
(5) $V(\pi^e) = c_0 + c_1 V(FE)$
(6) $V(FE) = d_0 + d_1 MV(\pi)$
(7) $V(FE) = e_0 + e_1 MV(y)$

MV(y) is measured as a moving variance of the percentage change in the nominal GNP (quarterly data). $MV(\pi)$ is measured as a moving variance of the percentage change in the consumer price index, MV(CPI), for both monthly and quarterly data and also as a moving variance of the percentage change in the GNP deflator MV(PGNP) for quarterly data. To measure inflation uncertainty, V(FE), CW(1982) suggest to use the mean squared error of inflation forecasts drawn from the survey of inflationary expectations. This is a cross-sectional measure of dispersion of forecast errors across individuals:

$$(8)\quad V_t(FE) = \sum_{i=1}^{n}(\pi^e_{it} - \pi_t)^2/n = \sum_{i=1}^{n}(\pi^e_{it} - \bar{\pi}^e_t)/n + ({}_t\bar{\pi}^e - {}_t\pi)$$
$$= V_t(\pi^e) + (\pi_t - \bar{\pi}^e_t)^2$$

Where π^e_i is the expected inflation rate of individual i, π is actual inflation rate $\bar{\pi}^e$ is the survery's mean forecast and n is the number of forecasters. The first term on the right hand side of equation (8) is the variance of forecasts, which has been used in previous studies as a proxy for inflation uncertainty (e.g. Levi and Makin, 1980, and Mitchell, 1981) .

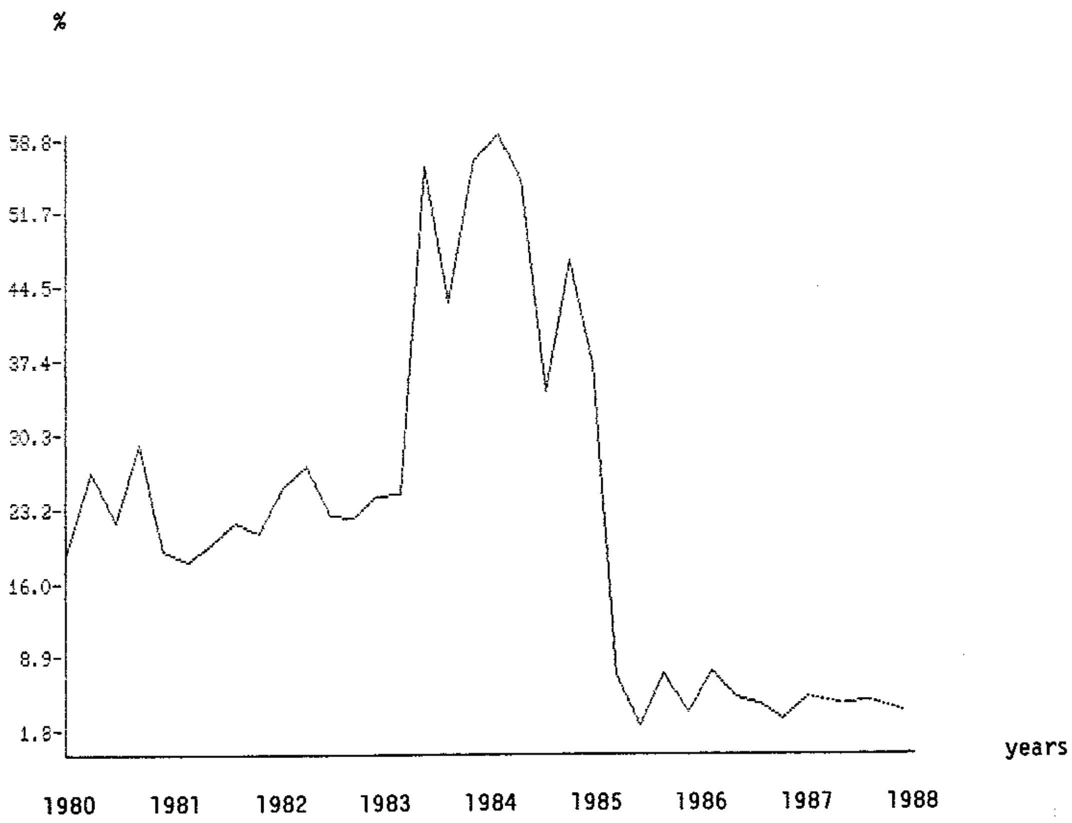
All equations were estimated using the OLS procedure. However, whenever the hypothesis of no serial correlation could not be accepted, a first order autoregressive process for the error term was assumed and maximum likelihood (ML) estimates were obtained using a search procedure. (See Maddala, 1977, p. 279.)

The Empirical Results

As was mentioned earlier, the availibility of the data regarding inflationary expecatations limits the sample to the 1980.1 - 1988.3 period. Over this period, the inflationary experience in Israel had changed dramatically, as evident from Figure 1. In the 1980.1 - 1985.2 period quarterly inflation was extremely high: it varied between 18% and 59% (94% - 539% in annual terms) and averaged 31% (194% annually). Following a successful stabilization policy in July 1985, inflation in the later sub-period (1985.3-1988.3) decreased drastically. It declined from 37% in the third quarter of 1985 to 7% in the quarter immediately following and then hovered within a relatively narrow band; between 2% and 7% per quarter (8% - 31% in annual terms). [6]

Figure 1

Quarterly Inflation Rates: 1980.1-1988.3



CW propositions are based on the confusion between aggregate and relative changes. This confusion is likely to intensify when inflation is high. Thus the equations were estimated first just for the high inflation sub-period: 1980.1-1985.2. The results are provided in Table 1 for the EMV measures. The striking result is that all of C&J propositions are strongly supported by the high inflation data. This conclusion is valid for all methods of estimation and for the quarterly and motnly measures of the MV variable, as well as for all moving variances whether calculated at center or end of period. [7]

Equation (8) suggests that for a contant forcast error the slope coefficent iri equation 1.5 should be one. Fbwever, if the forecast error varies and it is positively correlated with V(FE) (as is indeed the case) then the coefficient in equation 1.5 would be biased downwards, and this explains the low estimate of 0.29.

It is quite interesting to examine whether the theory is supported at relatively low rates of inflation too. This was done by reestimating the equations for the full sample period which includes the relatively low inflation data from the post-July 1985 stabilization program. These results, for the EMV measures, [8] are provided in Table 2. The inclusion of the relatively low inf lation sub-period in the sample results in a substantial decline in the explanatory power of the regressions, as is eodent from a comparison of Tables 1 and 2. Significant results are obtained only in equations 2.4, 2.5 and 2.7, supporting the last three propositions (c, d and e) of CW, regarding the positive relationship between inflation uncertainty and the variances of inflationary expectations across markets, the aggregate demand shock and actual inflation. The first two propositions regarding the relationship between the variance of inflationary expectations across markets and the variances of the aggregate demand shock and actual inflation are not supported by the full sample results, as was the case in the Mitchell and Taylor (1982) study.[9] It should be noted, however, that the use of the moving average measure of inflation variability may, be inappropriate during the transition from high to low inflation. While market participants may have lowered their inflationary expectations, the moving average meaure still registers much higher levels of inflation. This may be the cause for the insignificant results obtained for propositions (a) and (b) in the full sample.

An important finding of this study concerns the correlation between V(FE) and $V(\pi^e)$ and $MV(\pi)$. As was mentioned Earlier V(FE) should be used as a measure of inflation uncertainty. However, many empirical studies have used $V(\pi^e)$ or $MV(\pi)$ instead. The high significant correlation between V(FE) and $V(\pi e)$ (.64-.66), which is fond for both the high inflation period and the fullsample data lends credibility to findings based on the $V(\pi^e)$ measure.However, a high significant correlation between V(FE) and $MV(\pi)$ (.50-.82)is found only for the high inflation period. This calls for caution in interpreting MV(u) as a measure of inflation uncertainty in low inflation periods.

CONCLUSIONS

This paper tests, for the first time, the empirical relationship between the variance of inflationary expectations across markets, the variance of aggregate clemand, inflation uncertainty and the variance of inflation, in a high inflation economy.

The theortical positive relationship between the above variables, suggested by CW (1979, 1982), is strongly supported by the results of this study for the high inflation period. The relationship holds for a variety of measures f or the variabiLity of inflation (monthly and quarterly data for the consumer price index and quarterly data for the GNP deflator) and for different techniques of calculating moving variances (centered or end of period figures). There is a clear indication that the higher and more variable is the inflation rate, the stronger is the relationship between the above mentioned variables. When the relatively low inflation data is added to the sample, there is support for CW propositions regarding the positive relationship between inflation uncertainty, the variance of aggregate demand, the variance of inflationary expectations across markets and the variance of actual inflation. However, similarly to Mitchell and Taylor (1982), there is no support for CW propositions regarding the positive association between the variance of inflationary expectations across mattets and the variance of inflation and aggregate demand.

Erratic government policies cause high and variable inflation, which, according to the results reported earlier, increase inflation uncertainty and the variance of inflationary expectations across markets. This, in turn, reduces economic activity and leads to misallocation of resources. Thus the results call for a consistent and stable economic policy.

TABLE 1

Regressions of the Variance of Inflationary Expectations, $V(\pi^e)$, and Inflation Uncertainty, V(FE): 1980.1-1985.2
(All moving variances are calculated at end of period)

Eq. No.	Dependent Variable	Constant	MV(y)	MV(π)	V(FE)	R^2 O.W.	Estimation procedure	Measure of V
1.1	$V(\pi^e)$	8.67 (1.92)	.25 (8.29)			.773 2.20	ML	Q,7
1.2	$V(\pi^e)$	8.15 (1.89)		.27 (8.95)		.808 2.33	ML	Q,9 CPI
1.3	$V(\pi^e)$	-.21 (-.05)		2.24 (7.29)		.713 2.39	OLS	M,20 CPI
1.4	$V(\pi^e)$	7.73 (1.78)			.29 (6.45)	.659 1.72	OLS	
1.5	V(FE)	12.23 (.97)	.69 (7.61)			.741 1.98	ML	Q,6
1.6	V(FE)	9.49 (.68)		.70 (7.85)		.752 1.87	ML	Q,12
1.7	V(FE)	.05 (.00)		5.16 (9.51)		.817 2.13	ML	M,11

Numbers in parentheses are t-values.

The last column provides data on the way V was constructed: Q, M refer to quarterly and monthly data, respectively, followed by -the number of periods used. The price variable reported in the table is based on the consumer price index. Virtually the same results were obtained for the GNP price deflator.

TABLE 2

Regression of the Variance of Inflationary Expectations, $V(\pi^e)$ and Inflation Uncertainty, V(FE): 1980.1 - 1988.3
(All moving variances are calculated at end of period)

Eq. No.	Dependent Variable	Constant	mv(y)	MV(π)	V(FE)	R^2 D.W.	Estimation procedure	Measure of V
2.1	$V(\pi^e)$	8.80 (2.00)	-.10 (-1.58)			.020 2.14	ML	Q,5
2.2	$V(\pi^e)$	9.59 (2.01)		.01 (.25)		-.028 2.06	ML	Q,6 CPI
2.3	$V(\pi^e)$	6.85 (1.49)		.52 (1.88)		.072 1.94	ML	M,13 CPI
2.4	$V(\pi^e)$	5.16 (1.60)			.33 (7.90)	.644 2.33	OLS	
2.5	V(FE)	23.31 (1.77)	.24 (2.44)			.128 1.72	OLS	Q,5
2.6	V(FE)	23.83 (1.88)		14 (1.01)		.001 2.25	ML	Q,5 CPI
2.7	V(FE)	21.32 (1.77)		1.70 (3.19)		.212 1.63	OLS	M,11 CPI

See notes to Table 1.

NOTES

1. Fischer (1981) uses the same data to analyze the relationship between the variance of inflationary expectations across markets, actual inflation and expected and unexpected inflation.
2. Surveys of inflationary expectations exist for some European countries, but the respondents' answers are qualitative rather than quantitative. (e.g. Visco (1984) for Italy, Knobl (1974) for Germany and Carlson and Parkin (1975) for the UK).
3. Taylor (1981) reaches a similar conclusion, using a different theoretical framework. In his model the positive relationship between $V(\pi^e)$ and $V(\pi)$ is caused by changes in the variability of exogenous shocks which affect both variables in the same way.
4. Questionnaires are sent on the 15 th of the first month in the quarter, when the inflation rate for the last month of the previous quarter is th made public. 101 responses nailed before the 15 of the second month in the quarter (when the inflation rate for the first month is published) are included in the sample.
5. A more (detailed description of the data is provided in Ungar and Zilberfarb (1991) and is available from the authors.

6. For a description and analysis of the stabilization policy, see, e.g., Bruno (1986).
7. The results for the CMV measures and for the GNP price deflator are available from the authors.
8. Using the CMV measures would result in loss of observations belonging to the already short second sub-period. Therefore only the EMV measures were used.
9. Similar conclusions are derived from regression analysis, limited to the 1985.3-1988.3 period.

REFERENCES

Bruno, M. "Sharp Disinflation Strategy: Israel 1985", *Economic Policy,* 2, 1986, 379-402.

Carlson, J.A. and Parkin, M. "Inflation Expectations", Economica, Vol. 42, 1975, 123-38.

Cukierman, A. Inflation, Staflation, Relative Prices and Imperfect Information, Cambridge University Press, 1984.

Cukierman, A. and Wachtel, P. "Differential Inflationary Expectations and the Vari abi l i ty of the Rate of Inf l ati on *Ameri can Economi c Revi* ew, Vol . 69, Sept. 1979, 595-609.

__________"Inflationary Expectations: Reply and further thoughts on Inflation Uncertainty", *American Economic Review,* Vol. 72, June 1982, 508-512.

Fischer, S. "Towards an Understanding of the Costs of Inflation II", in: *The Costs and Consequences of Inflation,.* Carnegie-Rochester Comference Series on Public Policy No. 15, North-Holland, 1981.

Knobl, A. "Price Expectations and Actual Price Behavior in Germany", *International Monetary Fund* Staff Papers, Vol. 21, 1974, 83-100.

Levi, M. and Makin, J. "Inflation Uncertainty and the Phillips Curve: Some Empirical Evidence", *American Economic Review,* Vol. 70, No. 5, 1980, 1022-7.

Lucas, R.E. HSome International Evidence on Output-Inflation Tradeoffs", *American Economic* Review, Vol. 63, June 1973, 326-34.

Maddala, G.S. *Econometrics,* McGraw-Hill, 1977.

Mitchell, D.W. "Determinants of Inflation Uncertainty", *Eastern EconomicJournal,* Vol. 7, No. 2, April 1981, 111-117.

Mitchell, D.W. and Taylor, H.E. "Inflationary Expectations: Comment", *American Economic Review,* Vol. 72, June 1982, 502-507.

Taylor, J.B. "On the Relation Between the Variability of Inflation and the Average Inf lation [Zate", in: *The Costs and Consequences of Inf lation,* Carnegie-Rochester Conference Series on Public Policy no 15, North-Holland, 1981.

Ungar, M. and Zilberfarb, B. "A Survey of Inflation and Exchange Rate Forecasts: Sample Description", Technical Report, the Azrieli Research institute, Bar-Ilan University, 1991.

Visco, 1. *Price Expectations in Rising* Inflation, Amsterdam: North- Holland, 1984.