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 Chillemi and Wochet (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, a 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 on inflationary expectations across markets. Such data can be found in surveys of inflationary expectations of individuals, since the surveys respondents used in different markets which they are assumed to represent. The two most famous and commonly used sources for inflationary expectations in the L.S. (Livingston's and the University of Michigan SRC surveys) have been used for the empirical analysis in CW (1979, 1982). While CW provide empirical support for their propositions, their results have been questioned by Mitchell and Taylor (1982). No further attempt 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. 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, $V(\sigma^2)$, increases when the variance of the aggregate demand shock, $V(\gamma)$, increases.

b) There is a positive relationship between $V(\sigma^2)$ and the variance of actual inflation $V(\sigma)$. The intuition of proposition (b) is that since the behavior of inflation becomes more erratic there is more disagreement about the future course of inflation.

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c) There is a 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(πa)

e) There is a positive relationship between V(FE) and V(x).

All propositions 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(y|x) on a moving variance of nominal GNP change, V(y), and on nominal personal income change, V(FI). For the Livingston data both V(FI) and V(y) have a positive and significant effect on V(y|x) as suggested by the model. For the SRC data only V(y) is significant.

To test proposition (b) by regressing V(x) on V(y|x) where the latter is measured for the consumer price index, V(CPI), and for the GNP deflator, V(PGDP). For both measures of V(y) 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(x) is not significantly associated with V(y|x). The results for proposition (a) (and V(y)) have a significant negative effect on V(y|x) contrary to proposition (a), while V(FI) 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 coefficient of V(y) and V(FI), V(CPI) and V(PGDP) 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 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(x), V(πa) 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 70 respondents returned their questionnaires in time to be included in the sample. The response rate, which was measured since 1965, was quite high: it varied between 45% and 69%, averaging 50%. Some of the participants in the survey are the same individuals throughout most of the entire sample period. Others were added to the mailing list as it was expanded, or when they took a position held by another survey participant. 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.

$$\text{(1)} \quad \text{CMV} = \sum_{i=1}^{n} (x_i - \bar{x})^2 / (2n + 1)$$

$$\text{(2)} \quad \text{EMV} = \sum_{i=1}^{n} (x_i - \bar{x})^2 / (1 + b)$$

Secondly, rather than fixing the value of the equation (1) and (2) (e.g. as 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 R² for the regression equation. For variables where data is available both monthly and quarterly, MV was calculated for both frequencies.

To test the CW propositions the following regressions were estimated.

$$\text{(3)} \quad V(x) = a_0 + a_1 \text{CMV}(y)$$

$$\text{(4)} \quad V(πa) = b_0 + b_1 \text{MV}(x)$$

$$\text{(5)} \quad V(x) = c_0 + c_1 \text{CV}$$

$$\text{(6)} \quad V(π_a) = d_0 + d_1 \text{MV}(π_a)$$

$$\text{(7)} \quad V(π_a) = c_0 + c_1 \text{CV}(π_a)$$

MV(y) is measured as a moving variance of the percentage change in the nominal GNP (quarterly data). MV(x) is measured as a moving variance of the percentage change in the consumer price index, V(CPI), for both monthly and quarterly data and also as a moving variance of the percentage change in the GNP deflator MV(PGDP) (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.

$$\text{(8)} \quad V(FE) = \sum_{i=1}^{n} (x_i - \bar{x})^2 / n = \sum_{i=1}^{n} (x_i - \bar{x})^2 / n + (\bar{x} - \bar{x})^2$$

Where $\bar{x}$ is the expected inflation rate of individual i, $x$ is actual inflation rate, $\bar{x}$ is the survey'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 minimum likelihood (ML) estimates were obtained using a search procedure. (see Maddala, 1977, p. 276)

The Empirical Results

As was mentioned earlier, the availability of the data regarding inflationary expectations limits the sample to the 1980.1 - 1983.3 period. Over this period, the inflationary experience in Israel had changed dramatically, as evident from Figure 1. In the 1980.1 - 1982.2 period, quarterly inflation was extremely high: it varied between 18% and 59% (94% - 359% in annual terms) and averaged 31% (194% annually). Following a successful stabilization policy in July 1985, inflation in the later sub-period (1983.3 - 1985.3) decreased drastically. It declined from 5% in the third quarter of 1985 to 0% in the quarter immediately following and then hovered within a relatively narrow band between 2% and 7% per quarter (0% - 3.1% in annual terms).
CW proportions 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 (1981.1-1985.2). The results are provided in Table 1 for the EMV measures. The striking result is that all of the EMV propositions are strongly supported by the high inflation data. This conclusion is valid for all methods of estimation and for the quarterly and monthly measures of the MV variable, as well as for all moving variances whether calculated at center or end of period.

Equation (7) suggests that for a constant forecast error the slope coefficient in equation 1.5 should be one. However, if the forecast error varies and it is positively correlated with V(WE) (as is indeed the case) then the coefficient in equation 1.5 would be biased downwards, and this explains the low estimate of 0.28.

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, are provided in Table 2. The inclusion of the relatively low inflation sub-period in the sample results in a substantial decline in the explanatory power of the regressions, as is evident 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. 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 inflation expectations, the moving average measure 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(WE) and V(a) and MV(a). As was mentioned earlier V(WE) should be used as a measure of inflation uncertainty. However, many empirical studies have used V(a) or MV(a) instead. The high significant correlation between V(WE) and V(a) (44.66), which is found for both the high inflation period and the fullsample data lends credibility to findings based on the V(a) measure. However, a high significant correlation between V(WE) and MV(a) (.50-.85) is found only for the high inflation period. This calls for caution in interpreting MV(a) 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 demand, inflation uncertainty and the variance of inflation, in a high inflation economy.

The theoretical 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 for the variance 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 markets and the variance of inflation and aggregate demand.

Erroneous government policies cause high and variable inflation, when, 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, \( V(e^t) \), and Inflation Uncertainty, \( V(\text{FE}) \): 1980.1-1985.2**

(All moving variances are calculated at end of period)

<table>
<thead>
<tr>
<th>Eq. No.</th>
<th>Dependent Variable</th>
<th>Constant</th>
<th>( MV(y) )</th>
<th>( MV(e) )</th>
<th>( V(\text{FE}) )</th>
<th>( R^2 )</th>
<th>Estimation procedure</th>
<th>Measure of ( V )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>( V(e^t) )</td>
<td>8.67</td>
<td>(.92)</td>
<td>25</td>
<td>(.29)</td>
<td>.773</td>
<td>ML</td>
<td>Q,.7</td>
</tr>
<tr>
<td>1.2</td>
<td>( V(e^t) )</td>
<td>8.15</td>
<td>(.89)</td>
<td>27</td>
<td>(.95)</td>
<td>.888</td>
<td>ML</td>
<td>Q,.9</td>
</tr>
<tr>
<td>1.3</td>
<td>( V(e^t) )</td>
<td>-21</td>
<td>(.05)</td>
<td>2.24</td>
<td>(7.29)</td>
<td>.713</td>
<td>OLS</td>
<td>M,.20</td>
</tr>
<tr>
<td>1.4</td>
<td>( V(e^t) )</td>
<td>7.75</td>
<td>(1.78)</td>
<td>29</td>
<td>(6.45)</td>
<td>.659</td>
<td>OLS</td>
<td></td>
</tr>
<tr>
<td>1.5</td>
<td>( V(\text{FE}) )</td>
<td>12.22</td>
<td>(.97)</td>
<td>69</td>
<td>(7.61)</td>
<td>.741</td>
<td>ML</td>
<td>Q,.6</td>
</tr>
<tr>
<td>1.6</td>
<td>( V(\text{FE}) )</td>
<td>9.49</td>
<td>(.68)</td>
<td>70</td>
<td>(7.85)</td>
<td>.752</td>
<td>ML</td>
<td>Q,.12</td>
</tr>
<tr>
<td>1.7</td>
<td>( V(\text{FE}) )</td>
<td>.05</td>
<td>(.00)</td>
<td>5.16</td>
<td>(9.51)</td>
<td>.817</td>
<td>ML</td>
<td>M,.11</td>
</tr>
</tbody>
</table>

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, \( V(e^t) \) and Inflation Uncertainty, \( V(\text{FE}) \): 1980.1 - 1988.3**

(All moving variances are calculated at end of period)

<table>
<thead>
<tr>
<th>Eq. No.</th>
<th>Dependent Variable</th>
<th>Constant</th>
<th>( mv(y) )</th>
<th>( MV(e) )</th>
<th>( V(\text{FE}) )</th>
<th>( R^2 )</th>
<th>Estimation procedure</th>
<th>Measure of ( V )</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>( V(e^t) )</td>
<td>8.80</td>
<td>(.10)</td>
<td>25</td>
<td>(.29)</td>
<td>.773</td>
<td>ML</td>
<td>Q,.7</td>
</tr>
<tr>
<td>2.2</td>
<td>( V(e^t) )</td>
<td>9.59</td>
<td>(.01)</td>
<td>27</td>
<td>(.95)</td>
<td>.888</td>
<td>ML</td>
<td>Q,.9</td>
</tr>
<tr>
<td>2.3</td>
<td>( V(e^t) )</td>
<td>6.85</td>
<td>(.25)</td>
<td>2.24</td>
<td>(.95)</td>
<td>.713</td>
<td>OLS</td>
<td>M,.20</td>
</tr>
<tr>
<td>2.4</td>
<td>( V(e^t) )</td>
<td>5.16</td>
<td>(.16)</td>
<td>29</td>
<td>(6.45)</td>
<td>.659</td>
<td>OLS</td>
<td></td>
</tr>
<tr>
<td>2.5</td>
<td>( V(\text{FE}) )</td>
<td>23.31</td>
<td>(1.77)</td>
<td>69</td>
<td>(7.61)</td>
<td>.741</td>
<td>ML</td>
<td>Q,.6</td>
</tr>
<tr>
<td>2.6</td>
<td>( V(\text{FE}) )</td>
<td>23.83</td>
<td>(1.88)</td>
<td>70</td>
<td>(7.85)</td>
<td>.752</td>
<td>ML</td>
<td>Q,.12</td>
</tr>
<tr>
<td>2.7</td>
<td>( V(\text{FE}) )</td>
<td>.05</td>
<td>(.00)</td>
<td>5.16</td>
<td>(9.51)</td>
<td>.817</td>
<td>ML</td>
<td>M,.11</td>
</tr>
</tbody>
</table>

Numbers in parentheses are t-values.

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 unexpected inflation.

2. Surveys of inflationary expectations call for some European countries, but the respondents' answers are qualitative rather than quantifiable. (E.g. Vincenzo 1984 for Italy, Schmitt 1979 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 \( V(\hat{e}^t) \) and \( V(e) \) is erased by changes in the variability of exogenous shocks which affect both variables in the same way.

4. Observations are not on the 15th of the first month in the quarter, when the inflation rate for the last month of the previous quarter is made public. 101 responses missed 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 Zilhöfer (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 GNU 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

Production of Education: Are Socioeconomic Characteristics Important Factors?

Kwabena Gyimah-Brempong* and Anthony O. Gyapong**

Production of Education: Are Socioeconomic Characteristics Important Factors?

In a review of 114 studies on public education, Hanushek (1979) finds that only a small proportion find any significant relationship between school resources and student performance while most of these studies are significant relationships between socioeconomic characteristics of communities (SEC hereafter) and educational outcomes. However, most studies include SEC on the demand side as taste variables but not as productive factors. If student background and socioeconomic characteristics of communities are important determinants of student performance, then communities with large amounts of characteristics that enhance (decrease) educational outcomes will spend more (little) on school resources to obtain the same level and quality of educational attainment as communities without such characteristics. Research results of the importance of SEC have policy implications regarding the current debate over how best to improve the performance of the educational system in the United States.

The importance of SEC in the production of local public goods has not received a systematic treatment in empirical research on education production. Some researchers have included measures of SEC only as state variables without theoretical justification (Margo 1986, Summers and Windz 1977). However, Hamilton (1983), Buse (1961), and Hanushek (1979) have argued theoretically that SEC affects both the demand for, as well as the production of, local public goods and should be included in the estimation of production functions of local public goods. Dynarski, Schub and Zampelli (1989), using a production function approach and data from California school districts, finds SEC to be important determinants of educational outcomes. Other studies (Buse 1986, Gyimah-Brempong 1989) have justified the inclusion of SEC in the production function of public goods.

These studies have not, however, treated education as a joint production process. Some of the same inputs are used to produce many educational outputs. Moreover, the relationships among these educational outputs may be noncausal and, hence, may not be correctly modeled with a simultaneous equation model. It is, therefore, necessary to use an approach that accounts for jointness in the production of education without assuming causal relationships among the educational outputs.

Researchers who have included SEC in their studies of education production functions have employed restrictive functional forms and have based their conclusions about the importance of SEC solely on microeconometrics. Those who have employed flexible functional forms to investigate education production (Cohn, Rhode and Sammons 1989, Catten and Samtron: 1989, and Janzen 1985), on the other hand, have not investigated the effect of SEC on education production.

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