NBER WORKING PAPER SERIES

WAGE EXPECTATIONS IN THE LABOR MARKET: SURVEY EVIDENCE ON RATIONALITY

Jonathan S. Leonard

Working Paper No. 440

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge MA 02138

February 1980

The research reported here has been supported by the National Bureau of Economic Research and is part of the NBER's research program in Economic Fluctuations. I thank Benjamin Friedman and Richard Freeman for their comments, and Frank Endicott for his foresight and assistance in providing the data. Any opinions expressed are those of the author and not those of the National Bureau of Economic Research.

Working Paper 440
February, 1980

Wage Expectations in the Labor Market Survey Evidence on Rationality

ABSTRACT

Using a new set of directly observed wage expectations among firms, this paper finds that in general firms' forecasts fail the unbiasedness and efficiency requirements of weak-form rational expectations. These market participants consistently underestimate the wages they actually end up paying, and their expectations do not efficiently utilize the information in past realizations. The mean absolute forecast error of two percent compares with an error of only five percent if static expectations were held. The major source of wage forecast error seems to be errors in predicting demand, rather than in predicting supply or the general price level. Wage forecast errors are positively correlated across fields with distinct supply patterns, and are positively correlated with quantity forecast error. The properties of stochastically weighted expectations and the effectiveness of the wage and price controls of the early 1970's are also discussed.

Jonathan S. Leonard
Harvard University
Department of Economics
Littauer Center
Cambridge, Massachusetts 02138

(617) 868-3924

In much of the recent economic literature, expectations play a role akin to that of the higher being in theological discussions: commanding the center of attention, powerfully affecting events, but rarely revealing itself directly. With only scant or indirect empirical evidence, economists have fallen back on rules of thumb such as "rational expectations (R.E.) may be a reasonable assumption for financial markets but a tenuous one for labor markets". Survey evidence of expectations in the financial market have been studied elsewhere[1] and a useful summary of the methodology is presented in Friedman (1980). This paper shall examine survey evidence of expectations in the labor market.

The effectiveness of monetary policy in Phillip's curve type trade-offs depends critically on the rationality of firms and workers. Do agents on the demand side of a competitive market that meets annually have or develop R.E.? If there is systematic error in their forecasts of market wages, is it due to errors in forecasting demand or supply, or to misjudging the general price level that will prevail? How has inflation affected their accuracy? These are all questions that must be answered empirically before we can judge the distortions caused by inflation, and the real effects of monetary policy on labor markets.

This paper uses a new set of directly observed wage expectations among market participants. Section I will test the unbiasedness and efficiency properties of these observed expectations. The sources of observed forecast error will be analyzed in section II, followed by the conclusion.

Section I. Tests of Weak-Form Rationality

Every year large firms hire inexperienced college graduates in competitive markets. The supply to these markets is largely determined four years previously - the time it typically requires to earn a Bachelors degree. Since 1948, Frank Endicott of Northwestern University has published the results of his annual survey of employers' wage expectations. The survey of about 170 large and medium sized corporations is conducted in November, calling for half-year ahead forecasts of the monthly starting wages of inexperienced college graduates by field of specialty, as well as data on past realizations[2]. Together these firms comprise a substantial force in the market, hiring about one-seventh of all new engineers for example. The statistical properties of the Endicott data are discussed in Appendix A.

The statistical tests of this section will show that employers' expectations are not far from the mark, but that in six of the eight fields tested these expectations fail the unbiasedness and efficiency requirements of weak form rationality. These basic results are generally in accord with those of Turnovsky and Wachter (1972), who reject the hypothesis of R.E. among the Livingston sample concerning the average weekly wage in manufacturing. On the other hand, in the Endicott sample of market participants I do find evidence of rational expectations of wages in some more disaggregated markets.[3] While the wage forecast error is small in absolute size, less than two percent of the actual wage on average, it is significant. For comparison, if firms naively held static expectations, the worst they would do would be a forecast error of five percent. The mean absolute error in a simple regresion on trend in the full sample of realizations is only about one percent.

Rational expectations are tested in Table 1 by regressing the realized wage on the wage that had been predicted:

$$W_t = a + b \; {}_tW^*_{t-1} + e_t \qquad (1)$$

If agents have R.E., then a=0 and b=1; the expected wage is an unbiased predictor of the actual wage. F-tests accept this null-hypothesis in the fields of sales, chemistry and mathematics, but reject it in the other five fields. In accord with R.E., there is no significant evidence of autocorrelated errors in any of the fields. On average, firms repeatedly underestimate what they will actually end up paying in all eight fields.

Implicit in this discussion is the firm's loss function for errors in forecasting wages. The unbiasedness tests in Table 1 employ two alternative assumptions: that firms optimize their forecasts for 1) the linear wage, or for 2) the log wage. By Jensen's Inequality, an unbiased forecast of some variable X will in general be a biased forecast of a convex non-linear function of X. Rather than conduct a random search over non-linear functions, I have taken the log of wages as a plausible candidate. If firms optimized their forecasts for the log of wages, they need not exhibit R.E. in linear wages even if they do in log wages. Table 1 shows evidence of this in only one case. Since the rest of the unbiasedness results are unchanged by taking the log transformation, the remainder of this paper shall refer to the linear form only.

It is worthwhile looking in more detail at the case of engineering, where firms' expectations are farthest from the mark. The cob-web supply structure and sensitivity to demand shocks of this market have been studied by Freeman (1976). Engineering is among the fields with the most volatile supply, as measured by the coefficient of variation of its share in total degrees. But it is also the one field where enrollment data is systematically collected, so the information needed to forecast supply six months or three years ahead is readily available[4]. Yet employers consistently err in their wage forecasts.

Note that employers seem to have R.E. in some fields with cob-web structure, such as chemistry and mathematics, but fail in liberal-arts, accounting and business where supply is smoother and no evidence of the more complicated cob-web supply structure has been found (Freeman and Leonard 1978). Supply variation, as indicated by the existence of cob-web supply, does not appear to be the dividing line between fields in which employers do or do not exhibit R.E. These results indicate that if employers understand how wages are determined, then either they cannot predict supply even in fields dominated by simple trend growth, or they cannot accurately predict industry demand six months ahead. Alternatively, they may be able to predict real market clearing wages, but fail to forecast the general price level. Section II will examine the sources of this forecast error in more detail.

Firms that predict wages for a number of fields may be able to form more efficient forecasts by exploiting the cross-field error structure. The appropriate test of joint unbiasedness in this case would be Zellner's (1962) seemingly unrelated regression procedure, presented in Table 2. The test statistic λ, which is - 2 times the log of the likelihood ratio, allows us to reject the null hypothesis of joint unbiasedness, $a = o$ and $b=1$, across all eight fields for the sample period 1965 to 1978 at the 90% confidence level, and across the four fields with requisite data for the slightly longer period 1962 to 1978 at the 99% confidence level.

To be rational, expectations must not only be unbiased, they must also efficiently use the available information. In particular, expectations and realizations should identically incorporate the information contained in past realizations (see Pesando 1975). In the specification that

(2) $$W_t = a + \sum_{i=1}^{N} b_i W_{t-i} + e_t$$

(3) $${}_tW^*_{t-1} = a' + \sum_{i=1}^{N} b'_i W_{t-i} + e'_t$$

the hypothesis implied by R.E. is that $b_i = b'_i$ for all i, and $a = a'$. Since six out of the eight fields fail Bartlett's test for homoskedastic errors across equations (2) and (3), the usual Chow test for equality of coefficients is not valid. Mullineaux (1978) suggests subtracting (3) from (2) yielding:

(4) $$W_t - {}_tW^*_{t-1} = (a-a') + \sum_{i=1}^{N} (b_i - b'_i) W_{t-i} + v_t$$

Under the null hypothesis, all the coefficients should equal zero, and there should be no autocorrelation of the errors. Choosing N to minimize the standard error of (3), F-tests allow the rejection of the null-hypothesis of R.E. in all fields except chemistry and mathematics. The evidence against efficiency in Table 3 is weaker for economics, which fails the Mullineaux type test, but passes a Chow test for equality of coefficients. Note also in Table 3 that the forecast errors in engineering, liberal-arts and sales are not orthogonal to past actual wages: direct evidence against R.E.

In this section I have presented the results of two separate tests of weak-form R.E.: unbiasedness and efficiency. Two of the eight fields, chemistry and mathematics, pass both tests. If the fields are considered independent Bernoulli trials, then we can state at a 75 percent level of confidence that employers do not have rational expectations.

While in general employers' expectations are significantly different than those required by R.E., it is arguable whether it would profit any firm to invest in the information needed to improve the accuracy of these forecasts. When past actual wages could be used to improve forecasting as noted above, it is difficult to justify why firms do not use them efficiently, since the information is presumably at hand and the processing nearly costless. The same argument holds for correcting the bias in forecasts. That firms find it costly to err in their wage forecasts can be inferred from a simple market test: from the long and profitable existence of consulting firms that survive by performing compensation surveys of professionals, including new hires, and selling the results, the obvious conclusion is that other firms are willing to pay to be told what market wages are or will be. This is not implausible, given the developed planning and budgeting mechanism in firms today. If a firm offers too little, it risks encountering delay and difficulty in filling its openings, or getting poor quality workers with higher training and turnover costs. If it offers too much, it will get locked into paying more than it needed to. For a firm hiring 100 engineers whose market clearing wage is $25,000, the mean absolute error of 2 percent found in the sample translates into an overpayment of $50,000 in the first year. The resulting compression of the wage structure is likely to create upward pressure on the wages of other employees in the firm. In the following section I demonstrate some of the other data that could be used to improve wage forecasts at little cost to the firm.

Section II. The Sources of Forecast Error

Why do employers err in their forecasts? Should we be surprised that their expectations are not rational? It would be troubling if in practice employrs were not predicting a supply that had been largely fixed four years earlier. It would be slightly more comforting to know they erred in forecasting market demand or inflation six months ahead. This section tries to determine whether employers erroneously forecast wages because of errors in predicting supply or demand or the general price level. The underlying assumption is that employers understand that real wages in a competitive market are determined by supply and demand.

Consider the following simple model of the labor market for new college graduates. The market demand for graduates in the i'th field in year t is:

5) $$N^D_{it} = a_i + b_{i1} G_t + b_{i2} X_{it} - b_{i3} W_{it}/P_t + e_{it}$$

where

N^D_{it} = number demanded

G_t = common component of demand across fields.

X_{it} = demand shift term for field i

W_{it}/P_t = real wage

Market supply is given by:

$$6)\quad N^S_{it} = \alpha_i + \beta_{i1}D_t + \beta_{i2}\, W_{i,t-4}/P_{t-4} + V_{it}$$

where

D_t = common supply component across fields

$W_{i,t-4}/P_{t-4}$ = real wage, lagged four years.

Modelling the supply of college graduates as a function of past wages is theoretically and empirically justified in Freeman (1976), and in Freeman and Leonard (1978). Solving this recursive structure for real wages yields

$$7)\quad \frac{W_{it}}{P_t} = \frac{-1}{b_{i3}}\left[(\alpha_i - a_i) + \beta_{i1}D_t + \beta_{i2}\frac{W_{i,t-4}}{P_{t-4}} - b_{i1}G_t - b_{i2}X_{it} + V_{it} - e_{it}\right]$$

Assume that the errors are independently identically distributed with mean zero.

As noted in the previous section, firms consistently underestimate across time and fields the nominal wages they end up paying. There are three ways this may occur in the above model.

1) The firms underestimate the price level, P.

2) The firms overestimate D, the common component of supply.

or 3) The firms underestimate G, the common component of demand.

For example, if firms underestimate G by the amount G' then

$$8)\quad {}_t\frac{W^*}{P}{}_{i,t-1} = E_{t-1}\left(\frac{W_{i,t}}{P_t}\right) - \frac{b_{i1}}{b_{i3}}\,G'$$

where $E_{t-1}(W_{i,t})$ is the mathematical expectation of eq. 3 and and the wage forecast error is simply $\frac{-b_{i1}}{b_{i3}} G'$.

If errors in projecting G are the only errors the firms make, then wage forecast errors across firms will be perfectly correlated. In addition, if firms underestimate demand, then both the actual wage and the actual number of hires will be greater than expected, due to movement up the supply curve. The evidence I shall present in this section suggests that errors in forecasting demand are the major source of wage forecast error.

In the Endicott Survey, employers forecast not only the wages they expect to pay six months in the future, but also the number of people they expect to hire at that wage. Since the expected market clearing wages are not greatly dispersed, the quantities demanded by each firm are summed to give a rough estimate of market demand[5]. If employers know the true demand, but err in predicting supply, then I expect to observe a negative correlation between wage forecast error and quantity forecast error. Alternatively, if the market supply schedule were known to all employers six months ahead but demand were a mystery, wage forecast error would be positively correlated with the quantity forecast error[6]. For example, let firms expect a demand curve shifted further out than actually prevails. This will intersect the known supply curve at a higher wage and a higher quantity than actually occurs- yielding the positive correlation. Empirically, such demand surprises seem to dominate the market. Although the quantity data is not very reliable[7], quantity forecast errors are positively correlated with wage forecast errors in three of the four fields for which the requisite data was available for the period 1962 to 1978. For accounting, the correlation coefficient was .77, for sales .63, for engineering .47, and for business -.13.

This evidence of demand side surprises is reinforced by the positive correlation of forecast errors across fields in Table 4. Since the supply cycles of the various fields are distinct (Freeman and Leonard 1978), and in some cases the fields are substitutes, the correlation of forecast errors across fields would be due to a common supply shock if firms were ignorant of massive demographic changes, which is unlikely. The evidence again points to common errors across firms in forecasting market demand.

I obtain a clear picture of the source of wage forecast error by testing for the orthogonality of the error to past information that is readily available. The theory of R.E. states that forecast errors should be uncorrelated with such information. In all eight fields wage forecast error is orthogonal to real wage lagged four or five years- a key variable determining supply. Similarly, with the exceptions of sales and chemistry, forecast error is orthogonal to the number of graduates lagged one year. Engineering, however, tells a different story. A substantial portion of engineering supply is determined by freshman year enrollments. This information is made available by the Engineering Manpower Commission, facilitating supply forecasts three years ahead. Yet the firms in the Endicott sample do not appear to use this information to form unbiased forecasts. I find a significant negative correlation between engineering enrollments three or four years previously and current forecast error. This is consistent with a world in which employers are surprised by a shift in supply that occured four years ago.

Surprisingly, the wage forecast error is not significantly correlated with the current or past year's rate of inflation, so there is no strong evidence that misperceptions of inflation account for the forecast error[8]. The absolute accuracy of the forecasts has declined in recent years. In engineering business and liberal arts the error is significantly correlated with last year's price level. This, however, suggests a simple scale effect: the larger the level of nominal wages, the larger the error.

Lucas (1976) and others have argued that if monetary policy is perfectly anticipated, it will be matched by price level changes and have no real effects.

Barro (1978) has presented empirical support for this model, showing that real output changes were correlated with unexpected monetary policy, while price level changes may be explained by anticipated monetary policy. To corroborate this rational expectations model, I would need to find that wage forecast error was correlated only with that part of monetary policy which was unanticipated. I find that with the exception of engineering, wage forecast error is orthogonal to expected money supply, and curiously, to unexpected money supply as defined by Barro (1978). It is implausible that firms that have difficulty forecasting demand in their labor markets could accurately predict inflation and monetary policy, particularly that part of money supply that Barro defines as unexpected. A more plausible interpretation is that monetary policy affects the wage and price level only with long lags, so that actual market wages as well as expectations are little affected by current monetary policy.

Even if perfectly anticipated, inflation creates what some companies consider real problems of adjustment. "...the inflationary trend of wages in general...(has) put the price so high that it is difficult to keep the salaries of present employees in line with the increasing starting rates of graduates." "Salary compression will force reductions in the number of college graduates we can hire." The first quote is from the 1953 Endicott Report, the second is from 1979. Starting wages are typically more responsive to market pressures than are the wages of established workers. Employers may forecast starting wages in line with established wage structures, which would help explain why they have consistently underestimated actual starting wages during the past twenty years of inflation.

How did employers wage expectations react to the wage and price controls imposed during the early seventies? Such controls are sometimes recommended as the only policy short of inducing a recession that can reduce inflationary expectations, albeit at the cost of reduced economic efficiency. The Endicott data shows that in November, 1971, before wage-price guidelines had been firmly established following the freeze of August 15, 1971, firms expected wages to increase by only one percent over their 1971 levels. This decline in expected wage growth is not solely due to the freeze, since actual and expected wage growth had already slowed significantly prior to the freeze. In November of 1970 firms expected wage growth of only two percent, as expectations reacted quickly to the slowing of actual wage growth. Three years later, rather than expecting a burst of wage inflation with the phase-out of controls, firms were predicting only a three percent increase,below the guidelines and below the actual five percent increase that occured during 1974. While controls were in place, wage expectations did not become significantly more accurate, perhaps because although particular controls did limit wage growth, controls policy itself was unstable during this period.

Finally, if one wants a rule of thumb to describe wage expectations, they seem to be extrapolative in these market[9]. In contrast to Turnovsky and Wachter's results, in this data set the extrapolative model fits the observed expectations better than the adaptive expectations model does, with an adjusted R-squared of .99.

In sum these results suggest that firms would fall short of the requirements of R.E. even in a world without changing inflation rates. It appears that employers err in forecasting wages for the most part because they err in predicting demand.

Section III. Conclusion

Expectations play such an important role in economic theory that the scant direct empirical evidence available bears considerable interest. The evidence from the Endicott Survey of market participants tells a mixed story, allowing the acceptance of the rational expectations hypothesis in two of the eight fields tested. Employers appear to err in forecasting market demand six months ahead, and do not efficiently utilize a supply indicator set four years previously in engineering. All of this suggests the usefullness of further empirical study of the formation of expectations.

Appendix A. The Statistical Properties of Weighted Averages

The Endicott Report has published only weighted averages of actual and expected wages since 1965. These are the wage data used in this paper. The weighted average is given by

$$\hat{W} = \frac{\sum_{i=1}^{J} N_i W_i}{\sum_{i=1}^{J} N_i}$$

where N_i = # of people to be hired by firm i

W_i = average wage to be paid by firm i

for notational simplicity let $Z_i = \frac{N_i}{\sum_{i=1}^{J} N_i}$

The null-hypothesis of R.E. requires that $E(W_i) = W$ for all i, where W is the realization and W_i is the prediction. We want to investigate the statistical properties of $\hat{W}$ and compare them to those of the unweighted average $\tilde{W}$, where

$$\tilde{W} = \frac{\sum_{i=1}^{J} W_i}{J}$$

A stochastic weighted average of the W_i will be equal in expectation to W if and only if the covariance of the Z_i and W_i is zero because:

$$E(\hat{W}) = E \sum^{J} Z_i W_i$$

$$= \sum^{J} EZ_i W_i$$

$$= \sum^{J} [E(Z_i)E(W_i) + COV(Z_i, W_,)]$$

$$= W + J^*COV(Z_i W_i)$$

The bias of the weighted average equals J * $COV(Z_i, W_i)$. I argue that it is reasonable to assume that $COV(Z_i, W_i) = 0$ in the Endicott data since the scale of demand by field differs greatly across firms - some hire no engineers, others hire hundreds. This scale effect probably dominates the negative covariance one might expect between quantity and wage from movement along a demand curve. Under the assumption that $COV(Z_i, W_i) = 0$, if the null-hypothesis $E(W_i) = W$ is true then $E(\hat{W}) = W$ is also true.

If one does not accept the assumption that $COV(Z_i, W_i) = 0$, then the bias of the forecasts = $J^*COV(Z_i, W_i)$. If $COV(Z_i, W_i) < 0$, because of shifts along the demand curve for example, then we expect the weighted average to underestimate the realization, the bias increasing with the number of firms. Such would be the case if our sample consisted of firms that differed only in their expectation of future wages.

Empirically this does not appear to be a major source of error. By the above argument $E(\hat{W}) < E(\tilde{W})$. In fact I find the opposite. During the years 1962 to 1964 for which both series are available, I find that the mean weighted expectation, $\hat{W}$, is greater than the mean unweighted expectation, $\tilde{W}$, by six dollars, pooling across engineering, accounting, business and sales.

Further tests also support the validity of the use of weighted expectations in this sample. Replicating the unbiasedness tests with unweighted expectations changes the result only in the field of business. For the fields for which requisite data is available, the F-statistics against the null-hypothesis a=o and b=1 are engineering: 93.6, accounting: 67.9, business: 0.6, and sales: 0.06. These tests are not directly comparable with those of Table 1 since the weighted sample includes the inflation plagued 1970's while the unweighted observations are for 1954 to 1964. Similarly, the result of the cross-field correlation of forecast error is essentially unchanged: all four fields have positively correlated wage forecast errors. In most cases the correlation is greater. As an additional test, I pool time-series data for the above four fields for the year 1962 to 1964 during which weighted and unweighted expectations are reported. F-tests do not reject the null-hypothesis of equality of coefficients at the .01 level when actual wages are regressed on weighted or unweighted expected wages. All of this suggests that the results reported in the text are not affected by the use of weighted expectations.

If firms that hire more people invest more in information to improve their forecasts, then the weighted average will have a lower variance than the unweighted average, and may have a lower mean-squared-error. If the precision of W_i is directly proportional to N_i then

$$\text{Variance } (\hat{W}) = \frac{k}{\sum_{i=1}^{J} N_i}$$

which is strictly less than

$$\text{Variance } (\hat{W}) = K * \sum_{i=1}^{J} \frac{1}{N_i}$$

where k is an arbitary constant.

So, assuming constant bias over time, the efficiency and orthogonality tests in this paper are not adversely affected by the use of weighted averages.

References

Robert Barro, "Unanticipated Money, Output, and the Price Level in the United States", Journal of Political Economy, 86, (August, 1978), 549-580.

Frank Endicott, "The Endicott Report: Trends in the Employment of College and University Graduates in Business and Industry", annual editions 1948-1979.

Richard Freeman, "A Cob-web Model of the Supply and Starting Salary of New Engineers", Industrial and Labor Relations Review, 25, (January, 1976), 236-248.

Richard Freeman and Jonathan Leonard, "Autoregressive Degree Patterns: Evidence of Endogenous Cycles in the Market?", Proceedings of the 30th Annual Meetings of the Industrial Relations Research Association, 30,(January, 1978), 10-19.

Benjamin Friedman, "Survey Evidence on the 'Rationality' of Interest Rate Expectations", Journal of Monetary Economics, forthcoming.

William E. Gibson, "Interest Rates and Inflationary Expectations: New Evidence", American Economic Review, 62,(December,1972), 854-865.

Jonathan Leonard, Evan Barrington, and Katherine Shaw, "Improved Methodologies for Forecasting New Entrants in Science and Engineering", M.I.T. Center for Policy Alternatives working paper, September, 1978.

Robert E. Lucas, "Econometric Policy Evaluation: A Critique", in The Phillips Curve and Labor Markets, edited by Karl Brunner and Allan H. Meltzer, Amsterdam: North Holland, 1976.

Donald J. Mullineaux, "On Testing for Rationality: Another Look at the Livingston Price Expectations Data", Journal of Political Economy, 86, (April, 1978), 329-336.

John H. Muth, "Rational Expectations and the Theory of Price Movements", Econometrica, 29,(July,1961), 315-335.

James E. Pesando, "A Note on the Rationality of the Livingston Price Expectations", Journal of Political Economy, 83,(August,1975), 849-858.

David H. Pyle, "Observed Price Expectations and Interest Rates", Review of Economics and Statistics, 59, (August,1973), 275-280.

Potluri Rao, "Specification Bias in Seemingly Unrelated Regressions" in W. Sellekaerts (ed.), Essays in Honor of Tinbergen, vol.2., New York, 1974, 101-113.

Stephen J. Turnovsky, "Empirical Evidence on the Formation of Price Expectations", Journal of the American Statistical Association, 65,(December, 1970),1441-1454.

Stephen J. Turnovsky, and Michael L. Wachter, "A Test of the 'Expectations Hypothesis' Using Directly Observed Wage and Price Expectations", Review of Economics and Statistics, 54,(February,1972), 45-54.

Arnold Zellner, "An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests for Aggregation Bias", Journal of the American Statistical Association, 57,(June, 1962), 348-368.

American Council on Education, A Factbook on Higher Education, Washington, 1977.

College Placement Council, College Placement Council Salary Survey, annual editions.

Engineering Manpower Commission of the Engineers Joint Council, Engineering and Technology Enrollments, 1969-1978, New York, annual editions.

U.S. Depatment of Labor, Handbook of Labor Statistics 1978, Washington, 1978.

U.S. Office of Education, Advance Report on Enrollments, Washington, annual editions.

U.S. Office of Education, Engineering Enrollments and Degrees, Washington, annual editions.

Footnotes

* Harvard University, Department of Economics

1. Empirical work on price and interest rate expectations has been done by Friedman, Gibson, Mullineaux, Pyle, Turnovsky, and Turnovsky and Wachter. Turnovsky and Wachter also tested wage expectations, rejecting rational and simple adaptive and extrapolative models of expectations. With the exception of Friedman, all of these authors used the Livingston expectations data.

2. The actual question asked on the 1978 Endicott Survey is: "The table on the following page has been designed to gather information regarding the number of beginning college graduates, both men and women, recruited by your company last year and the number to be recruited during the next twelve months. We are interested in hirings at the bachelor's level and also at the Master's level. In addition, you are asked to indicate average starting rates for graduates of 1978 classes and to estimate, as realistically as possible, what the average starting rates will be for 1979 graduates. By average starting salary, we mean actual first-month gross earnings. In estimating starting salaries for 1979, please indicate what you think the average will be at the end of the season, taking into account past trends, inflation, and possible competition for the best qualified graduates in certain fields."

3. To the extent that firms can set wages they will trivially fulfill the requirements of R.E. However, wages do seem to clear these markets and unemployment is typically low. As evidenced by College Placement Council Data, wage offers do change during the course of a recruiting season.

4. Before 1965 enrollment data was collected and published by the U.S. Office of Education. In a notable case of the private market stepping in to serve a function that government had ceased to fulfill, the Engineering Manpower Commission of the Engineers Joint Council has collected engineering enrollment data since 1965.

5. More strictly, I only observe directly the average of each firm's expectation of a point on its own demand curve. It is possible for a few firms to expect high market demand and report the resulting high wages driving the firm up its own unchanged demand curve. While this may be true for a few firms that do not expect their demand to shift with market demand, it cannot be consistent behavior for the market as a whole. If the firms expect high market demand, then in a representative sample, the average of each firm's own expected demand at a given wage will indicate market demand. In any case, the arguments in the text are more striking if they are interpreted simply as each firm wrongly predicting its own demand, which should be easier than predicting market demand.

6. Here we relax the assumption that supply responds only to past, not current, real wage.

7. Actual and expected hires are reported for different samples and so are not strictly comparable. I used average hires per firm.

8. Wage forecast error is not in general significantly correlated with errors in forecasting the inflation rate as measured by the Livingston data. This suggests that firms have difficulty predicting the real wage rate. Direct evidence of employers' inflation rate expectations from the Endicott Report for 1965, 1976, and 1978 are .10, .08, and .08, which compare with the actual rates of change of the GNP price deflator of .09, .05, and .09 respectively.

8. While the extrapolative model in which expectations are given as a function of the past two years realizations is the best rule of thumb, the S.E.E. is typically minimized in a regression that includes the actual wage lagged three years.

Table 1. Tests of Unbiasedness

Line	Field	Period	Realization Mean	Realization σ	Expectation Mean	Expectation σ	a	b	D.W.	S.E.E.	F-statistic
1.	Engineering	1962-1978	881.7	252	864.8	240	-25.9(13.5)	1.05(.02)	1.78	14.4	17.09*
2.	"	"	6.74	.28	6.72	.27	-.14(.093)	1.02(.014)	1.49	.015	13.28*
3.	Accounting	"	795.6	211	779.3	208	10.8(17.3)	1.01(.02)	2.21	17.9	7.10*
4.	"	"	6.64	.27	6.62	.28	.12(.13)	.99(.019)	2.12	.021	9.16*
5.	Business	"	686.9	168	673.5	160	-18.0(23.8)	1.05(.03)	1.60	22.0	4.05**
6.	"	"	6.50	.24	6.49	.24	.03(.21)	1.00(.032)	1.44	.031	3.22
7.	Sales	"	719.2	187	712.5	185	5.7(26.9)	1.00(.04)	2.91	27.2	.52
8.	"	"	6.55	.26	6.54	.26	-.04(.21)	1.01(.032)	2.80	.033	.60
9.	Liberal Arts	1965-1978	714.9	139	701.6	127	-51.3(22.4)	1.09(.03)	1.75	14.4	10.22*
10.	"	"	6.55	.19	6.54	.18	-.31(.20)	1.05(.031)	1.68	.021	5.93**
11.	Chemistry	"	859.6	196	845.9	187	-22.3(27.3)	1.04(.03)	2.29	21.3	3.77
12.	"	"	6.73	.22	6.72	.22	-.11(.19)	1.02(.028)	2.25	.022	3.27
13.	Mathematics	"	816.7	171	802.6	167	.26(33.5)	1.02(.04)	2.07	24.6	2.34
14.	"	"	6.69	.21	6.67	.21	.07(.30)	.99(.044)	2.04	.033	1.89
15.	Economics	"	767.1	144	754.3	141	-1.48(19.6)	1.02(.03)	2.53	13.0	7.06*
16.	"	"	6.63	.19	6.61	.19	.03(.18)	1.00(.027)	2.70	.019	5.49**

Note: Variables in log form on even lines, in linear form on odd lines. Standard Errors in parentheses.

* Significant at .01 level.

** Significant at .05 level.

Table 2. Seemingly Unrelated Regression Estimates.

Field	1962-1978 $\lambda = 27.92$** a	b	D.W.	1965-1978 $\lambda = 29.36$* a	b	D.W.
Engineering	-19.7 (12.6)	1.04 (.01)	1.74	-16.5 (16.8)	1.04 (.02)	1.71
Accounting	9.1 (16.2)	1.01 (.02)	2.22	31.0 (23.0)	.98 (.03)	2.21
Business	-13.0 (22.0)	1.04 (.03)	1.58	-25.0 (29.5)	1.05 (.04)	1.84
Sales	6.3 (25.1)	1.00 (.03)	2.91	10.5 (32.8)	1.00 (.04)	3.01
Liberal Arts				-43.5 (20.1)	1.08 (.03)	1.72
Chemistry				5.0 (25.5)	1.01 (.03)	2.04
Mathematics				9.2 (30.4)	1.01 (.04)	2.03
Economics				.4 (18.0)	1.02 (.02)	2.52

*Significant at .05 level

**Significant at .01 level

λ=-2*log of the likelihood ratio

D.W. = Durbin - Watson statistic

Table 3. Mullineaux-Type Efficiency Tests.

Field	Bartlett's Statistic	a	b_1	b_2	b_3	F	h	S.E.E.
Engineering	4.16*	-30.1 (15.8)	.056 (.02)	-	-	15.2**	.33	15.1
Accounting	6.47*	13.1 (19.6)	.005 (.02)	-	-	6.46*	-.42	18.5
Business	10.6**	-34.1 (25.5)	.070 (.04)	-	-	4.42*	.24	21.2
Sales	5.74*	5.6 (23.9)	-.883 (.25)	.934 (.26)	-	4.90*	-2.3*	20.4
Liberal Arts	3.19	-73.0 (20.7)	.123 (.03)	-	-	15.67**	-.71	12.1
Chemistry	3.89*	-17.9 (32.7)	.040 (.04)	-	-	3.39	-.39	22.4
Mathematics	4.14*	19.1 (38.4)	-.003 (.05)	-	-	2.95	.45	24.2
Economics	.0004	24.6 (23.3)	.069 (.16)	-.663 (.20)	.602 (.18)	12.1**	-.84	7.9

* Significant at .05 level.

** Significant at .01 level.

h is Durbin's h-statistic for testing serial correlation in the presence of a a lagged dependent variable.

Table 4. Cross-field Correlation of Wage Forecast Error, 1965-1978.

	2	3	4	5	6	7	8
1. Engineering	.06	.34	.81	.74	.62	.38	.30
2. Accounting		-.38	.30	.04	.49	.09	.17
3. Sales			.06	.20	-.06	.21	.06
4. Business				.77	.66	.10	.15
5. Liberal Arts					.38	-.06	.24
6. Chemistry						.45	.13
7. Mathematics							-.04
8. Economics							