

DIRECT MEASUREMENT OF
POPULAR PRICE EXPECTATIONS

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1. Introduction

Expectations are an important determinant of economic behavior. Yet the analysis of economic expectations has suffered from the methodological deficiencies of inadequate measurement. Throughout the literature, expectations have been treated as unobservable, and have therefore been measured only indirectly. The test of any hypothesis about expectations has been the degree to which it explained the behavior of some other variable assumed to be a function of expectations. For example, most conclusions about expectations of inflation have been based on interest rate and wage equations. Given the difficulty of testing even the simplest hypothesis when the only evidence is indirect, it is not surprising that the scope of economists' models of expectations has remained limited. It is symptomatic that all of these models, with one notable exception, rely on the same questionable premise--that the expectations of a group or individual concerning a given variable are based solely on the past history of that variable.¹ Clearly this assumption is open to challenge. One would hardly think, for instance, that a consumer's expectations about prices the day after a price freeze would be based solely on the history of inflation before the freeze. Yet it is difficult to test anything more subtle than that hypothesis when the only available evidence is indirect.

The object of this paper is to develop and test a direct measure of expectations of inflation, a particularly critical economic variable. A direct measure is here taken to mean one constructed from a sample survey in which individuals are asked to state their expectations explicitly. The paper focuses on a popular forecast of the rate of change of consumer prices in the forthcoming year which is calculated from responses to the Michigan Survey of Consumer Finances. This measure is presented in section 2.

The Michigan Survey and others like it have existed for some time, but, a few recent studies notwithstanding, most economists continue to regard survey measures as inherently unreliable.² Their principal criticism is that the

¹The exception is the theory of rational expectations in Muth [1961].

²Most similar to the Michigan surveys are occasional polls of popular price expectations taken by the Harris and Gallup organizations both in the United States and elsewhere. The first Gallup poll question regarding prices dates to 1937. See Roper Public Opinion Research Center [1972]. The results of an unpublished Gallup survey of price expectations in the United Kingdom are the subject of a study by Carlson and Parkin [1973]. This being said the Michigan survey is the most complete source for the United States. Nonetheless the questions regarding price expectations have not been extensively used. Outside of the reports of the Michigan Survey Research Center, not many studies have made use of this data. All of them are studies of the effect of inflation on consumption, such as Mueller [1959]. Juster and Wachtel [1972a] (who use a measure similar to the one developed

opinions an individual expresses in an interview are not the same as the opinions on which he acts. At issue in this criticism is whether direct or indirect measures of expectations best explain actual behavior. Tests of the explanatory power of the direct measure of expected inflation developed in section 2 are presented in sections 3 and 4. The results demonstrate that the Michigan measure of expected inflation, particularly when combined with a related measure of unexpected inflation, explains one aspect of actual behavior--wage increases--better than several currently used indirect measures of expected inflation. When the Michigan measures are added to the wage equations of Perry [1970], Eckstein and Brinner [1972], and Gordon [1971], they perform better than these authors' own indirect measures in the first two cases, and as well as the indirect measure used in the third case.

The contention of Friedman and others that in the long run there is no trade-off between inflation and unemployment hinges on the sensitivity of wage increases to expected price increases. Until recently, empirical tests of the Friedman hypothesis have relied exclusively on indirect measures of expectations of inflation.³ The experiments in sections 3 and 4, based on a direct measure of expectations, provide new evidence substantiating the existence of a long-run trade-off between inflation and unemployment.

2. Price Expectations in the Michigan Survey

The Survey of Consumer Finances is a survey of a representative sample of U.S. households, numbering around 3000, conducted in January or February of every year since 1946, first by the Division of Program Surveys, U.S. Department

in this study), and Taylor [1973].

One survey measure of price expectations which has attracted a certain amount of attention recently is the biannual survey of business economists conducted since 1947 by Joseph A. Livingston, one-time financial editor of the Philadelphia Bulletin. The Livingston measure has been analyzed by Turnovsky [1970], and has been used in wage studies by Gordon [1971] and Turnovsky and Wachter [1972]. It has also been used in studies of the effect of inflation on interest rates by Pyle [1972] and Gibson [1972].

³The two exceptions are Gordon [1971] and Turnovsky and Wachter [1972], who use the Livingston index in wage equations for the U.S. See note 2. However the applicability to a study of wages of a measure based solely on the opinions of economists is questionable. The experiments in sections 3 and 4 represent a first attempt to incorporate a measure of popular expectations of inflation in U.S. wage equations.

of Agriculture, and then by the Survey Research Center of the University of Michigan.⁴ Since 1952 it has been supplemented by additional national surveys taken in the summer and winter of each year; and since 1959 the Survey and its supplements have been administered roughly on a quarterly basis. The questions asked have dealt with both demographic and financial characteristics and with attitudes about economic conditions.

One of the questions asked in almost every survey has been the following:⁵

Thinking about prices of things you buy in general, do you think they will go up in the next year or so, or go down, or stay where they are now?

In addition, since the second quarter of 1966 (1966:2), respondents expecting prices to go up, have been asked:

How large a price increase do you expect? Of course nobody can know for sure, but would you say that a year from now prices will be about 1 or 2% higher, or 5%, or closer to 10% higher than now, or what?

It is possible to estimate the mean and other moments of the distribution of expectations of price change since 1966:2 from the answers to both of these questions. The critical question, however, is how to infer similar quantitative estimates from the limited data available before 1966.

A suggestive discussion to this problem can be found in Theil's analysis of the Munich Business Test in Chapter four. Theil constructs from the percentage of respondents expecting sales to rise, fall, and stay the same, a dispersion index, which he also calls the balance.

$$BAL = \frac{+ \% Rise - \% Fall}{\% Rise + \% Fall + \% Same} \cdot$$

He then discusses qualitatively the relationship between BAL and the complete distribution of forecasts. His discussion can be pushed further and applied to the problem of price expectations.

⁴The first survey in 1946 was conducted by the Division of Program Surveys of the U.S. Department of Agriculture. The Survey Research Center was founded at Michigan later that year and has administered all subsequent surveys.

⁵The precise wording of the question has in fact varied from time to time, as is pointed out in the appendix. The wording given here is that used after 1960. See 1970 Survey of Consumer Finances, p. 257.

Let X be an individual respondent's expectation of the rate of price increase in the forthcoming year; let the density and cumulative distribution over the population of such expectations be respectively $f(X)$ and $F(X)$. Let the mean be $EXPT$. If one takes the "stay the same" response to correspond to a prediction of some small change between $+\delta$ and $-\delta$, and if, for the sake of simplicity, one assumes that "stay the same" responses are equally distributed between positive and negative changes, then

$$BAL = \int_0^{\infty} f(X)dX - \int_{-\infty}^0 f(X)dX ,$$

or

$$(1) \quad BAL = 1 - 2F(0).$$

If the shape of the distribution were known, (1) would provide a relation between BAL and $EXPT$ which could be used to estimate $EXPT$ prior to 1966:2.

The assumption maintained in this paper is one which seems reasonable a priori though it is difficult to test, namely that $f(X)$ is normal.⁶ Let the standard variable corresponding to X , be

$$Z = \frac{X - EXPT}{SIG} ,$$

where SIG is the standard deviation of X . Let the cumulative distribution of the standard normal variable be $G(Z)$. Then, under the normality assumption, (1) is equivalent to

$$(1') \quad BAL = 1 - 2G\left(\frac{-EXPT}{SIG}\right) .$$

This is a relation between $\frac{EXPT}{SIG}$ and BAL , which, when graphed, is seen to pass through the origin and to be approximately linear over most of the range of BAL .⁷

⁶ Answers to the question which has been asked since 1966:2 (How large a price increase do you expect?) have been coded in five intervals. See appendix. However, probably because of the way the question is worded, the answers cluster in the three intervals 1-2%, 5%, and 10% or more; and this makes it impossible to use them to test for the shape of the underlying distribution. This problem probably does not affect the value of $EXPT$, though it may have an effect on the value of SIG .

⁷ BAL is positive and negative in the post World War II period, but its absolute value is rarely greater than .85.

The following linear approximation to (1') was estimated using post 1966:2 data for the three relevant variables.

$$(2) \frac{EXPT}{SIG} = 1.50 \quad BAL \\ (140.3)$$

$$R^2 = .922 \quad \text{period of fit: } 1966:2-1972:3,^8 \\ d-w = 1.812 \quad \text{with omissions.}$$

Equation (2) would permit backwards extrapolation of EXPT if SIG were known. But, like EXPT itself, SIG can only be measured directly after 1966:2. Therefore an attempt was made to derive an equation for SIG using the post 1966:2 data. The plot of SIG revealed a modest rise between 1966 and 1968 from 2.5 to 2.6 followed by a sharp increase to 3.0 in 1969 and 1970. A plausible interpretation of this pattern is that it reflects a slight tendency for the standard deviation to rise as the mean rises plus an increase in popular uncertainty about the future course of prices in the first two years of the Nixon administration, when inflation and unemployment were both increasing at the same time. One suspects that 1969-70 was a period of general uncertainty about the future of the U.S. economy and that this mood would naturally have affected the variance of popular forecasts of the rate of inflation. In order to test that hypothesis it was decided to regress SIG after 1966:2 against EXPT and an index of popular uncertainty about economic conditions.

The index chosen, with some reservations, was the Index of Consumer Sentiment, an average of dispersion indices based on five attitudinal questions in the Michigan Survey of Consumer Finances. Though the questions ask about optimism and pessimism concerning economic conditions, there is also some basis for treating the Index as a measure of uncertainty.⁹ George Katona, the originator of the Index, appears to have had that interpretation in mind in some of his writings.¹⁰

⁸The way in which EXPT and SIG were estimated from the interval responses to the questionnaires is explained in the appendix. Three quarters in which the survey either did not ask about prices at all or asked only for qualitative and not quantitative responses were omitted. These are 1966:4, 1967:2, and 1968:1.

⁹The questions on which the Index is based are listed in the appendix.

¹⁰In The Powerful Consumer, Psychological Studies of the American Economy, Katona uses the term "confidence" to refer to psychological factors such as those the Index is intended to measure. In the introductory chapter entitled "Income and Confidence", he says,

Lip service has long been paid to 'waves of confidence' of 'waves of mistrust' which may play a role along with changes in financial conditions in the fluctuations of the economy. Up to the present

At least one of the important consumption studies in which the Index is used treats it as a measure of uncertainty.¹¹ Finally, it has been reported in a recent study of risk premiums in the bond market that these premiums are highly statistically correlated with the Index.¹²

In line with the preceding discussion, the following estimate was obtained.¹³

$$(3) \quad \text{SIG} = 3.56 + .20\text{EXPT} - .018\text{MOOD}$$

(17.1) (4.30) (-15.6)

$$R^2 = .968$$

$$d-w = 1.89$$

period of fit = 1966:3-1971:2,
with omissions.

MOOD is the Michigan Index of Consumer Sentiment. Combining (2) and (3) one obtains the following equation for backwards prediction of EXPT:^{14,15}

$$(4) \quad \text{EXPT} = \frac{5.35 \text{ BAL}}{1 - .30\text{BAL}} - \frac{.0027\text{MOOD} \cdot \text{BAL}}{1 - .30\text{BAL}}$$

(17.0) (-15.6)
(4.27) (4.27)

This equation was used to calculate values for EXPT from 1952:4 through 1966:1, which were then combined with the measure of EXPT taken directly from the Michigan Survey from 1966:2 through 1972:3. Details of data construction are discussed in the appendix.

time however, this consideration has hardly influenced either government or business policies.... Only in recent years has any serious effort been made to subject the role of the psychology of the people in economic matters to scientific study. (Katona [1960], p. 3.)

¹¹Juster and Wachtel [1972a, 1972b].

¹²In an unpublished paper presented to the Financial Research Center Conference, Princeton University, March 16, 1973, Dwight Jaffee reported finding that the spread between BAA and AAA bonds of the same type of issuer and same maturity is highly negatively correlated with the Index of Consumer Sentiment.

¹³Equation (3) was estimated using two quarter averages of all variables. This procedure was chosen as a simple procedure for adjusting for marked negative serial correlation in earlier estimates. The omitted observations are the ones for which the data problems mentioned in note 5 would have influenced the results. The sample period here stops short of Phase 1 and Phase 2 controls because of the presumption that the controls may have caused structural change in the degree of uncertainty associated with price expectations. Slight adjustments made in the published figures for MOOD are discussed in the appendix.

¹⁴Each coefficient in equation (4) is the product of coefficients in (2) and (3). Each variance was estimated as the variance of the linear terms of the Taylor's series approximation to the product. The t-statistic in parentheses under the coefficient is based on that estimated variance.

¹⁵It was felt that, the arguments in the text notwithstanding, some uncertainty remains regarding the proper interpretation of MOOD, and consequently regarding

The series for EXPT constructed in this manner is plotted in Figure 1 alongside the contemporaneous two quarter rate of change of the consumer price index at an annual rate and two other variables described later. EXPT rises regularly and steadily throughout the period until the first Nixon freeze. It shows much less variability than the rate of change of the actual consumer price index. In fact comparison with the latter reveals the existence of long periods in which inflation was consistently either more or less than expected. From 1959 through 1965 the public consistently expected more inflation than it experienced, as measured by the CPI. Then when actual inflation soared in 1966 expected inflation merely continued its rising trend, though its variability increased markedly. Consequently during the Vietnam and post Vietnam inflation the public persistently underpredicted the amount of inflation. These patterns will themselves be the subject of a further study. But first EXPT must be compared with alternative indirect measures of inflationary expectations.

3. Competing Measures

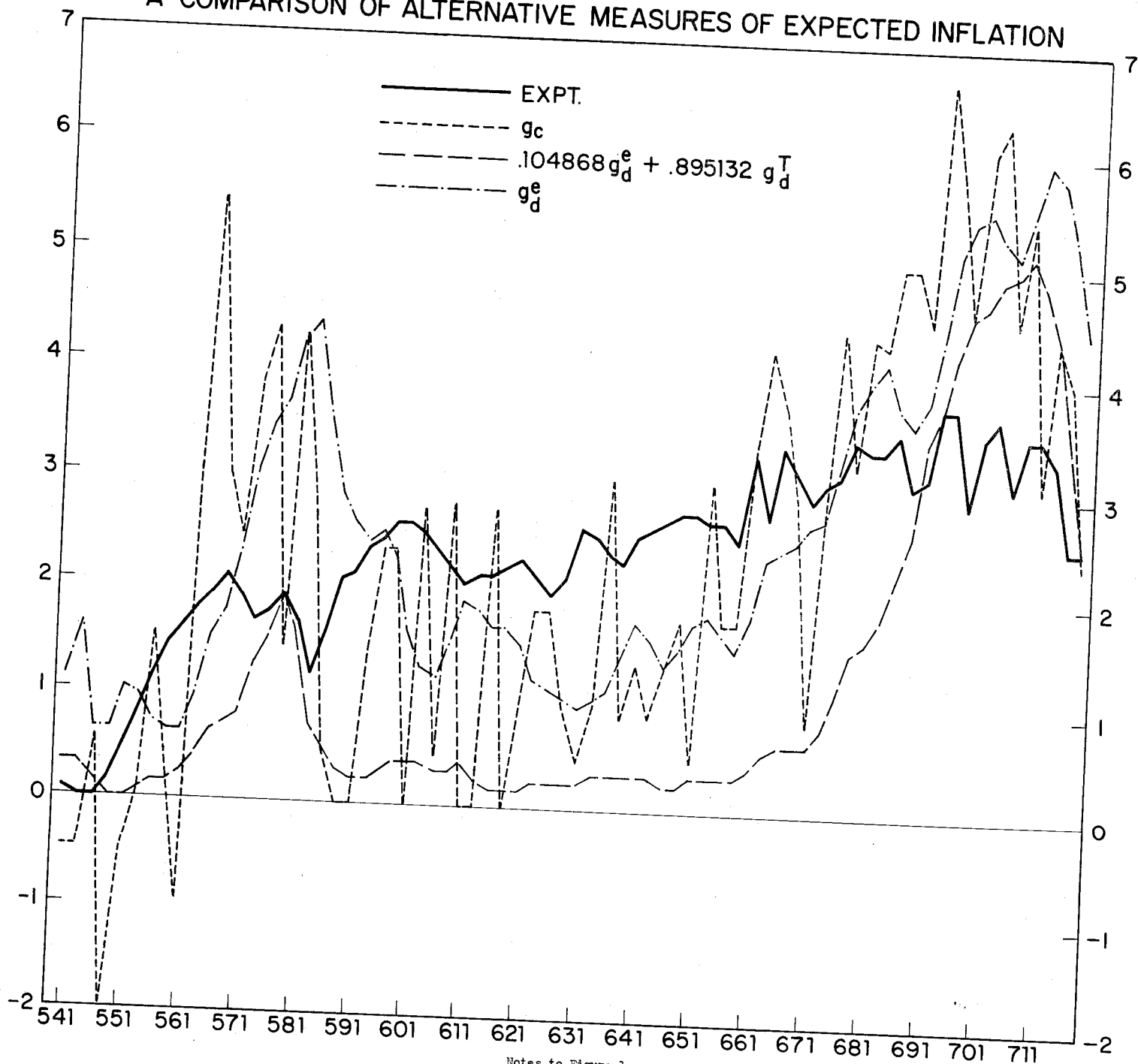
As explained earlier, it was decided to test the validity of EXPT by comparing its ability to explain wage increases with that of the indirect measures embodied in three recent studies on wage increases which are the subject of a comparative study by Gordon [1972]. The equations--Perry [1970], Eckstein and Brinner [1972], and Gordon [1971]--were selected because of the convenience of Gordon's comparative study and because in two of these three equations, particular emphasis had been placed on specification of the price expectations variable.¹⁶ They will be referred to subsequently as the test equations.

In all three test equations price expectations are represented by past rates of price change. Perry's specification is the simplest, namely that the quarterly

the validity of equation (3) and the related equation (4). Therefore an alternative measure of EXPT was constructed based on the assumption that prior to 1966:2 SIG was a constant equal to its average value from 1966:2 to 1968:4. The years from 1969 on were excluded from the average on the grounds that they were not characteristic. All of the experiments reported in sections 3 and 4 below were also conducted with this alternate measure. As it turned out, both the two series and the results of the tests based on them were very similar. When compared with its sharp movement in 1969-70, the entire previous history of MOOD back to the first observation in 1952:4 is relatively stable. Therefore the behavior of an EXPT series based on MOOD is quite similar to that of an EXPT series based on the assumption of a constant SIG.

¹⁶Gordon kindly supplied us with his complete data base.

Figure 1
A COMPARISON OF ALTERNATIVE MEASURES OF EXPECTED INFLATION



Notes to Figure 1

Notes: EXPT = The popularly expected rate of change of consumer prices in the forthcoming year, constructed from the Michigan Survey of Consumer Finances according to Eq. 41. g_c = The quarterly rate of change of the CPI at an annual rate, the measure of expected inflation used in Perry [1970]. The expression $.105 g_d^e + .895 g_d^T$ = A weighted average of the two expected inflation measures in Eckstein and Brinner [1972]. See Table II. g_d^e = The expected inflation measure used in Gordon [1971]. See Table III.

rate of change of the wage rate is a function of the quarterly rate of change of the consumer price index, lagged one quarter. Eckstein and Brinner lengthen somewhat the distributed lag and add an additional threshold effect.¹⁷ Their distributed lag spans the full year prior to the current quarter, and has weights which decline linearly to zero. Their threshold variable is the positive excess over 2.5 percent of the average annual rate of inflation during the two previous years. Gordon's specification is the most complex. His expectations variable is a twelve quarters long, freely estimated, polynomial, distributed lag function of the quarterly rate of change of the deflator for personal consumption expenditures. In addition he introduces another price variable to represent the short-run effect of product demand on labor, namely an eight quarter polynomial distributed lag function of the difference between the rate of change of the deflator for private nonfarm GNP and the personal consumption deflator. Conceptually this is not in any way an expectations variable, but it is clear that statistically it may be correlated with expectations variables.

Figure 1 compares the indirect measures of expected inflation of these three authors with the direct Michigan measure, EXPT.¹⁸ The Michigan measure clearly presents an entirely different picture of expectations of inflation from that portrayed by the other measures.

The balance of the specification of each of the test equations is described in the studies cited above, including Gordon [1972].

Gordon's estimation procedure, which is followed here, is to estimate each equation in both one-quarter form and two-quarter form. In this paper, in the one-quarter form, the dependent variable is a one-quarter rate of change of the wage rate at an annual rate and all independent variables are either one quarter rates of change at an annual rate or one quarter averages of level variables, or distributed lag functions of either of these. The two-quarter form is simply a

¹⁷They also, as does Gordon, replace the consumer price index with the deflator for personal consumption expenditures. Gordon [1971], p. 111, note 12 argues that the treatment of the price of the consumption of housing by homeowners in the deflator is preferable.

¹⁸The graph of the Eckstein-Brinner measure combines their distributed lag variable with their threshold variable using weights based on the coefficients of those variables in the two-quarter estimate of the authors' original equation in column 1 of Table II.

two-quarter average of both the left- and right-hand side of the one-quarter equation.¹⁹

Gordon's estimates of the original equations for the period 1954:1-1970:4 appear in col. 1 of Tables I, II, III. In each block of the column, the two-quarter estimate and its t -statistic are presented above the corresponding one-quarter estimate.²⁰ Precise variable definitions appear in the glossary accompanying each Table. In view of the well known instability of recently estimated wage equations over moderately differing sample periods, Gordon [1972] estimated each of the original equations in samples going from 1954:1 to 1966:4 and 1968:4 as well as 1970:4. The tests reported below were also repeated for the two smaller sample periods. Though those results are not presented in tabular form, reference will be made to them in the discussion that follows.

¹⁹ Both Perry's and Eckstein and Brinner's original estimates were in the four-quarter form which has been standard for many wage studies in the U.S. However, Gordon rejects this traditional procedure because it introduces excessive positive serial correlation and increases the danger of simultaneity bias. The first of his alternates, the one-quarter form, is in a sense the most natural, since the purpose of these equations is to explain the one-quarter rate of change of the wage rate. However, it turns out in estimation that one-quarter equations usually display significant negative serial correlation. Therefore he turns to the two-quarter form, and upon finding that two-quarter equations display roughly the same degree of positive serial correlation, he argues that the pair of estimates brackets the efficient estimate.

Other differences between the estimates in Gordon [1972], which are followed here, and the original by each author includes the following: All inflation variables have been lagged one quarter to reduce simultaneity, and the dependent variable and sample periods have been standardized. It should be noted that our estimates of Gordon's equation in col. 1 of Table 3 differs slightly from Gordon's own in Gordon [1972], because Gordon constrains both the level and the first derivative of his polynomial distributed lag to be zero in the furthest period, whereas our regression program was only able to constrain the level to be zero. However, the differences are small, and all our other benchmark results agree exactly with Gordon's.

In addition to the variables listed in Tables I, II, and III, each of the original equations has one or more different personal and/or social security tax variables. All of these variables are highly orthogonal to the other independent variables, and their estimated coefficients are quite insensitive to changes in the other independent variables; therefore we have excluded these coefficients from our tables.

²⁰ There is a slight difference in presentation between our tables and those in Gordon [1972]. In Gordon [1972] the standard errors of estimate of all two-quarter and one-quarter equations are reported at two-quarter and one-quarter rates respectively. In this paper, all standard errors are reported at annual rates.

4. Significance Tests

Expected inflation influences wage change in a very simple manner in each of the three test equations. An increase in expected inflation results in a fractional increase in wage change in the following quarter. The availability of a direct measure such as ours permits a more complex modeling of the impact of expectations. One hypothesis, originally advanced by Turnovsky and Wachter [1972], is that in addition to the initial impact effect there is a "catch-up" effect whereby wages catch up with a portion of the difference between recent inflation and previous expectations.

This effect is difficult to represent if one's measure of expectations is itself based on recent inflation. But if one is willing to use a direct measure such as EXPT, the effect can readily be represented by the difference between recent inflation and an appropriate past value of EXPT. How far back one should go depends on the manner in which unexpected inflation is thought to influence current wage change. Reasoning that unexpected inflation influences wage change through 1) increasing worker demands in new contract negotiations, and 2) activating escalator clauses, we maintain that it is the average amount of unexpected inflation over the past year which is relevant²¹ and, therefore, that the catch-up effect may be represented by a variable such as the following:

$$(5) \text{ CATCH} = g_d^4 - \overline{\text{EXPT}}_{-4}$$

In this expression, g_d^4 is the four-quarter rate of change of the deflator for consumer expenditures, d, the index of actual consumer price used in two of the test equations. $\overline{\text{EXPT}}_{-4}$ is the average of EXPT four and three quarters ago. This average is used in place of EXPT itself in order to remove some of the purely random variability of the series.

²¹The average duration of union contracts is about 3 years and has not changed much between 1954 and 1970, the maximum span of our sample period. See Ward [1959], Ward [1965], Sparrough and Bolton [1972]. There is less evidence on the frequency of wage adjustments in non-union employment, but the norm appears to be 1 year. By giving union contracts a weight of .2 and non-union wage adjustments a weight of .8 one comes up with a very rough estimate of the average time span between major wage decisions in the private economy of 1.4. But, since some of the catch-up effect can be thought to operate through escalator clauses, which frequently can be activated quarterly, we decided to pick one year as a better measure of the relevant average adjustment period. All of the catch-up effects estimated in Tables I-III were also estimated with a six-quarter specification, and the differences proved to be marginal.

In view of the above discussion, two tests will be performed with each of the selected equations. The first will be a simple comparison of the explanatory power of EXPT and the given, indirect measure of expected inflation, on the assumption that there is no catch-up effect. This test will consist of adding EXPT₋₁ to the original equation.²² The second test will be a test of the joint hypothesis that EXPT is the better measure of expectations and that there is a catch-up effect. It will consist of adding EXPT₋₁ and CATCH₋₁ to the original equation.²² Since the two hypotheses just mentioned interact, it is quite possible that EXPT₋₁ may fail the first test even though EXPT₋₁ and CATCH₋₁ together pass the second one. This in fact occurs in one case. What it means there is that the catch-up phenomenon is so strong that unless it is accounted for the true influence of EXPT cannot be observed.

The a priori ranges for values of the coefficients of EXPT₋₁ and CATCH₋₁ are both between 0 and 1, though there is no a priori restriction on which of the two should be larger. Workers may respond either more or less to unexpected inflation than they do to expected inflation. The results obtained are reported in columns 2, 3 and 4 of Tables I, II, III. Columns 2 and 3 report coefficient estimates when EXPT₋₁ and both EXPT₋₁ and CATCH₋₁ are added to the original equation. Column 4 presents coefficients estimates when the original expected inflation variables are dropped and EXPT₋₁ and CATCH₋₁ take their place.

In Perry's equation, EXPT₋₁ is not significant when entered alone (Table I, col. 1). However, both EXPT₋₁ and CATCH₋₁ are significant and Perry's rate of change of the consumer price index is not when the two Michigan variables are added together (Table I, col. 2). The superiority of the latter equation to Perry's original equation clearly supports the two Michigan variables.

When EXPT₋₁ is entered alone in the Eckstein-Brinner equation, both g_d^* , the distributed lag measure, and EXPT₋₁ are significant in the two-quarter estimate, and neither are in the one-quarter estimate (Table II, col. 1). The threshold variable, g_d^T , remains significant in these and all estimates for the sample period extending through 1970:4.

²²The one quarter lag allows for a response delay and parallels the uniform lag specification in Gordon [1972]. See note 19.

²³In the discussion that follows, unless otherwise indicated, an individual coefficient will be said to be significant if it passes a one-tailed t-test at the 10 percent level, and a group of coefficients will be said to be all significantly different from zero if they pass the appropriate F test at the 10 percent level.

Again, a more clear verdict is obtained when the two Michigan measures are entered together (Table II, col. 2). Both $EXPT_{-1}$ and $CATCH_{-1}$ are then individually significant in the two-quarter estimate and $EXPT_{-1}$ is significant and $CATCH_{-1}$ barely misses significance in the one-quarter estimate. By contrast, the Eckstein-Brinner distributed lag variable is insignificant in both estimates. This leaves the threshold variable, g_d^T , as the only significant Eckstein-Brinner variable. When additional evidence concerning instability of the coefficient of g_d^T is considered, the verdict that emerges is one favorable to the Michigan variables.

Except for a brief period in 1957-58, the threshold variable is only positive during the high inflation period of the late 60's and early 70's. Not surprisingly, its coefficient in the original Eckstein-Brinner equation is not significant for the shorter sample periods tested (1954:1-1966:4, 1954:1-1968:4). In fact, when the equation in Table II, col. 3 is reestimated for those sample periods, the Eckstein-Brinner threshold variable, g_d^T is never significant, and g_d^* is only significant in the two-quarter equations, whereas $EXPT_{-1}$ is significant in all equations and $CATCH_{-1}$ in the two-quarter equations. Moreover, in those shorter sample periods, all estimates of the equation with only Michigan variables have lower standard errors than the corresponding estimates of the original Eckstein-Brinner equation. In short, when the evidence from these three sample periods is considered together, it supports the Michigan variables rather than the Eckstein-Brinner variables.

The tests performed with Gordon's equation resulted in a stand-off between the Michigan variables and Gordon's expected inflation variable. When $EXPT_{-1}$ is entered alone, both it and Gordon's distributed lag measure, g_d^e , are significant in two-quarter and one-quarter estimates (Table III, col. 2).²⁴ When $CATCH_{-1}$ is added, the two-quarter estimate favors Gordon's variable while the one-quarter favors the Michigan variables,²⁵ and judgment is again left in balance.²⁶

²⁴ Gordon in fact uses four variables to estimate the distributed lag in g_d^e . Therefore, the appropriate test of the hypothesis that not all of the coefficients of the distributed lag are equal to zero is an F -test of the reduction of variance due to those four variables jointly. The appropriate test of the hypothesis that the sum of the coefficients is positive is a one-tailed t -test based on the ratio of that sum to its standard error. In Table III, col. 2, g_d^e passes both the F -test and the t -test. (Only the t -statistic is reported in the Table.)

²⁵ On the one hand, in the two-quarter estimate, the Michigan variables both have the wrong sign and Gordon's expected inflation variable passes both the F -test and the t -test. (See note 24.) On the other hand, in the one-quarter estimate, $EXPT_{-1}$ is significant, and Gordon's variable passes the F -test, but not the t -test. The individual coefficients of his distributed lag start with large negative values and then switch to large positive ones. This questionable pattern causes the sum of those coefficients to be insignificant.

²⁶ Results for the 1966:4 and 1968:4 sample periods are very similar insofar

In summary, if one views the tests performed with the Perry, Eckstein-Brinner, and Gordon equations as a whole, the evidence supports the joint hypothesis that the direct Michigan measure of expectations has more explanatory power than indirect measures and that there is a catch-up effect. Strictly speaking, the results obtained with Gordon's equation neither confirm nor reject this hypothesis, but, when they are viewed in context with the results for the other equations, they contribute to the overall support for the hypothesis.

In fact the strength of this support increases when one realizes that the tests which were made give the benefit of the doubt to each author's original specification. As is pointed out in Gordon [1972], there is strong evidence of interaction between the independent variables in wage equations. Goodness of fit depends not only on the variables chosen, but also on their particular combination, and presumably, each author's original equation embodied his preferred combination of selected variables. Therefore adding the Michigan variables to equations already estimated by other authors constituted a relatively stringent test of those variables.²⁷

5. The Structure of Wage Equations

The tests reported in the preceding section provide new evidence concerning the structure of wage equations which is of interest in its own right. They constitute the first tests of the Friedman hypothesis which have been made using a directly measured popular forecast of the rate of inflation, and as such they do not support the Friedman hypothesis. In a steady-state in which all inflation was anticipated, CATCH would be identically equal to zero, and, therefore, the

as the relative significance of different measures of expected inflation is concerned, and do not alter this stand-off decision.

²⁷The support for EXPT and CATCH is definitely linked. EXPT by itself does not have as much explanatory power as it does when the catch-up effect is accounted for. It is also true that no evidence of the catch-up effect can be found in the selected equations if expected inflation is not represented by EXPT. An attempt was made to test the catch-up hypothesis independently by constructing catch-up variables using the Perry, Eckstein-Brinner, and Gordon expected inflation measures in place of EXPT. However, when each author's "own" catch-up variable was added to his original equation, it invariably proved to be insignificant. Nonetheless, this interdependence of the support for EXPT and CATCH does not weaken its strength.

existence of a trade-off between inflation and unemployment would depend solely on the magnitude of the coefficient of EXPT. In the estimates reported in column 4 of each table, this coefficient lies between .3 and .7 and is always significantly different from one.

The results of section 4 also clearly substantiate the importance of the catch-up phenomenon. This phenomenon has interesting implications for the nature of the feedback from prices to wages which can be best presented by decomposing CATCH into its parts and then rearranging the terms of

$$\gamma \text{EXPT}_{-1} + \lambda \text{CATCH}_{-1}$$

as follows:

$$(6) \quad \overset{4}{g}_d_{-1} + (\gamma - \lambda) \text{EXPT}_{-1} + \lambda (\text{EXPT}_{-1} - \overline{\text{EXPT}}_{-5}) .$$

It is immediately clear that expected inflation is not the only channel for feedback from prices to wages. Recent inflation, as represented by $\overset{4}{g}_d$, also influences wage increases. In fact, even if EXPT somehow remained constant, the Phillips curve would become vertical if γ were equal to one. The estimates of in column 4 of the three tables are all significantly less than one.

It is also clear that the influence of expected inflation decomposes into a level effect and a rate of change effect. In fact, if $\gamma = \lambda$, a hypothesis which cannot be rejected in any of the estimates in column 4 of the three tables, the level effect vanishes and only the transient influence remains. The moral is that policy-makers considering measures to reduce the rate of wage increase must consider their effect on unexpected as well as expected inflation. Pronouncements designed to bring down inflationary expectations--of which there have been many in the United States recently--may have little lasting effect if they do not by the same token also reduce actual inflation.

6. Conclusion

The tests performed in sections 3 and 4 of this paper demonstrate that the direct measures of expected and unexpected inflation developed here using responses to the Michigan Survey of Consumer Finances explain wage changes as well as or better than the indirect measures used in three recent studies. The significance of this result is in its implication for our understanding of expectations. As has been shown in Figure 1, the Michigan measure of expected inflation differs dramatically from the indirect measures of Perry, Eckstein and Brinner, and Gordon.

If the Michigan measure is correct, the other measures must be incorrect. But that observation constitutes a damning judgment, since the other measures represent the current state of knowledge regarding expectations of inflation.

Such a judgment leads one to seek a better understanding of expectations. Though that endeavor will be the subject of another study, hopefully this paper will have provided some of the data needed to extend the knowledge of expectations beyond the limited state to which it has been confined by the deficiencies of indirect measurement.

TABLE I: PERRY WAGE EQUATION

General Notes for Tables I, II, III:

Estimated coefficients fro two quarter equations (with their t-statistics in parentheses) appear in the top half of each row; estimates (and t-statistics) for one quarter equations appear in the bottom half. The sample period for all equations is 1954:1-1970:4.

Definitions given below are for one quarter equations. Variables in the two quarter equations are all two quarter averages of the corresponding variable in the one quarter equations. The symbol ξ_X represents the quarterly rate of increase of the variable X at an annual rate, and $\xi_{X-\tau}$ the same quarterly rate of increase lagged τ quarters.

Variable Definitions:

ξ_W : the dependent variable. W is an hourly earnings index for production workers in the private nonfarm economy, adjusted for overtime and changes in interindustry mix. The index has further been adjusted to include fringe benefits. See Gordon [1972].

U*: Weighted unemployment rate. [See Perry, 1970.]

DU: Unemployment dispersion index. [See Perry, 1970.]

D_G: Guidepost dummy. Set equal to 0.25 in 1962:1, 0.50 in 1962:2, 0.75 in 1962:3, 1.0 in 1962:4 to 1966:4, 0.75 in 1967:1, 0.50 in 1967:2, 0.25 in 1967:3, and 0.0 in other periods.

C: Consumer price index.

EXPT: Annual rate of inflation expected, forthcoming year. Michigan Survey. See appendix.

CATCH: Unexpected inflation during preceding year, at annual rate. Michigan Survey. See p. 10.

Variable	1 Original Equation	2 EXPT Added	3 EXPT CATCH Added	4 Perry's Expectations Excluded
Inverse of Weighted Unemployment, 1/U*	.0010 (.42)	.0001 (.30)	.0001 (.27)	.0001 (.28)
Unemployment	.00012 (.46)	.0001 (.46)	.0001 (.44)	.0001 (.43)
Unemployment Dispersion Index, DU	.099 (4.43)	.102 (3.60)	.095 (3.62)	.093 (3.57)
Guidepost Dummy, D _G	.106 (4.31)	.105 (3.44)	.093 (3.15)	.092 (3.15)
Expected Price Increases:	-.017 (-8.12)	-.017 (-7.96)	-.013 (-5.86)	-.013 (-5.91)
Consumer Price Index, ξ_{C-1}	-.018 (-6.95)	-.018 (-6.81)	-.014 (-4.70)	-.014 (-4.73)
Expected Price Increases:	.136 (2.15)	.139 (2.03)	-.073 (-1.82)	
Michigan Survey, EXPT ₋₁	.092 (1.37)	.089 (1.21)	-.050 (-1.58)	
Expected Price Increases:	-.022 (-.14)	-.022 (-.14)	.381 (2.04)	.281 (2.00)
Michigan Survey, CATCH ₋₁	-.019 (.10)	-.019 (.10)	.348 (1.59)	.274 (1.56)
Unexpected Price Increases:			.488 (3.39)	.405 (3.97)
Michigan Survey, Standard Error			.443 (2.73)	.388 (2.97)
Durbin Watson	.00604 .00796	.00609 .00801	.00562 .00760	.00560 .00756
	0.83 1.80	.83 1.80	.88 1.95	.88 1.94

TABLE II: ECKSTEIN-BRINNER WAGE EQUATION

Variable	1 Original Equation	2 EXPT Added	3 EXPT and CATCH Added	4 E-B Expectations Excluded	Variable Definitions:
Inverse of	.0016	.002	.001	.001	
Conventional	(8.32)	(8.19)	(7.29)	(6.37)	ξ_W : Dependent variable. Same as Table I.
Unemployment	.0018	.002	.002	.001	U: Conventional unemployment rate.
Rate, 1/U	(6.29)	(6.01)	(5.28)	(4.67)	D_G : Guidepost dummy. Same as Table I.
Guidepost	-.0069	-.009	-.008	-.009	d: Personal consumption deflator.
Dummy, D_G	(-3.96)	(-4.16)	(-3.64)	(-3.97)	g_d^* : Expected inflation variable with imposed weights:
	-.0076	.009	-.008	-.010	$g_d^* = 0.4g_{d-1} + 0.3g_{d-2} + 0.2g_{d-3} + 0.1g_{d-4}$
	(-2.86)	(3.01)	(-2.58)	(-3.01)	(See Gordon [1972].)
Expected Price	.244	.157	-.163		ξ_d^T : Threshold inflation variable
Increases:	(2.25)	(1.29)	(-.624)		= 0.0 if $[(d_{-j} - d_{-j})/d] \leq 0.05$;
Consumption	.113	.031	-.299		otherwise = $\frac{1}{2} \left[\frac{d_{-1} - d_{-9}}{d_{-5}} \leq 0.05 \right]$.
Deflator, g_d^*	(.71)	(.18)	(-.90)		(See Eckstein-Brinner [1972] and Gordon [1972])
Inflation	.821	.784	.779		EXPT: Same as Table I.
Threshold,	(3.95)	(3.78)	(3.79)		CATCH: Same as Table I.
g_d^T	.966	.914	.886		
	(3.16)	(2.96)	(2.87)		
Expected Price			.534	.706	
Increases:			(1.90)	(7.22)	
Michigan Survey,			.573	.622	
EXPT-1			(1.56)	(4.62)	
Unexpected Price			.377	.492	
Increases:			(1.38)	(4.31)	
Michigan Survey,			.413	.438	
CATCH-1			(1.16)	(2.78)	
Standard Error	.00584	.00579	.00574	.00630	
	.00892	.00890	.00888	.00932	
Durbin	1.27	1.30	1.36	1.14	
Watson	2.24	2.26	2.29	2.12	

TABLE III: GORDON WAGE EQUATION

Variable	1 Original Equation	2 EXPT Added	3 EXPT and CATCH Added	4 Gordon's Price Variables Excluded	Variable Definitions:
Unemployment	.047 (3.05)	.036 (2.09)	.024 (1.32)	.037 (2.21)	ϵ_W : Dependent variable. Same as Table I.
Dispersion Index, U^D	.049 (2.18)	.030 (1.20)	.037 (1.40)	.040 (1.76)	DU : Same as Table I.
Disguised Unemployment Rate, U^H	-.605 (-5.24)	-.704 (-5.31)	.693 (5.30)	-.808 (6.09)	U^D : Disguised unemployment rate. See Gordon [1972]. U^H : Unemployment rate of hours. See Gordon [1972].
Unemployment Rate of Hours, U^H	-.626 (-3.43)	-.786 (-3.88)	-.760 (-3.70)	-.735 (-3.89)	d : Personal consumption deflator.
Expected Price Increases: Consumption ^e Deflator, ϵ_d	-.238 (-1.26)	-.325 (-1.66)	.420 (-2.08)	-.223 (-1.42)	ϵ_d^e : Distributed lag on the quarterly rate of change of the personal consumption deflator, with weights estimated as a polynomial distributed lag, starting in $t-1$, with individual coefficients constrained to lie along a fourth degree polynomial with level set equal to zero in the most distant period ($t-12$). The coefficients in the Table are the sum of the estimated weights. The numbers in parentheses are not t -statistics. They are the ratio of this sum to its standard error.
Product Price, $\epsilon_p - \epsilon_d$.608 (5.16)	.539 (.13)	1.075 (3.02)	-.213 (-1.05)	$(\epsilon_p - \epsilon_d)$: Distributed lag on the difference between the quarterly rate of change of p , the private nonfarm deflator, and the quarterly rate of change of d , starting in $t-1$, with individual coefficients constrained to lie along a third degree polynomial and set equal to zero in the most distant period ($t-7$). The coefficients are sums of estimated weights, and each number in parentheses is the ratio of this sum to its standard error.
Expected Price Increases: Michigan Survey, EXPT-1	.739 (3.89)	.843 (.20)	1.102 (4.24)	.514 (4.05)	EXPT: Same as Table I.
Unexpected Price Increases: Michigan Survey, CATCH-1	.768 (2.45)	.921 (.32)	.750 (1.97)	.513 (2.82)	CATCH: Same as Table I.
Standard Error	.00412	.00408	.00402	.00504	
Durbin	.00736	.00722	.00724	.00764	
Watson	1.50	1.57	1.69	1.12	
	2.61	2.63	2.56	2.23	

APPENDIX

A question regarding the direction of price change similar to the one quoted in section 2 has been included in almost every Survey of Consumer Finances since the inception of the survey in 1946. Raw data on the percentage of responses by category were obtained from reports on the Survey of Consumer Finances in several issues of the Federal Reserve Bulletin for 1946 through 1952, from Consumer Expectations, 1953-1956 by George Katona and Eva Mueller for 1952 through 1955, and subsequently from 1960 Survey of Consumer Finances by the Michigan Survey Research Center, and the succeeding annual publications of the Survey Research Center. Since 1968 the annual publications of the Center have not reported separately the percentage of respondents expecting prices to stay the same, go down, and the percentage uncertain. That data plus all of the data for 1971 and 1972 were kindly supplied to us by Fay Schmiedeskamp, director of the Surveys of Consumer Finances.

As is mentioned in the text, the wording of the question has varied from time to time. Since 1959 the wording has been as reported in section 2. From 1951 to 1959 the question asked about "prices of household items and clothing", and from 1946 to 1951 about "prices of things in general". Overlapping periods were always available when the question changed form, and the overlap was used to link the different series.

Since 1959, the survey has usually been conducted four times a year. The timing of the surveys, however, has not been consistent, year by year, nor do survey dates necessarily match the midpoints of calendar quarters (February 15, May 15, August 15, and November 15). Prior to 1959, the survey was taken with varying frequency during each year. Consequently, whenever data was not available, or available at off times during the year, the series, which had been linked as described above, were interpolated linearly.

The question added to the survey in May 1966 asks for quantitative estimates from those respondents who expect prices to rise. The answers to this question were used to estimate the mean and standard deviation of expected price increases, EXPT and SIG. These answers have been coded in intervals (1-2%, 3-4%, 5%, 6-9%, 10% or more, don't know how much).

A mean of positive expected price increases was calculated by assigning the midpoint to each interval and 10% to the "10% or more" category. By assuming that the mean thus calculated reflected the average expectation of the "don't know how much" category, and by assigning a prediction of zero to the "fall" and "same" categories, a mean was obtained for all respondents who expressed a definite opinion in their answer to the first question. The standard deviation for this class of respondents was calculated in a consistent manner. The remainder of the sample, those who either did not answer the first question, or answered that they were uncertain whether prices would rise, fall, or stay the same, was assumed to be distributed as the rest of the sample. Therefore the mean and standard deviation just described were taken as referring to the entire sample.

The raw data on percentage of respondents by category were obtained from the same sources as the raw data on answers to the first question from 1966 on, and were interpolated in the same manner. No linking was necessary.

The questions on which the Index of Consumer Sentiment, MOOD in equations (3) and (4) of the text, is based on the following:

1. "We are interested in how people are getting along financially these days. Would you say that you and your family are better off or worse off financially than you were a year ago?"
2. "Now looking ahead--do you think that a year from now you people will be better off financially, or worse off, or just about the same as now?"
3. "Now turning to business conditions in the country as a whole--do you think that during the next twelve months we'll have good times financially, or bad times, or what?"
4. "Looking ahead, which would you say is more likely--that in the country as a whole we'll have continuous good times during the next five years or so, or that we will have periods of widespread unemployment or depression, or what?"
5. "About the big things people buy for their homes--such as furniture, house furnishings, refrigerator, stove, television, and things like that. For people in general, do you think now is a good or a bad time to buy major household items?"

The Survey Research Center averages the dispersion indices for these five questions to obtain the Index. It is then rebased so that its value in February 1966 is 100. See Survey of Consumer Finances, 1970, p. 247. The Index is published regularly. The raw data used in this study was obtained from Survey of Consumer Finances, 1967, pp. 247-248, and Survey of Consumer Finances, 1970, p. 207. This series was linearly interpolated in the same way the answers to price questions were.

A mimeographed listing of the complete constructed series for EXPT and SIG from 1952:4 to 1972:3 may be obtained from the author on request.

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