How Robust are Quantified Survey Data? Evidence from the United States

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Abstract

Much survey data on consumer expectations is collected in the form of qualitative tendency surveys. For econometric modelling purposes it is useful to translate these into quantitative measures of the mean and dispersion of expectations. This paper develops "quantified" measures of unemployment, interest rate and inflation expectations for the US. These are compared with each other, and with direct quantitative estimates of expected inflation, and they are used to explore what factors matter for consumer perceptions of their own financial situation, and for their assessment of the economy as a whole. Mean expectations estimates form qualitative surveys appear fairly robust, but estimated standard deviations prove very unreliable.

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1. Introduction

In the monthly surveys of US consumers conducted in the United States by the Survey Research Center of the University of Michigan, individuals are asked questions about (a) their perceptions and expectations of general business conditions, (b) their perceptions and expectations about their own household's financial situation, and (c) their expectations about a range of economic indicators, including unemployment, borrowing costs, and prices. One aim of this paper is to determine which of these general economic indicators really matters to consumers, and whether uncertainties about unemployment, interest rates and inflation are as important as their expected values. Parallel to this, we are interested in the reliability of the survey data, and in particular the robustness of estimates of the mean and dispersion of expectations inferred in different ways from qualitative survey questions.

For the most part, the surveys do ask qualitative questions. For example the Michigan SRC survey asks: During the next 12 months, do you think that prices in general will go up,or go down, or stay where they are now? The questions are asked about unemployment, interest rates, past and future general business conditions, and the past and future financial situation of the respondent's household are similar. Responses are reported in the form of balance statistics – the difference between the percentage of respondents expecting prices to go up and the percentage expecting prices to go down, with the implication is that this gives information about the inflation expectations of a typical consumer. On this understanding the balance statistics are fed into press reports, into broader indices of consumer confidence, and in some cases into indices of leading economic indicators.

Under strong assumptions, it is possible to translate the qualitative survey responses into quantitative estimates of the mean and standard deviation of the distribution of expectations across survey respondents. The pioneering paper is the Carlson and Parkin (1975) study of UK Gallup poll data. Their key assumptions are that the distribution of expectations is normal, that the range of price changes which elicit a

no-change response is constant over time and symmetric around zero, and that expectations are unbiased. As it happens, the Michigan SRC also asks for quantitative estimates of future inflation, so for this variable it is possible to obtain direct measures of the mean and standard deviation of the expectations distribution, and test the reasonableness of these assumptions.

Quantified mean expectations have been used to test whether consumer expectations are efficient or technically rational, and as inputs into econometric models. The standard deviation of individual expectations looks as if it should contain information about the degree of uncertainty of a typical respondent, and uncertainty about employment, interest rates and inflation should in turn affect consumer decisions. However, the conditions under which the dispersion of individual expectations correlates with subjective uncertainty prove to be quite restrictive, and, perhaps because of this, less use has been made of data on the dispersion of expectations in economic modelling.

The first step in the paper (Section 2) is to set out a framework for analysing qualitative survey responses, and to clarify the relationship between dispersion and uncertainty. We then (Section 3) examine how this framework can be used to interpret aggregate survey responses, and discuss the statistical properties of quantified expectations and dispersion measures from the SRC surveys. Finally (Section 4) we assess what expectations and uncertainties really matter for economic well-being, as perceived by US consumers. We also test whether the inflation expectations obtained from qualitative lead to the same inferences as the directly measured inflation expectations.

We find that mean expectations of unemployment, interest rates and inflation are all statistically significant determinants of consumer expectations about general business conditions. Unemployment and inflation also impact significantly on expectations about household's own financial position. Consumer seem subject to some fallacy of composition in framing these expectations, with general business conditions expected to behave in a regressive way (with bad times expected to follow good times), while their own financial situation is simply extrapolated (with bad times followed by more

bad times…). Regarding the quality of the survey-based expectations, we find that mean inflation expectations are fairly robust, with similar results obtained regardless of whether qualitative or quantitative measures are used. The same is not true of the dispersion of expectations, however. Measures of the standard deviation of inflation expectations, for example, differ significantly between quantitative and qualitative surveys, and produce contradictory and counterintuitive results in our models of consumer expectations formation.

2. A Model of Individual Survey Responses

The Michigan SRC Surveys of Consumers started in 1946, and were conducted two or three times per year until 1960, when (with a few interruptions) they moved to a quarterly cycle with surveys in February, May, August and November each year. Starting from January 1978 the survey has been run monthly. The early surveys were based on quota samples of around 1000 to 3000 individuals, but by 1980 the sample size had been reduced to around 500. The survey is currently conducted by telephone, with a rotating sample consisting of around 60% new randomly selected households, and 40% reinterviews of respondents from the survey 6 months earlier. Individuals within each household selected to obtain a representative age and gender profile.

Table 1 sets out selected questions currently asked in the survey. The first two, labelled PFP and PFE, ask about changes in the past and expected financial position of the respondent's family. The next two (BCP, BCE) ask about the respondent's perceptions of changes in past "business conditions" in general, and expected future business conditions. The final three sets of questions (UE, RE, PE) ask more specifically about the expected direction of change in unemployment, interest rates and prices. Supplementary to the price question, respondents are asked to provide a quantitative estimate the rate of inflation over the next 12 months (QE). The PFP and PFE questions, the BCP and BCE questions, and the qualitative price expectations question PE, have all been present in the survey from its early days. The unemployment and interest rate questions start in November 1960 and February 1969 respectively. Quantitative information on inflation expectations QE was initially

gathered in the form of range information, starting in May 1966, and the current form of the question was introduced in August 1977.

For the qualitative questions, our data consist of the percentage responses in each category. For the quantitative inflation expectations question PE, the SRC publish data on the mean and variance of the individual expectations, and the percentages of responses lying in various ranges (< 0, 0, 1-2, 3-4%, 5%, 5-10%, over 10%).

To interpret these figures, it is helpful to have some model of the mental process that a respondent might go through as he or she answers the survey questions. We start by defining the information environment of the individual respondent, and develop an expression describing the mean and variance of his or her subjective probability distribution for the surveyed variable. Then we look at how this might translate into a qualitative (up/ same/ down) response to the survey question. Finally we consider the aggregate distribution of responses across individuals, and the conditions under which its mean and variance might provide information about the subjective probability distributions of individual respondents.

2.1 Information environment

The framework used to interpret unemployment, interest rate and inflation expectations (and by implication general business conditions) is similar to that developed in Batchelor (1986a) and Batchelor and Orr (1991). We suppose that at the time of survey t individual respondent i accesses three kinds of information relevant to the forecasting of variable y_t, say:

- an estimate y_{it} based on individual-specific information
- an estimate y_{ht} based on the time series history of the target variable
- a government policy target y_{gt}

In the case of inflation expectations, the individual-specific data might depend on the individual's shopping basket. In the case of unemployment expectations, it might

depend on the individual's own situation, or on the unemployment rate among friends or in the local community. In the case of interest rate expectations it might depend on the individuals debt position and credit rating. Respondents also have some general information from news media.

The precision of these estimates is likely to vary across individuals, as

$$y_{it} = y_t + u_{it}, \quad u_{it} \sim N(0, \tau_{it}^2)$$

where τ_{it}^2 is a measure of the variance of individual experiences of the target variable, and for simplicity of exposition the distribution is assumed normal. Fishe and Idson (1990) use micro-data from the SRC survey to show that the size of the forecast errors (and the number of "don't know responses) in inflation expectations are correlated negatively with factors like age, education and income, which are associated with greater economic activity, and hence with superior information acquisition and processing. Ceteris paribus, and more controversially, errors are negatively correlated with gender, where male = 1, female = 0.

We assume that the variable follows the process:

$$\begin{aligned} y_t &= y_{gt} \text{ with probability } \pi_{it} \\ &= y_{ht} + u_{ht}, \quad u_{it} \sim N(0, \tau_{ht}^2) \text{ with probability } 1 - \pi_{it} \end{aligned} \qquad (1)$$

where π_{it} is the probability that the government target will be enforced, an index of the credibility of policy. Differences in individual political affiliations are liable to induce differences in π_{it} and hence more optimistic expectations among the supporters of the incumbent government. Absent the policy, y_{ht} is the time series prediction of y, and τ_{ht}^2 is a measure of the volatility of the target variable over time. Many macroeconomic variables follow near unit root processes, so that the time series prediction can be proxied by the lagged observed value y_{t-1}, possibly with an added drift.

From observations on y_{it}, y_{gt}, and y_{ht} the respondent can form a subjective probability distribution for the target variable. If the individual is rational in the sense of Muth (1961) this will coincide with the statistically optimal conditional distribution. Following DeGroot (1971, p167) this distribution will be $N(\mu_{it}, \sigma_{it}^2)$ where

$$\mu_{it} = w_{it}\, y_{it} + (1- w_{it}) \{ \pi_{it}.\, y_{gt} + (1- \pi_{it}).y_{ht}\} \tag{2}$$

$$\sigma_{it}^2 = \frac{\tau_{it}^2(1-\pi_{it})\{\pi_{it}(y_{ht}-y_{gt})^2+\tau_{ht}^2\}}{\tau_{it}^2+(1-\pi_{it})\{\pi_{it}(y_{ht}-y_{gt})^2+\tau_{ht}^2\}} \tag{3}$$

and the weight w_{it} assigned to individual-specific as opposed to general information is

$$w_{it} = \frac{(1-\pi_{it})\{\pi_{it}(y_{ht}-y_{gt})^2+\tau_{ht}^2\}}{\tau_{it}^2+(1-\pi_{it})\{\pi_{it}(y_{ht}-y_{gt})^2+\tau_{ht}^2\}} \tag{4}$$

The upper panel of Figure 1 shows the distribution of expectations for a typical individual.

The estimate μ_{it} is the individual's estimate of the value of the target variable, and the variance σ_{it}^2 is a measure of individual uncertainty. The expectation is a weighted average of the individual-specific estimate, the time series estimate and the government target, with weights that reflect the relative precisions of these estimates and the credibility of the target.

Uncertainty similarly depends positively on the variance of the individual-specific information, the volatility of the variable over time, the credibility of the government target, and the gap y_{ht}-y_{gt} between the time series estimate of the underlying variable, and the government target for that variable. Batchelor and Orr (1991) explore the analytics of the inflation uncertainty expression (3). Among other things, it implies that uncertainty is raised by deviations of inflation from target rates, and that increased policy credibility will only decrease uncertainty if credibility is already above a certain minimum threshold. Otherwise the announcement of a target far from

the current rate of inflation increases uncertainty by widening the range of possible future outcomes for inflation.

2.2 Survey Responses

Given this subjective probability distribution, how will a survey respondent answer the question: do you expect the value of y to fall, remain unchanged, or rise? Following Batchelor (1986b) and consistent with the above model of rational information processing, we assume that the respondent implicitly conducts a hypothesis test of the null of no change H0: $m_{it} = y_{t-1}$ against the alternatives H1: $m_{it} > y_{t-1}$ or $m_{it} < y_{t-1}$, where m_{it} is the true mean of individual i's subjective probability distribution. One way of viewing the no-change null is that it implies that individual specific information has no value ($w_{it} = 0$), and either that $\pi_{it} = 0$ (no policy effectiveness), or that $y_{gt} = y_{ht} = y_{t-1}$ say, so that the variable y is already at its target level. In this case, the subjective variance in (3) reduces to τ_{ht}^2, the time series volatility measure.

The form of the test is to reject the null if

$$\mu_{it} - y_{t-1} > \delta^{+}_{it}$$

or

$$\mu_{it} - y_{t-1} < -\delta^{-}_{it} \qquad (5)$$

where the δ_{it} are critical values chosen so as to minimise the expected disutility of Type I and Type II errors. The middle panel of Figure 1 shows the distributions of an individual's expectations under null and alternative hypotheses, the areas measuring the probabilities of Type I and type II error, and the critical values δ_{it}. Ceteris paribus, the δ_{it} will depend positively on the gap between the estimated mean μ_{it} and the benchmark no-change value of the variable y_{t-1}. If the variance under the null depends only on τ_{ht}^2, the δ_{it} will also depend positively on the time series variance, since an increase in τ_{ht}^2 reduces the relative probability of a Type 1 error.

For at least some of the variables in the SRC survey, the critical values are likely to be asymmetric. For the questions relating to unemployment, interest rates and inflation, and even general business conditions, the individual respondents do not have a stake in the outcome. They are likely to treat positive and negative Type II errors (i.e. missed signals of change in the economy) symmetrically. However, when thinking about their own financial position, the conventional assumption is that individuals have concave utility functions. Potentially damaging events such as an increased probability of unemployment, increased interest costs on debt, and increased inflation, would be treated as more serious than potentially beneficial events. For variables FPP and FPE, the critical value δ^{+}_{it} applied to adverse events is likely to be smaller than the critical value δ^{-}_{it} for beneficial events.

Recently, some direct evidence on the properties of individual thresholds has become available. In the quarterly IFO World Economic Survey, experts are asked about whether 6-month ahead inflation rates (in 90 countries!) will be higher, lower, or remain unchanged. In July 2004, participants were additionally the % by which inflation would have to rise/ fall for them to make a positive response to the survey question. From pooled data for major economies, Henzel and Wollmershauser (2005) confirm that these thresholds vary directly with the average expected inflation rate, directly with the past volatility of inflation, and are higher for increases in inflation than for falls in inflation. This is encouragingly consistent with the above signal detection theory of survey responses.

3. Interpreting Aggregate Survey Data

Suppose the survey conducted at t has n_t respondents. Of these, some number, say n_t^A report that they expect variable y to fall, since for these individuals, $\mu_{it} - y_{t-1} < -\delta^{-}_{it}$. Similarly n_t^C will report that they expect y to rise since for them $\mu_{it} - y_{t-1} < \delta^{+}_{it}$. The survey responses are the reported to users in the form of the proportions A_t, B_t and C_t of the sample expecting a fall, no change and a rise, where for example $A_t = n_t^A/n_t$ and $C_t = n_t^C/n_t$. We have seen that individuals have expectations drawn from heterogeneous distributions, and will in general use different decision rules to frame

their answers. Can these response proportions be used to make inferences about the average and standard deviation of the expectations μ_{it} across individuals? Can the responses be used to make inferences about average subjective uncertainty σ_{it}^2 ?

We start be setting out the theory of "quantification" of aggregated survey responses, then look at the results of quantifying the Michigan SRC surveys.

3.1 Quantification

In order to make progress, some assumption must be made about the form of the distribution of μ_{it} across individuals, shown in the lower panel of Figure 1. Responses to a qualitative survey are conventionally summarised in the form of a "balance statistic", $C_t - A_t$, measuring the difference between the proportion expecting a rise in the underlying variable, and the proportion expecting a fall. The conventional understanding is that this is proportionate to, or is at least strongly informative about, the average individual expectation. However, the balance statistic is a sufficient statistic for the average individual expectation μ_t only under a very unrealistic assumption about the distribution of the individual expectations. As made explicit in some early work on the quanification of tendency surveys (Pfanzagl, 1952; Their, 1958), the μ_{it} must follow a discrete signum distribution, of the form

$$\mu_{it} = \begin{cases} -\theta & \text{with probability A} \\ 0 & \text{with probability B} \\ +\theta & \text{with probability C} \end{cases}$$

For any critical values δ^-_{it} and $\delta^+_{it} < \theta$, the expected value and variance of the distribution can be estimated from the survey responses by the Balance and Disconformity statistics

$$BAL_t = \theta (C_t - A_t) \qquad (6)$$

$$DIS_t = \theta^2 \{(C_t + A_t)^2 - (C_t - A_t)^2\} \qquad (7)$$

In press reports, θ is set to 1, but it could be chosen to ensure that the Balance statistic had the same average value as the target variable over a run of surveys, in which case (6) would yield a series of quantitative estimates of the average expectations μ_t of individuals.

Carlson and Parkin (1975) instead assume that the distribution of mean expectations across individuals is normal, and that the critical values δ^-_{it} and δ^+_{it} are symmetric, equal for all individuals, and constant over time, so that $\delta^-_{it} = \delta^+_{it} = \delta$, say. Then the mean and standard deviation of expectations across individuals can be estimated as:

$$CPMEAN_t = \delta\,(a_t + b_t)/(a_t - b_t) \qquad (8)$$

$$CPSD_t = \delta.-2/(a_t - b_t) \qquad (9)$$

Where a_t and b_t are percentiles of the cumulative normal distribution corresponding to the sample proportions A_t and $(A_t + B_t)$. Again, these can be turned into quantitative estimates by choosing δ to ensure that expectations are unbiased.

While the use of a continuous distribution is more realistic, the conditions under which the mean individual expectations will be normally distributed are very restrictive. Specifically, μ_{it} will be normal only if all individuals are sampling from the same distribution of individual-specific information (so all are equally well informed) and that all individuals hold the same beliefs about the credibility of policy targets. In this case, the μ_{it} will effectively be draws from the same sampling distribution for the mean, and will indeed be normally distributed in large samples.

Under these conditions, the standard deviation of mean expectations across individuals is proportionate to the common standard deviation of individual expectations (see for example Batchelor 1986a), so that the dispersion of mean expectations can be used as a proxy for individual uncertainty about the target variable. In the US Survey of Professional Forecasters, respondents are asked to provide a probability distribution for inflation and growth forecasts, so it is possible to

test directly whether forecaster disagreement over the mean inflation rate is correlated with average subjective uncertainty. For this group of forecasters at least, the evidence is encouraging. For example, Giordani and Soderlind (2003) report a correlation of +.83 for inflation expectations. Some studies (for example, Rich, Raymond and Butler, 1992) have tried to measure this correlation indirectly, by testing whether dispersion in the Michigan SRC consumer inflation expectations data is higher at times when forecasts are particularly inaccurate, with negative results. However, this assumes that subjective uncertainty about inflation is rational. Batchelor and Zarkesh (2000) show that is not true of the professional forecasters in the Survey of Professional Forecasters, so it is unlikely to hold for the lay respondents to the Michigan SRC surveys.

On the other hand, theory and evidence is strongly against homogeneity in individual probability distributions. Under our model, the distribution of mean expectations can be characterised as a mixture of normal distributions. If individuals differ only in the precision with which they gather economic information, this would argue for the use of a symmetric fat-tailed distribution rather than a normal curve, since mixtures of normals with the same expected values show positive kurtosis (see, for example, Titterington, Smith and Makov, 1985). If individuals additionally differ with respect to beliefs about policy effectiveness, say, the mixture distribution will become asymmetric.

Responses to the Michigan SRC quantitative inflation expectations question QE can be used to generate direct estimates of the mean, standard deviation, skewness and kurtosis of the US consumer inflation expectations, and the results are shown in Figure 2. The two series for the mean and standard deviation correspond to alternative estimates computed from the individual data, and from grouped data. The distribution is consistently mildly positively skewed, and is highly leptokurtic. This is in line with earlier evidence from Carlson (1975), Batchelor (1981, 1982) and Lahiri and Teigland (1987), and with the theory above. Some caution must be exercised in interpreting the SRC quantitative data, however. Curtin (1996) notes that the individual expectations distribution in any month is heavily influenced by outliers. Although these may not be too influential on the mean, they do induce a lot of volatility in month to month

estimates of the standard deviation of expectations across individuals, even after trimming or winsorizing the data. These outliers also make the distributions look fat-tailed, and explain the volatility of the kurtosis figures in the lower panel of Figure 2.

Some studies have used mildly non-normal, fat-tailed distributions such as the logistic and t-distributions to the estimation of a_t and b_t in (8) and (9), and there have been some recent applications of asymmetric distributions in the quantification of tendency surveys, notably Balcombe (1996) on New Zealand data, and Berk (1999) and Nielsen (2003) on Europe-wide inflation expectations. Encouragingly, these papers find little practical difference between the series for mean expectations generated from balance statistics, normal curves, and non-normal distributions such as non-central t- and scaled chi-squared distributions. However, these results do not carry over into comparisons of standard deviations. Batchelor (1986c) shows that for plausible patterns of responses, the disconformity measure of dispersion (7) will be negatively correlated with the Carlson Parkin variance measure based on (9). For the SRC data there is only a weak correlation between the Carlson Parkin standard deviation (9) and the standard deviations directly estimated from the quantitative survey question.

None of the above studies addresses the problem of time variation and asymmetry in the response thresholds. This matters because any systematic movement in δ will mapped directly into mean expectations through (8). With different thresholds $-\delta^-$ and δ^+. the mean and standard deviation of expectations are estimated by

$$\text{ASMEAN}_t = (a_t\delta^+ + b_t\delta^-)/(a_t - b_t) \qquad (8')$$

$$\text{ASSD}_t = -2(\delta^+ + \delta^-)/(a_t - b_t) \qquad (9')$$

This will change the average value and volatility of the expectations estimates. However, the asymmetric threshold estimates (8') and (9') are simply linear transforms of the Carlson Parkin estimates (8) and (9), so their use will not affect any inferences from linear models using the quantified expectations data.

Some studies have used variable thresholds. Seitz (1988) uses a time-varying parameter model, in which the δ follow a random walk. Batchelor (1986b) and Batchelor and Orr (1988) implement a variant of the Carlson-Parkin model in which thresholds are symmetric but vary systematically with the mean and variance of inflation expectations, and with past volatility in inflation. Their model is

$$TVMEAN_t = \delta_t (a_t + b_t)/(a_t - b_t) \qquad (8')$$

$$TVSD_t = \delta_t .-2/(a_t - b_t) \qquad (9')$$

where

$$\delta_t = d_0 + d_1 (a_t + b_t)/(a_t - b_t) + d_2 .-2/(a_t - b_t) + \delta_3 VOL_t + v_t \qquad (10)$$

Here, the first two regressors are the unscaled mean and standard deviation from the survey data, proxies for the mean and standard deviation of individual expectations, and VOL_t is the standard deviation of the target variable over the past year, proxying the time series volatility τ_{ht} in (1).

3.2 Application to SRC data

The data used in this study start in February 1969, and are quarterly up to January 1978, when the monthly surveys begin. In the case of the questions about past and future business conditions, and past and future financial situation, there is no single "actual" variable against which the survey responses can be benchmarked. Variables FPP, FPE, BCP, BCE have therefore been quantified using the formulae (8) and (9) with the threshold d = 1. Time series for the expectations variables FPE and BCE are shown on Figure 3.

Interest rate, unemployment and inflation expectations have been quantified using, respectively, the 3-month US Treasury Bill yield, the seasonally adjusted US civilian unemployment rate, and the consumer price index respectively. The T-bill yield is not

a consumer borrowing rate, but is available for a long period, and is highly correlated with consumer loan rates. For each variable, three sets of mean and dispersion estimates are calculated from the survey responses, corresponding to the constant threshold, constant asymmetric threshold and time-varying threshold models above.

The thresholds, and the parameters of the model of thresholds in (10), are chosen so as to minimise the mean square error in the mean forecast. This is not exactly the same as the "unbiasedness" assumption of Carlson and Parkin (1975), who set δ to make average mean inflation expectations equal to average actual inflation rates. While this may be reasonable for price expectations, it is not a sensible procedure for variables like changes in unemployment and interest rates that have mean values in our sample close to zero. For inflation also we have the possibility of relaxing the assumption that expectations are unbiased with respect to actual inflation, and assuming instead that expectations are unbiased with respect to the mean expectations revealed by the quantitative question in the SRC survey. So we generate three additional sets of inflation expectation measures, with the thresholds selected so as to minimise the mean square deviation between the mean expectations derived from responses to the qualitative PE and quantitative QE survey questions.

Table 2 summarises the results of estimating these thresholds and threshold models. The procedure works well for unemployment and inflation, but quantifying interest rate expectations proves difficult. This least squares criterion leads to implausibly low values of the symmetric threshold (around 0.10%) and a negative value for the upper threshold in the asymmetric model. To make the figures more realistic we have set the symmetric threshold = 0.25%, and constrained the upper threshold in the asymmetric model to 0. The time varying parameter model produced implausibly large negative coefficients d_2 and d_3 on dispersion and time series volatility, and these have been set to zero. This does not significantly affect the error in mean interest rate forecasts, and does not affect linear inferences from the data.

Figure 3 compares resulting mean expectations of unemployment, interest rates and inflation. The asymmetric threshold estimates of mean unemployment and interest rate expectations tend to be lower than those from the symmetric Carlson Parkin

model. For inflation, the two estimates are almost identical. The time varying threshold estimates of mean unemployment and interest rate expectations are very close to the Carlson Parkin means. However, for inflation they are systematically different, giving higher expectations figures in the early part of the data period, up to about 1981, and lower figures later in the sample, from 1991 onwards. The time varying threshold means are much closer to actual inflation, since the Carlson Parkin estimates tend consistently to underestimate inflation in the 1970s, and overestimate inflation in the 1990s. The models for thresholds estimated by minimising the error between qualitative survey means and SRC means are very similar to those from the method matching survey means with actual inflation, and hence the resulting estimates for the mean and standard deviation of inflation are also very close. In what follows we use the figures scaled to actual inflation.

Figure 4 compares estimates of the standard deviation of expectations across survey respondents. The asymmetric threshold estimates of standard deviations tend to be higher than the symmetric estimates for unemployment and interest rates, but again very close for inflation. For unemployment and inflation, the time varying threshold models produces standard deviation estimates which are correlated with time series volatility. However, for unemployment these estimates sometimes become negative. As discussed above, for interest rates no significant effect of volatility or dispersion on threshold could be found. Even so, the time varying threshold models for interest rates produce estimates of the standard deviation which are often negative. In the case of inflation, the Carlson Parkin and asymmetric threshold models suggest that the dispersion of individual expectations is much greater than the time series standard deviation of inflation. In addition the Carlson Parkin and asymmetric threshold models suggest that the standard deviation of expectations across individuals has remained more or less constant since 1981, in spite of several subsequent episodes of increased variability in inflation. The time varying threshold model tracks changes in the volatility of inflation more closely, falling in the 1990s as inflation became more stable. Overall the impression is that allowing the response threshold to vary with the standard deviation of expectations and with time series volatility produces more realistic inflation expectations estimates, but is of less value in quantifying unemployment rates and interest rates.

Figure 5 compares the mean and standard deviations from the quantified inflation expectations with the directly computed means and standard deviations from the quantitative question in the SRC survey. The means are fairly closely correlated. The time varying threshold model fits better in the volatile 1970s, when the Carlson-Parkin models underestimate both actual inflation and the SRC mean expectation of inflation. In the mid 1990s, however, the time varying threshold model, while closer to actual inflation, understates the mean expectation in the SRC survey. In this period – when inflation expectations do appear to have been biased upwards – the Carlson Parkin models do a better job in mimicking the SRC quantitative means.

The lower panel of Figure 5 compares standard deviations. This picture is more worrying. All the quantified expectations series have standard deviation estimates well below the standard deviation of responses to the SRC quantitative survey question. Moreover, the patterns of movement over time are quite different. As seen above, the constant threshold and asymmetric threshold models produce very stable standard deviation estimates. However, the SRC quantitative data show dispersion that start high in the 1970s, fall markedly in the early 1980s, and again in the late 1990s. The time varying threshold model does fall between the 1970s and 1980s. But its average level then remains stable, with a couple of idiosyncratic peaks, one in 1987 when the SRC data shows a local trough. While mean expectations from qualitative survey data seem to be informative, corresponding estimates of the dispersion of expectations across respondents seem to be of much less value.

4. Impact of Uncertainty on Expectations

These differences between qualitative and quantitative measures of dispersion matter only if they are misleading when used in modelling and decision making. In this final section of the paper we estimate simple models of the formation of consumer expectations about general business conditions, and about their own financial situation. Inputs to these models are the mean and standard deviation of unemployment, interest rate and inflation expectations. We then test whether the

quantified inflation expectations yield results similar to the directly measured inflation expectations.

The models are:

$$BCEMEAN_t = a_o + a_1 BCEMEAN_{t-1} + a_2\, QDUM_t\, BCEMEAN_{t-1} + a_3\, BCPMEAN_t + a_4 UEMEAN_t + a_5 REMEAN_t + a_6 PEMEAN_t + a_7 BCPSD_t + a_8 UESD_t + a_9 RESD_t + a_{10} PESD_t + u_t \quad (11)$$

$$FPEMEAN_t = b_o + b_1 FPEMEAN_{t-1} + b_2\, QDUM_t\, FPEMEAN_{t-1} + b_3\, FPPMEAN_t + b_4 UEMEAN_t + b_5 REMEAN_t + b_6 PEMEAN_t + b_7 FPPSD_t + b_8 UESD_t + b_9 RESD_t + b_{10} PESD_t + v_t \quad (12)$$

where with obvious notation, BCEMEAN is the mean quantified response to the question BCE relating to expectations about changes in expected business conditions, BCPMEAN is the mean perceived change in past business conditions, FPEMEAN is the mean expected change in own household financial situation, and FPPMEAN the perceived past change in financial situation. BCPSD and FPPSD are the standard deviations of perceived past changes in business conditions and financial situation. The lagged dependent variables allows expectations to adjust gradually to changes in economic variables. QDUM is a dummy taking the value 1 in the period February 1969-November 1977, when our data is quarterly rather than monthly, and the dynamics of adjustment of expectations are therefore different.

UEMEAN is the quantified mean expected change in unemployment, REMEAN the expected change in interest rates, and PEMEAN the expected inflation rate. UESD, RESD and PESD are their respective standard deviations. For each of these variables there are three possible measures – based on the constant threshold Carlson Parkin model, the asymmetric threshold model, and the time varying threshold model. In the case of inflation expectations PEMEAN and PESD can also be measured directly from the quantitative SRC survey question. Since the asymmetric threshold measures are perfectly correlated with the constant threshold measures, they will give identical results for significance levels in the regressions (11) and (12), so we do not consider

them here. The time varying threshold models for unemployment and interest rates are also unsatisfactory, producing negative values for standard deviations in some months, so we use only the constant threshold measures for these variables.

We therefore estimate three variants of each equation, one using the Carlson Parkin estimator for PEMEAN and PESD, the second using the time varying threshold model for PEMEAN and PESD, and the third using the estimates from the quantitative survey question. The results are shown in Table 3. The models have been estimated by ordinary least squares with the variance covariance matrix of coefficients adjusted for up to12-th order serial correlation in the residuals due to the overlapping forecast horizons of the surveys.

The upper panel shows the models for the determinants of expectations of future business conditions. Interestingly, all models show some kind of mean reversion in expectations, with a negative relation between perceptions of past changes in business conditions and expected future changes. Additionally, mean expectations of unemployment, interest rates and inflation all impact significantly and negatively on consumers expectations for future business conditions. As scaled here, the coefficients on unemployment are almost twice as large as the coefficients on interest rate expectations, suggesting that a 1% rise in the expected unemployment rate is treated as equivalent to a ½% rise in T-bill yields. However, because of uncertainty about the scaling of interest rate expectations, this should not be taken too literally.

The coefficients on inflation expectations are very similar across the different measures of mean expectations, which is encouraging for the use of survey-basaed inflation expectations measures. All suggest that increased inflation impacts negatively on consumer expectations about business conditions. All suggest further that inflation is treated as a far less serious problem than interest rate and unemployment. Roughly, a 1% increase in expected unemployment is estimated to be as serious as a 10-15% increase in inflation, and similarly a 1% hike in interest rates is treated as equivalent to a 6-10% increase in inflation, depending on which expectations measure is used.

In all specification, the dispersion of expectations about unemployment is, rather curiously, associated with a significantly lower assessment of future business conditions. The dispersion of interest rate expectations does not seem to impact on expected business conditions. Whether the dispersion of inflation expectations appears significant depends on what measure is used. The standard deviation of quantitative survey responses is not significant, nor is the standard deviation derived from the Carlson Parkin constant threshold method. However, the time varying threshold estimate does suggest that a higher dispersion of inflation estimates significantly affects expectations of business conditions.

The lower panel of Table 3 reports results for the parallel regression (12) explaining mean consumer expectations about their own household's financial situation. In these models, expectation seem to be extrapolative rather than regressive, with a positive relation between perceived past trend in financial position and the expected future trend. Mean expectations of unemployment affect expectations of financial position negatively, but interest rate expectations do not. Again, inflation expectations are significant, and this result is obtained from both qualitative and quantitative measures. The coefficients are similar across models, and suggest that inflation is treated as a more serious threat to individual consumers than to the economy as a whole. A 1% increase in unemployment expectations has the same impact on expected household financial position as a 2-3% increase in inflation.

As with the model of expected business conditions, there is a positive relation between the dispersion of consumer unemployment expectations and the mean expected financial position of households. Similarly, the standard deviation of interest rate expectations does not correlate with financial expectations. The results for the dispersion of inflation expectations depend on what measure of expectations is used. The standard deviation of responses to the quantitative questions in the SRC survey is significantly negatively associated with household financial expectations. However, the Carlson-Parkin standard deviation measure is not significant, and the time varying threshold model suggests a marginally significant positive relation.

5. Conclusions

For many countries no quantitative inflation expectations data are available, and consumer sentiment about inflation and other variables is collected and reported in qualitative form. The results from this paper have some good news and some bad news for users of such data.

One piece of good news is that estimators of mean expectations derived from qualitative data do seem robust. There is plenty of room for disagreement about exactly how best to characterise the distribution of individual expectations, and how best to model consumer responses to survey questions. However, for practical purposes these problems do not seem to matter. The resulting series for mean inflation expectations have similar general properties to each other, and to directly estimated expectations. And they seem to yield similar inferences when used in econometric modelling.

A second incidental piece of good news is that our extensions of the quantification technique to other variables have yielded some insights into consumer expectations formation. For example, consumers extrapolate trends in their own situation, but assume that tends in the general economy will reverse. Since the aggregate of individual household performance should match general business conditions, this suggests some irrationality or behavioural bias in individual perceptions of economic activity.

The bad news relates to the information content of the dispersion of expectations of inflation and other variables. The dispersion of unemployment has counterintuitive coefficients in both business conditions and household financial position models, with high dispersion associated with expectations of an improving economy. The standard deviations of inflation obtained from the qualitative data have very different properties from the standard deviations estimated from quantitative data. There are reasons to suppose that the quantitative data may be unduly influenced by outliers, and hence too noisy. However, this does not account for the large downward bias in the qualitative measures, nor for the absence of any consistent pattern over time in the

Carlson Parkin type measures. The qualitative inflation dispersion measures perform differently from the quantitative measures when used in models of consumer expectations, so the differences are operationally significant, so inferences from measures of “uncertainty” derived from these qualitative survey data cannot be regarded as reliable.

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Table 1. Selected Questions from the University of Michigan Survey Research Center Survey of Consumers

Variable	Survey question
FPP	We are interested in how people are getting along financially these days. Would you say that you (and your family living there) are better off or worse off financially than you were a year ago? Better Now/ Same/ Worse/ Don't Know
FPE	Now looking ahead--do you think that a year from now you (and your family living there) will be better off financially, or worse off, or just about the same as now? Will be Better Off/ Same/ Will be Worse Off/ Don't Know
BCP	Would you say that at the present time business conditions are better or worse than they were a year ago? Better Now/ About the Same/ Worse Now/ Don't Know
BCE	And how about a year from now, do you expect that in the country as a whole business conditions will be better, or worse than they are at present, or just about the same? Better a Year from Now/ About the Same/ Worse a Year from Now
UE	How about people out of work during the coming 12 months--do you think that there will be more unemployment than now, about the same, or less? More Unemployment/ About the Same/ Less Unemployment
RE	No one can say for sure, but what do you think will happen to interest rates for borrowing money during the next 12 months--will they go up, stay the same, or go down? Go Up/ Stay the Same/ Go Down/ Don't Know
PE	During the next 12 months, do you think that prices in general will go up, or go down, or stay where they are now? Go Up/ Stay the Same/ Go Down/ Don't Know
	If Stay the Same: Do you mean that prices will go up at the same rate as now,or that prices in general will not go up during the next 12 months?
QE	By about what percent do you expect prices to go(up/down) on the average, during the next 12 months? Per Cent / Don't Know
	If Per Cent > 5%: Let me make sure I have that correct. You said that you expect prices to go (up/down) during the next 12 months by (X) percent. Is that correct?
	If Don't Know: How many cents on the dollar do you expect prices to go (up/down) on the average, during the next 12 months?

Source: University of Michigan Survey research Center web site
http://www.sca.isr.umich.edu/main.php

Table 2. Estimates of Threshold Models

Model	*Notation*	*Parameters*	*Unemployment*	*Interest Rate*	*Inflation v Actual*	*Inflation v SRC*
Constant Threshold	***CP***	δ	0.58	0.25	1.82	1.96
		Fit (RMSE)	*0.89*	*1.98*	*2.73*	*1.86*
Asymmetric Threshold	***AS***	$\delta-$	-1.76	-0.89	-2.61	-0.04
		$\delta+$	0.63	0.00	1.47	2.81
		Fit (RMSE)	*0.80*	*1.95*	*2.73*	*1.83*
Time Varying Threshold	***TV***	***d0***	1.30	-0.02	0.64	1.68
		d1	0.01	0.07	-0.11	-0.42
		d2	-1.64	0.00	0.35	0.66
		d3	1.65	0.00	1.77	1.17
		Fit (RMSE)	*0.84*	*1.97*	*1.98*	*1.34*

Table shows estimated values of thresholds used in quantifying unemployment, interest rate and inflation expectations, using text equations (8) and (9), (8') and (9'), and (8'') and (9''). Fit (RMSE) is the root mean square errors in the mean expectations relative to the appropriate target variable. In the Inflation v.Actual column parameters have been chosen to minimise mean square error of inflation expectations. In the Inflation v. SRC column, parameters have been chosen to minimise differences between quantified mean expectations and the SRC survey means. The thresholds δ and δ+ for the interest rate have been constrained to 0.25% and 0% respectively.

Table 3. Explanatory Equations for Expected Business Conditions and Expected Financial Position

Dependent variable = Mean Expected Business Conditions BCEM

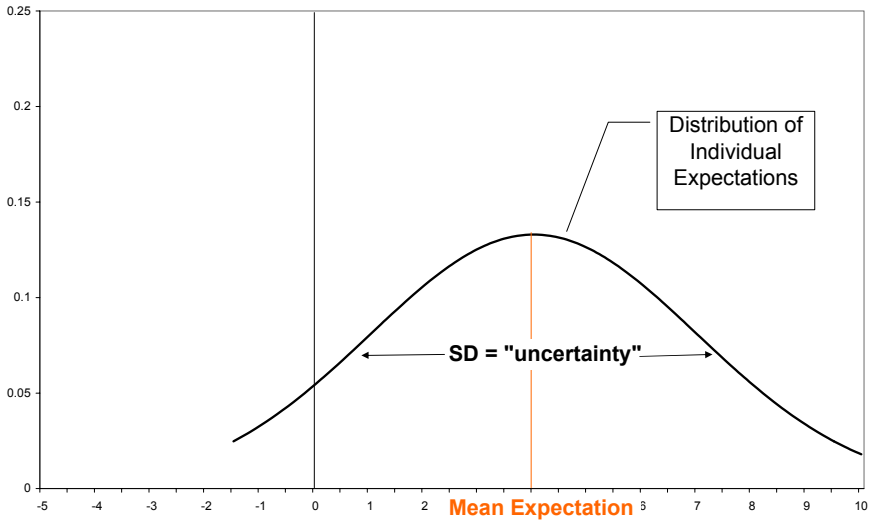
	Inflation Expectations Measure					
Variable	***Carlson-Parkin Constant Threshold***		***Time-Varying Threshold***		***SRC Quantitative Survey Question***	
	coefficient	t-stat	coefficient	t-stat	coefficient	t-stat
Constant	0.3807	*4.10*	0.2596	*3.58*	0.1109	*1.62*
BCEMEANt-1	0.5053	*14.63*	0.4643	*13.67*	0.3971	*11.70*
QDUMt BCEMEANt-1	-0.2628	*-4.14*	-0.2312	*-3.80*	-0.2179	*-3.80*
BCPMEANt	-0.0177	*-4.04*	-0.0216	*-5.12*	-0.0230	*-5.76*
UEMEANt	-0.6339	*-11.19*	-0.6620	*-12.17*	-0.7583	*-14.40*
REMEANt	-0.3387	*-2.77*	-0.4405	*-3.97*	-0.4395	*-4.39*
PEMEANt	**-0.0567**	***-4.77***	**-0.0487**	***-5.90***	**-0.0505**	***-7.67***
UESDt	0.3770	*3.09*	0.4243	*3.65*	0.8467	*7.49*
RESDt	-0.1525	*-0.56*	-0.2707	*-1.04*	0.3270	*1.30*
PESDt	**0.0092**	***0.20***	**0.0632**	***3.00***	**0.0079**	***1.24***
RSQ	0.85		0.86		0.87	
Durbin Watson	1.71		1.80		1.77	
Durbin h	2.34		1.63		1.84	

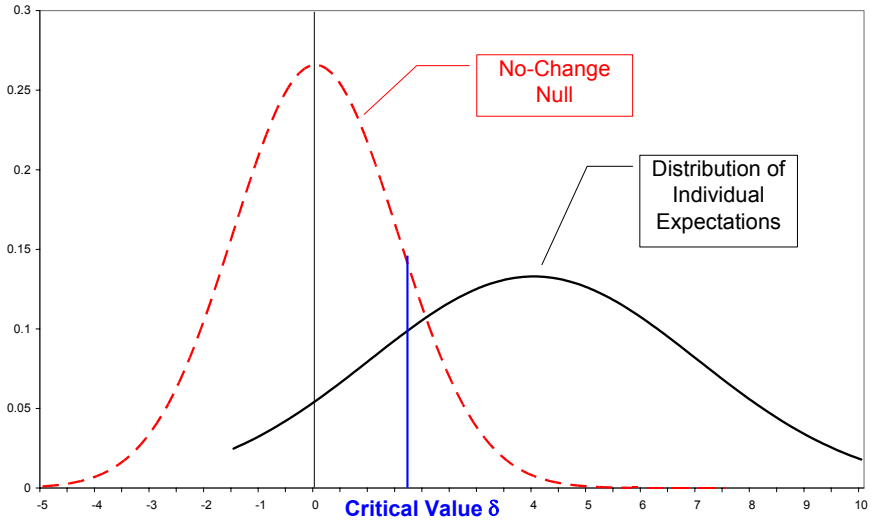
Dependent variable = Mean Expected Financial Position FPEM

	Inflation Expectations Measure					
Variable	***Carlson-Parkin Constant Threshold***		***Time-Varying Threshold***		***SRC Quantitative Survey Question***	
	coefficient	t-stat	coefficient	t-stat	coefficient	t-stat
Constant	0.0637	*0.74*	0.1614	*2.28*	0.4202	*5.26*
FPEMEANt-1	0.6063	*17.02*	0.5215	*13.85*	0.3310	*7.53*
QDUMt FPEMEANt-1	-0.1064	*-2.60*	-0.0810	*-2.09*	-0.0097	*-0.26*
FPPMEANt	0.1956	*9.12*	0.1868	*9.09*	0.1328	*6.45*
UEMEANt	-0.0611	*-2.32*	-0.0524	*-2.10*	-0.1303	*-5.42*
REMEANt	-0.0579	*-0.63*	-0.1056	*-1.28*	-0.0391	*-0.53*
PEMEANt	**-0.0301**	***-3.47***	**-0.0294**	***-4.75***	**-0.0421**	***-7.79***
UESDt	0.3452	*3.41*	0.2943	*3.03*	0.2990	*3.42*
RESDt	0.0892	*0.42*	0.0169	*0.08*	0.5122	*2.63*
PESDt	**0.0350**	***1.03***	**0.0265**	***1.72***	**-0.0105**	***-2.02***
RSQ	0.82		0.84		0.86	
Durbin Watson	2.32		2.32		2.08	
Durbin h	-2.55		-2.53		-0.65	

Text equations (11) and (12) estimated by ordinary least squares on data quarterly from February 1969 to November 1977, and monthly from January 1978 to October 2004.

Figure 1. Individual Expectations and Survey Responses





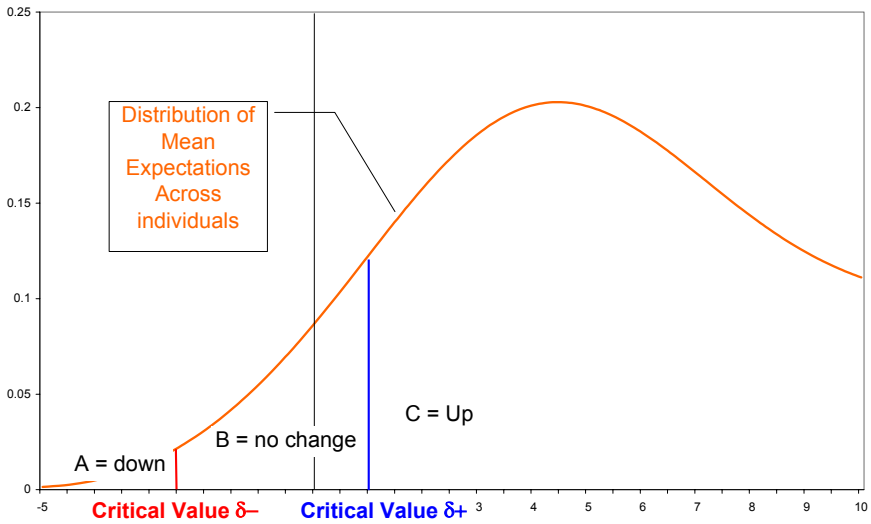
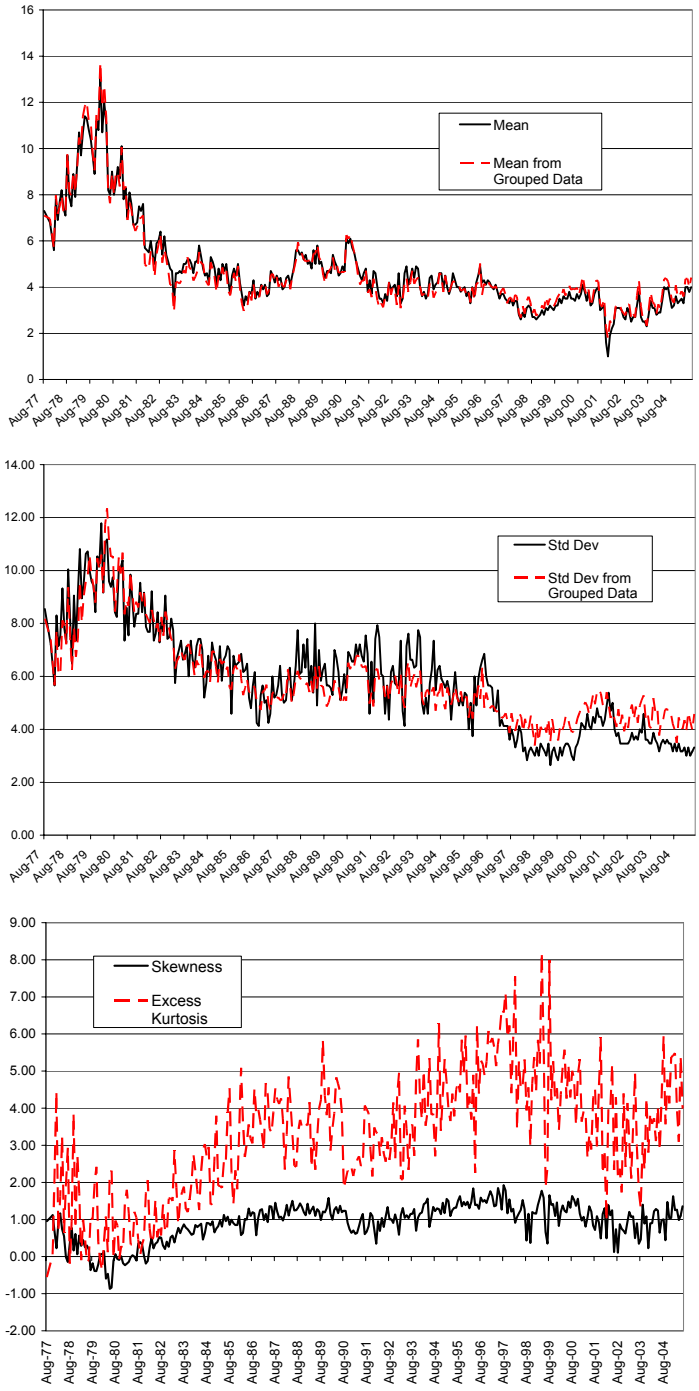
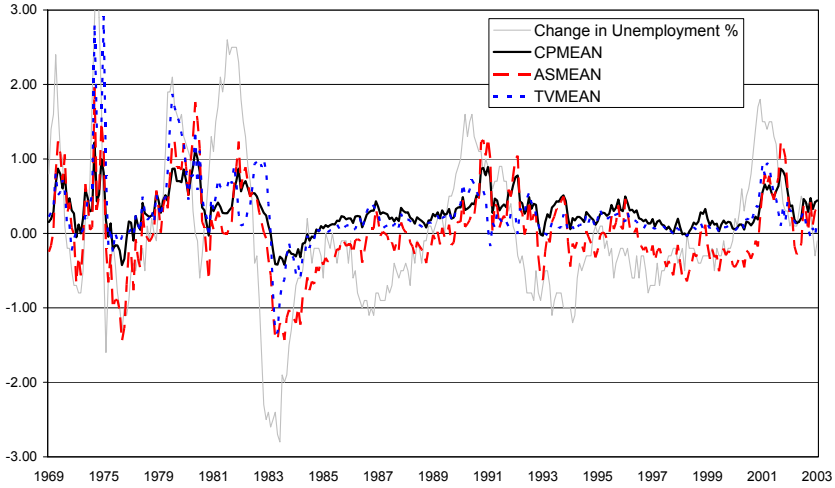


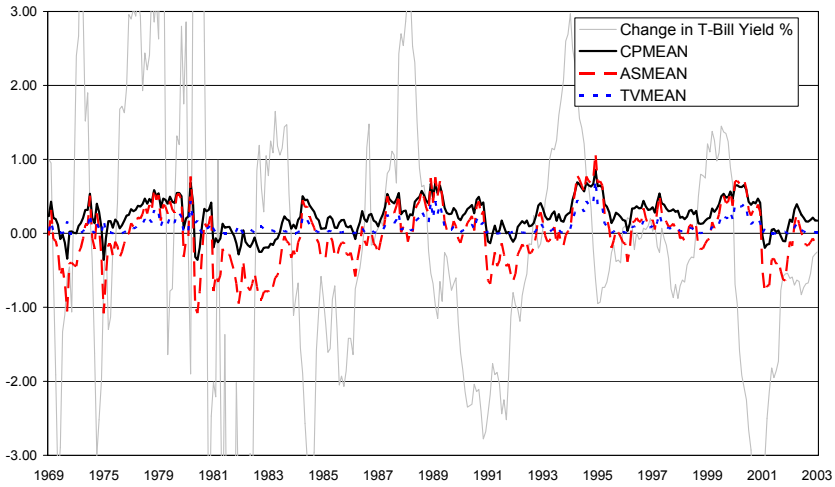
Figure 2. US Inflation Expectations: Quantitative Michigan SRC Data



Notes: Top Panel shows mean calculated from individual data (MSRC) and grouped data. Middle Panel shows standard deviations from individual (SSRC) and grouped data. Bottom panel shows skewness and excess kurtosis from grouped data.

Figure 3. Alternative estimators of mean expectations





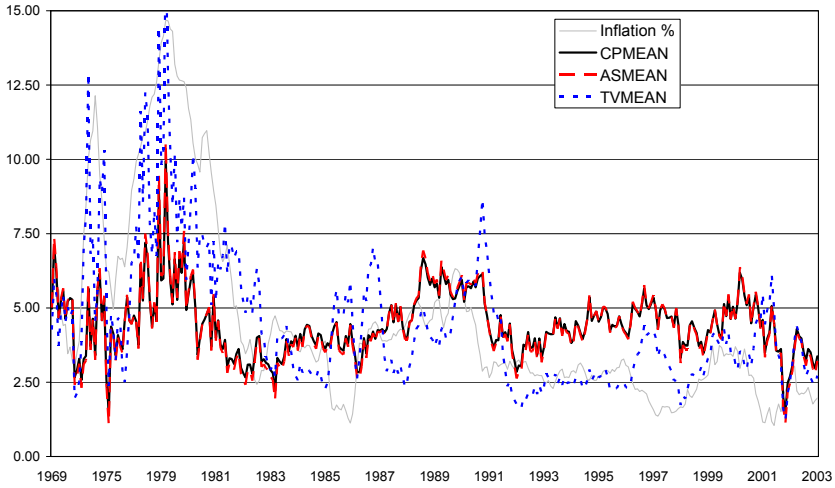
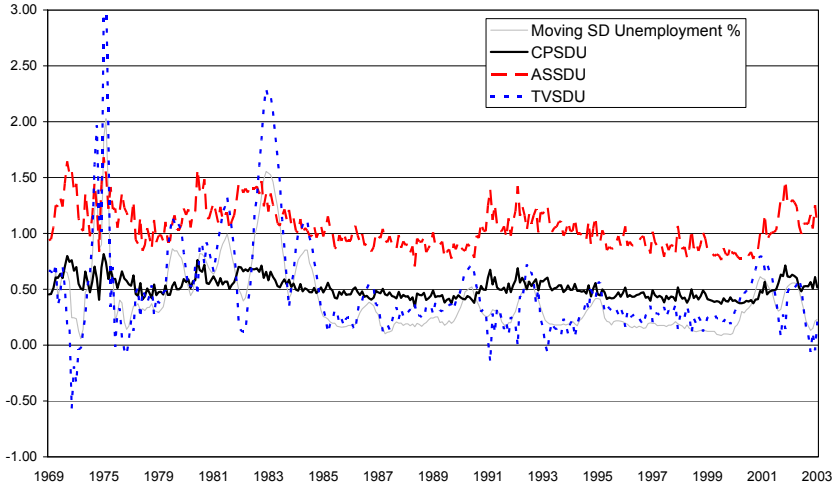
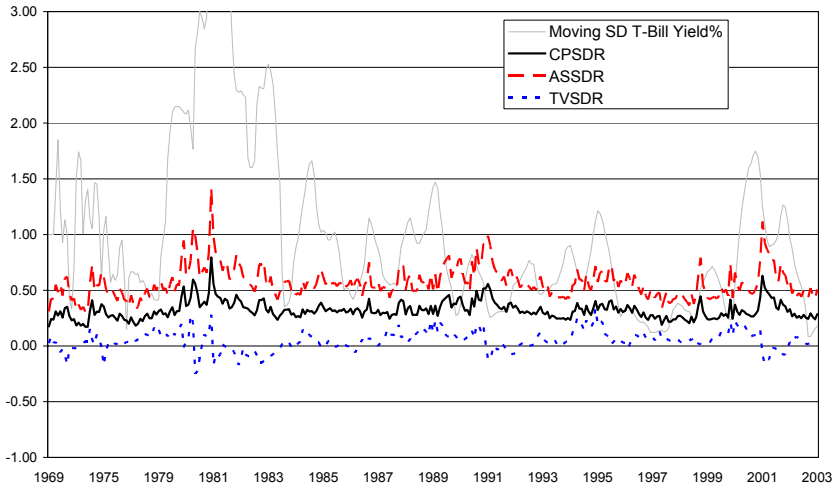


Figure 4. Alternative Estimators of Standard Deviation of Expectations





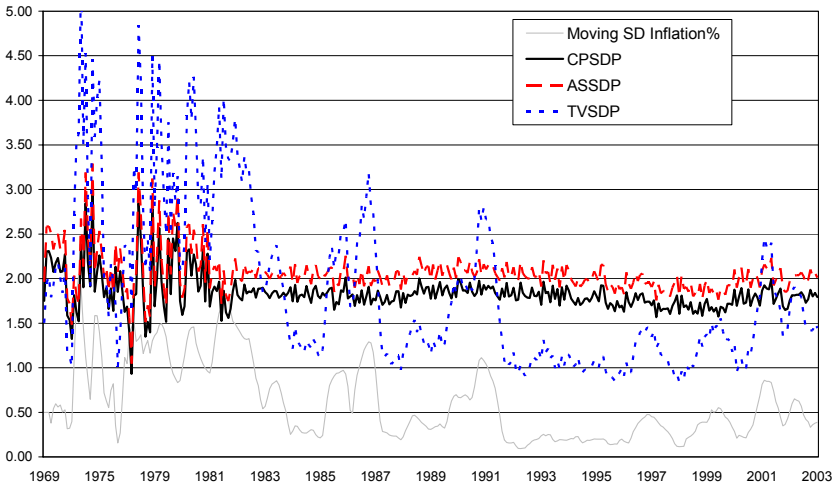


Figure 5. Michigan SRC Inflation Expectations v. Quantified Expectations