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Working Paper

Testing Near-Rationality using Detailed Survey Data

Sveriges Riksbank Working Paper Series, No. 183

Provided in Cooperation with:
Central Bank of Sweden, Stockholm

Suggested Citation: Bryan, Michael F.; Palmqvist, Stefan (2005) : Testing Near-Rationality using Detailed Survey Data, Sveriges Riksbank Working Paper Series, No. 183, Sveriges Riksbank, Stockholm

This Version is available at:
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SVERIGES RIKSBANK
WORKING PAPER SERIES
183

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Michael F. Bryan and Stefan Palmqvist

APRIL 2005

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TESTING NEAR-RATIONALITY USING DETAILED SURVEY DATA*

Michael F. Bryan† and Stefan Palmqvist‡

Sveriges Riksbank Working Paper Series
No. 183
April 2005

Abstract

This paper considers the evidence of "near-rationality," as described by Akerlof, Dickens, and Perry (2000). Using detailed surveys of household inflation expectations for the United States and Sweden, we find that the data are generally unsupportive of the near-rationality hypothesis. However, we document that household inflation expectations tend to settle around discrete and largely fixed "focal points," suggesting that both U.S. and Swedish households gauge inflation prospects in rather broad, qualitative terms. Moreover, the combination of a low-inflation environment and an inflation target in Sweden has been accompanied by a disproportionately high proportion of Swedish households expecting no inflation. However, a similar low-inflation trend in the United States, which does not have an explicit inflation target, reveals no such rise in the proportion of households expecting no inflation. This observation suggests that the way the central bank communicates its inflation objective may influence inflation expectations independently of the inflation trend it actually pursues.

JEL Codes: D1, D7, E6
Keywords: inflation expectations, rationality, inflation targeting, Phillips curve

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* We would like to thank Lars Jonung for comments as well as suggesting this line of research, Christoph Knoppik and John Roberts for comments, Guhan Venkatu, Linsey Molloy, and Pat Higgins for excellent research assistance, Richard Curtin at the Survey Research Center of the University of Michigan, the NIER, and Anita Olsson-Malmberg of Statistics Sweden for supplying the data. We have also benefited from presenting the paper at the EEA-ESEM conference in Madrid, the European Commission, the Federal Reserve System's Macroeconomic Research Group, the NIER, the Reserve Bank of Australia, Sveriges Riksbank, and Växjö University. The views expressed in this paper are solely the responsibility of the authors and should not be interpreted as reflecting the views of the Federal Reserve Bank of Cleveland, the Federal Reserve System, or the Executive Board of Sveriges Riksbank.
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1. Introduction

Since Phelps (1967) and Friedman (1968), economists have generally accepted the proposition that, in an environment in which expectations converge to fully rational, the natural rate of unemployment represents the threshold to which a central bank can permanently reduce unemployment without accelerating inflation. Akerlof, Dickens, and Perry (2000), hereafter ADP, have proposed that some agents form "nearly rational" inflation expectations, a behavioral assumption whereby agents either underweight inflation (only incorporate a fraction of it) when making decisions or, in the extreme, they ignore it altogether. Further, as the economic incentive to anticipate inflation varies from agent to agent, the proportion of nearly rational agents in the economy is an inverse function of inflation, producing a "kink" in the long-run Phillips curve below the natural rate of unemployment (see figure 1, which reproduces the long-run Phillips curve derived by ADP from their theoretical model). The mechanism by which this kink is produced is as follows: At zero inflation, rational as well as nearly rational individuals expect no inflation, which makes actual inflation equal to expected. As inflation rises above zero, the nearly rational agents underestimate inflation, and thus overestimate their real wage increases, work more, and thereby drive down unemployment. However, as inflation rises, some of the agents that were nearly rational at lower inflation rates find it worthwhile to start predicting inflation accurately and thus switch to forming rational inflation expectations. As a consequence, as inflation increases, a smaller proportion of households form nearly rational expectations, which tends to push their unemployment in the opposite direction. The interaction of these two effects suggests that unemployment is minimized (employment is maximized) at a low, but nonzero rate of inflation.

Figure 1. Long-run Phillips Curve Under Near-rationality.

Percent

Source: Akerlof, Dickens, and Perry (2000), figure 1.

In the ADP model, the natural rate of unemployment is merely a special case of the sustainable long-run unemployment rates, in which either the rate of inflation is zero or so high that all agents find it advantageous to make decisions using rational inflation expectations. The authors stop short of providing precise estimates of the inflation rate that minimizes unemployment and, indeed, they "resisted the temptation to call the unemployment-minimizing rate of inflation the optimal rate."[1] The welfare implications of the ADP model are not perfectly clear since, via the efficiency wage assumption, productivity also varies with the rate of inflation. Further, the wedge between actual and perceived real wages that causes an unwitting substitution between labor and leisure needs to be evaluated relative to the distortions created by wage and price frictions in the model. But subsequent discussion by ADP is less cautious, and they state that "Zero

[1] Akerlof, Dickens, and Perry (2000), p. 19.

inflation is an inappropriate policy target [of the central bank] because it raises the sustainable rate of unemployment by a significant amount. […] Moderate inflation, which includes the range of [U.S.] experience of recent years, with the core CPI rising at a 2 to 2.5 percent annual rate, allows the economy to operate with low unemployment. Such an inflation rate yields maximum prosperity."[2]

Whether it provides a prescription for an optimal inflation rate or not, the ADP model gives a rationale for why a central bank might target inflation at a moderately positive level, which, in practice, virtually every central bank with an inflation target has chosen to do.[3] The existence of nearly rational agents as described in ADP implies that a central bank must produce a modest inflation if the minimization of unemployment is among its long-run objectives.

In this paper we test whether the assumption of near rationality conforms to households' inflation expectations as measured by survey data. We find that these data fail to reveal the correspondence between nearly-rational agents and inflation, as suggested by ADP. However, we document that the inflation expectations of both U.S. and Swedish households are clearly qualitative in nature, and that, during the period of inflation targeting in Sweden, a disproportionately high proportion of Swedes ignore inflation when the CPI has been held close to the Riksbank's inflation target of 2 percent. Despite a nearly identical inflation performance, no such pattern is revealed in the U.S. data. This observation suggests that the way the central bank communicates its inflation objective may influence inflation expectations independently of the inflation trend it actually pursues.

[2] Akerlof, Dickens, and Perry (2001), pp. 7-8.
[3] See e.g. Kuttner (2004).

The paper is organized as follows. In section 2 we first revisit the evidence presented in ADP in support of nearly-rational inflation expectations, and question whether these tests provide evidence in favor of their specific form of near-rationality. We then demonstrate that direct measures of inflation expectations, as recorded by survey data, are generally unsupportive of the specific form of near-rationality suggested by ADP. However, the detailed survey data, examined further in section 3, reveal an intriguing "qualitative" pattern in the inflation expectations of households. We evaluate the detailed U.S. and Swedish survey data across alternative inflation regimes and document what appears to be one form of "near-rationality" in inflation expectations akin to that proposed by ADP. Finally, section 4 concludes.

2. The Evidence of Near-Rational Inflation Expectations

In this section, we bring the theory of nearly-rational inflation expectations to the data. We first review the evidence in favor of near rationality, as presented in Akerlof, Dickens, and Perry (2000) for the United States, and Lundborg and Sacklén (2001) for Sweden. We argue that their methodology and data is unable to distinguish their specific form of near-rationality from other forms of less-than-fully-rational inflation expectations. To test the specific form of near-rationality suggested by ADP, we therefore use detailed survey data on households' inflation expectations in the United States and Sweden.

2.1. Re-Examining the Evidence In Favor of Near-Rationality

To test the near rationality hypothesis, Akerlof, Dickens, and Perry estimate Phillips curves of the following general form using U.S. data,

$$\pi_t = \alpha + \beta\pi^e_{t,t-n} + \gamma(L)u_t + \varepsilon_t\,, \qquad (1)$$

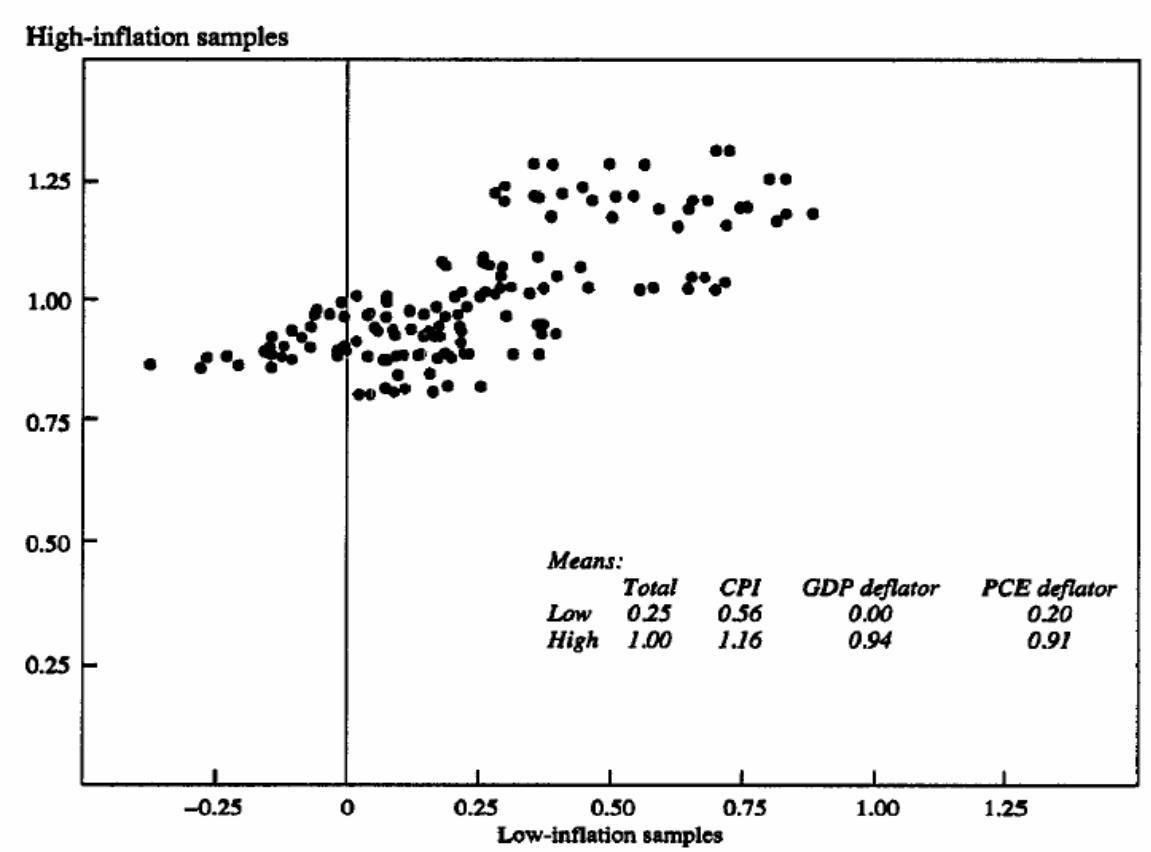
where π is realized inflation, π^e is expected inflation formed at some earlier date (typically, one year ago), and u is the unemployment rate.[4] Equation (1) is estimated in two subperiods, high inflation, where the five-year inflation trend exceeds 4 percent, and low inflation, where the inflation trend is less than 3 percent, or, alternatively, less than 2.5 percent. For each subperiod, they specify equation (1) using different lag structures, and use alternative measures of inflation, inflation expectations, and the unemployment rate. Inflation is measured as the annual percent change in the CPI, the GDP deflator, or the PCE deflator, expected inflation is taken from the University of Michigan's Survey of Consumer Attitudes or the Livingston Survey of Professional Forecasters, and unemployment is measured as the rate for all workers, the rate for 25- to 54-year old males, or as Shimer's (1988) demographically adjusted series.[5] The alternative specifications of the high- and low-inflation samples and the different lag structures, combined with the different measures of inflation, inflation expectations, and the unemployment rate yield a total of 144 alternative estimated price equations for each sample (see figure 2, which reproduces the high- and low-inflation βs estimated this way by ADP.) ADP find that while the constellation of the estimated βs is approximately unity in the high-inflation sample (mean = 1.00), it is significantly less than one in the low-inflation sample (mean = 0.25). This finding is consistent with their near-rationality hypothesis as it shows that only a fraction of aggregate expected inflation enters the

[4] They also estimate wage Phillips curves, with similar empirical results. We therefore only describe the results and method used to estimate the price Phillips curves.

[5] As an alternative to using survey data on expectations, they also report results from adaptive expectations using a distributed lag of past inflation rates with similar results.

estimated Phillips curve equations in the low-inflation sample, while in the high-inflation sample, aggregate expectations are fully incorporated into the estimated equations.

Figure 2. Coefficients on Expected Inflation for Alternative Phillips Curve Specifications in High- and Low-inflation Samples.



Source: Akerlof, Dickens, and Perry (2000), figure 6.

Having found evidence consistent with the near-rationality hypothesis, ADP turn to the long-run Phillips curve. Using a nonlinear representation, ADP approximate their model using a variety of alternative "right-hand side" variables. Regarding the inflation rate that minimizes long-run unemployment, ADP conclude that "the densest cluster of estimates spans a range from 1.5 to 3 percent for the inflation rate that maximizes employment in the long run. The estimated unemployment reduction from operating the

economy at that inflation rate (rather than at zero or high inflation) falls mainly in the range from 0.5 to 3 percentage points."[6]

Lundborg and Sacklén (2001) follow the approach used by ADP to estimate a long-run, expectations-augmented Phillips curve for Sweden. When survey measures of inflation expectations are used, they find that the unemployment-minimizing rate of inflation is about 4 percent, compared to Sweden's current inflation target of 2 percent. In Lundborg and Sacklén (2003), the authors show that under the conditions laid out by ADP, the minimization of unemployment is likely to be welfare maximizing. If Sweden were to raise its inflation target to 4 percent, the authors claim, unemployment would be permanently reduced from 4 to 2 percent, output would rise, and effort would decrease.

Of course, the fact that the estimated β in equation (1) drops below unity in a low-inflation environment is not a direct test of near-rationality but merely the observation that the covariance of actual and expected inflation (given the cyclical state of the economy) falls relative to the variance of inflation expectations, and this may be true for a number of less-than-fully-rational expectation assumptions. As an example, suppose that a fraction of the population expects an inflation rate that on average equals the central bank's long-run inflation target and the remainder form rational expectations. Suppose further that if observed inflation remains close to the target, the central bank gains credibility and a rising proportion of agents expect the central bank to deliver the stated objective. Under such an expectations formation, a β less than unity would also be observed if one estimates equation (1) in the low-inflation sample, whereas β would be unity in the high-inflation sample. As a matter of fact, any expectations scheme where a

[6] Akerlof, Dickens, and Perry (2001), p. 7.

part of the population hold expectations centered around *any* constant is consistent with the findings in figure 2.

As the method and data used by ADP and Lundborg and Sacklén are unable to distinguish between their specific form of near-rationality from other, less-than-fully-rational inflation expectations formations, we follow the approach suggested by Nordhaus in the general discussion of ADP, and "test whether inflationary expectations in fact have responded to experienced inflation in the nonlinear way suggested by the paper."[7] To conduct such tests one needs direct measures of inflation expectations, and we therefore use survey measures of inflation expectations. In the following subsections we describe the survey data on households' inflation expectations and look for evidence of near-rationality in the aggregate average responses as well as at the individual level.

2.2. Evidence of Near-Rationality in Aggregate Survey Data

Our data on inflation expectations consists of two surveys. For the United States we use individual responses from the Michigan Survey of Consumer Attitudes for the period 1978-1999. These data are collected monthly from a national survey of at least 500 respondents. For Sweden, we use the Households Purchasing Plans (HIP) survey for the period 1979-2001.[8] The HIP survey was conducted on a quarterly basis from 1979 until 1992 and on a monthly basis thereafter. The HIP originally consisted of about 10,000 households, but its size has been reduced over time to reach the current levels of about 1,500 respondents.

[7] Brookings Paper on Economic Activity 2000:1, p. 56.
[8] There was a significant break in the mean survey response at the beginning of 2002, see Palmqvist and Strömberg (2004). We therefore choose to end the Swedish sample in 2001.

Both surveys ask similarly posed and structured questions. In the Michigan survey, respondents are first asked, *"During the next 12 months, do you think that prices in general will go up, or go down, or stay where they are now?"* Respondents are then asked to quantify their answer by the question, *"By about what percent do you expect prices to go up (down) on average, during the next 12 months?"* In Sweden, respondents are asked *"If you compare with the situation today, do you think prices in general over the next 12 months will [increase, be about the same, decrease somewhat]?,"* which is followed by "*By how many percent do you think they will [increase/decrease]?"*[9,10]

The model used by ADP to derive the long-run Phillips curve contains no dynamics, making direct tests of near-rationality virtually impossible. As an example, suppose that the economy is hit by a transitory shock to the inflation rate, making the inflation rate increase temporarily. Should such a shock induce the nearly rational agents to start forming rational inflation expectations, or does a change in behavior require that the shock have persistent effects on the inflation rate? As the ADP-model provides no guidelines on what triggers a change in behavior, we proceed along two paths. We first identify different inflation "regimes" in the two countries. This approach only requires that, to be consistent with ADP near rationality, a change in the expectations formation occurs when the economy switches from one inflation regime to another. We also look at

[9] Both surveys probe the "stay the same" response with a follow-up question, albeit with somewhat different purposes. The Michigan survey follow-up question concerns whether the respondent intended to say that prices would remain the same, or whether inflation would remain the same. The follow-up question in the HIP tries to separate those who think that prices will be constant over the next 12 months from those who believe in a small, but non-zero, rate of inflation. In the case of the Michigan survey, extreme responses are asymmetrically truncated at the values of –10 percent and +50 percent. No truncation is used in the HIP.

[10] From October 1995 and onwards there are five qualitative response options available, so this account refers to the surveys January 1979-September 1995. For a description of the current surveys, see Palmqvist & Strömberg (2004).

all available data, which implies that the expectations formation is consistent with ADP near rationality if every change in inflation induces a change in the expectations formation in accordance with the near-rationality hypothesis.

To identify the different inflation regimes in the two countries, we conducted Bai-Perron (1998) break-points tests on the U.S. CPI and the core CPI in Sweden.[11, 12] These break-points are shown in figure 3 together with the average inflation rate between two break dates, henceforth referred to as the "inflation trend." The tests reveal that both nations experienced two break-points in our data, yielding three distinct inflation regimes. The regimes are remarkably similar for the two countries. In the United States, the first inflation break is estimated between July and August of 1982, when the inflation trend drops from 10.2 to 3.9 percent. The second break occurs between January and February of 1991, when the inflation trend falls to 2.7 percent. In Sweden, the first break in the inflation data is estimated between the December of 1983 and January of 1984 as the inflation trend drops from 9.6 percent to 6.0 percent. The second break occurs between March and April of 1991, when the inflation trend is reduced to 2.5 percent. Sweden announced a formal inflation target in January 1993, but at the time of the introduction of inflation targeting the inflation rate had already fallen substantially. Thus, our test picks up a break prior to the announcement of inflation targeting. Note that since the early 1990s, the United States and Sweden have followed nearly identical low-

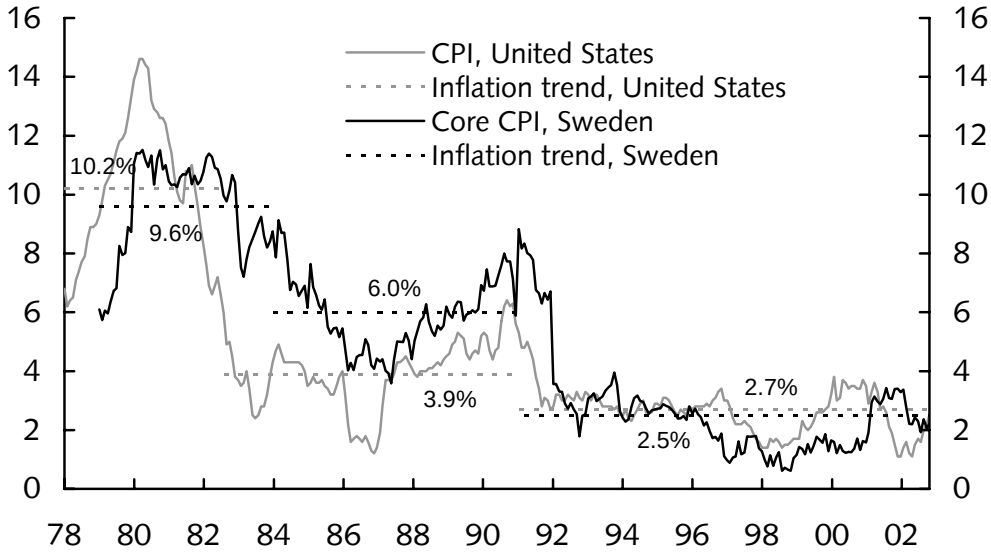
[11] The Bai-Perron test uses a sequential procedure that jointly identifies the number of breaks implied by the data, and estimates the timing of those breaks.

[12] The U.S. CPI measures costs of owner occupied housing on a rental equivalence basis. The Swedish CPI includes mortgage rates as a cost of owner occupied housing. Thus, to get comparable inflation measures we use the Swedish core CPI (called UND1X) as our inflation benchmark throughout the paper, since it excludes mortgage rates (as well as the direct effects of changes in indirect taxes and subsidies.) However, all of the results presented in the paper are robust to the choice of inflation benchmark in Sweden.

inflation paths, regarding actual as well as trend inflation, after having formerly followed higher trends.

Figure 3. Inflation Regimes in the United States and Sweden.

Percent



Sources: Bureau of Labor Statistics, Statistics Sweden, and own calculations.

Notes: The inflation trends refer to the average inflation rate between two break dates, where the break dates are identified by the Bai-Perron (1998) break-point test.

Regarding the difference between expected and actual inflation, near-rationality implies that household inflation expectations errors should correspond to inflation in a nonlinear way: At zero inflation there is no difference between those who ignore inflation and those who are fully rational. Hence, the aggregate (the average across households) expectations error should be zero at price stability. In a low, but nonzero inflation environment, however, as some fraction of individuals continues to ignore inflation while the rest form their expectations rationally, the ADP-model predicts that, aggregate inflation expectations are less than realized inflation. As inflation continues to rise, a larger proportion of the population form their expectations in a fully rational way, so that

the aggregate expectations error, eventually, shrinks as the added accuracy of the rational agents more than offsets the increasingly negative expectations errors of the nearly-rational. Eventually (at very high inflation), the ADP framework assumes everyone is fully rational and the aggregate expectations error tends to zero again.

Our first test of near-rationality therefore amounts to computing the average aggregate expectations errors across the different regimes, and checking whether these expectations errors correspond to inflation in such a nonlinear way. In table 1 we report the average aggregate inflation expectations errors for the United States and Sweden in the full sample period as well as in the different regimes.

Table 1. Household Inflation Expectations Errors and Inflation in the United States and Sweden

Country	Period	Average aggregate expectations error	Average inflation
United States	1978:01-1999:12	0.39	4.8
United States	1978:01-1982:07	-1.28	10.2
United States	1982:08-1991:01	0.63	3.9
United States	1991:02-1999:12	1.01	2.7
Sweden	1979:I-2001:12	-0.09	5.2
Sweden	1979:I-1983:IV	-0.88	9.6
Sweden	1984:I-1991:I	0.73	6.0
Sweden	1991:II-2001:12	-0.16	2.5

Notes: The inflation measures refer to the CPI in the U.S. and the core CPI (UND1X) in Sweden. Expectations errors are calculated as the expected inflation minus 12-month forward inflation.

We quickly note that in the United States, aggregate inflation expectations errors are, on average, relatively small (about 8 percent of the realized inflation rate), and positive. This is somewhat problematic, since rational expectations argues that these average aggregate errors should be zero, and near-rationality implies that they should be negative (non-positive). However, a large number of studies have found a positive “bias”

in mean survey data for the United States when the benchmark for comparison is an aggregate consumer price index.[13] In other words, U.S. survey data on household inflation expectations are typically higher than the officially reported CPI-measures. As reported earlier, these survey data do not record household predictions of any particular inflation statistic, but rather the growth rate of "prices in general," leaving ambiguous the benchmark against which respondent accuracy should be judged.[14] To compensate for any potential benchmark error, we focus on the differences in the expectations errors across the three regimes. In the United States, as inflation is reduced from about 10 to about 4 percent, households switch from under- to overpredicting inflation. As inflation is reduced further, from about 4 to about 3 percent, U.S. households overestimate inflation even more. That average aggregate inflation expectations errors in the United States increase as inflation is reduced is a strong contradiction of the ADP near-rationality hypothesis.

In Sweden, households' inflation expectations roughly coincide on average with realized inflation. However, as inflation is reduced from about 10 to about 6 percent, households switch from under- to overestimating inflation, and, as inflation is reduced further, from about 6 to 2.5 percent, households again start underpredicting inflation. While the behavior of aggregate expectations errors across the last two regimes in Sweden is broadly consistent with ADP near-rationality, the general, "inverted U-shape" observed across all three regimes is hard to reconcile with near-rationality.

[13] A recent study of this "bias" is Mehra (2002).

[14] Bryan and Venkatu (2001b) analyze, among other things, the responses in the *FRBC/OSU Inflation Psychology Survey* and show that about 66 percent of the interviewed households had heard of the CPI. While those 66 percent gave very accurate estimates of what had happened to the CPI, their average response to the question about "prices in general" was more than twice as high as the increase recorded by the CPI. This finding suggests that whatever price measure households have in mind when they answer the question about "prices in general," it is probably not the CPI.

As argued earlier, it is not clear from the ADP-model whether a transitory increase in inflation should cause the nearly rational households to start forming rational expectations or if the increase must be more persistent to induce a changed behavior. In table 1 we looked at changes in the inflation trend, which can be thought of as representing permanent changes in the inflation rate. In the following, we instead consider all fluctuations in inflation and regress aggregate household inflation expectations errors on the rate of inflation with the simple, nonlinear form,

$$\pi^{e}_{t,t-12} - \pi_t = \alpha + \beta_1 \pi_t + \beta_2 \pi_t^2 + \varepsilon_t , \qquad (2)$$

where π^e is aggregate expected inflation from the survey twelve months ago, and π is the inflation rate. If ADP-type near-rationality holds, we expect to find $\alpha = 0$, $\beta_1 < 0$, $\beta_2 > 0$, and $|\beta_1| > \beta_2$. The results of this experiment are in table 2.

Table 2. Expectations Errors as a Nonlinear Function of Inflation in the United States and Sweden

Country	Period	α	β_1	β_2	R^2
United States	1978:01-1999:12	2.97*** (0.40)	-0.68*** (0.15)	0.02 (0.01)	0.68
United States [a)]	1978:01-1999:12	2.62*** (0.51)	-0.50** (0.21)	0.01 (0.01)	0.52
Sweden	1979:I-2001:12	-0.24 (0.37)	0.20 (0.20)	-0.03 (0.02)	0.10

Notes: Standard errors using the Newey-West procedure are shown within parenthesis. ***, **, and * denote significance at the 1, 5, and 10 percent level. [a)] Uses expectation values posted on University of Michigan's Survey of Consumer Attitudes website which imputes values for "up, don't know" and "down, don't know" based on the distribution of known responses.

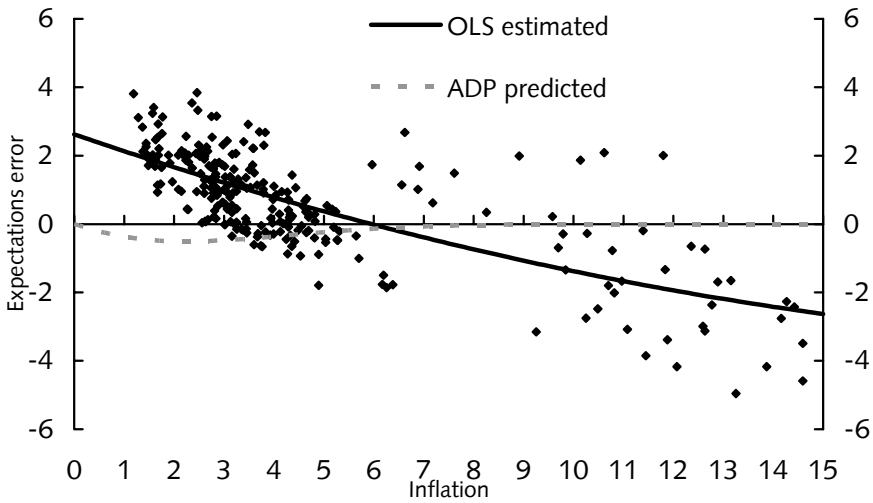
In the first two rows we see the results from the Michigan survey. Aggregate expectations errors tend to be about 3 percent at zero inflation. As argued before, a significant constant in the U.S. data need not be evidence against near-rationality.

Consistent with ADP-type near-rationality, we find that the coefficient on the inflation rate is of the expected sign and significant, but the coefficient on squared inflation, while having the expected sign, is not significant. In the case of Sweden, consistent with ADP-type near-rationality, aggregate expectations errors are not significantly different from zero at price stability. However, neither the coefficient on inflation nor the coefficient on squared inflation is significant or of the expected sign, which is fairly strong evidence against ADP-type near-rationality.

In figure 4 we show the expectations errors for the U.S. data, together with the fitted values from equation (2), as well as the U-shaped relation predicted by the ADP model. The dashed line is the expected relationship under near-rationality, where we have assumed that at zero inflation half of the agents are fully rational and at 5 percent inflation 95 percent of the agents are fully rational, which corresponds to the assumptions made by ADP in their theoretical work. The dots are the actual expectations errors from the Michigan survey plotted against the realized CPI-inflation. Figure 5 shows the corresponding findings obtained with Swedish data. These figures further illustrate the findings in table 2 in that the expectations errors do not vary with the rate of inflation as predicted by the ADP near-rationality hypothesis. The figures also suggest that the evidence against the near-rationality hypothesis is robust to the simple, quadratic, functional form in equation (2), since they indicate that there is no other natural specification that would pick up a nonlinear relation supporting the near-rationality hypothesis.

Figure 4. Aggregate Expectations Errors and Inflation in the United States.

Percentage points, percent

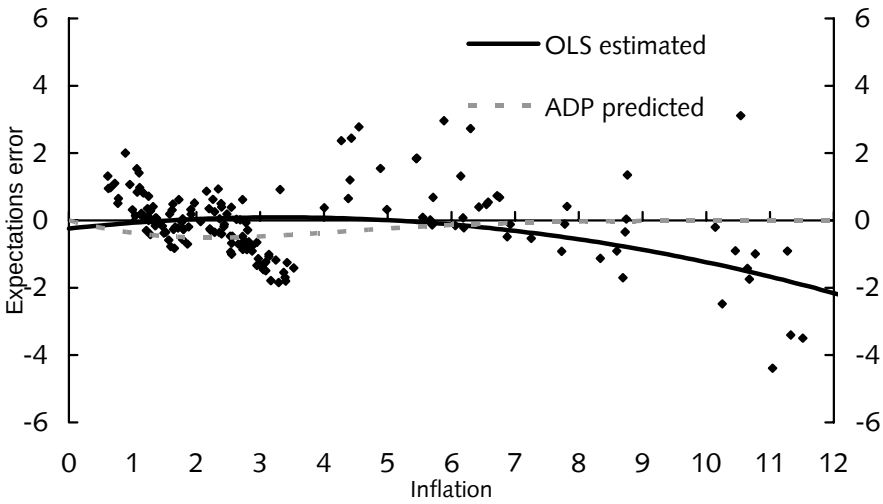


Sources: Bureau of Labor Statistics, University of Michigan's Survey of Consumer Attitudes, and own calculations.

Notes: The data refers to the period 1978-1999. The dashed line represents the predicted relation under near-rationality. The dots represent actual expectations errors, plotted against the 12-month forward inflation rate, and the solid line is the estimated relationship from equation (2).

Figure 5. Aggregate Expectations Errors and Inflation in Sweden.

Percentage points, percent



Sources: Statistics Sweden and own calculations.

Notes: The data refers to the period 1979-2001. The dashed line represents the predicted relation under near-rationality. The dots represent actual expectations errors, plotted against the 12-month forward inflation rate, and the solid line is the estimated relationship from equation (2).

Overall, we find evidence of the ADP near-rationality thesis lacking in the aggregate data. The relationship between errors in household inflation expectations and inflation does not correspond to the model's prediction. However, a complete evaluation of the ADP model requires a more careful examination of behavior of the individual household inflation predictions, a topic to which we now turn.

2.3. Evidence of Near-Rationality in the Micro-Data

A key implication of the near-rationality hypothesis is that when inflation is below some threshold, some individuals underpredict inflation, or, in the extreme, they ignore it altogether. The lower the inflation rate the greater is the proportion of households that underpredict or ignore inflation. A simple test of near-rationality would therefore be to check whether the proportion of households that ignore or underpredict inflation is inversely related to inflation. However, before doing that we need to address the evidence that households hold very different expectations about inflation.[15]

In terms of the ADP-framework, allowing for heterogeneous responses from the proportion of households that form rational expectations implies that we no longer know whether a household that expects no inflation belongs to the nearly-rational or rational proportion of the population. Also, if we allow for heterogeneity among the rational individuals it seems plausible that the fraction of zero responses among the rational individuals increases when inflation falls. We would therefore expect the fraction of

[15] That households hold heterogeneous inflation expectations is documented in, e.g., Jonung (1981), Bryan and Venkatu (2001a), and (2001b), Carroll (2003), Mankiw, Reis, and Wolfers (2003), Souleles (2004), and Palmqvist and Strömberg (2004). From the early work on survey measures of expectations, it is clear that the causes of heterogeneity in inflation opinions are important to consider when testing the assumption of rational expectations formation. See, e.g., the discussion about rationality in survey measures between Figlewski and Wachtel (1981) and (1983) and Kimball and Joines (1983). Keane and Runkle (1990) provide further insights on this note. The fact that households form heterogeneous inflation expectations is, however, something that must be considered when testing *any* hypothesis about expectations formation.

households expecting no inflation to vary inversely with inflation even in the case where all agents form rational expectations.

Near-rationality combined with heterogeneity of responses among rational individuals therefore implies that the test for near-rationality must be modified. As inflation falls, there will be more nearly-rational households expecting no (or underpredicting) inflation, and there will be a greater proportion of rational households expecting no inflation. In the extreme case, where nearly-rational households ignore inflation, the fraction of households expecting no inflation should thus vary nonlinearly with inflation in order to be consistent with near-rationality. In the case where the nearly-rational individuals underpredict inflation, ADP near-rationality only requires that the fraction of households underpredicting inflation varies inversely (i.e., not necessarily nonlinearly) with inflation. In table 3 we show the fraction of households expecting no inflation, and the fraction of households underpredicting inflation in the full sample and the three regimes.

Table 3. Fraction of Households Expecting No Inflation, Fraction of Households Underpredicting Inflation, and Inflation in the United States and Sweden

Country	Period	Fraction of zeros	Fraction underpredicting	Average inflation
United States	1978:01-1999:12	0.18	0.54	4.8
United States	1978:01-1982:07	0.18	0.66	10.2
United States	1982:08-1991:01	0.17	0.56	3.9
United States	1991:02-1999:12	0.18	0.47	2.7
Sweden	1979:I-2001:12	0.41	0.62	5.2
Sweden	1979:I-1983:IV	0.07	0.65	9.6
Sweden	1984:I-1991:I	0.10	0.49	6.0
Sweden	1991:II-2001:12	0.54	0.65	2.5

Notes: The inflation measures refer to the CPI in the U.S. and the core CPI (UND1X) in Sweden.

In the United States, there are on average 18 percent of the respondents that expect no inflation over the next year, and 54 percent of the respondents underpredict inflation on average. As we go from one inflation regime to another, the proportion of households expecting no inflation is almost unaffected, whereas the proportion of households underpredicting inflation falls with the inflation trend. Thus, irrespective of which form of near-rationality we are considering (ignoring or underpredicting inflation), these findings are inconsistent with near-rationality. If anything, table 3 suggests that, counter to near-rationality, more households underpredict inflation at high rates of inflation.

In Sweden, the proportion of households expecting no inflation increases as inflation is reduced from about 10 to about 6 percent, and it increases substantially as inflation is reduced further, which is consistent with the predictions of the extreme version of ADP where the nearly-rational individuals ignore inflation. The substantial increase in the proportion of households expecting no inflation is also associated with a rise in the proportion of households underpredicting inflation. The only evidence against ADP in the case of Sweden is that the proportion of households underpredicting inflation falls by almost 20 percentage points when Sweden goes from the first to the second inflation regime.

Looking at the full data set, we regress the fraction of households expecting no, or underpredicting, inflation on the rate of inflation with the simple, nonlinear form,

$$f = \alpha + \beta_1 \pi_t + \beta_2 \pi_t^2 + \varepsilon_t , \qquad (3)$$

where f is the fraction of households expecting no, or underpredicting, inflation, and π is the inflation rate. We expect to find $\alpha = 0.5$, $\beta_1 < 0$, $\beta_2 > 0$, and $|\beta_1| > \beta_2$ if ADP near-rationality holds. The results of this experiment are in table 4.

Table 4. Proportion of Households Expecting No Inflation and Proportion of Households Underpredicting Inflation as a Nonlinear Function of Inflation in the United States and Sweden

Country	Period	α	β_1	β_2	R^2
United States, no inflation	1978:1-1999:12	0.17*** (0.02)	0.01 (0.01)	0.00 (0.00)	0.12
United States, underpredicting	1978:1-1999:12	0.20*** (0.05)	0.11*** (0.02)	-0.01*** (0.001)	0.62
Sweden, no inflation	1979:I-2001:12	0.77*** (0.04)	-0.14*** (0.02)	0.01*** (0.00)	0.80
Sweden, underpredicting	1979:I-2001:12	0.72*** (0.04)	-0.06*** (0.02)	0.01*** (0.00)	0.12

Notes: Standard errors using the Newey-West procedure are shown within parenthesis. ***, **, and * denote significance at the 1, 5, and 10 percent level.

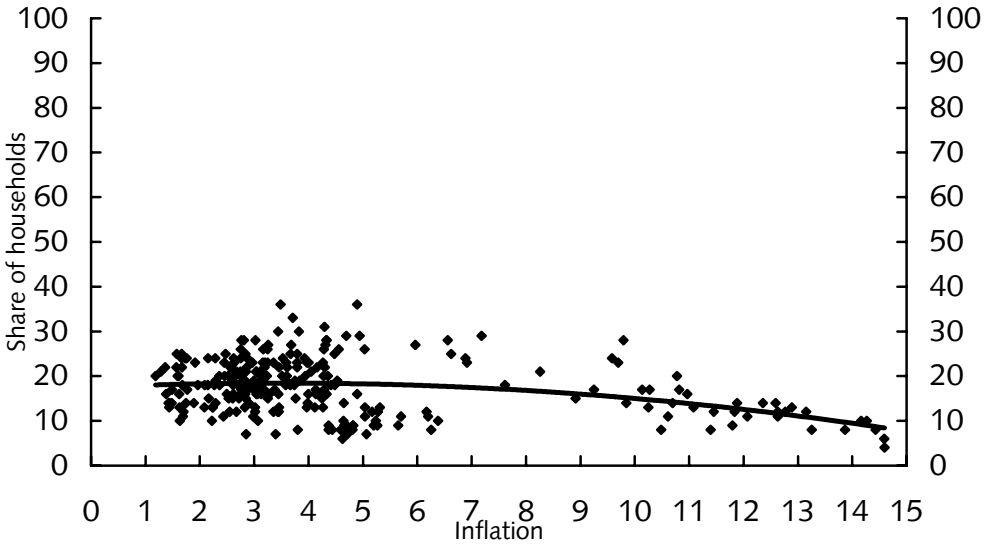
Table 4 shows that, in the United States, there is no relation between the proportion of households expecting no inflation and the actual inflation rate. Regarding the proportion of households underpredicting inflation, we find that both the coefficient on inflation and the coefficient on squared inflation are of the wrong sign and significant. For Sweden we find that both the fraction of households expecting no inflation and the fraction of households underpredicting inflation conforms with the predictions of near-rationality.

Figures 6 and 7 show the fraction of households expecting no inflation over the coming year as a function of the realized inflation rate in the United States and Sweden, respectively. We have also included the estimated relationship from table 4 in the figures. In the U.S. data, there is no relationship between the realized rate of inflation and the

proportion of households predicting price stability. Thus, our findings for the U.S. in table 4 are robust to the simple quadratic functional form we assume in equation (3). We also see that the results are much different in the HIP data for Sweden. Clearly, the proportion of Swedish households predicting no inflation jumps, and substantially so, when the realized rate of inflation falls below 3 percent. Thus, the behavior of the proportion of households expecting no inflation is broadly in line with the predictions of ADP.

Figure 6. Share of U.S. Households Expecting No Inflation and Inflation.

Percent

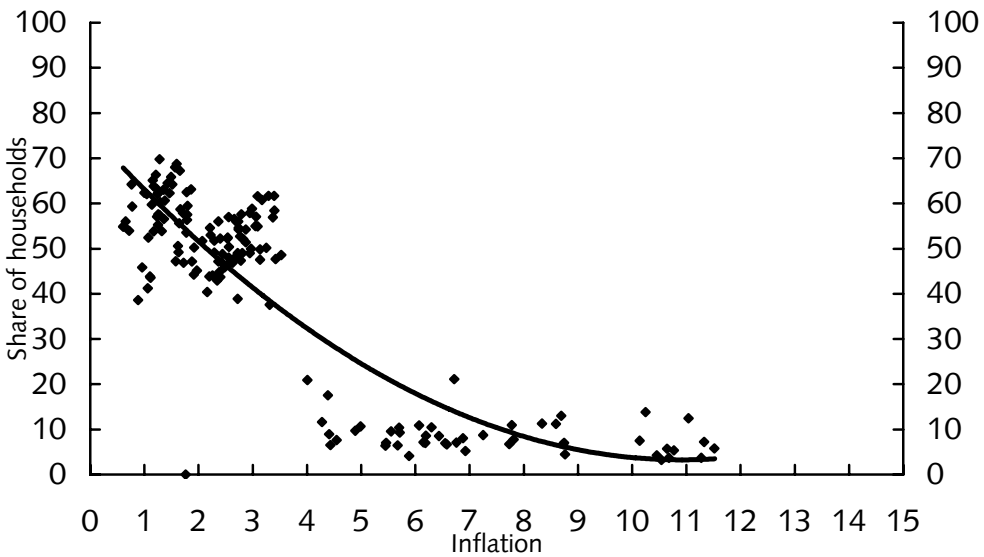


Sources: Bureau of Labor Statistics, University of Michigan's Survey of Consumer Attitudes, and own calculations.

Notes: The data refers to the period 1978-1999. The dots represent the proportion of households expecting no inflation, plotted against the 12-month forward inflation rate, and the solid line is the estimated relationship from equation (3).

Figure 7. Share of Swedish Households Expecting No Inflation and Inflation.

Percent



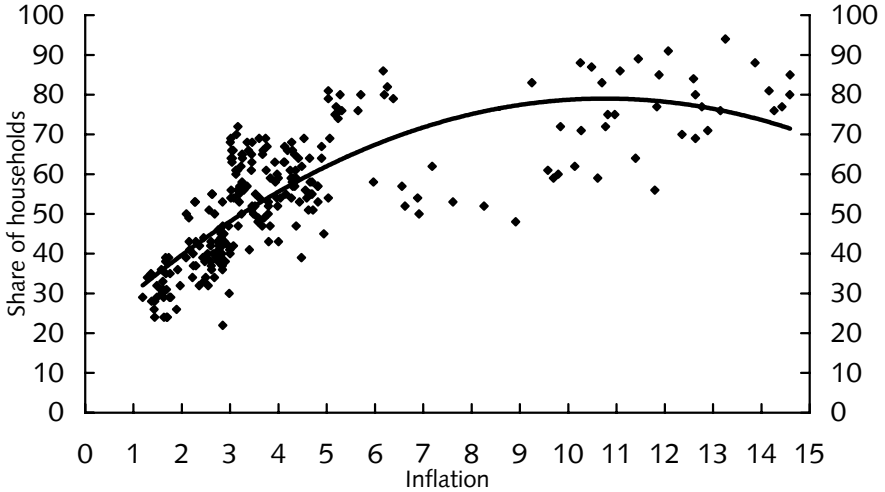
Sources: Statistics Sweden and own calculations.

Notes: The data refers to the period 1979-2001. The dots represent the proportion of households expecting no inflation, plotted against the 12-month forward inflation rate, and the solid line is the estimated relationship from equation (3).

Similarly, we can check the proportion of U.S. and Swedish households who underpredict inflation as a function of realized inflation (figures 8 and 9), and again, we observe a striking difference between the two nations. In the United States, the proportion of households underestimating inflation is negatively related to inflation, in direct conflict with the predictions of ADP near-rationality. However, in Sweden, the proportion of households under-predicting inflation rises appreciably as inflation falls under 3 percent, again, seemingly consistent with the predictions of the ADP framework. However, at rates of inflation greater than 5 percent, the under-prediction of inflation by Swedish households rises again, which is hard to reconcile with their model.

Figure 8. Share of U.S. Households Underpredicting Inflation and Inflation.

Percent

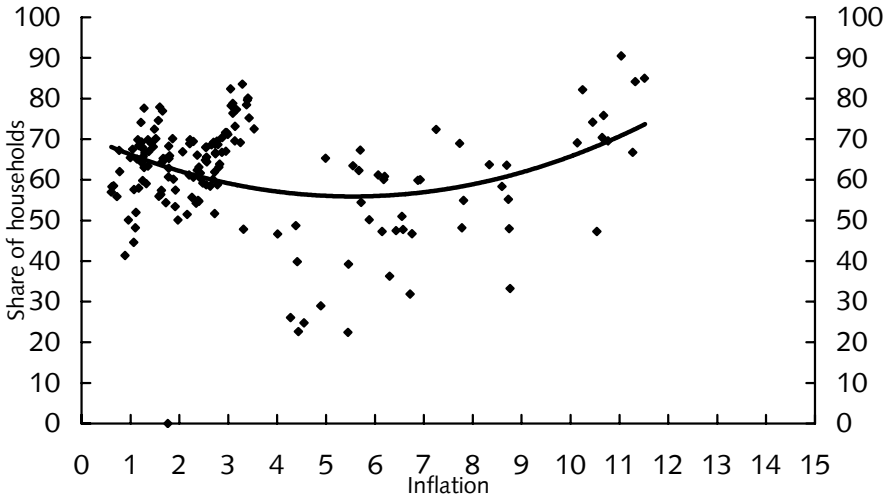


Sources: Bureau of Labor Statistics, University of Michigan's Survey of Consumer Attitudes, and own calculations.

Notes: The data refers to the period 1978-1999. Each dot represents the proportion of households underpredicting inflation, plotted against the 12-month forward inflation rate, and the solid line is the estimated relationship from equation (3).

Figure 9. Share of Swedish Households Underpredicting Inflation and Inflation.

Percent



Sources: Statistics Sweden and own calculations.

Notes: The data refers to the period 1979-2001. Each dot represents the proportion of households underpredicting inflation, plotted against the 12-month forward inflation rate, and the solid line is the estimated relationship from equation (3).

Thus, we have shown that the evidence in aggregate survey data is generally unsupportive of near-rationality, both in the United States and in Sweden. In the U.S. microdata we find further evidence against near-rationality, whereas the Swedish microdata seem more supportive of ADP-type near-rationality. In order to disentangle this seeming contradiction, we believe a more thorough understanding of the distributional characteristics of household inflation expectations is in order. Specifically, how are inflation expectations distributed across households and in what ways is that distribution related to the realized inflation rate? This is the subject of section 3.

3. "Focal Points" and the Qualitative Nature of Household Inflation Expectations

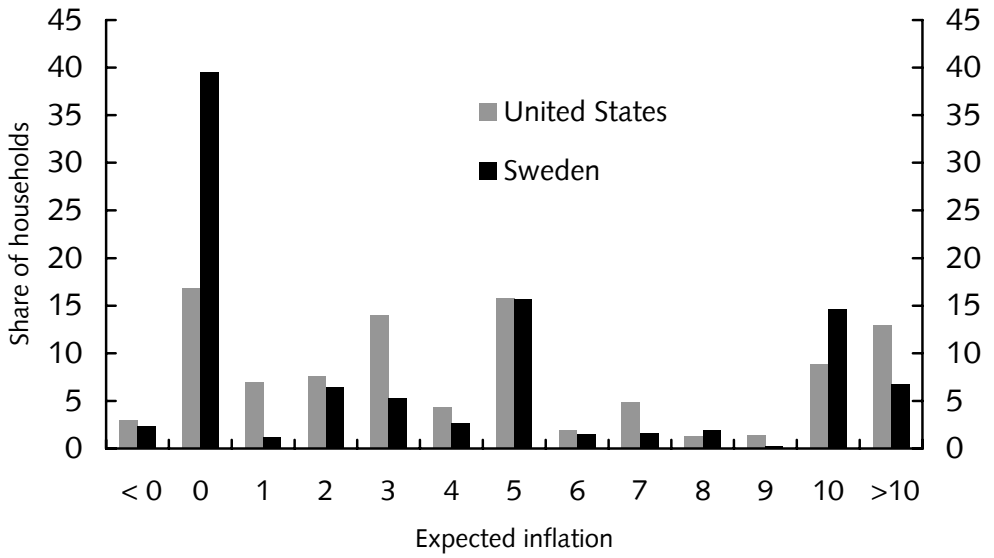
Checking year-ahead inflation expectations in the United States, as measured by the Michigan survey, reveals that less than 5 percent of all responses are noninteger values, that is, responses tend to be given as discrete numbers. Moreover, the distribution of U.S. expectations is strangely multimodal, with nearly equal shares of respondents expecting rates of price increases of 0, 3, and 5 percent. Further, the distribution also has disproportionately large shares of responses at 7 and 10 percent. See figure 10, which shows the distribution of year-ahead household inflation expectations in the United States and Sweden. These distributions are computed from more than 100,000 individual survey responses in the United States and about 300,000 responses in Sweden.

The distributional characteristics of the HIP data for Sweden reveal a strikingly similar propensity for household inflation expectations to concentrate around a few

discrete numbers. As in the United States, the Swedish distribution has disproportionately large shares of respondents expecting 0, 5, and 10 percent inflation. The concentration around 3 and 7 percent is, however, less pronounced in Sweden. For the full-sample, the proportion of Swedish households reporting an expectation of price stability is also much larger than what is observed for the United States (40 vs. 17 percent.) The formation of expectations in both the United States and Sweden thus appear to be formed in terms of "focal points", which we define as an expected inflation at which the proportion of responses is greater than the integer response immediately above and below it.

Figure 10. Distribution of Inflation Expectations in the United States and Sweden.

Percent



Sources: University of Michigan's Survey of Consumer Attitudes, Statistics Sweden, and own calculations.

Notes: The data refers to the period 1978-1999 for the United States, and 1979-2001 for Sweden. The bars represent the proportion of households expecting a particular inflation rate in each country.

The unusual and unexpected congregation of household inflation expectations around certain focal points suggests that households form their inflation predictions in largely qualitative terms. That is, they tend to report inflation predictions that are consistent with

no, low, and high inflation, but they do not appear to distinguish between potential minor variations around those rates. We believe this finding is broadly in the spirit of ADP near-rationality—a substantial share of households may not have adequate incentive to accurately gauge the inflation outlook beyond these rather broad characterizations. We refer to this idea as the formation of "qualitative expectations," of which the ADP near-rationality is a particular subset.

To investigate whether these focal points in household inflation predictions are stable (i.e., whether inflation alters the location of a focal point) we studied the monthly distributions of responses in the two surveys. Using our definition of a focal point, an expectation with a higher proportion of responses than the integer response immediately above and below it, we recorded the proportion of months that a given expectation satisfied that definition. The results are shown in table 5.

For example, in the Michigan survey, the proportion of households expecting zero inflation exceeds the proportion of those expecting 1 percent inflation and those expecting 1 percent *deflation* in 90.8 percent of all survey months. Similarly, proportions of reported household inflation expectations of 3, 5, 7, and 10 percent satisfy our definition of a focal point in almost every month. These focal points are also stable across the three inflation regimes, see the following three columns in table 5, suggesting that the focal points are largely unaffected by the inflation trend pursued by the Fed.

Table 5. Focal Points in Inflation Expectations, United States and Sweden

Expected inflation rate	United States				Sweden			
	1978:01-1999:12	1978:01-1982:07	1982:08-1991:01	1991:02-1999:12	1979:I-2001:12	1979:I-1983:IV	1984:I-1991:I	1991:II-2001:12
0	90.8%	100%	88.2%	90.7%	100%	100%	100%	100%
1	3.8%	0.0%	7.8%	1.9%	0.0%	0.0%	0.0%	0.0%
2	0.0%	0.0%	0.0%	0.0%	69.1%	45.0%	51.7%	77.9%
3	99.6%	100%	100%	99.1%	29.6%	55.0%	41.4%	22.1%
5	100%	100%	100%	100%	100%	100%	100%	100%
7	93.6%	100%	99.0%	85.1%	29.6%	0.0%	27.6%	35.4%
8	0.4%	0.0%	0.0%	1.0%	24.5%	100%	44.8%	5.5%
10	100%	100%	100%	100%	100%	100%	100%	100%
12	4.8%	3.6%	7.1%	2.9%	27.0%	100%	28.6%	3.2%
13	37.6%	72.7%	33.3%	21.5%	0.0%	0.0%	0.0%	0.0%
15	68.7%	83.6%	65.4%	63.2%	75.0%	100%	96.6%	64.9%
16	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Inflation	4.8%	10.2%	3.9%	2.7%	5.2%	9.6%	6.0%	2.5%

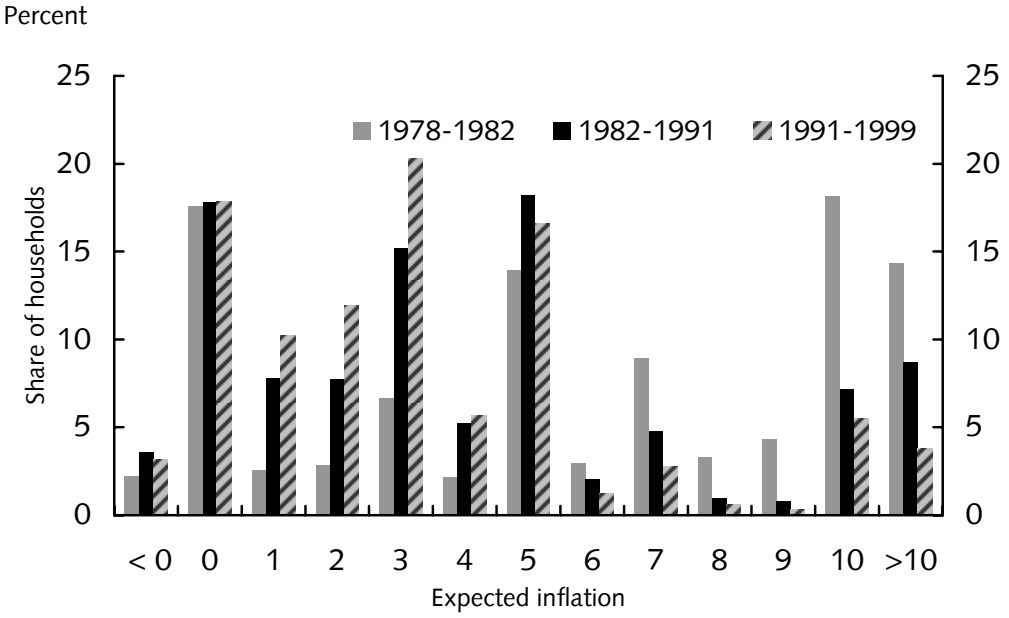
Note: The proportions reported in the table refer to the proportion of months a particular response is picked more often than the integer immediately above and below it. To save space, we have omitted those integers that never satisfied our definition of a focal point, i.e., 4, 6, 9, 11, and 14 percent.

In Sweden, the same numbers satisfy the definition of a focal point in almost all survey months, with a couple of exceptions. The most notable exception regards the responses in the 1-4 percent range. While 3 percent was the most common focal point in this range during the first inflation regime, 2 and 3 percent are almost equally important in the second regime, and 2 percent becomes the most common focal point in the last inflation regime. This finding suggests that, in Sweden, the announcement of an explicit inflation target of 2 percent has altered the location of a focal point, from 3 to 2 percent. Another difference from the U.S. findings is that the response of 7 percent does not seem to be a focal point in Sweden. In fact, 8 percent is a focal point during the first inflation

regime, whereas 7 percent emerges as a focal point as inflation is reduced. Thus, our findings regarding the stability of these focal points support our speculation that households evaluate inflation prospects in largely qualitative terms.

In figure 11 we examine the distribution of household inflation expectations in the United States in each of the three inflation regimes. Note the recurring concentrations of inflation expectations around 0, 3, 5, 7, and 10 percent. A large share of responses for inflation expectations greater than 10 percent is also seen in the high-inflation regime (when inflation averaged 10 percent.) While the existence of a focal point is unaffected by the inflation regime, the proportion of responses at any particular focal point is clearly related to the inflation regime. The share of households having inflation expectations of 7, 10, or greater than 10 percent falls sharply between the high- and medium-inflation regimes, while the proportions around 5, and 3 percent inflation rise appreciably. As the inflation trend falls further, this time to a low-inflation environment, so do the shares around the higher focal points, while the share predicting 3 percent inflation rises (from around 15 percent to 20 percent).

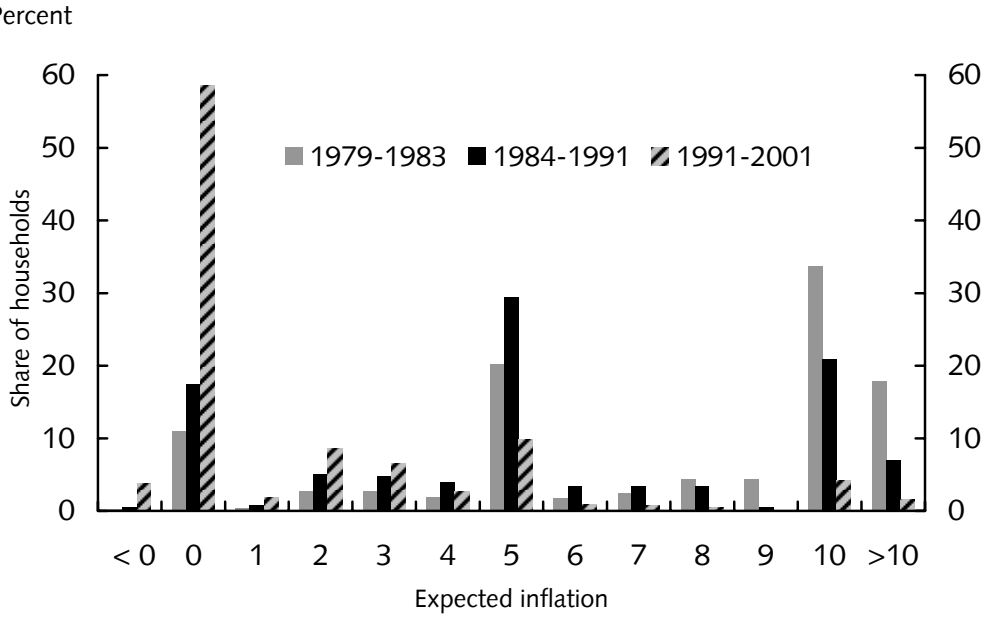
Figure 11. Distribution of U.S. Inflation Expectations in Three Inflation Regimes.



Sources: University of Michigan's Survey of Consumer Attitudes, and own calculations.

We next examine the distribution of household inflation expectations in the HIP data for the three Swedish inflation regimes (see figure 12.) We note that, as in the United States, large shifts from the higher to the medium and lower focal points occur as the inflation trend breaks to lower levels. However, as Swedish core inflation breaks downward to a 2.5 percent trend, the proportion of household expectations around the zero-inflation focal point jumps sharply in a way certainly suggestive of ADP near-rationality. This proportion of zero-inflation responses is nearly three times greater than what we see in the U.S. data, despite the fact that the nations followed the same inflation trend over roughly the same period. Thus, while the Swedish data seems supportive of near-rationality, the observed differences between the two countries instead suggest that the findings are a consequence of a changed policy.

Figure 12. Distribution of Swedish Inflation Expectations in Three Inflation Regimes.



Sources: Statistics Sweden, and own calculations.

One key distinguishing characteristic between the two nations' inflation experiences is that Sweden's low-inflation period has been accompanied by a formal inflation objective for the Riksbank centered on 2 percent. The announcement of this target corresponds to the date at which the HIP-data record a sharp rise in the zero-inflation expectations responses. It is curious that the modal focal point for the HIP data is zero, and not the announced 2 percent inflation objective of the central bank. This may be explained by the observation that while a large percentage of Swedish households understand that one of the Riksbank's main tasks is to maintain price stability (44 percent), only about 22 percent know that the operational inflation target is defined as an annual increase in the CPI of 2 percent.[16] In other words, the Swedish public seems to

[16] Riksbank Survey of Monetary Policy Credibility, October 14, 2002. The main results are summarized in Sveriges Riksbank Press Release No. 60, 2002.

have appreciated that the Riksbank is targeting inflation while remaining relatively unaware of what, exactly, that target is. This type of central bank credibility may have induced the near-rational type of expectations response we observe in the Swedish survey data.

4. Conclusions

In this paper, we considered the evidence of "near-rationality" in household inflation expectations using detailed survey data. We reject the specific form of near-rational inflation expectations suggested by the work of Akerlof, Dickens, and Perry and are unable to demonstrate several of the key testable propositions of their theory. In particular, the U.S. data seems very unsupportive of near-rationality, whereas the Swedish data is more inconclusive.

The detailed survey data reveal the existence of "focal points" in the distribution of inflation expectations responses, which seems to indicate a largely qualitative character of the way inflation expectations are formed – households tend to predict inflation in discrete terms that are broadly dispersed. While the locations of these focal points appear to be fairly stable across very different inflation regimes, we record significant shifts in the proportion of responses across the focal points when the inflation trend shifts.

Further, we were able to identify a substantial difference between the distributions of the inflation expectations of individuals in the United States and Sweden in the post-1992 period, even though both nations followed nearly identical low-inflation trends.

This difference between the two nations was not evident in the higher-inflation subsamples. Our interpretation of this finding is that inflation targeting in Sweden has substantially increased the proportion of Swedes who ignore inflation. Thus, while our findings for Sweden are broadly consistent with near-rationality we believe our findings are a consequence of a changed policy rather than evidence of near-rationality.

While our finding that households gauge inflation prospects in broad, qualitative terms, is similar in spirit to the behavior posited by ADP, the policy implications are quite different. ADP rests on a behavioral assumption – that households underpredict inflation at low rates. Thus, according to ADP a central bank can exploit that behavior and permanently reduce unemployment, giving rise to a "kinked" long-run Phillips curve. Our findings instead suggest that the average response may very well coincide with the actual inflation rate. A central bank that permanently raises its inflation trend – in particular if it raises an explicit inflation target – is likely to affect the location of a focal point. However, there is no support in the data that households will underpredict inflation at higher inflation rates. Thus, such a higher inflation trend will not affect the long-run unemployment. We therefore conclude that the long-run Phillips curve is vertical, and that such an attempt to "fool" households will only result in higher inflation combined with higher average inflation expectations.

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Evaluating Implied RNDs by some New Confidence Interval Estimation Techniques by *Magnus Andersson* and *Magnus Lomakka* 2003:146
Taylor Rules and the Predictability of Interest Rates by *Paul Söderlind, Ulf Söderström* and *Anders Vredin* 2003:147
Inflation, Markups and Monetary Policy by *Magnus Jonsson* and *Stefan Palmqvist* 2003:148
Financial Cycles and Bankruptcies in the Nordic Countries by *Jan Hansen* 2003:149
Bayes Estimators of the Cointegration Space by *Mattias Villani* 2003:150
Business Survey Data: Do They Help in Forecasting the Macro Economy? by *Jesper Hansson, Per Jansson* and *Mårten Löf* 2003:151
The Equilibrium Rate of Unemployment and the Real Exchange Rate: An Unobserved Components System Approach by *Hans Lindblad* and *Peter Sellin* 2003:152
Monetary Policy Shocks and Business Cycle Fluctuations in a Small Open Economy: Sweden 1986-2002 by *Jesper Lindé* 2003:153
Bank Lending Policy, Credit Scoring and the Survival of Loans by *Kasper Roszbach* 2003:154
Internal Ratings Systems, Implied Credit Risk and the Consistency of Banks' Risk Classification Policies by *Tor Jacobson, Jesper Lindé* and *Kasper Roszbach* 2003:155
Monetary Policy Analysis in a Small Open Economy using Bayesian Cointegrated Structural VARs by *Mattias Villani* and *Anders Warne* 2003:156
Indicator Accuracy and Monetary Policy: Is Ignorance Bliss? by *Kristoffer P. Nimark* 2003:157
Intersectoral Wage Linkages in Sweden by *Kent Friberg* 2003:158

Do Higher Wages Cause Inflation? by *Magnus Jonsson* and *Stefan Palmqvist* 2004:159
Why Are Long Rates Sensitive to Monetary Policy by *Tore Ellingsen* and *Ulf Söderström* 2004:160
The Effects of Permanent Technology Shocks on Labor Productivity and Hours in the RBC model by *Jesper Lindé* 2004:161
Credit Risk versus Capital Requirements under Basel II: Are SME Loans and Retail Credit Really Different? by *Tor Jacobson, Jesper Lindé* and *Kasper Roszbach* 2004:162
Exchange Rate Puzzles: A Tale of Switching Attractors by *Paul De Grauwe* and *Marianna Grimaldi* 2004:163
Bubbles and Crashes in a Behavioural Finance Model by *Paul De Grauwe* and *Marianna Grimaldi* 2004:164
Multiple-Bank Lending: Diversification and Free-Riding in Monitoring by *Elena Carletti, Vittoria Cerasi* and *Sonja Daltung* 2004:165
Populism by *Lars Frisell* 2004:166
Monetary Policy in an Estimated Open-Economy Model with Imperfect Pass-Through by *Jesper Lindé, Marianne Nessén* and *Ulf Söderström* 2004:167
Is Firm Interdependence within Industries Important for Portfolio Credit Risk? by *Kenneth Carling, Lars Rönnegård* and *Kasper Roszbach* 2004:168
How Useful are Simple Rules for Monetary Policy? The Swedish Experience by *Claes Berg, Per Jansson* and *Anders Vredin* 2004:169
The Welfare Cost of Imperfect Competition and Distortionary Taxation by *Magnus Jonsson* 2004:170
A Bayesian Approach to Modelling Graphical Vector Autoregressions by *Jukka Corander* and *Mattias Villani* 2004:171
Do Prices Reflect Costs? A study of the price- and cost structure of retail payment services in the Swedish banking sector 2002 by *Gabriela Guibourg* and *Björn Segendorf* 2004:172
Excess Sensitivity and Volatility of Long Interest Rates: The Role of Limited Information in Bond Markets by *Meredith Beechey* 2004:173
State Dependent Pricing and Exchange Rate Pass-Through by *Martin Flodén* and *Fredrik Wilander* 2004:174
The Multivariate Split Normal Distribution and Asymmetric Principal Components Analysis by *Mattias Villani* and *Rolf Larsson* 2004:175
Firm-Specific Capital, Nominal Rigidities and the Business Cycle by *David Altig, Lawrence Christiano, Martin Eichenbaum* and *Jesper Lindé* 2004:176
Estimation of an Adaptive Stock Market Model with Heterogeneous Agents by *Henrik Amilon* 2005:177
Some Further Evidence on Interest-Rate Smoothing: The Role of Measurement Errors in the Output Gap by *Mikael Apel* and *Per Jansson* 2005:178
Bayesian Estimation of an Open Economy DSGE Model with Incomplete Pass-Through by *Malin Adolfson, Stefan Laseén, Jesper Lindé* and *Mattias Villani* 2005:179
Are Constant Interest Rate Forecasts Modest Interventions? Evidence from an Estimated Open Economy DSGE Model of the Euro Area by *Malin Adolfson, Stefan Laseén, Jesper Lindé* and *Mattias Villani* 2005:180
Inference in Vector Autoregressive Models with an Informative Prior on the Steady State by *Mattias Villani* 2005:181
Bank Mergers, Competition and Liquidity by *Elena Carletti, Philipp Hartmann* and *Giancarlo Spagnolo* 2005:182

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Riksbank Printing Office Stockholm 2005

ISSN 1402-9103