

Geiger, Martin; Scharler, Johann

**Working Paper**

## How do people interpret macroeconomic shocks? Evidence from U.S. survey data

Working Papers in Economics and Statistics, No. 2018-12

**Provided in Cooperation with:**

Institute of Public Finance, University of Innsbruck

*Suggested Citation:* Geiger, Martin; Scharler, Johann (2018) : How do people interpret macroeconomic shocks? Evidence from U.S. survey data, Working Papers in Economics and Statistics, No. 2018-12, University of Innsbruck, Research Platform Empirical and Experimental Economics (eeecon), Innsbruck

This Version is available at:

<https://hdl.handle.net/10419/184990>

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**University of Innsbruck**  
**Working Papers in Economics and Statistics**

The series is jointly edited and published by

- Department of Banking and Finance
- Department of Economics
- Department of Public Finance
- Department of Statistics

Contact address of the editor:  
research platform "Empirical and Experimental Economics"  
University of Innsbruck  
Universitaetsstrasse 15  
A-6020 Innsbruck  
Austria  
Tel: + 43 512 507 71022  
Fax: + 43 512 507 2970  
E-mail: [eeecon@uibk.ac.at](mailto:eeecon@uibk.ac.at)

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# How do people interpret macroeconomic shocks? Evidence from U.S. survey data

Martin Geiger\*      Johann Scharler†

July 3, 2018

## Abstract

We study the revision of survey expectations in response to macroeconomic shocks, which we identify in vector autoregressive models with sign restrictions. We find that survey respondents distinguish between movements along the Phillips curve and shifts of the Phillips curve, depending on the type of the shock that hits the economy. In addition, expectations about future interest rate dynamics are revised broadly in line with a Taylor rule. While the macroeconomic shocks account only for a small share of the forecast error variance of survey measures elicited from consumers, they are more relevant for the expectations of professional forecasters. This result is consistent with models of rational inattention.

Keywords: Macroeconomic Expectations, Michigan Survey, Structural Vector Autoregression, Zero and Sign Restrictions

JEL codes: E00, E32, D84

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\*Department of Economics, University of Innsbruck, Universitätsstrasse 15, A-6020 Innsbruck, Austria, Phone: +43 (0)512 507 71024, E-Mail: Martin.Geiger@uibk.ac.at

†Department of Economics, University of Innsbruck, Universitätsstrasse 15, A-6020 Innsbruck, Austria, Phone: +43 (0)512 507 71010, E-Mail: Johann.Scharler@uibk.ac.at

# 1 Introduction

How do people interpret macroeconomic developments and form expectations? To the extent that views about current and future developments influence decision making, macroeconomic outcomes themselves should depend on agents' perceptions.<sup>1</sup> In other words, people's perceptions should be an integral element of the propagation mechanism for shocks. In fact, macroeconomic models assign a key role to expectations and forward-looking behavior.<sup>2</sup> Yet, empirically, relatively little is known about how people interpret shocks.

We estimate vector autoregressive (VAR) models with U.S. macroeconomic data and aggregated survey data from the University of Michigan's Surveys of Consumers (Michigan Survey) and from the Survey of Professional Forecasters (SPF) to study how expectations are revised in response to structural macroeconomic shocks. To identify shocks, we impose zero and sign restrictions on the impulse responses of the macroeconomic variables. Specifically, we identify aggregate demand (AD) shocks, aggregate supply (AS) shocks, and monetary policy (MP) shocks. To disentangle AD and AS shocks we restrict the unemployment rate and the inflation rate to move in the same direction in case of an AD shock, and in opposite directions following an AS shock. In addition, we assume that a restrictive policy shock gives rise to the same dynamics for output and the price level as an adverse AD shock, but with the additional restriction that the interest rate increases. These restrictions are a standard characterization of the shocks we are interested in and are consistent with a wide range of macroeconomic models (see e.g. Smets and Wouters, 2005; Peersman, 2005; Smets and Wouters, 2007; Fry and Pagan, 2011).

Our analysis is closely related to Carvalho and Nechio (2014) who analyze whether expectations are consistent with a Taylor rule relationship and argue that a better understanding of monetary policy enhances the effectiveness of monetary policy. Along similar lines, Dräger et al. (2016) find that central bank communication increases the understanding of key macroeconomic concepts.

The VAR approach that we adopt in this paper is well-suited for the analysis for several reasons. First, we are able to study dynamic responses of the survey measures, while the existing literature

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<sup>1</sup>Armantier et al. (2015) find that expectations elicited from surveys and choices in a laboratory experiment are correlated. Barnes and Olivei (2017) show empirically that information about consumers' attitudes obtained from the University of Michigan's Survey of Consumers has forecasting power for consumption.

<sup>2</sup>For an overview on the role of expectations in macroeconomic models and the propagation of shocks see e.g. Evans and Honkapohja (2001). A related, albeit distinct, issue is the modeling of expectations (see, among others, Carroll, 2003; Milani, 2007; Coibion and Gorodnichenko, 2015a).

focuses on contemporaneous relationships. Since expectations may not be updated instantaneously, the contemporaneous relationship may not capture all relevant information. Second, and perhaps more importantly, the identified shocks are orthogonal by construction, which simplifies the interpretation of the results. For instance, analyzing whether expectations are consistent with a Phillips curve is complicated by the fact that the Phillips curve may shift due to AS shocks. Dräger et al. (2016) assume that short-run fluctuations are either predominantly due to AD shocks when comparing people’s expectations with the predictions of a Phillips curve relationship,<sup>3</sup> or that AS shocks are adequately captured by oil price movements. In our analysis, we explicitly distinguish between AD and AS shocks and characterize the responses of the survey measures accordingly. Similarly, when analyzing whether expectations are consistent with a Taylor rule, Carvalho and Nechio (2014) and Dräger et al. (2016) assume that movements in the interest rate are due to systematic monetary policy rather than shocks to the Taylor rule. Our identification approach, in contrast, ensures that policy shocks are orthogonal to AS and AD shocks. Therefore, we can explicitly disentangle systematic policy responses and policy shocks.

We find that in response to an adverse AD shock, survey respondents expect unemployment to increase and inflation to decrease, which is consistent with a Phillips curve relationship. At the same time, the expected interest rate decreases, which is in line with a Taylor rule. These findings corroborate the results reported in Carvalho and Nechio (2014) and Dräger et al. (2016). For adverse AS shocks, we find that unemployment and inflation are both expected to increase. Thus, survey respondents correctly distinguish between AD and AS shocks. In other words, they distinguish between movements along the Phillips curve and shifts of the Phillips curve. Following an adverse AS shock, the expected interest rate increases, which indicates that survey respondents expect the Fed to put more weight on inflation than on real economic developments in the aftermath of an AS shock. Overall, these results suggest that survey answers are consistent with the propagation mechanisms for AD and AS shocks in standard macroeconomic models. Concerning MP shocks, the evidence is less conclusive. The responses of the expectation measures are characterized by a high degree of dispersion and the effects are less persistent. Thus, while survey respondents interpret the effects of AD and AS shocks on interest rates in line with the systematic monetary policy reaction incorporated in standard models, our results indicate that the interpretation of the effects of MP

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<sup>3</sup>However, there is some empirical evidence indicating that AS shocks are quantitatively important sources of business cycle fluctuations (see e.g. Smets and Wouters, 2005, 2007).

shocks is less clear.

We also study how consumers adjust consumption plans in response to shocks to see whether the adjustments are consistent with expectations about the macroeconomic influence of shocks. Survey respondents increasingly plan to reduce consumption in response to adverse AS and AD shocks, where the response is stronger and more persistent after adverse AS shocks. This result is in line with the larger expected macroeconomic effects of AS shocks.

When we compare the results obtained with the Michigan Survey data to those obtained using the SPF, we find that consumers and professional forecasters interpret shocks in a remarkably similar way. However, with respect to how important the macroeconomic shocks are in shaping the dynamics of the survey expectations, pronounced differences emerge between the two groups of respondents. While the identified shocks explain only small shares of the forecast error variance of consumer expectations, they account for a sizable fraction of the forecast error variance of the SPF expectation measures. Since consumers are likely to have weaker incentives to collect and analyze information about macroeconomic conditions, this outcome is consistent with models of rational inattention (e.g. Sims, 2003).

The remainder of this paper is structured as follows: Section 2 describes the survey data from the Michigan Survey and the SPF. In Section 3 we discuss the estimation and the identification strategy. In Section 4 we present the results and in Section 5 we explore the robustness of our results. Section 6 concludes the paper.

## 2 Survey Data

For our analysis we use survey data from the Michigan Survey and from the SPF.<sup>4</sup> In the Michigan Survey the respondents are households and the survey answers should therefore be indicative for how consumers view economic developments.<sup>5</sup> While we primarily consider data obtained from the Michigan Survey, we also conduct the analysis using data from the SPF to see how consumers perceive macroeconomic developments in comparison to financial and economic experts.

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<sup>4</sup>These data are widely used to study expectations in a macroeconomic context. See e.g. Carvalho and Nechio (2014); Coibion and Gorodnichenko (2015b); Wong (2015); Bachmann et al. (2015); Dräger et al. (2016).

<sup>5</sup>Coibion and Gorodnichenko (2015b) argue that firms' expectations about economic activity and inflation are better approximated by household answers compared to answers from professional forecasters, since small and medium-sized enterprises usually have no professional forecasters on staff and are not likely to use professional forecasting services.

## 2.1 The Michigan Survey

A minimum of 500 telephone interviews are documented each month by the Survey Research Center at the University of Michigan. The households are selected to ensure that the sample is representative for the U.S. population (Alaska and Hawaii are excluded from the surveys). Survey questions cover three areas: demographics, how survey respondents assess the prospects for their own financial situation, and how they view prospects for the economy in general.

To evaluate how survey respondents interpret shocks, we focus on questions about the future developments of inflation, the interest rate, and real developments. The Michigan Survey contains quantitative as well as qualitative questions. For expected inflation we use point estimates obtained from answers to the following two questions:<sup>6</sup>

(A12) *‘During the next 12 months, do you think that prices in general will go up, or go down, or stay where they are now? (A12b) By about what percent do you expect prices to go (up/down) on the average, during the next 12 months?’*

The remaining questions that we use in our analysis are qualitative. To capture expectations about interest rates we consider the following question:<sup>7</sup>

(A11) *‘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?’*

To infer expectations about real economic activity, we use the following question:

(A10) *‘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?’*

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<sup>6</sup>In fact, the point estimates of the expected inflation rate are a combination of answers to questions A12 and A12b. For all respondents that reach question A12b, we consider the point estimates, but not all respondents reach question A12b. Respondents indicating that prices stay the same in question A12 are asked a follow up question clarifying whether they mean that prices or that inflation stays the same. Those who specify that they mean that inflation remains the same, then have to provide the quantitative point estimate (i.e. they have to answer question A12b). Those respondents who confirm that they believe that prices stay constant are not asked for their point estimate and do not reach question A12b. They are automatically assigned a quantitative point estimate of 0.

<sup>7</sup>It has to be noted that this question does not refer to a specific interest rate and respondents may not specifically have the monetary policy rate in mind.



In addition to expectations about the macroeconomic environment, we also study how survey respondents plan to adjust consumption in response to structural shocks.

We study the adjustment of consumption plans using the question:<sup>8</sup>

(A18) *‘About the big things people buy for their homes – such as furniture, a refrigerator, stove, television, and things like that. Generally speaking, do you think now is a good or bad time for people to buy major household items?’*

To include the survey data in our VAR analysis, we aggregate the answers across respondents for each month  $t$ . Specifically, for the question about the expected inflation rate (question A12b), we simply average over the estimates provided by respondents. For the qualitative questions (A11, A10, and A18), we use balance scores (see e.g. Leduc and Sill, 2013; Survey Research Center, 2015). As an example for the construction of the balance scores, consider the answers to question A11.

We calculate the balance score as the share of respondents indicating that interest rates for borrowing money during the next 12 months will go up minus the share of respondents indicating that interest rates go down and multiply this difference by 100 to allow for a interpretation in percentage points. Finally, we add 100 so that the balance score fluctuates around 100, as it is standard in the literature. Balance scores for the answers to questions A10 and A18 are obtained analogously.

Figure 1 displays the time series for the aggregated survey answers beginning with January 1978 to July 2016. Shaded areas indicate NBER recessions. Panel A shows that expected inflation has declined strongly during the early 1980s along with the onset of the Great Moderation. According to Panel B and Panel C, the balance scores for expected interest rate and unemployment developments exceed the level of 100 in most periods. Thus, survey respondents have a tendency to expect that borrowing becomes more expensive and that unemployment will increase. Nevertheless, Panel D shows that people, on average, plan to increase consumption spending, despite higher expected borrowing costs and a pessimistic overall outlook for the economy. While this outcome is somewhat surprising at first glance, it is consistent with the so-called illusion of control fallacy, which states that people have a tendency to view their individual situation and things that depend on their own decisions optimistically, ignoring available information that paints a less optimistic picture (Langer,

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<sup>8</sup>Bachmann et al. (2015) use this question to study the influence of expected inflation on consumption plans at the zero lower bound.

1975).

We also see that the expectation measures fluctuate over the business cycle. As recessions set in, respondents tend to expect a lower inflation rate and lower interest rates, while relatively more respondents expect unemployment to increase. With respect to planned consumption, a relatively lower share of respondents states that it is a good time to consume.

## 2.2 The Survey of Professional Forecasters

The SPF elicits survey answers from a group of approximately 40 private sector economists from financial and research institutions who generate forecasts about key macroeconomic variables. Respondents fill out a questionnaire form and provide point estimates for a number of variables and various forecasting horizons ranging from one quarter to 10 years. In contrast to the Michigan Survey, the SPF is conducted with a quarterly frequency. Another difference is that the SPF elicits point estimates, whereas the Michigan Survey asks for qualitative forecasts of the unemployment rate and the interest rate .

For our analysis, we use the cross-sectional averages provided by the Federal Reserve Bank of Philadelphia. Specifically, we use the three quarter ahead forecast for the headline consumer price index (CPI) inflation rate (denoted CPI5 in the SPF dataset), the three-month Treasury bill rate (TBILL5), and the unemployment rate (UNEMP5). Data for the expected T-Bill rate and the expected CPI inflation rate are available from the third quarter of 1981 while the expected unemployment rate is available since 1968.<sup>9</sup>

Figure 2 shows the time series for these survey measures from the third quarter of 1981 until the third quarter of 2016 together with the NBER recession dates indicated by the light grey areas. During recessions, respondents expect the unemployment rate to go up and the inflation rate and the T-Bill rate to go down. These dynamics correspond to the pattern we obtained with consumer data from the Michigan Survey, discussed above.

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<sup>9</sup>The SPF also asks to forecast real consumption expenditures (RCONSUM) at different horizons. Although this question could be related to consumption plans and could therefore be used analogously to Question A18 from the Michigan Survey, we do not use this question for the analysis. The reason is that while Question A18 in the Michigan Survey asks consumers about their own consumption plans, the consumption question in the SPF asks professionals to forecast aggregate consumption. Thus, the answers to these two questions have rather different interpretations.

### 3 Estimation and Identification

#### 3.1 Estimation

We estimate reduced-form VAR models of the type

$$x_t = c + \sum_{l=1}^L B_l x_{t-l} + e_t,$$

where  $x_t$  is a vector of endogenous variables,  $c$  is the constant,  $B_l$  is the matrix of reduced-form coefficients at lag  $l$ , and  $e_t$  is a vector of residuals with covariance matrix  $\Sigma_e = E(e_t e_t')$ .

The vector of endogenous variables contains the aggregated expectation measures from either the Michigan Survey or from the SPF along with macroeconomic data. The macroeconomic variables are chosen to correspond closely to the variables for which survey respondents provide forecasts. In the baseline estimation we include the seasonally adjusted civilian unemployment rate, the annual growth rate of the seasonally adjusted CPI for urban consumers (i.e. inflation rate), and the Federal Funds rate (FFR) provided by the Federal Reserve Economic Data (FRED) database of the Federal Reserve Bank of St. Louis. An additional advantage of using the unemployment rate as a proxy for economic activity is that it is usually not revised ex post (see also Leduc and Sill, 2013). In a further analysis, we also use the industrial production (IP) index and the CPI to identify macroeconomic shocks.

To ensure that we do not pick up major structural breaks, we only consider the sample starting with the beginning of the Great Moderation, which we date with January 1985, until the onset of the Great Recession in June 2007, in the baseline estimations. In additional estimations, we explore the robustness of our results by extending the sample until July 2016. Given the availability of data discussed in Section 2, we estimate the VAR with monthly data when using the Michigan Survey data, and with quarterly data when using data from the SPF. Despite the different frequencies of the data, the Akaike information criterion suggests a lag length of  $L = 2$  for both estimations.<sup>10</sup>

We estimate the reduced-form VAR using Bayesian methods with the Normal-Wishart distribution as an uninformative prior density for the reduced form coefficients. The posterior density of the reduced form coefficients is therefore Normal-Wishart with the location parameters  $B = [B_1, \dots, B_L]'$  and the covariance matrix  $\Sigma_e$  (Uhlig, 1994). To identify structural shocks we

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<sup>10</sup>In a robustness analysis, we estimate the VAR with 12 lags.

apply a zero-and-sign-restrictions algorithm based on Rubio-Ramirez et al. (2010) and Arias et al. (2017), which works as follows: For each draw from the distribution of the reduced form parameters, we take the Choleski factor of  $\Sigma_e = PP'$  and use random orthogonal matrices  $Q$  to obtain alternative decompositions  $\Sigma_e = PQQ'P'$ , and orthogonal shocks  $u_t = (PQ)^{-1}e_t$ . The matrix  $Q$  is constructed such that the zero restrictions are fulfilled. To obtain the distribution of permissible SVAR models we iterate the algorithm 1,000 times in the following steps. We draw one set of parameters from the posterior distribution of the reduced form VAR. For this set of parameters we check whether we can find a transformation that is admissible in terms of the sign restrictions. Specifically, we keep drawing  $Q$  matrices until either a permissible transformation is found (then we retain the candidate model and proceed with the next iteration of the algorithm) or a maximum number of 1,000 draws of the matrix  $Q$  is reached (then we proceed without retaining any model). In most cases we find a permissible model for each draw from the posterior distribution of the reduced form models, which is reassuring in terms of the empirical plausibility of the imposed sign restrictions (Giacomini and Kitagawa, 2015).

Since the system is set-identified, the prior is only flat over the reduced form coefficients but not necessarily over the structural coefficients as the decomposition of the variance-covariance matrix  $\Sigma$  using random orthogonal matrices  $Q$  (where  $Q'Q = I$ ) incorporates an implicit prior distribution (Baumeister and Hamilton, 2015, 2017). However, as shown in Giacomini and Kitagawa (2015), inference is less sensitive to the distribution of  $Q$  if zero restrictions are imposed.

### 3.2 Identification

We impose a combination of sign and zero restrictions on the impulse response functions to identify AD, AS and MP shocks. Table 1 summarizes our identification scheme. In response to an adverse AD shock, economic activity and inflation decline. In the baseline specification, we use the unemployment rate as a proxy for economic activity. Hence, we restrict the unemployment rate to increase and the inflation rate to decrease.<sup>11</sup> According to a Taylor rule, the central bank responds to this shock by lowering the interest rate. Consequently, we restrict the policy rate to go

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<sup>11</sup>To explore the robustness of our results, we replicate the baseline estimations using industrial production as a measure for output and impose the opposite signs compared to the unemployment rate.

down.<sup>12</sup> Standard macroeconomic models predict that AS shocks, such as price mark-up shocks, wage mark-up shocks, or technology shocks (see e.g. Smets and Wouters, 2007), move economic activity and inflation in the same directions. Consistent with this, we restrict the unemployment rate and the inflation rate to go up. In addition, we restrict the response of the policy rate to increase. Here we essentially assume that the central bank puts relatively more weight on price stability in its objective function. Finally, to identify MP shocks we impose the restrictions that along with an increase in the interest rate, the unemployment rate rises and the inflation rate decreases. These restrictions are consistent with standard macroeconomic models (e.g. Smets and Wouters, 2005, 2007) and are used widely in the empirical literature (Fry and Pagan, 2011). All sign restrictions are imposed on impact plus three consecutive months.

Although the sign restrictions ensure that the macroeconomic shocks are orthogonal, it is still conceivable that the identified shocks are not orthogonal to exogenous changes in expectations. Suppose, for instance, that aggregate demand changes due to a change in the private sectors’s assessment of future economic activity that is not induced by changes in the economic situation itself. And suppose also that these effects are strong enough to influence economic activity.<sup>13</sup> Relying exclusively on the sign restrictions, we would falsely classify these dynamics as the endogenous response of expectation variables to exogenous macroeconomic shocks, rather than the other way around.

To address this issue, we impose additional zero restrictions that render the macroeconomic shocks orthogonal to expectations shocks. Specifically, we impose the additional restriction that the expectation measures respond to macroeconomic shocks only with a lag of one period. Since expectation shocks should be quickly visible in the survey variables, these additional restrictions allow us to disentangle exogenous macroeconomic shocks from exogenous expectation shocks.

Although the restriction that survey measures only respond with a lag to macroeconomic shocks may at first glance appear rather restrictive, it is in fact consistent with the timing of the Michigan Survey. The survey is conducted during each month and data on the current unemployment rate and the inflation rate are published with a delay in the first half of the following month. Hence,

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<sup>12</sup>Since the sample for our baseline estimation excludes the Great Recession, the zero lower bound does not complicate our identification scheme. In the robustness analysis we evaluate the sensitivity of our results towards restricting the sample period and replace the FFR by a shadow rate as an alternative measures for the monetary policy.

<sup>13</sup>Leduc and Sill (2013) find that expectations shocks are a quantitatively important source of business cycle fluctuations.

data about contemporaneous macroeconomic developments have not yet been published at the time the survey is conducted. Consequently, survey respondents should respond to macroeconomic data and developments only with a lag. It has to be noted, however, that survey respondents may still have some contemporaneous information about interest rate developments at the time the survey is conducted.<sup>14</sup>

The SPF is conducted with a quarterly frequency and the response deadline is generally the third week of the second month of the quarter. At this point respondents can observe contemporaneous macroeconomic data which are relevant for the respective quarter through releases of monthly data. Thus, the zero restrictions would be less plausible with SPF data. Therefore, we follow Leduc and Sill (2013) and redefine quarters such that the first month of a quarter is the month respondents provide forecasts. Following this logic, the redefined first quarter consists of February, March, April. The second quarter consists of May, June, July, and so on.<sup>15</sup>

## 4 Results

### 4.1 Results for Consumers

Figure 3 shows the responses of the endogenous variables to an AD shock in the first column, to an AS shock in the second column, and to a MP shock in the third column. The responses of the macroeconomic variables are shown in Panel A and the responses of the expectation measures, which are either a balance score (for unemployment and interest rate expectations), or a point estimate (for the expected inflation rate), are displayed in Panel B. In Panel C, we present the responses of the balance score of people’s consumption plans.

The solid lines represent the pointwise-median responses and the dashed lines are the closest-to-median responses as suggested in Fry and Pagan (2011).<sup>16</sup> For ready comparisons across the different shocks, all responses are normalized so that the unemployment rate rises by one percentage point on impact. Each subfigure also shows bands corresponding to the 5th and the 16th percentiles (lower limits of the shaded areas) as well as the 84th and the 95th percentiles (upper limits of the

<sup>14</sup>See also the discussion in Leduc and Sill (2013).

<sup>15</sup>To generate the macroeconomic data for the redefined quarters we consider quarterly averages of the monthly data described above.

<sup>16</sup>The closest-to-median responses are the responses from a single model that is selected such that the responses of this single model exhibit the minimum deviations from the pointwise-median responses among all set-identified models.

shaded areas) of the distribution of the set-identified models.

We display responses for the macroeconomic variables in Panel A and the responses of planned consumption in Panel C for horizons of up to 24 months. In the Michigan Survey, the respondents are asked to provide an assessment of macroeconomic developments during the next 12 months. Therefore, we show the responses of the expectation variables in Panel B only for horizons of up to 12 months. Although we impose the sign restrictions only on impact plus 3 periods, the responses of the macroeconomic variables, which are shown in Panel A, are rather persistent. This indicates that the restrictions are generally well supported by the data.

We see from the responses shown in the first column in Panel B that the balance score of the unemployment expectation increases in response to the AD shock. The expected inflation rate declines in response to the shock. Hence, we conclude that survey respondents interpret AD shocks in a way consistent with a Phillips curve relationship, or more precisely, as a movement along the Phillips curve. In other words, expectations are revised in line with how standard macroeconomic models characterize the propagation of these shocks. We also see that survey respondents expect lower interest rates, which is consistent with the interest rate dynamics suggested by a Taylor rule.

The second column of Panel B shows that the balance score of the unemployment expectations, as well as the expected inflation rate increase after an adverse AS shock. These dynamics are again consistent with the predictions of standard theory as AS shocks are viewed as shifts of the Phillips curve, rather than movements along the Phillips curve. Thus, survey respondents correctly distinguish between AD and AS shocks. Although the responses of the balance score summarizing interest rate expectations are initially largely positive, they are less persistent than for the other expectation variables and tend to turn negative 4 months after the shock. This may, however, reflect the rather muted response of the FFR itself (shown in Panel A).

Finally, the last column shows the responses of the expectation measures to a MP shock. We see that the balance score of unemployment expectation increases on impact and the expected inflation rate declines. While these responses are consistent with the effects that a monetary contraction exerts in standard models, the increase in the balance score of the unemployment expectations is only short-lived. Interestingly, survey respondents predominantly expect lower interest rates after an adverse policy shock, even though the Federal Funds rate, according to Panel A, remains persistently positive following a contractionary policy shock. One interpretation is that survey

respondents underestimate the persistence of the shock and expect a stronger degree of mean-reversion. Alternatively, survey respondents may confuse the monetary policy shock with an AD shock to which the central bank responds endogenously. Also note that the responses of the survey expectations to MP shocks are generally less systematic as the distribution of permissible models is relatively wide.

Overall, the interpretation of AD and AS shocks is largely in line with the propagation mechanisms for AD and AS shocks in standard macroeconomic models. In the event of AD shocks, respondents expect a movement along the Phillips curve and future interest rates to respond as suggested by a Taylor rule relationship. These results support the findings in Carvalho and Necho (2014) and Dräger et al. (2016), who report that people generally tend to form expectations consistent with a Phillips curve and a Taylor rule type relationship. Following an AS shock, unemployment and inflation expectations are revised in the same direction indicating that people expect a shift of the Phillips curve. Thus, survey respondents correctly distinguish between AD and AS shocks. Interest rate expectations increase following a contractionary AS shock, which suggests that survey respondents expect the Fed to react more strongly to inflation than to real economic developments in the aftermath of an AS shock. Following an MP shock, the responses of the expectation variables are generally characterized by a high degree of dispersion and the effects are less persistent. While people appear to interpret the effects of AD and AS shocks on interest rates in line with the usual systematic monetary policy reaction, they appear to have a less clear interpretation of the macroeconomic effects of MP shocks.

We also see that the responses of the expectation variables build up over the first few months after a shock in most cases. While this hump-shaped pattern is partly due to the imposed zero restrictions, it also suggests that survey participants update expectations only gradually, which may be due to e.g. informational rigidities (see e.g. Mankiw and Reis, 2002; Coibion and Gorodnichenko, 2012, 2015a).

Having analyzed how consumers interpret macroeconomic developments, we now turn to the question if and how they adjust consumption plans in response to the shocks. Panel C of Figure 3 shows the responses of the balance score associated with planned consumption. Planned consumption drops strongly and persistently after an AS shock, whereas the decline is only short-lived following an AD shock. This pattern is consistent with the more pronounced and more persistent



responses of expected unemployment in case of the AS shock. In addition, higher actual and expected inflation may drag on the perceived purchasing power of income resulting in lower planned consumption in case of the AS shock. Interestingly, the contractionary MP shock does not lead to a reduction in planned consumption.

While we find that survey answers are broadly consistent with the propagation mechanisms captured in standard macroeconomic models, the question arises how people arrive at their answers to the survey questions. On the one hand, survey answers mirror how perceived macroeconomic developments are interpreted in light of the respondents' views about macroeconomic relationships. In this case, survey answers reveal how people interpret macroeconomic developments. On the other hand, it is also conceivable that survey respondents simply use the latest observations of the unemployment rate, the inflation rate, and the interest rate, and extrapolate these developments into the future without having any views about their interconnectedness. We argue that simple extrapolation is unlikely for at least two reasons. First, if survey answers were mainly the result of univariate extrapolation, and given that the responses of the macroeconomic variables are fairly persistent, the responses of the expectation measures should replicate the responses of the macro variables fairly closely. While we find this to be the case in most instances, there are exceptions. For instance, survey respondents expect the interest rate to decline in response to a monetary policy shock, although the actual interest rate increases persistently. And second, we re-estimate the VAR with the annual growth rate of IP as a proxy for real economic activity instead of the unemployment rate and modify the sign restrictions accordingly. Thus, we identify the shocks using industrial production and study the response of expectations about unemployment. Although we interpret IP and unemployment both as proxies for economic activity, the link between the macroeconomic variables and the expectation variables is less tight in this specification and extrapolation should become harder.<sup>17</sup>

Figure 4 shows the responses, which are normalized so that the growth rate of IP drops by 5 percentage points on impact.<sup>18</sup> The responses of the macroeconomic variables in Panel A are qualitatively similar to those shown in Figure 3. More importantly, the responses of the survey

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<sup>17</sup>The contemporaneous correlation between the annual growth rate of IP and the unemployment rate is -0.23 for the observation period from January 1985 until June 2007. We also re-estimate the VAR with levels of the CPI and industrial production in the robustness analysis in Section 5.

<sup>18</sup>This scaling implies that the impact responses of the inflation rate and the policy rate are of similar orders of magnitude as in the baseline estimation where shocks are scaled so that the unemployment rate rises by one percentage point on impact.

measures in Panels B and C exhibit patterns that are similar to those found with the baseline specification. In particular, the responses of the balance score for expected unemployment are insensitive to using an alternative measure of economic activity for the identification of shocks.

To understand how important macroeconomic shocks are for the dynamics of the survey measures, we compute forecast error variance decompositions (FEVD) for the set-identified models. Table 2 shows the median of contributions of the macroeconomic shocks at horizon  $h$ , together with the 16th and the 84th percentile of the distributions. We again show the contributions of the macroeconomic shocks to the forecast errors of the expectation measures for horizons up to 12 months, while we show contributions for the macroeconomic variables and planned consumption for 24 months.

From Panel A of Table 2 we see that the structural shocks explain large shares of the forecast error variance of the macroeconomic variables. While the AD shock generally dominates the dynamics of the unemployment rate and the FFR, the AS shock captures the largest share of the forecast error variance of the inflation rate. The MP shock explains the forecast error variance of the macroeconomic data to a smaller extent. Overall, the shares of the forecast error variance accounted for by the shocks are of an order of magnitude similar to what other studies find (see e.g. Smets and Wouters, 2007; Ramey, 2016).

In contrast to the macroeconomic variables, looking at Panel B of Table 2, the structural shocks generally explain only small shares of the forecast error variance of the expectation measures. The AD shock accounts for only up to roughly 3 percent of the forecast error variance associated with the expectation variables, regardless of the horizon. A similar conclusion emerges for the MP shock. The AS shock plays a somewhat more prominent role and accounts for up to roughly 10 percent of the forecast error variance of the expected inflation rate. Nevertheless it also accounts for only up to approximately 1 percent of the forecast error variance of the interest rate expectation for most horizons considered. The shares of forecast error variance of planned consumption accounted for by the macroeconomic shocks are shown in Panel C. While AD and MP shocks play only a limited role in shaping the dynamics in these data, the AS shock explains a somewhat larger share of the forecast error variance, especially at higher horizons.

Overall, we conclude that although survey respondents react to macroeconomic fluctuations in a way that is broadly consistent with theory, the structural shocks play only a minor role for the dy-

namics of the survey measures. In particular, the low shares of forecast error variance captured by AD shocks suggest that consumers are only aware of their importance in shaping the business cycle to a limited extent. In addition, we observe that the structural shocks tend to be more important in shaping the forecast error variance of inflation expectations compared to unemployment expectations. This finding relates to Coibion et al. (2015) who report that survey respondents adjust expectations about inflation more readily than expectations about unemployment when exposed to news about these variables.

## 4.2 Results for Professional Forecasters

Do professional forecasters process and interpret shocks the same way households do?<sup>19</sup> To address this question, we re-estimate the VAR with survey data obtained from the SPF and identify shocks using the same identification scheme as in the baseline specification with the consumer data (see Table 1). We impose the sign restrictions on impact plus one quarter.

Figure 5 shows the responses to contractionary AD, AS and MP shocks. Responses are normalized so that on impact, the unemployment rate rises by one percentage point. Recall that the data frequency is quarterly now and that the forecasting horizon in the SPF is three quarters. Due to the forecasting lead, we show IRFs for macroeconomic variables for 8 quarters in Panel A, and for survey measures for 4 quarters in Panel B.

The responses of the macroeconomic variables are similar to those that we obtained in the baseline estimation, except for a few small differences. The unemployment rate responds slightly more persistently to AD and AS shocks and more pronouncedly to MP shocks. The impact response of the inflation rate to an AS shocks is also somewhat more pronounced when we consider quarterly data.

The first column in Panel B shows that professional forecasters expect the unemployment rate to increase, and the inflation rate as well as the interest rate to decrease in response to an adverse AD shock. Thus, professional forecasters interpret AD shocks in a way consistent with standard theory. The second column shows that professional forecasters expect the unemployment rate and the expected inflation rate to increase after an AS shocks. Hence, professional forecasters

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<sup>19</sup>It is well documented that household forecasts tend to be less efficient and more disperse. Moreover, forecasts by professionals may lead those made by households (Mankiw et al., 2004; Carroll, 2006). Carvalho and Nechio (2014) and Dräger et al. (2016) find that a larger fraction of survey responses by professional forecaster tends to be theory consistent.

also correctly distinguish between movements along the Phillips curve and shifts of the Phillips curve. We also see that professional forecasters initially expect the interest rate to increase after an AS shock, indicating that they expect the Fed to respond with a policy tightening to the shock. Although the actual FFR increases slightly in response to an AS shock, it does so only temporarily. Overall, these patterns again match what we found with consumer expectations. Finally, the responses in the third column show that professional forecasters expect the unemployment rate to increase and the inflation rate to decrease after a MP shock. This matches the responses of the macroeconomic counterparts and is consistent with standard models. Responses of interest rate expectations are not very systematic, but tend to go down, which is similar compared to the estimations with consumer data.

Although the impulse response analysis shows that professional forecasters and consumers interpret shocks similarly, we see from the FEVD of the expectation variables, shown in Panel B of Table 3, that stark differences arise in terms of the extent to which shocks are taken into account when expectations are revised.<sup>20</sup> For the forecasting horizons considered, the AD shock accounts for up to 38 percent of forecast error variance of the unemployment expectations and for up to approximately 18 percent of the forecast error variance of interest rate expectations, respectively. Hence, professionals' interpretations rely much more heavily on AD shifts than interpretations by consumers. For inflation expectations, the AD shock plays a much smaller role, accounting for only up to slightly less than 5 percent of the forecast error variance. However, this is consistent with the fact that the AD shock is also relatively less important in explaining the forecast error variance of the realized inflation rate (see Panel A). The contributions of the AS shock to the forecast error variance of expectations are relatively lower compared the AD shock. While the AS shock still accounts for up to 11 percent of the forecast error variance of unemployment expectations, it accounts for less than 5 percent of the variation in inflation expectations, and for less than 1 percent in case of interest rate expectations. The MP shock, in contrast, contributes relatively little to the forecast error variance of the expectation measures.

While the contributions vary across the expectation measures and across shocks, we find that the share of forecast error variance that can be attributed to the identified shocks is substantially higher when we use data from the SPF. Overall, we conclude that although professional forecast-

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<sup>20</sup>For the sake of completeness we also show FEVDs of the macroeconomic variables in Panel A of Table 3. The shares are of similar orders of magnitude as in the baseline estimation with the consumer data.

ers interpret macroeconomic shocks in a similar way as consumers, they pay more attention to macroeconomic developments than consumers. Since professional forecasters have stronger incentives to keep track of macroeconomic developments, this outcome is in line with models of rational inattention (Sims, 2003; Coibion and Gorodnichenko, 2015a; Maćkowiak and Wiederholt, 2015).

## 5 Robustness Analysis

In this section, we present a series of robustness analyses to support our results. We evaluate individual level data, re-estimate the baseline model with a longer sample period, and assess the sensitivity of our results with respect to the specification of the VAR model and the identification scheme.

### 5.1 Theory-Consistency and Individual Level Data

A potential drawback of our analysis is that the aggregated survey measures do not take into account how survey respondents interpret macroeconomic developments at an individual level. Consider for instance an AD shock and suppose that a group of respondents expects that unemployment will increase and that prices will remain stable. Another group indicates that unemployment will remain stable and that prices will decrease. At an individual level, these expectations are not consistent with standard theory. Nevertheless, when we aggregate the responses across groups, the balance score summarizing expected unemployment increases, while the average expected inflation rate decreases, indicating that the shock is interpreted in a theory-consistent way.

To address this issue, we aggregate the survey data taking into account whether the joint responses of individual respondents are theory-consistent. A respondent is classified as interpreting a negative AD shock, for instance, as theory-consistent, if the associated survey answers indicate that unemployment is expected to go up while the inflation rate and interest rates are expected to decline (and vice versa for positive AD shocks). We classify respondents with expectations consistent with positive and negative AS and MP shocks analogously.

Based on these classifications we compute shares of respondents having expectations consistent with positive and negative AD, AS and MP shocks and use balance scores to summarize positive and negative shares for each shock. Consider for instance expectations consistent with an AD shock. We subtract the share of respondents having expectations consistent with a positive AD shock

from the share of respondents having expectations consistent with a negative AD shock, multiply this relative score by 100 and add 100. Balance scores for expectations consistent with AS and MP shocks are constructed analogously. Since we consider responses to contractionary shocks, an increase in these balance scores indicates that the share of respondents having a theory-consistent interpretation goes up.

A complication arises since survey respondents provide a point estimate for the expected inflation rate. Therefore, we first need to transform the quantitative answers into an ordinal measure indicating whether the expected inflation rate goes down, remains constant or goes up. Based on Carvalho and Nechio (2014) and Dräger et al. (2016), we subtract past realized inflation rates from the individual quantitative point estimates for inflation.<sup>21</sup> We round the difference to the nearest integer and, according to the sign of the difference, generate the ordinal variable indicating the expected direction of change.

Figure 6 shows the impulse response functions obtained with our baseline specification where we replace the aggregated expectation measures with the balance scores indicating theory-consistency at the individual level. We estimate the VAR again with two lags of the endogenous variables as suggested by the Akaike information criterion. We see from Panel A that the responses of the macroeconomic variables are almost identical to the baseline results. The IRFs of the balance scores are shown in Panel B.

The top subfigure in the first column shows that the share of respondents interpreting the shock in a theory-consistent way increases after an adverse AD shock. Similarly, we see from the middle subfigure in the second column that, although the response of the balance score summarizing answers consistent with AS shocks is less persistent, relatively more survey participants evaluate the macroeconomic environment correctly as being the result of an AS shock. The third column shows responses to MP shocks. In line with our baseline analysis, we find that respondents have a less clear interpretation of MP shocks.

Overall, taking explicitly into account theory-consistency at the level of individual survey respondents, supports our main results.

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<sup>21</sup>The survey question regarding inflation simply asks people about percentage point increases in prices and not for a point estimate of a particular inflation measure. We relate respondents' expected increase in prices to the CPI, and subtract the average CPI inflation rate leading up to the month of the interview (from  $t - 12$  to  $t - 1$ ).

## 5.2 Consumer Characteristics

The aggregation of survey answer may hide potential heterogeneities among respondents. In the recent literature some evidence has been put forward that people update expectations and forecast macroeconomic variables differently depending on demographic characteristics such as education, income, age and gender.<sup>22</sup>

To address this issue, we now divide the sample along several demographic dimensions. First, we look at the role of education. We divide the sample into two sub-samples consisting of respondents with and without a university degree. For each sub-sample we aggregate inflation, unemployment and interest rate expectations as well as planned consumption as in the baseline and estimate our baseline with the resulting eight (instead of four) aggregate survey variables. The identification scheme is analogous to the baseline (see Table 1).

The results are shown in Figure 7, where the distributions of IRFs for the two groups are indicated by solid (respondents with a university degree) and dashed (respondents without a university degree) lines. We see that the two groups respond in a similar way, regardless of the shock. In particular, the dynamics of the IRFs for both groups are largely in line with the baseline results. This suggests that respondents revise expectations in a comparable way despite different levels of education. A similar picture emerges when we evaluate the role of age, income, and gender. The results are shown in Figures A.1, A.2, and A.3 in the Appendix. Overall, individual characteristics do not appear to systematically affect how survey respondents interpret shocks.

## 5.3 Longer Sample

We re-estimate the baseline VAR model with data until July 2016 to include more recent macroeconomic developments. However, the identification is complicated by the fact that the FFR remained constant at a level close to zero since the end of 2009 and that monetary policy was conducted through unconventional measures in the aftermath of the global financial crisis. Therefore, we use

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<sup>22</sup>E.g. Souleles (2004) finds that forecast errors by consumers are systematically correlated with demographic characteristics such as age, income and education. Easaw et al. (2013) report that people with higher education levels tend to have lower inflation expectations and absorb new information faster suggesting less informational rigidities for this subset of respondents. Malmendier and Nagel (2016) find evidence for age-dependent effects of inflation surprises suggesting that young people react more sensitively consistent with the fact that recent experiences account for a larger share of accumulated lifetime experiences. Coibion et al. (2015), in contrast, study survey data elicited from firms and report that inflation nowcast errors are not systematically affected by demographic characteristics once firm specific variables are controlled for.

the Shadow Short rate (SSR) suggested by Krippner (2015) instead of the FFR in this estimation.<sup>23</sup> The SSR is the shortest maturity rate estimated from a term-structure model that suitably takes account of the discontinuity in nominal interest rates at the zero lower bound. It is essentially equal to the FFR in conventional monetary policy environments. However, it can turn negative when the short term nominal interest is bounded by zero because it captures the effects of unconventional monetary policy (e.g. quantitative easing) on longer-maturity interest rates. The sign restrictions imposed on the responses of the FFR in the baseline are now imposed on the SSR. We use data from November 1985, which is the earliest date the SSR is available, until July 2016.

Figure 8 shows the results. The responses of the macroeconomic variables, and in particular of the SSR, to AS and AD shocks are remarkably similar despite the longer sample. The responses of the SSR to an MP shock are more pronounced and also more persistent than the response of the FFR in the baseline estimation. This suggests that due to the longer sample and the inclusion of the Great Recession period, we pick up monetary policy shocks with more pronounced effects onto the policy rate.

The responses of the survey measures to AD and AS shocks are remarkably robust and appear to be very similar compared to the baseline estimation. Only the response of people’s consumption plans varies slightly and tend to be comparatively more pronounced vis-à-vis AD shocks and comparatively less pronounced vis-à-vis AS shocks. In respect to the monetary policy shock we observe that the responses of expected unemployment and the expected inflation rate is similar than in the baseline. However, interest rate expectations respond positively to the MP shock which is in contrast to the baseline. This is actually in line with the distinct response of the SSR. Importantly, also for the estimation with the SSR and the longer sample, the wide bands suggest that people are relatively uncertain how to process MP shocks. Overall, the estimations with the longer sample using the SSR strongly support our main results from the baseline estimation.

## 5.4 Specification and Identification

As a final robustness analysis, we consider different specifications and identification schemes. First, we re-estimate the baseline VAR using the logarithm of industrial production and the logarithm of the CPI instead of the unemployment rate and the inflation rate. While we still use the baseline

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<sup>23</sup>The time series of the SSR is publicly available through Krippner’s homepage (<http://www.rbnz.govt.nz/research-and-publications/research-programme/research-staff-profiles/leo-krippner>)



identification scheme, we change the restrictions imposed on industrial production to capture a decline in economic activity.

Figure 9 presents the impulse response functions. We scale the shocks such that industrial production declines by 5 percent on impact, which corresponds to steady state deviations of the survey measures of a similar order of magnitude as in the baseline estimations. We see that our results remain largely unchanged when we use industrial production.

As a next step we use a slightly less restrictive identification scheme to explore the robustness of the results with respect to the identification assumptions. While we restrict the response of the FFR to an AS shock in the baseline, this restriction is not necessary to disentangle AS from AD and MP shocks. Figure 10 shows IRFs using the baseline identification scheme but without the restriction on the FFR in case of AS shocks. Since we impose fewer restrictions, the bands are wider, but overall the results are qualitatively similar to the baseline.

Finally, our results are robust to the inclusion of 12 lags of the endogenous variables in the VAR (see Figure A.4 in the Appendix).

## 6 Conclusion

How do people interpret macroeconomic shocks? Based on the SVAR analysis, we find that survey respondents interpret AD and AS shocks largely in line with the predictions of standard theory. AS shocks are viewed as shifts of the Phillips curve while AD shocks are interpreted as movements along the Phillips curve. In addition, expectations about future interest rates in the aftermath of AD and AS shocks are broadly in line with a Taylor rule. The interpretation of monetary policy shocks is less systematic, however, and not necessarily consistent with standard theory.

A large literature argues that central bank communication strongly influences the transmission of monetary policy (see e.g. Woodford, 2001; Blinder et al., 2008; Hoyerichts et al., 2009). However, most of this literature focuses almost exclusively on how central banks provide information, but takes it for granted that people interpret macroeconomic developments in a way consistent with theory. In this respect, our results are reassuring. In fact, our results indicate that survey respondents anticipate systematic monetary policy response vis-à-vis AD and AS shocks in line with the propagation mechanism in standard models. As it is argued in e.g. Bernanke (2013), this should enhance the effectiveness of monetary policy. However, one should keep in mind that the

macroeconomic shocks we consider play only a comparatively limited role in shaping the dynamics of macroeconomic expectations of the general public.

## References

- Arias, J. E., Rubio-Ramirez, J. F., and Waggoner, D. F. (2017). Inference Based on SVARs Identified with Sign and Zero Restrictions: Theory and Applications. *Mimeo*.
- Armantier, O., Bruine de Bruin, W., Topa, G., van der Klaauw, W., and Zafar, B. (2015). Inflation Expectations and Behavior: Do Survey Respondents act on their Beliefs? *International Economic Review*, 56(2):505–536.
- Bachmann, R., Berg, T. O., and Sims, E. R. (2015). Inflation Expectations and Readiness to Spend: Cross-Sectional Evidence. *American Economic Journal: Economic Policy*, 7(1):1–35.
- Barnes, M. L. and Olivei, G. P. (2017). Consumer Attitudes and Their Forecasting Power for Consumer Spending. *Journal of Money, Credit and Banking*, 49(5):1031–1058.
- Baumeister, C. and Hamilton, J. D. (2015). Sign Restrictions, Structural Vector Autoregressions, and Useful Prior Information. *Econometrica*, 83(5):1963–1999.
- Baumeister, C. and Hamilton, J. D. (2017). Inference in Structural Vector Autoregressions When the Identifying Assumptions are Not Fully Believed: Re-evaluating the Role of Monetary Policy in Economic Fluctuations. *Mimeo*.
- Bernanke, B. S. (2013). Communication and Monetary Policy: A speech at the National Economists Club Annual Dinner, Herbert Stein Memorial Lecture, Washington, D.C., November 19, 2013: Speech.
- Blinder, A. S., Ehrmann, M., Fratzscher, M., de Haan, J., and Jansen, D.-J. (2008). Central Bank Communication and Monetary Policy: A Survey of Theory and Evidence. *Journal of Economic Literature*, 46(4):910–945.
- Carroll, C. D. (2003). Macroeconomic Expectations of Households and Professional Forecasters. *The Quarterly Journal of Economics*, 118(1):269–298.

- Carroll, C. D. (2006). The Epidemiology of Macroeconomic Expectations. In Blume, L. E. and Durlauf, S. N., editors, *The economy as an evolving complex system, III: Current perspectives and future directions*, pages 5–30. Oxford University Press.
- Carvalho, C. and Nechio, F. (2014). Do people understand monetary policy? *Journal of Monetary Economics*, 66:108–123.
- Coibion, O. and Gorodnichenko, Y. (2012). What Can Survey Forecasts Tell Us about Information Rigidities? *Journal of Political Economy*, 120(1):116–159.
- Coibion, O. and Gorodnichenko, Y. (2015a). Information Rigidity and the Expectations Formation Process: A Simple Framework and New Facts. *American Economic Review*, 105(8):2644–2678.
- Coibion, O. and Gorodnichenko, Y. (2015b). Is the Phillips Curve Alive and Well after All? Inflation Expectations and the Missing Disinflation. *American Economic Journal: Macroeconomics*, 7(1):197–232.
- Coibion, O., Gorodnichenko, Y., and Kumar, S. (2015). How Do Firms Form Their Expectations? New Survey Evidence. *NBER Working Papers*, 21092.
- Dräger, L., Lamla, M. J., and Pfajfar, D. (2016). Are survey expectations theory-consistent? The role of central bank communication and news. *European Economic Review*, 85:84–111.
- Easaw, J., Golinelli, R., and Malgarini, M. (2013). What determines households inflation expectations? Theory and evidence from a household survey. *European Economic Review*, 61:1–13.
- Evans, G. W. and Honkapohja, S. (2001). *Learning and Expectations in Macroeconomics*. Princeton University Press.
- Fry, R. and Pagan, A. (2011). Sign Restrictions in Structural Vector Autoregressions: A Critical Review. *Journal of Economic Literature*, 49(4):938–960.
- Giacomini, R. and Kitagawa, T. (2015). Robust inference about partially identified SVARs. *Mimeo*.
- Hoerberichts, M., Tesfaselassie, M. F., and Eijffinger, S. (2009). Central bank communication and output stabilization. *Oxford Economic Papers*, 61(2):395–411.

- Krippner, L. (2015). *Zero Lower Bound Term Structure Modeling: A Practitioner's Guide*. Palgrave Macmillan.
- Langer, E. J. (1975). The illusion of control. *Journal of Personality and Social Psychology*, 32(2):311.
- Leduc, S. and Sill, K. (2013). Expectations and Economic Fluctuations: An Analysis Using Survey Data. *Review of Economics and Statistics*, 95(4):1352–1367.
- Maćkowiak, B. and Wiederholt, M. (2015). Business Cycle Dynamics under Rational Inattention. *Review of Economic Studies*, 82(4):1502–1532.
- Malmendier, U. and Nagel, S. (2016). Learning from Inflation Experiences. *The Quarterly Journal of Economics*, 131(1):53–87.
- Mankiw, N. G. and Reis, R. (2002). Sticky Information versus Sticky Prices: A Proposal to Replace the New Keynesian Phillips Curve. *The Quarterly Journal of Economics*, 117(4):1295–1328.
- Mankiw, N. G., Reis, R., and Wolfers, J. (2004). Disagreement about Inflation Expectations. In *NBER Macroeconomics Annual 2003, Volume 18*, pages 209–270. National Bureau of Economic Research.
- Milani, F. (2007). Expectations, learning and macroeconomic persistence. *Journal of Monetary Economics*, 54(7):2065–2082.
- Peersman, G. (2005). What caused the early millennium slowdown? Evidence based on vector autoregressions. *Journal of Applied Econometrics*, 20(2):185–207.
- Ramey, V. A. (2016). Macroeconomic Shocks and Their Propagation. In Taylor, J. B. and Uhlig, H., editors, *Handbook of Macroeconomics*, volume 2, pages 71–162. Elsevier.
- Rubio-Ramirez, J. F., Waggoner, D. F., and Zha, T. (2010). Structural Vector Autoregressions: Theory of Identification and Algorithms for Inference. *Review of Economic Studies*, 77(2):665–696.
- Sims, C. A. (2003). Implications of rational inattention. *Journal of Monetary Economics*, 50(3):665–690.

- Smets, F. and Wouters, R. (2005). Comparing Shocks and Frictions in US and Euro Area Business Cycles: A Bayesian DSGE Approach. *Journal of Applied Econometrics*, 20(2):161–183.
- Smets, F. and Wouters, R. (2007). Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach. *American Economic Review*, 97(3):586–606.
- Souleles, N. S. (2004). Expectations, Heterogeneous Forecast Errors, and Consumption: Micro Evidence from the Michigan Consumer Sentiment Surveys. *Journal of Money, Credit and Banking*, 36(1):39–72.
- Survey Research Center (2015). Survey Description (<https://data.sca.isr.umich.edu/fetchdoc.php?docid=24774>).
- Uhlig, H. (1994). What Macroeconomists Should Know about Unit Roots: A Bayesian Perspective. *Econometric Theory*, 10(3/4):645–671.
- Wong, B. (2015). Do Inflation Expectations Propagate the Inflationary Impact of Real Oil Price Shocks? Evidence from the Michigan Survey. *Journal of Money, Credit and Banking*, 47(8):1673–1689.
- Woodford, M. (2001). Monetary Policy in the Information Economy. *Jackson Hole Economic Policy Symposium: Proceedings*, pages 297–370.

Table 1: Restrictions on impulse response functions

	unempl. rate	inflation rate	FFR	unempl. expect.	inflation expect.	interest rate expect.	consum. plans
AD shock	↑	↓	↓	0	0	0	0
AS shock	↑	↑	↑	0	0	0	0
MP shock	↑	↓	↑	0	0	0	0

Notes: Sign restrictions are imposed on impact plus three months and correspond to contractionary shocks.

Table 2: Forecast error variance decomposition: consumer data (in percent)

	$h$	AD shock	AS shock	MP shock
Panel A: macroeconomic variables				
unempl. rate	1	46.12 (24.26, 67.51)	30.06 (12.98, 53.98)	8.94 (3.26, 24.40)
	6	31.39 (17.30, 47.67)	24.43 (11.60, 40.25)	3.73 (1.16, 12.72)
	12	20.32 (10.04, 32.79)	22.97 (11.34, 35.86)	2.37 (0.85, 8.07)
	24	12.33 (5.58, 21.97)	25.86 (14.01, 38.12)	2.40 (0.74, 6.58)
inflation rate	1	2.39 (0.44, 9.34)	47.48 (24.69, 67.03)	25.89 (8.44, 49.37)
	6	4.50 (1.44, 11.53)	37.37 (19.42, 53.36)	16.68 (4.78, 34.98)
	12	5.37 (1.93, 12.06)	31.81 (16.66, 47.06)	13.06 (3.65, 29.04)
	24	5.81 (2.13, 12.26)	27.83 (14.85, 42.07)	11.28 (3.62, 25.53)
FFR	1	42.61 (23.66, 56.70)	2.83 (0.57, 10.27)	20.41 (7.41, 39.74)
	6	24.25 (14.54, 33.45)	1.84 (0.34, 6.41)	7.64 (1.90, 16.74)
	12	15.57 (9.20, 23.52)	1.24 (0.32, 4.43)	4.83 (1.15, 11.79)
	24	10.35 (5.66, 17.76)	1.48 (0.41, 4.38)	4.97 (1.12, 11.80)
Panel B: expectation variables				
unempl. expect.	1	0.41 (0.04, 1.45)	1.46 (0.51, 2.85)	0.29 (0.02, 1.07)
	6	0.60 (0.15, 1.68)	3.24 (1.22, 6.23)	0.70 (0.23, 1.84)
	12	1.08 (0.40, 2.23)	4.16 (1.62, 8.18)	1.00 (0.33, 2.96)
inflation expect.	1	1.26 (0.38, 2.71)	1.97 (0.58, 4.02)	0.75 (0.09, 2.26)
	6	2.91 (0.99, 5.98)	9.94 (5.09, 15.70)	1.83 (0.35, 6.27)
	12	3.10 (1.10, 6.36)	9.87 (5.11, 16.33)	1.97 (0.58, 5.90)
int. rate expect.	1	1.08 (0.41, 2.18)	0.19 (0.02, 0.80)	0.22 (0.02, 0.87)
	6	1.76 (0.59, 3.79)	0.64 (0.19, 1.66)	0.76 (0.18, 2.20)
	12	1.99 (0.94, 3.79)	1.57 (0.55, 3.53)	1.09 (0.29, 2.94)
Panel C: consumption plans				
	1	0.52 (0.07, 1.40)	0.80 (0.16, 1.83)	0.11 (0.01, 0.53)
	6	0.86 (0.20, 2.52)	5.90 (2.92, 9.77)	0.98 (0.23, 2.96)
	12	0.95 (0.28, 2.73)	8.32 (4.13, 13.99)	1.47 (0.29, 4.78)
	24	1.34 (0.44, 3.17)	9.96 (4.67, 17.24)	1.79 (0.42, 5.90)

Notes: We indicate the median of the contributions in the FEVDs computed for each set-identified model for the respective horizon  $h$  in months, together with the 16th and the 84th percentile of the contributions in the FEVDs.

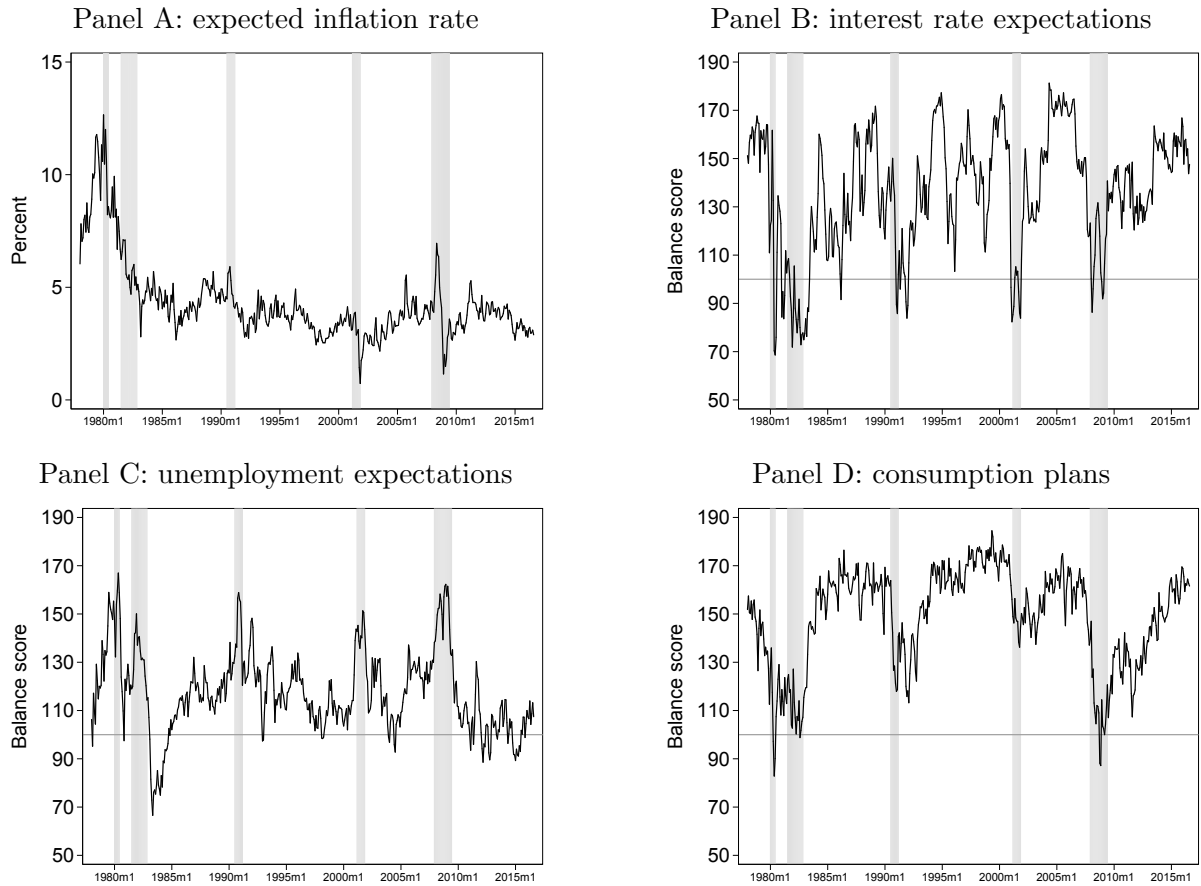
Table 3: Forecast error variance decomposition: SPF

	$h$	AD shock	AS shock	MP shock
Panel A: macroeconomic variables				
unempl. rate	1	55.58 (44.15, 66.88)	9.09 (3.14, 16.47)	2.51 (0.75, 7.18)
	2	52.85 (41.17, 64.66)	9.53 (3.55, 16.41)	1.62 (0.57, 4.69)
	4	46.87 (34.07, 59.42)	14.04 (5.93, 23.75)	1.87 (0.64, 4.01)
	8	36.28 (23.91, 50.75)	23.44 (10.54, 39.07)	2.34 (0.76, 7.21)
inflation rate	1	4.13 (1.15, 10.35)	67.70 (48.61, 80.01)	12.13 (2.55, 30.66)
	2	5.24 (1.54, 12.32)	61.28 (43.05, 74.14)	10.44 (2.21, 26.99)
	4	7.18 (2.56, 15.57)	49.32 (33.36, 63.59)	8.69 (2.12, 21.81)
	8	8.25 (3.46, 17.87)	39.42 (25.08, 53.18)	7.44 (2.08, 18.30)
FFR	1	23.29 (17.40, 30.13)	1.34 (0.38, 3.22)	3.07 (1.45, 5.31)
	2	23.44 (16.99, 31.63)	0.93 (0.35, 2.11)	1.75 (0.82, 3.21)
	4	23.60 (15.30, 33.25)	1.34 (0.49, 3.46)	1.19 (0.56, 2.76)
	8	21.39 (12.62, 32.06)	3.74 (0.88, 11.52)	1.65 (0.57, 4.93)
Panel B: expectation variables				
unempl. expect.	1	22.72 (16.15, 30.71)	4.59 (1.38, 9.16)	1.82 (0.36, 4.93)
	2	34.37 (24.35, 44.45)	7.39 (2.83, 13.38)	1.49 (0.35, 4.52)
	4	38.31 (26.58, 50.26)	11.51 (4.82, 19.60)	1.58 (0.62, 3.70)
inflation expect.	1	0.58 (0.06, 2.39)	4.39 (1.71, 8.56)	1.87 (0.37, 4.72)
	2	3.40 (1.09, 7.44)	4.92 (1.85, 9.10)	1.65 (0.55, 3.99)
	4	4.64 (1.41, 10.31)	4.48 (1.69, 9.16)	1.79 (0.74, 3.71)
int. rate expect.	1	7.25 (4.36, 11.32)	0.75 (0.12, 2.01)	0.26 (0.02, 0.96)
	2	14.73 (9.33, 21.33)	0.66 (0.19, 1.96)	0.36 (0.07, 1.14)
	4	18.48 (11.08, 28.00)	1.01 (0.34, 2.96)	0.54 (0.18, 1.49)

Notes: We indicate the median of the contributions in the FEVDs computed for each set-identified model for the respective horizon  $h$  in quarters, together with the 16th and the 84th percentile of the contributions in the FEVDs.

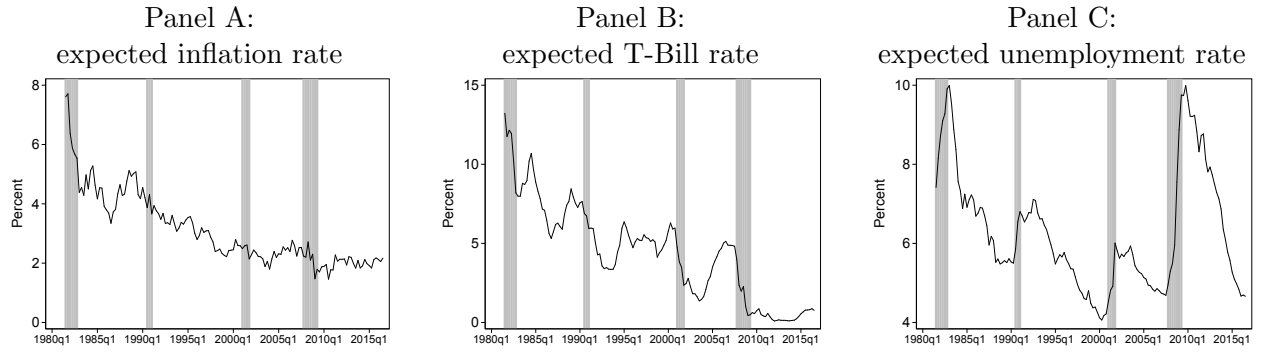


Figure 1: Time series of the aggregated survey measures from the Michigan Survey



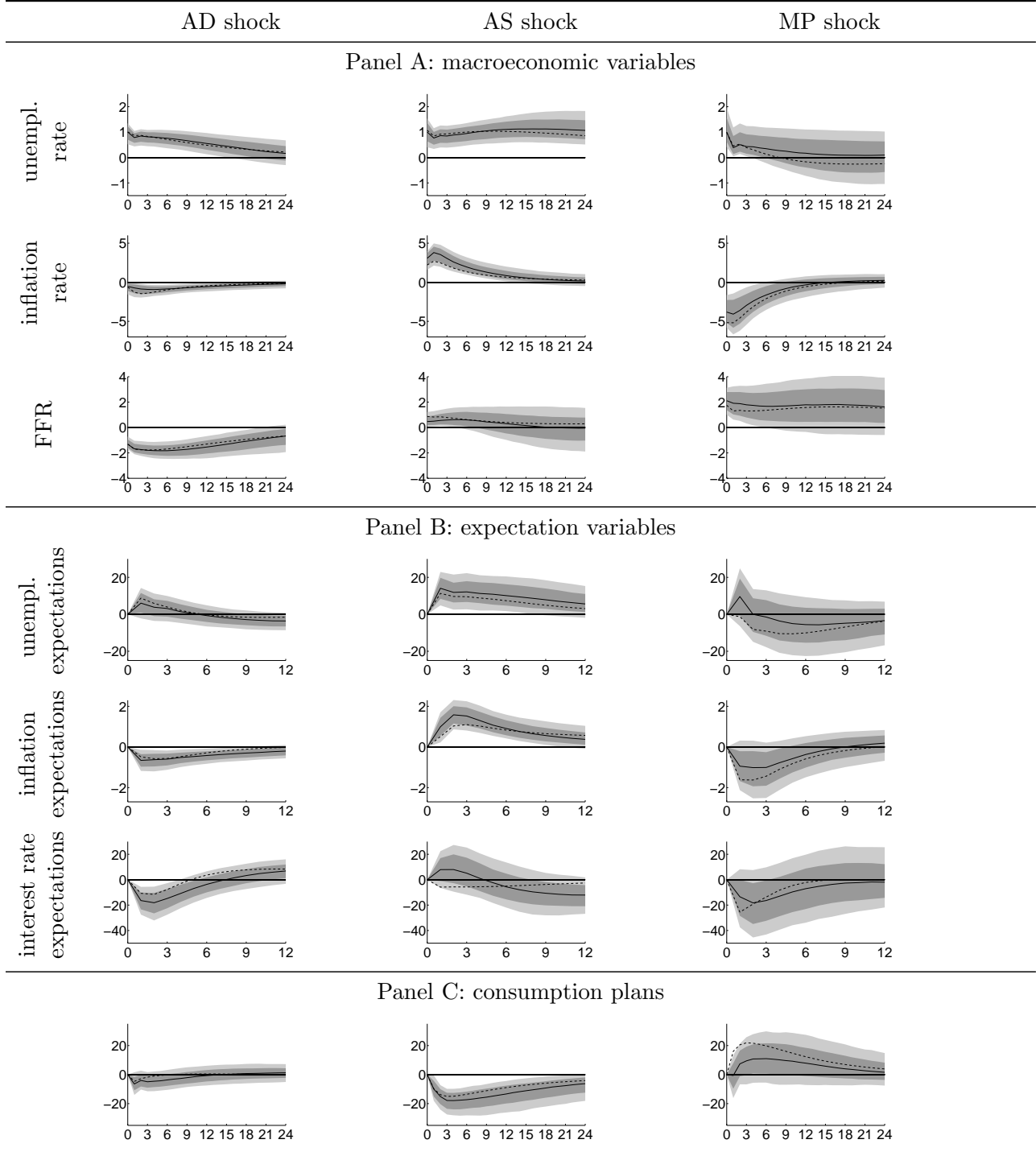
Notes: Shaded areas indicate economic downturns as classified by the NBER Business Cycle Dating Committee.

Figure 2: Time series of average point estimates from SPF respondents



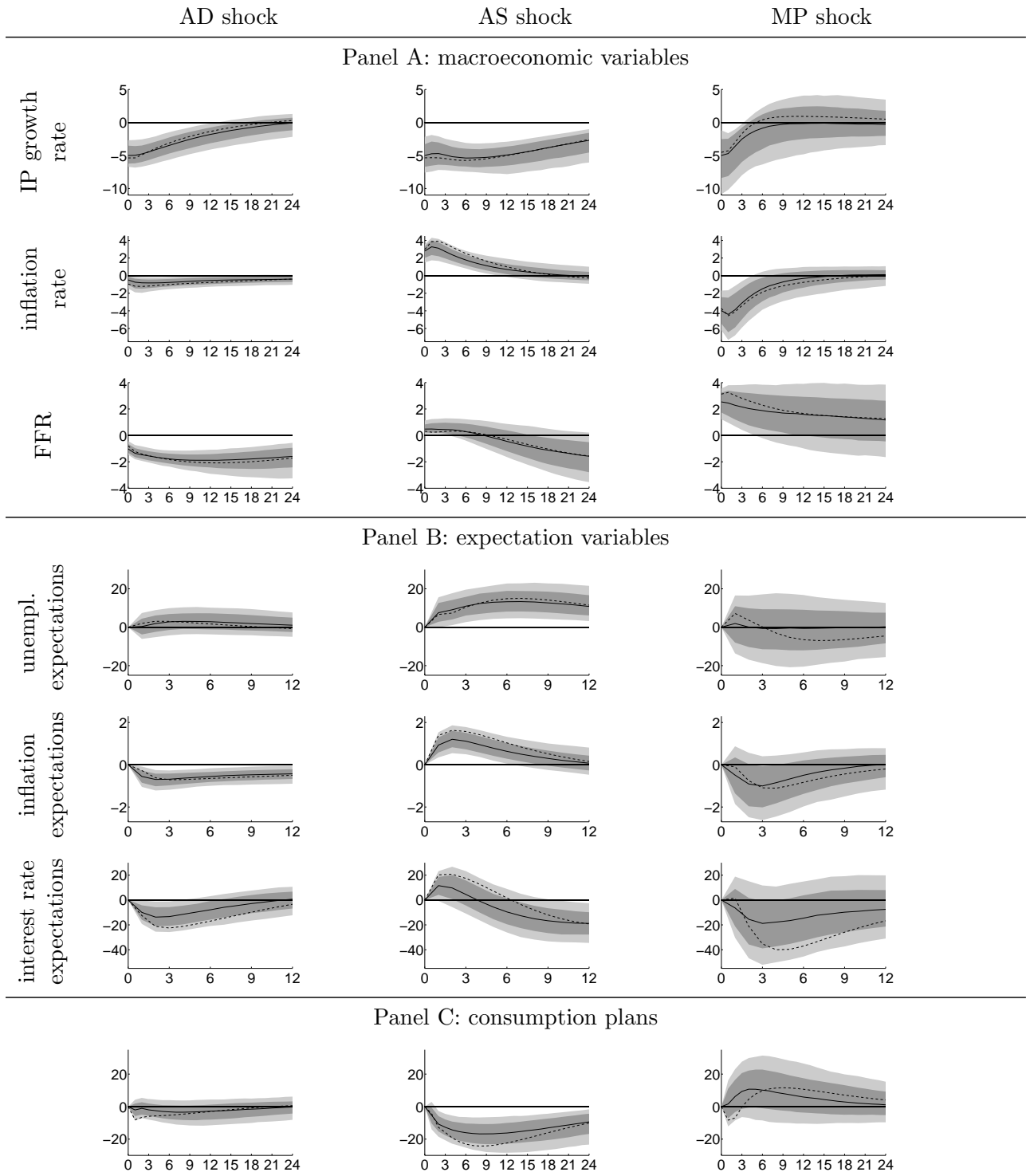
Notes: Shaded areas indicate economic downturns as classified by the NBER Business Cycle Dating Committee.

Figure 3: Impulse responses for the baseline estimation with consumer data



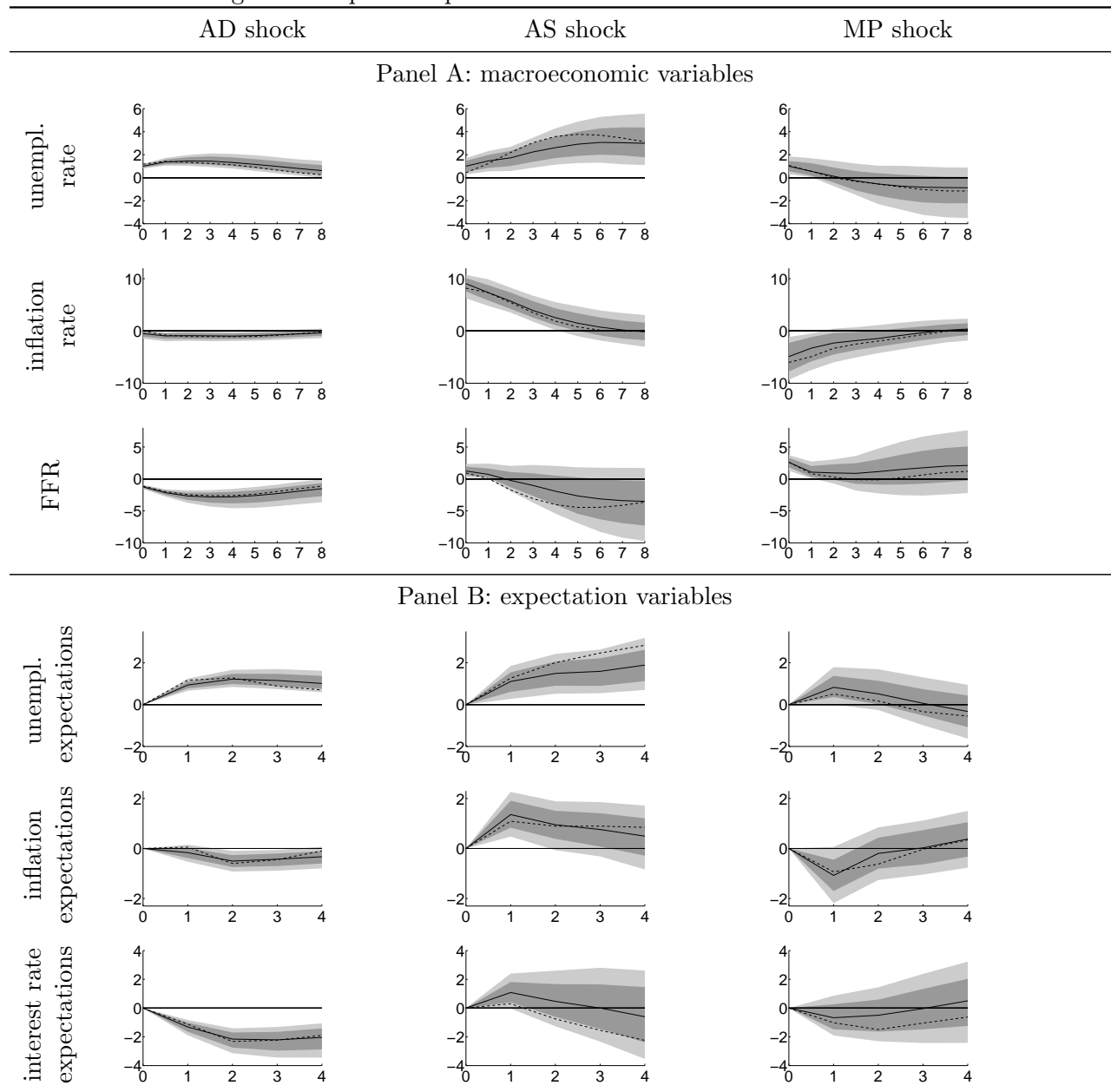
Notes: Inflation expectations are average point estimates of the future inflation rate while the other survey measures are summarized using balance scores. Solid lines represent the pointwise median responses, whereas the dashed lines show the responses of the closest-to-median model selected as proposed in Fry and Pagan (2011). The bands represent the distribution of set-identified models in the impulse response function representation (5th and 16th percentiles as well as the 86th and 95th percentiles).

Figure 4: Impulse responses for the estimation with annual growth rates of IP



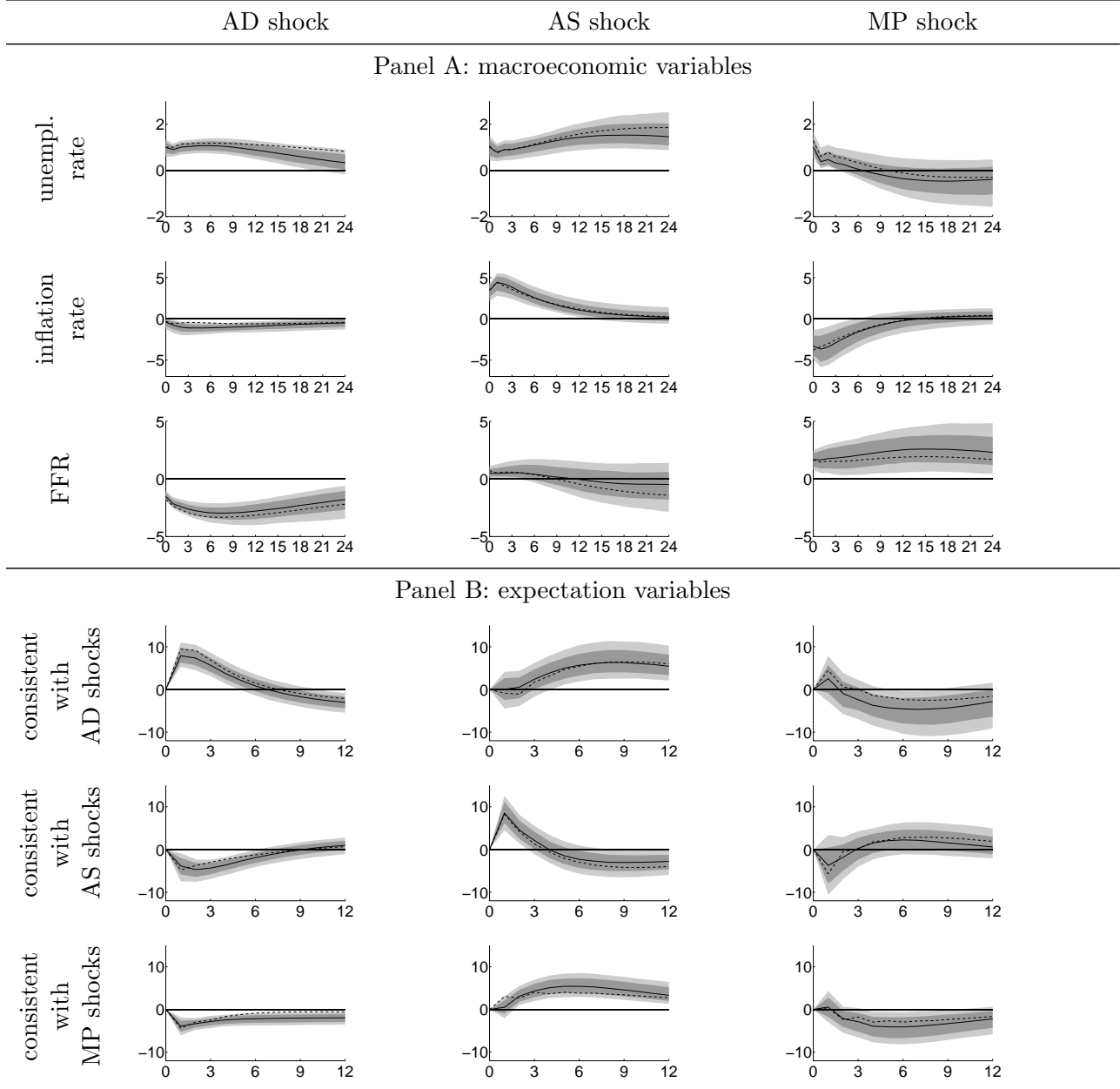
Notes: Inflation expectations are average point estimates of the future inflation rate while the other survey measures are summarized using balance scores. Solid lines represent the pointwise median responses, whereas the dashed lines show the responses of the closest-to-median model selected as proposed in Fry and Pagan (2011). The bands represent the distribution of set-identified models in the impulse response function representation (5th and 16th percentiles as well as the 86th and 95th percentiles).

Figure 5: Impulse responses for the estimation with SPF data



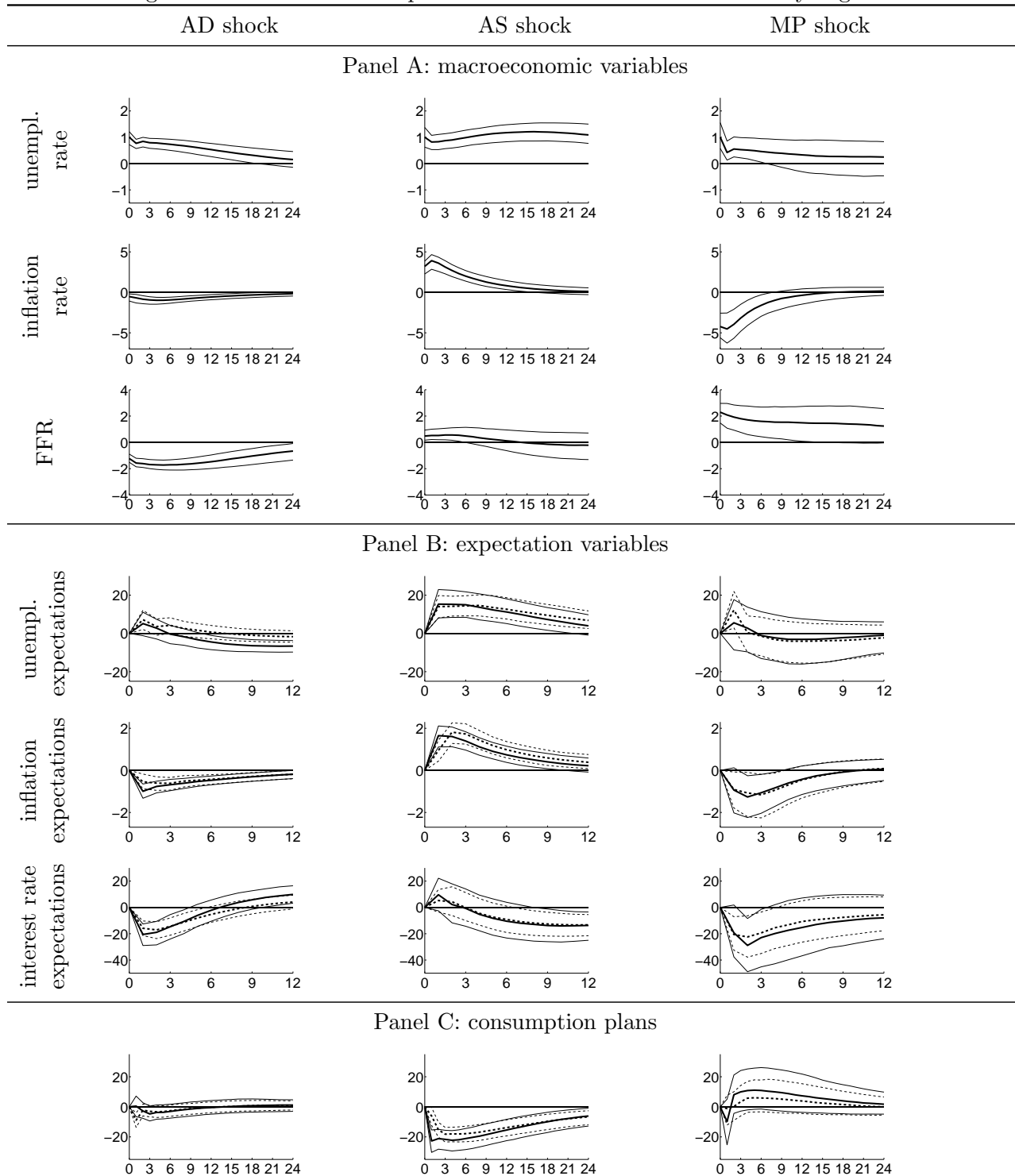
Notes: The expectation measures are average point estimates of the unemployment rate, the inflation rate and the three-month Treasury bill rate. Solid lines represent the pointwise median responses, whereas the dashed lines show the responses of the closest-to-median model selected as proposed in Fry and Pagan (2011). The bands represent the distribution of set-identified models in the impulse response function representation (5th and 16th percentiles as well as the 86th and 95th percentiles).

Figure 6: Theory-consistency on the individual level



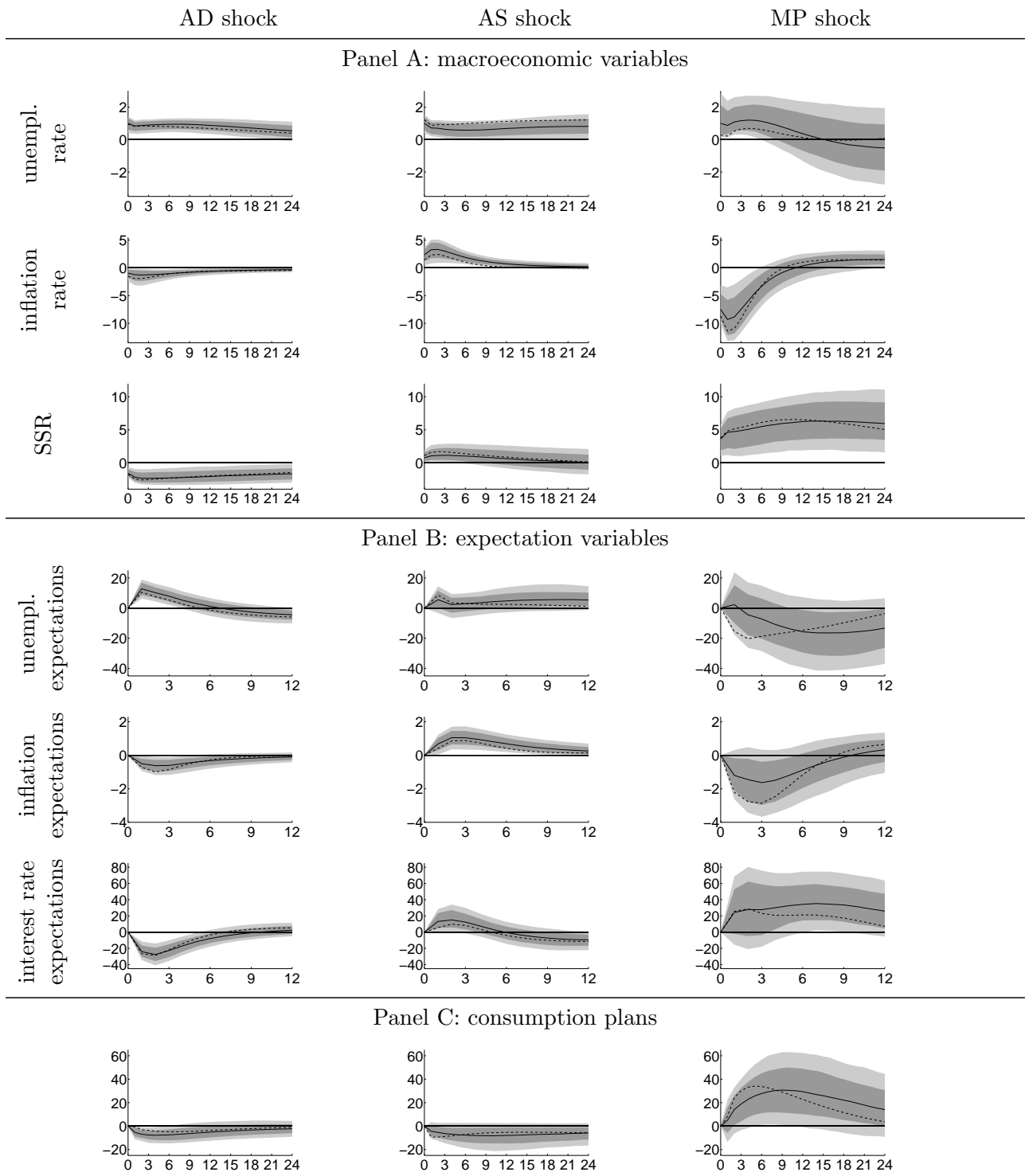
Notes: Expectations consistent with the macroeconomic shocks are summarized by balance scores. Solid lines represent the pointwise median responses, whereas the dashed lines show the responses of the closest-to-median model selected as proposed in Fry and Pagan (2011). The bands represent the distribution of set-identified models in the impulse response function representation (5th and 16th percentiles as well as the 86th and 95th percentiles).

Figure 7: Estimation for respondents with and without a university degree



Notes: Inflation expectations are average point estimates of the future inflation rate while the other survey measures are summarized using balance scores. The thick solid lines in Panel B represent the pointwise median responses of respondents with a university degree, the thick dashed lines refer to respondents without a university degree. The bands represent the distribution of set-identified models in the impulse response function representation (5th and 16th percentiles as well as the 86th and 95th percentiles).

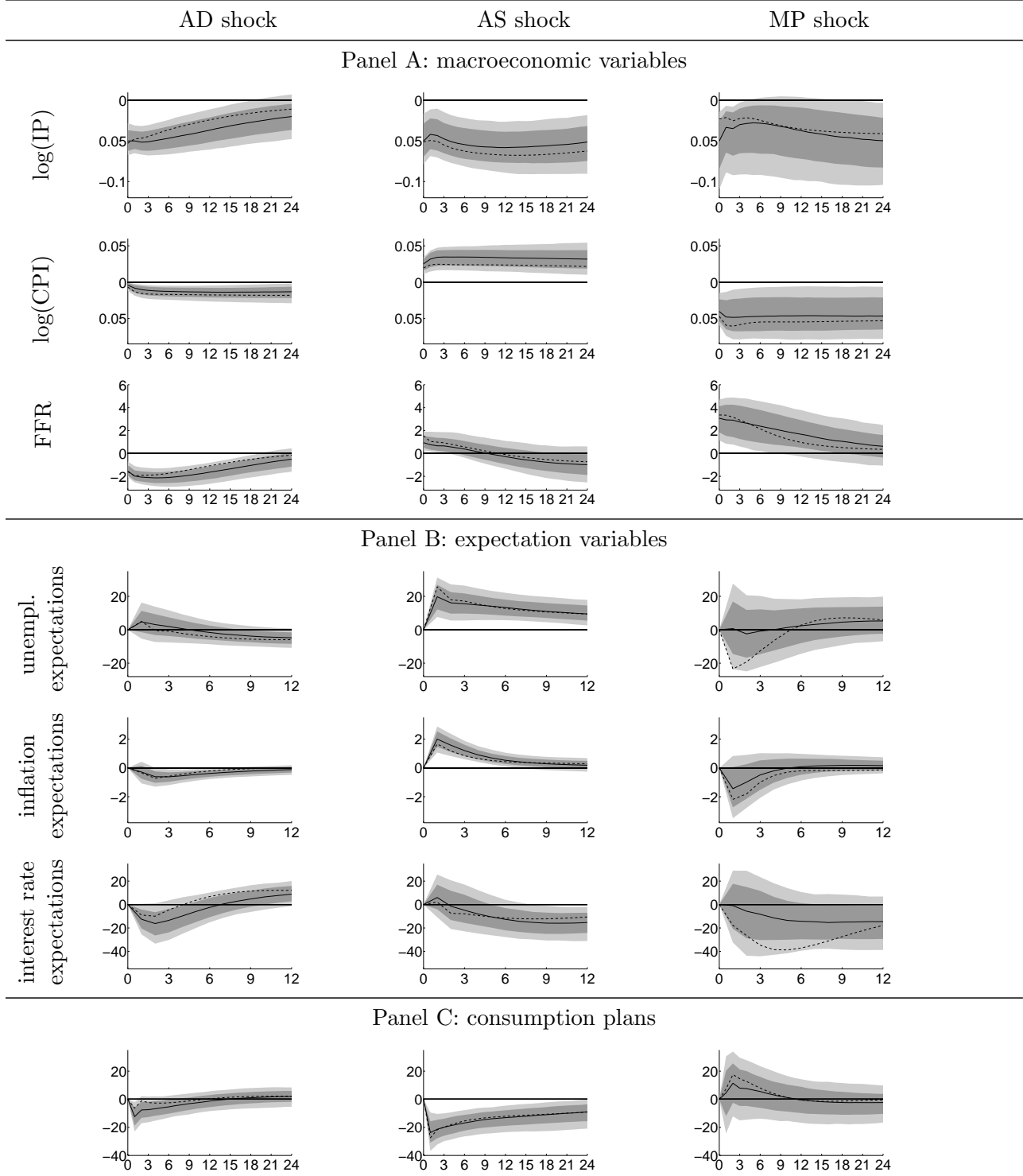
Figure 8: Estimation including data from the Great Recession using the SSR



Notes: Inflation expectations are average point estimates of the future inflation rate while the other survey measures are summarized using balance scores. Solid lines represent the pointwise median responses, whereas the dashed lines show the responses of the closest-to-median model selected as proposed in Fry and Pagan (2011). The bands represent the distribution of set-identified models in the impulse response function representation (5th and 16th percentiles as well as the 86th and 95th percentiles).

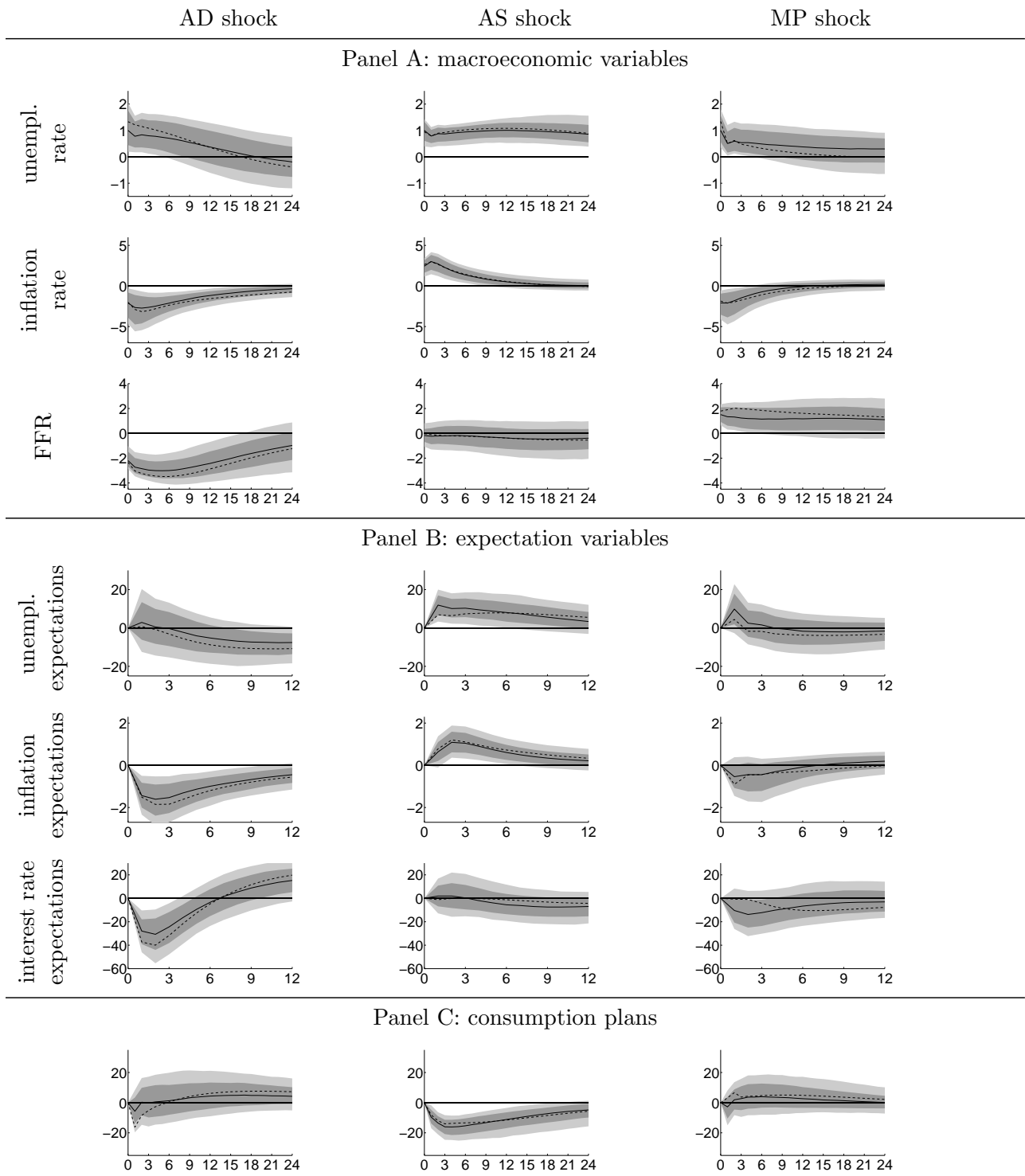


Figure 9: Estimation with IP and CPI levels



Notes: Inflation expectations are average point estimates of the future inflation rate while the other survey measures are summarized using balance scores. Solid lines represent the pointwise median responses, whereas the dashed lines show the responses of the closest-to-median model selected as proposed in Fry and Pagan (2011). The bands represent the distribution of set-identified models in the impulse response function representation (5th and 16th percentiles as well as the 86th and 95th percentiles).

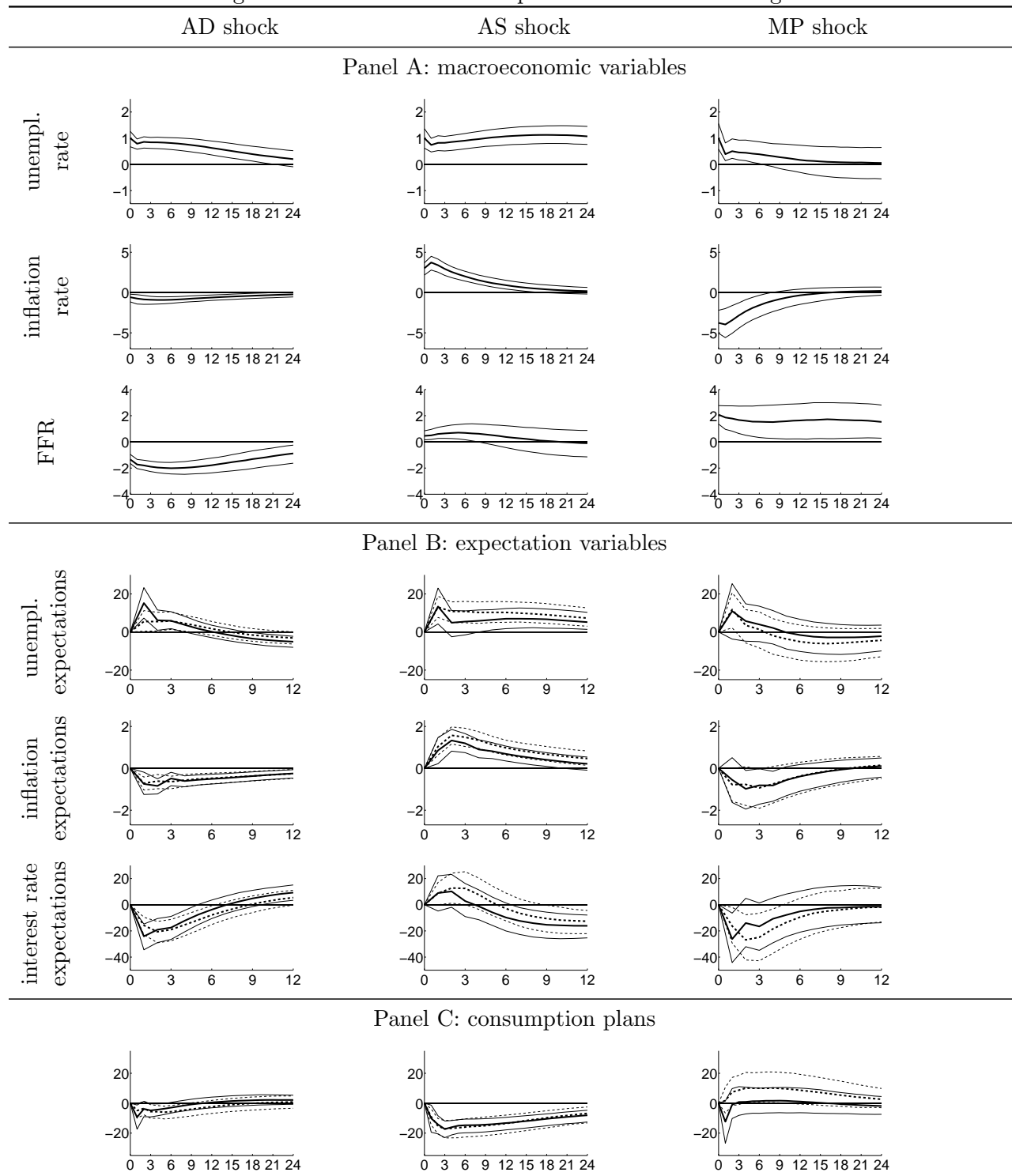
Figure 10: Identification without restriction on the FFR to identify AS shocks



Notes: Inflation expectations are average point estimates of the future inflation rate while the other survey measures are summarized using balance scores. Solid lines represent the pointwise median responses, whereas the dashed lines show the responses of the closest-to-median model selected as proposed in Fry and Pagan (2011). The bands represent the distribution of set-identified models in the impulse response function representation (5th and 16th percentiles as well as the 86th and 95th percentiles).

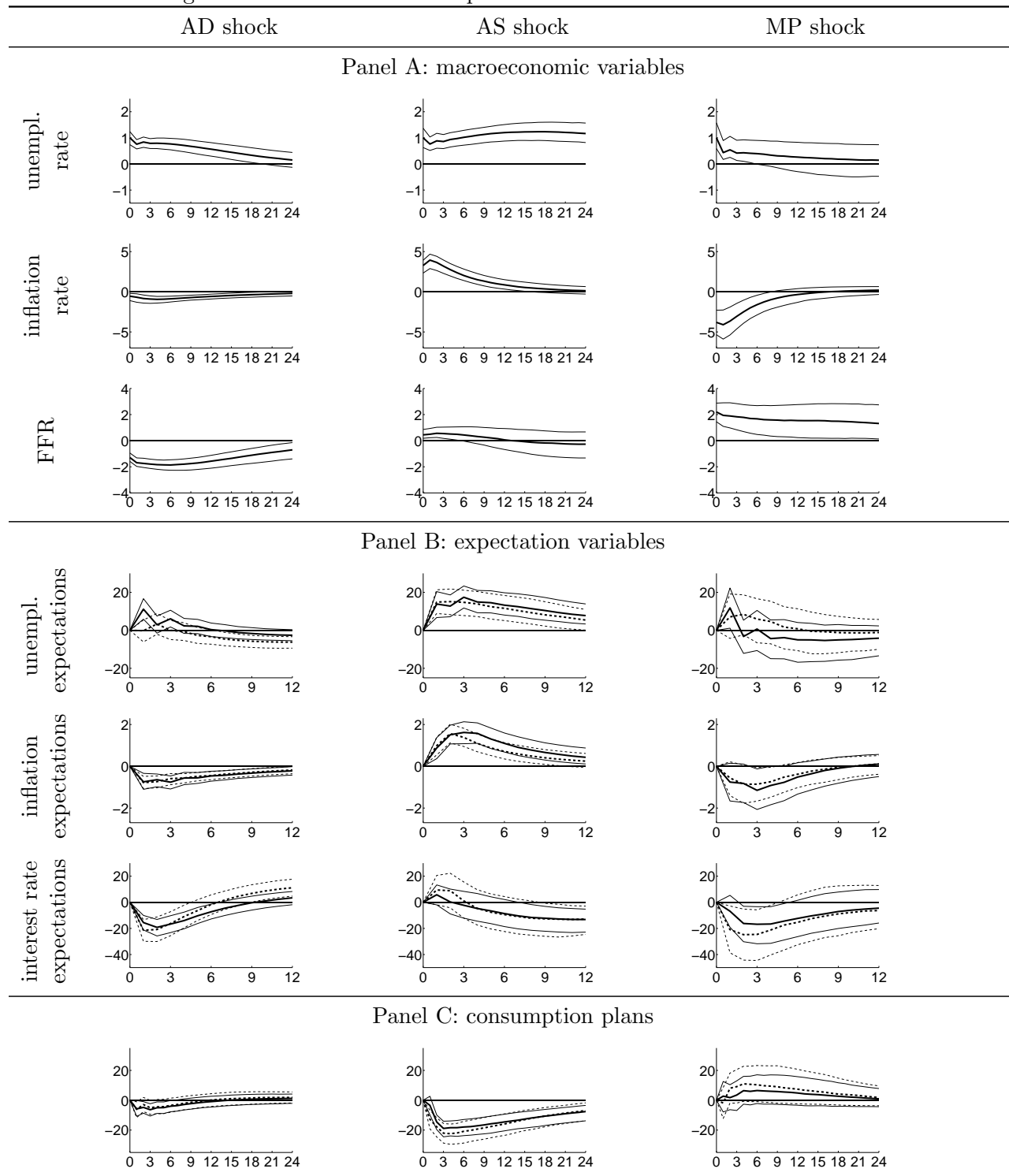
# Appendix

Figure A.1: Estimation for respondents with different age



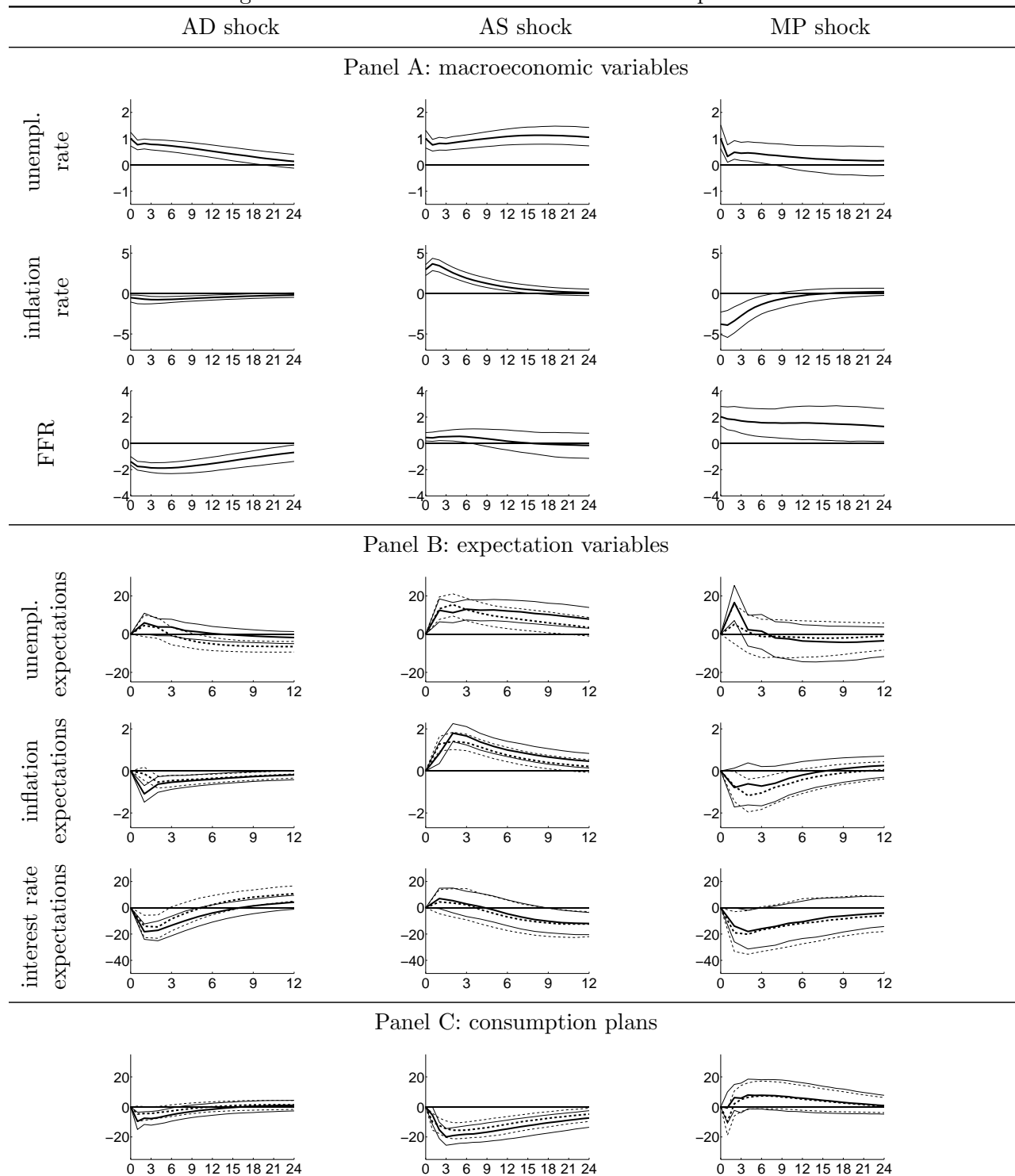
Notes: Inflation expectations are average point estimates of the future inflation rate while the other survey measures are summarized using balance scores. The thick solid lines in Panel B represent the pointwise median responses for older respondents (age  $\geq 65$ ), the thick dashed lines refer to responses of younger respondents. The bands represent the distribution of set-identified models in the impulse response function representation (5th and 16th percentiles as well as the 86th and 95th percentiles).

Figure A.2: Estimation for respondents with different income levels



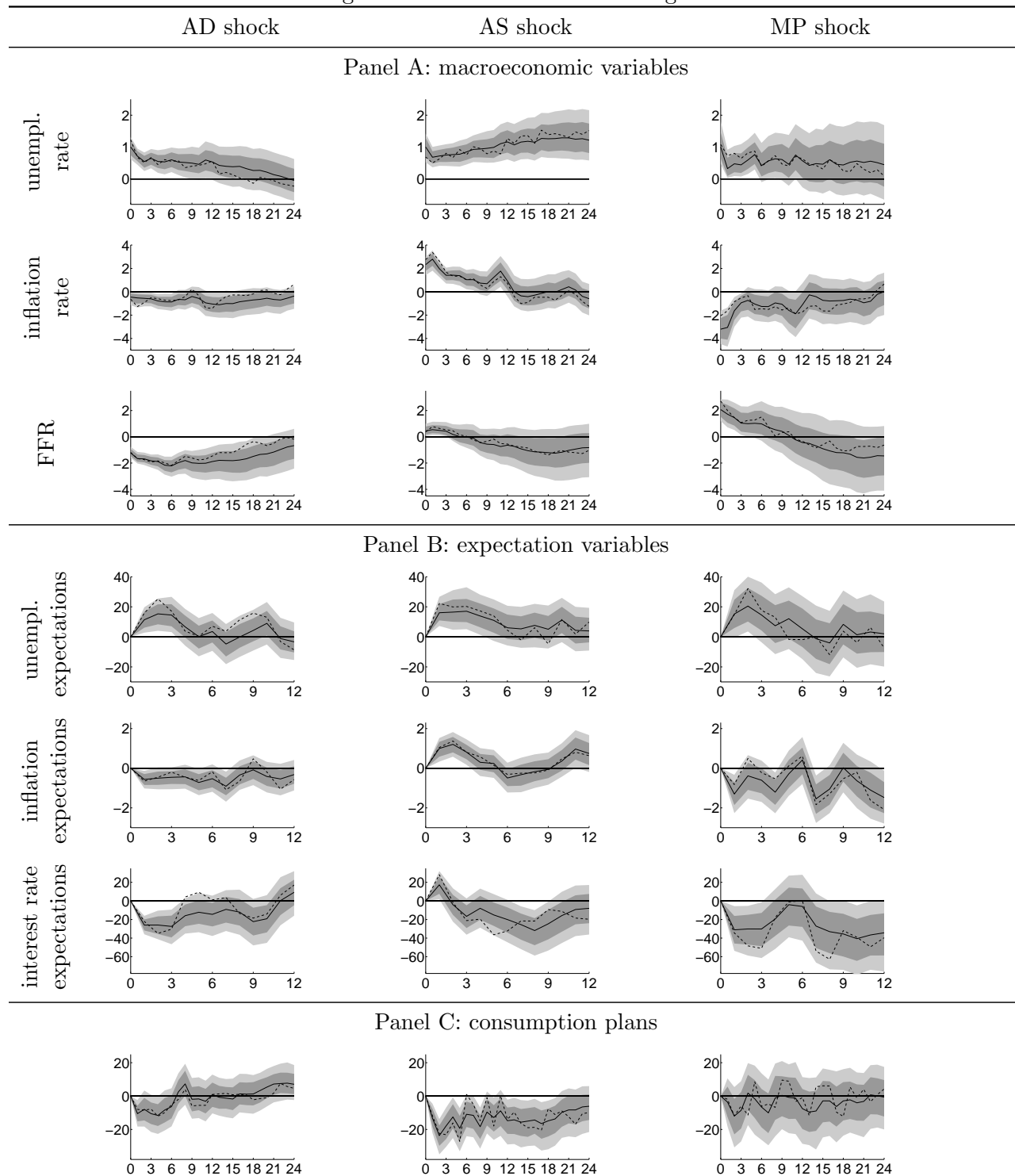
Notes: Inflation expectations are average point estimates of the future inflation rate while the other survey measures are summarized using balance scores. The thick solid lines in Panel B represent the pointwise median responses of respondents with higher income ( $\text{income} \leq \text{median}(\text{income})$ ), the thick dashed lines refer to respondents with lower income. The bands represent the distribution of set-identified models in the impulse response function representation (5th and 16th percentiles as well as the 86th and 95th percentiles).

Figure A.3: Estimation for female and male respondents



Notes: Inflation expectations are average point estimates of the future inflation rate while the other survey measures are summarized using balance scores. The thick solid lines in Panel B represent the pointwise median responses of female respondents, the thick dashed lines refer to male respondents. The bands represent the distribution of set-identified models in the impulse response function representation (5th and 16th percentiles as well as the 86th and 95th percentiles).

Figure A.4: Estimation with 12 lags



Notes: Inflation expectations are average point estimates of the future inflation rate while the other survey measures are summarized using balance scores. Solid lines represent the pointwise median responses, whereas the dashed lines show the responses of the closest-to-median model selected as proposed in Fry and Pagan (2011). The bands represent the distribution of set-identified models in the impulse response function representation (5th and 16th percentiles as well as the 86th and 95th percentiles).

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Martin Geiger, Johann Scharler

How do people interpret macroeconomic shocks? Evidence from U.S. survey data

**Abstract**

We study the revision of survey expectations in response to macroeconomic shocks, which we identify in vector autoregressive models with sign restrictions. We find that survey respondents distinguish between movements along the Phillips curve and shifts of the Phillips curve, depending on the type of the shock that hits the economy. In addition, expectations about future interest rate dynamics are revised broadly in line with a Taylor rule. While the macroeconomic shocks account only for a small share of the forecast error variance of survey measures elicited from consumers, they are more relevant for the expectations of professional forecasters. This result is consistent with models of rational inattention.

ISSN 1993-4378 (Print)

ISSN 1993-6885 (Online)