How do Macroeconomic Shocks affect Expectations? Lessons from Survey Data

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Abstract

We study the revision of macroeconomic expectations due to aggregate demand, aggregate supply and monetary policy shocks. Using zero and sign restrictions, the macroeconomic shocks are identified in a vector autoregressive model in which we include survey data that measure macroeconomic expectations. We find that, in general, people tend to revise expectations in a way that is consistent with standard theory. In particular, people appear to differentiate among the three types of shocks and tend to revise expectations according to the characteristics of the shock. Nevertheless, the accuracy of responses varies with respect to which shock we consider. People process demand shocks most accurately meaning that they revise expectations about economic activity, inflation and the interest rate in a way consistent with standard theory. For supply shocks we find that people at least revise expectations about economic activity and inflation in a theory consistent manner. In the event of monetary policy shocks, people tend to be relatively uncertain about how to process these shocks.

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

JEL codes: E00, E32, D84

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1 Introduction

Macroeconomic models assign a key role to expectations as an integral element of the propagation mechanism for shocks. To the extent that expectations about future developments determine agents' decisions, the adjustment of the economy in response to a shock depends on how agents perceive the impact of the shock.[1] Nevertheless, relatively little is known empirically about how peoples' expectations are shaped by macroeconomic shocks. In this paper, we provide an attempt to fill this gap and explore how macroeconomic expectations respond to identified, structural shocks. In particular, we evaluate whether people revise expectations in response to shocks in a way consistent with theory which would be a premise giving rise to the importance of expectations in the propagation of shocks.

We estimate a vector autoregressive (VAR) model which comprises of measures for the price level, the policy rate, economic activity and expectations over these variables. The measures of macroeconomic expectations are obtained from the University of Michigan's Surveys of Consumers, which we refer to as Michigan survey. To identify aggregate demand (AD) shocks, aggregate supply (AS) shocks and monetary policy (MP) shocks, we impose combinations of zero and sign restrictions derived from the literature. Using this framework, we primarily focus on the responses of expectations to identified shocks and evaluate whether revisions of expectations are consistent with the propagation mechanisms incorporated in standard DSGE models. In other words, we study whether people perceive the implications of shocks in a way that matches the theoretical assumptions.

We consider AD, AS and MP shocks because of their macroeconomic relevance and because they are relatively straight forward to identify using assumptions which are well established in the literature and consistent with a large number of models. Structurally, however, AD and AS shocks may be consistent with more specific shocks such as an uncertainty shock or a time preference shocks in case of an AD shock, or a mark-up shock and an oil supply shock in case of an AS shock (Blanchard and Quah, 1989; Smets and Wouters, 2007; Leduc and Liu, 2015).

We find that people assess the macroeconomic effects of the exogenous shocks, in general, accurately, meaning that they tend to revise expectations in a way that is consistent with the propagation mechanism in standard DSGE models. This is particularly true for the responses to AD shocks. In the aftermath of an adverse AD shock, we find that people expect unemployment to increase whereas they expect inflation and the interest rate to decrease over a one year

[1] The modeling of expectations are subject to an ongoing discussion (see, among others, Carroll, 2003; Milani, 2007).

horizon. This is not only consistent with the dynamics of the macroeconomic variables due to the shock, but also with the propagation of AD shocks in standard DSGE models. Moreover, the revision of the expectation variables is consistent with Taylor rule and Phillips curve type relationships, which are generally found to be prevalent in expectations data (Carvalho and Nechio, 2014; **?**). For adverse AS shocks, we also find that people revise unemployment and inflation expectations in a way which is consistent with the theoretical propagation mechanism. In case of AS shocks this means that people expect higher unemployment and higher inflation to materialize in response to the shock. Concerning expected interest rates after an AS shock, our results are somewhat less cut. Theoretically, interest rates should increase. In contrast to that we do not find that people systematically expect a monetary tightening due to contractionary AS shocks. Nevertheless, we do not conclude that the interest rate expectations are necessarily inconsistent with the characteristics of an AS shock. Since the effects of the AS shock onto the policy rate are empirically only temporary and become insignificant within the forecasting horizon in the expectations data, the responses of the interest rate expectation may instead well be consistent with these empirical patterns. Either way, the insignificant response of the interest rate expectations provides some evidence that interest rate expectations are not likely to be a primary channel for the propagation of AS shocks. In contrast to that, the rise in inflation expectations due to the AS shock promotes the role of inflation expectations in the propagation of an AS shock.

Comparing responses to AS with responses to AD shocks, it is interesting that people correctly distinguish among adverse AD and adverse AS shocks. While they expect unemployment to decrease in both cases, they register the opposing effects on inflation. In turn this implies that people appear to realize that the Phillips curve type relationship among economic activity and inflation is dominated in the aftermath of AS shocks. This is in contrast to the findings in **?** who argue that people appear to have this relationship in mind even during times of predominant AS shocks.

Concerning MP shocks it is quite striking that people appear to have relatively more problems to process them. The generally wide error bands of the expectation responses reflect a higher degree of uncertainty and do not suggest that people revise expectations in a particularly systematic way. Nevertheless, the responses tend to exhibit plausible signs. On average, people revise unemployment expectation upwards and inflation expectation downwards which is what we would expect from theory. Quite surprisingly and in contrast to theory, people do not expect higher interest rates but this might be related to the empirically short-lived steady

state deviation of the policy rate.

The paper is related to several strands of the literature. It is most closely related to Carvalho and Nechio (2014) and **?** who use survey data to study whether expectations data, in general, exhibit relationships which are consistent with macroeconomic theory. Both of these studies find that survey answers are largely consistent with the Taylor rule indicating that people understand the trade-offs faced by the Federal Reserve. **?** also study whether households correctly distinguish among real and nominal values (i.e. a Fisher equation type relationship), and, by studying expectations about inflation and unemployment, whether people form expectations consistent with a Phillips curve. They also conclude that central bank communication has improved the understanding of monetary policy. In contrast to these two papers, our focus lies on how peoples' expectations respond to identified, structural shocks which allow us to study causal relationships. While the Taylor rule and the Phillips curve might generally be reflected in macroeconomic expectations, it is not clear whether these relationships are also dominant in shaping expectations in response to macroeconomic shocks. E.g. a supply shock should push unemployment and inflation into the same direction which is contrast to a Phillips curve type relation. The SVAR approach allows us to study households structural perception of the economy more explicitly because we assess responses to exogenous and unanticipated shocks.

Moreover, the paper fits into a growing literature which studies expectations in VAR models. Wong (2015) and Leduc et al. (2007) study responses of inflation expectations vis-à-vis more specific macroeconomic shocks (e.g. oil price, fiscal and monetary policy shocks). Leduc and Sill (2013) study the effects of expectations shocks onto macroeconomic variables.

The remainder of this paper is structured as follows: Section 2 introduces the survey questions from the Michigan survey we use. In Section 3 we discuss the estimation technique and the identification strategy. In Section 4 we present the results and Section 5 presents some additional analysis discussing further measures of economic activity and other expectation measures. Section 6 concludes the paper.

2 Survey Data

We use survey data from the University of Michigan's Surveys of Consumers to measure the expectations on output, prices and interest rates. Each months, a minimum of 500 telephone interviews is conducted by the Survey Research Center at the University of Michigan. For the interviews, households are selected such that the sample is intended to be representative for the

U.S. population (Alaska and Hawaii are excluded from the surveys). Survey questions cover three areas: demographics, how consumers assess the prospects for their own financial situation, and how they view prospects for the economy in general. Concerning the latter, consumers are asked to evaluate short term and longer term developments. Since we are interested in the relation among expectations and business cycle fluctuations, we focus on economic expectations about short term developments. Specifically, we focus on survey questions that give us an indication on how consumers view the prospects of economic activity, inflation and the interest rate.

The answers in the survey are predominantly qualitative. Only for income and price developments respondents are additionally asked to provide point estimates, while this is e.g. not the case for unemployment and interest rates. Hence, for the sake of comparability, we only use qualitative survey answers.

In our analysis, we use the following question to measure interest rate expectations:
'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?'

Obviously, 'the interest rate for borrowing money' does not refer to a specific rate and respondents may not specifically have the monetary policy rate in mind. Nevertheless, following Carvalho and Nechio (2014) and **?** we use it as a proxy and assume the transmission mechanism of monetary policy performs sufficiently well such that respondents would give the same answer if they were asked to view the prospect of the policy rate.

For inflation expectations we use:
'During the next 12 months, do you think that prices in general will go up, or go down, or stay where they are now?'

Notably, for this question there are four instead of three possible answers: 'Go up', 'Go up (at same rate)', 'Same', 'Go down'. Since we assume a positive inflation rate in the steady state and we are interested in steady state deviations of expectations, we code 'Go up' as an increase in inflation expectations, 'Go up (at same rate)' as constant inflation expectation and both, 'Same' and 'Go down' as an expected decrease of the inflation rate.[2]

What survey questions to use in order to measure output expectations is slightly more ambiguous because there are three candidate questions that can be considered:
'How about people out of work during the coming 12 months – do you think that there will be

[2]This is contrast to the approach of **?** who characterize the responses 'Go up (at same rate)' and 'Same' as expecting no change in inflation.

more unemployment than now, about the same, or less?'

'During the next year or two, do you expect that your income will go up more than prices will go up, about the same, or less than prices will go up?'

'And how about a year from now, do you expect that in the country as a whole business conditions will be better, or worse than they are at present, or just about the same?'

For our baseline estimations we consider the first question concerning unemployment. We use the second and the third question for further analyses and to explore the robustness of the baseline results. Note that in the second question about personal income, the horizon of the forecast slightly deviates from the one in the questions about prices and the interest rate where the horizon is more concretely specified with 12 months. Following **?** we bear with this deviation in the real income question since it appears unlikely that the qualitative answers would be different if respondents were asked to give their 12 month prospect. In other words, we doubt that someone has e.g. negative real income expectations for the next 12 months and positive expectations for the next 24 months.

Following Leduc and Sill (2013) and the Survey Research Center (2015) we construct a balance score to aggregate expectations data for each period t:

$$x_t^{score} = \left(\frac{\sum_{i=1}^{N_t} x_{i,t}^{increase}}{N_t} - \frac{\sum_{i=1}^{N_t} x_{i,t}^{decreae}}{N_t} \right) 100 + 100,$$

where $x_{i,t}^{increase} = 1$ if respondent i expects an increase for the respective survey question from above and 0 otherwise. Similarly, $x_{i,t}^{decrease} = 1$ if respondent i expects a decrease for the respective survey question from above and 0 otherwise. Below we refer to the balance scores of interest rate, inflation and unemployment expectations as i^e, π^e and u^e. Figure 1 shows the time series of the balance scores used to aggregate expectation data. Income and business conditions expectations, which we use for further analysis, are referred to as y^e, bc^e.

To ensure that we do not pick up major structural breaks, in the baseline we only consider the time span beginning with the Great Moderation, which we date with January 1985, until the recent financial and economic crisis meaning that we do not consider observations after June 2007.

3 Methodology

We use a combination of zero and sign restrictions to identify AD, AS and MP shocks which are distinct from genuine expectation shocks. Before we discuss the identification approach, we lay out the estimation technique and the logic of the zero-and-sign restriction algorithm.

3.1 Estimation

The estimation equation for each reduced form VAR reads

$$X_t = \sum_{j}^{p} A_j X_{t-j} + e_t,$$

where X_t is a vector of endogenous variables, A_j is the matrix of coefficients at lag j, and e_t is a vector of residuals. Based on the Akaike information criterion we estimate the VAR with 2 lags. The vector of endogenous variables contains the expectations over unemployment, inflation and the interest rate which are measured as balance scores as well as the unemployment rate, the logarithm of the consumer price index (CPI) and the federal funds rate (FFR). The macroeconomic data are obtained from the Federal Reserve Economic Data (FRED) database. In our baseline estimations we use the seasonally adjusted monthly consumer price index for urban consumers (CPIAUCSL), the monthly effective federal funds rate (FEDFUNDS), and the seasonally adjusted civilian unemployment rate (UNRATE).

Considering a flat prior we fit the data with a Baysian VAR model. Since we assume that the data is due to a Gaussian process and the prior is given by a Normal-Wishart density, the posterior is Normal-Wishart distributed. Following e.g. Uhlig (1994) we obtain location parameters of the posterior directly from the regression coefficients, summarized in $A = [A_1, \ldots, A_p]'$, and from the covariance matrix Σ_e.

To identify structural shocks we apply a zero-and-sign-restrictions algorithm proposed in Rubio-Ramirez et al. (2010) and Arias et al. (2014). We take the Choleski factor from $\Sigma_e = PP'$ and use a random orthogonal matrix Q (where $Q'Q = I$) to obtain an alternative decomposition of the covariance matrix $\Sigma_e = PQQ'P'$. Premultiplying the estimation equation by $(PQ)^{-1}$ yields orthogonal shocks $\tilde{u} = (PQ)^{-1}e_t$ where the matrix Q is constructed in such a way that multiplication yields the zero restrictions on the impulse responses.

We iterate the algorithm 1,000 times with the following steps. We draw one set of parameters from the posterior distribution. For this set of parameters we check whether we can find a

transformation which is admissible in terms of the sign restrictions we impose on the impulse responses. 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 of 1,000 draws of the matrix Q is reached (then we proceed without retaining any model).

3.2 Identification

The identification scheme is shown in Table 1. The zero-and-sign restriction algorithm allows us to combine the two different identification approaches. We identify the macroeconomic shocks using sign restrictions derived from standard DSGE models and to ensure that we do not pick up expectations shocks, we impose zero restrictions on the expectations variables.[3] We choose to work with sign restrictions to identify structural macroeconomic shocks because this identification procedure is most closely related to theoretical models. This is particularly important for our analysis since we seek to study whether impulse response functions of expectation variables are theory consistent.

The intuition of the imposed sign restrictions with respect to AD shocks is that due to an adverse AD shock output and the price level goes down. We assume that the central bank reacts contemporaneously to output and inflation, and hence, the interest rate decreases. Following e.g. Blanchard and Galí (2010) we assume that there is a negative relationship among output and unemployment. In response to an AS shock the unemployment rate and the price level react into same directions. So far these sign restrictions are rather unambiguous and consistent with the typical interpretation of AS-AD diagrams from macroeconomic textbooks. The sign restriction for the AS shock on the interest rate may need some additional qualifications. It is not obvious how the central bank reacts to an AS shock because following a Taylor rule the interest rate is typically positively associated with both, output and inflation. By restricting the response of the interest rate to be positive in the event of a contractionary AS shock, we implicitly identify an AS shock with a pronounced increase in prices which is consistent with a price mark-up shock, a wage mark-up shock or with a technology shocks discussed in e.g. Smets and Wouters (2007). In response to a MP shock we assume that the unemployment rate rises while the price level decreases which is consistent with a large number of theoretical models. All sign restrictions are imposed on impact plus three consecutive months.

[3] Applying a recursive identification scheme, Leduc and Sill (2013) order expectations first to study the effects of expectations shocks on a number of macroeconomic variables.

4 Main Results

Figure 2 shows impulse responses 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.[4] The responses of the macroeconomic variables are shown in the upper panel and the responses of the expectation measures in the lower panel. The solid lines in the graphs represent the pointwise-median responses, whereas the dashed lines represent the closest-to-median responses selected as proposed in Fry and Pagan (2011). The pointwise-median responses are the medians of the distribution of the restricted posterior for each horizon h. The error bands represent the distribution of the restricted posterior: in the graphics we indicate the 5th and the 16th percentiles (lower limits of the shaded areas) as well as the 86th and the 95th percentiles (upper limits of the shaded areas). The closest-to-median responses are the responses from a single model which is selected such that the responses of this single model exhibit the minimum deviations from the pointwise-median responses among all models from the restricted posterior.

Before we turn to the impulse response functions of the expectations variables, we briefly discuss the responses of the macroeconomic variables to the macroeconomic shocks. The responses are rather standard given the identification strategy we employ. Due to the imposed sign restrictions, all responses have initially signs which are derived from standard DSGE models. Please recall that we impose the sign restrictions on impact plus three consecutive months. In response to an adverse AD shock, the unemployment rate rises while the CPI and the FFR drop. The responses of the macroeconomic variables are generally distinct and rather prolonged. The adverse AS shock precipitates a rise in the unemployment rate, in the CPI and in the interest rate. While we observe rather persistent responses for the unemployment rate and the CPI, the interest rate response becomes negative after approximately 6 months. Due to a MP shock, the unemployment rate and the policy rate rise while the price level drops. The error bands of the impulse responses of the unemployment rate and the CPI are considerably wider compared to the responses to AD and AS shocks.

The fact that the majority of responses are rather persistent despite the relatively short horizon for which the sign restrictions are imposed, greatly facilitates the analysis of the effects of the macroeconomic shocks on the expectation variables. The survey questions are geared towards an assessment of the prospects of the economy over a one year horizon. Therefore, persistent responses of the macroeconomic variables which exhibit clear steady state deviations

[4] We do not show responses to residual shocks because we have no structural interpretation for these shocks.

beyond a one year horizon are particularly suitable for our analysis.

In the analysis of the impulse response functions of the expectations measures, we mainly focus on whether respondents revise expectations due to the shock in a way consistent with theory. To evaluate that, we check whether the signs of the responses of the expectation measures in $h = 1$ are jointly consistent with the signs of their macroeconomic counterparts derived from standard DSGE models.

Turning now to the responses of expectation variables we first consider the responses of the expectation measures to an AD shock. The impulse response functions are shown in the first column in Panel B of Figure 2. Recall that the responses of the macroeconomic variables are rather persistent over the first year following the shock. To be consistent with theory, expectations about unemployment should be revised upwards, while respondents should revise inflation and interest rate expectations downwards. Quite notably, this is exactly what is reflected in the initial steady state deviations of the expectations balance scores in $h = 1$: The balance score of expectations about unemployment initially exhibit a positive sign while the balance scores of expectations about inflation and about the interest rate exhibit a negative sign. Although the initial response of unemployment expectations is less distinct, this indicates that respondents process AD shocks in a way we would expect from theory. The fact that as expectations about unemployment increase and expectations about inflation are revised downwards, interest rate expectations are revised downwards in the presence of AD shocks, is also consistent with a Taylor rule type relationship among the expectation variables. This result supports the findings in Carvalho and Nechio (2014) and **?**, who find evidence that respondents tend to form expectations which are consistent with the Taylor rule. Moreover, the responses of expectations about unemployment and inflation to an AD shock are consistent with a Phillips curve type relationship, which is generally found to be prevalent in expectations data (**?**).

For the AS shock impulse response functions are shown in the second column of the lower panel of Figure 2. From standard theory and from the empirical characteristics of the responses of the macroeconomic variables which are shown in the upper panel, balance scores for both, expectations about unemployment and expectations about inflation should initially increase. Furthermore, standard DSGE models suggest an increase in the policy rate which is why interest rate expectations should increase. Overall, the responses of the expectation variables tend to be consistent with the characteristics of an AS shock. The steady state deviations of the balance score of expectations about unemployment is positive and very pronounced. The response of the balance score of inflation expectations is less significant and comparatively temporary. Still,

although respondents appear to be more uncertain about the development of future inflation, we find evidence that they do realize the effects of an AS shock initially. The responses of balance score of the interest rate expectations are initially not significant and gradually move into the negative territory. Hence, interestingly it appears as if people do not expect a monetary tightening in the aftermath of an AS shock, which at first glance appears to be inconsistent with the predictions of standard DSGE models. However, as we see that the impulse response function of the FFR exhibits only a rather temporary increase, responses of the interest rate expectations might actually be related to this empirical pattern. Either way, the responses of the balance score of expectations about the interest rate vis-à-vis an AS shock cast some doubt on a prominent role of interest rate expectations for the propagation of supply shocks. In contrast, responses of inflation expectations do support the relatively strong emphasis that New Keynesian models put on inflation expectations as a part of the propagation mechanism for supply shocks.

Comparing the first with the second column in Panel B in Figure 2, we see that while vis-à-vis the AD shock respondents revise unemployment expectations on the one hand and inflation expectations on the other hand in opposite directions, respondents revise these expectations in the same direction when exposed to an AS shock. Quite strikingly, this result suggest that respondents apparently differentiate among AD and AS shocks and revise expectations according to the characteristics of the shock. In turn, this implies that in case of an AS shock, as we would expect from standard theory, respondents appear to realize that the Phillips curve relation is dominated by the AS shock. This finding provides evidence for some limitations for the result in **?**, who find that people generally tend to form expectations consistent with the Phillips curve.

The impulse responses precipitated by the MP shock are shown in the third column of Panel B in Figure 2. From standard theory one would expect the balance score of the unemployment expectations and interest rate expectations to initially increase while the balance score of the inflation expectations should initially decrease. Looking at the responses of the expectation variables, concerning the signs of the responses in $h = 1$ it is difficult to draw clear-cut conclusions. The initial responses of the expectations about unemployment and inflation in $h = 1$ tend to exhibit signs we would expect from standard theory. The fact the expectations about the interest rate are initially not distinct and even tend to go into the territory as h increases, is indeed at first glance a little puzzling and appears inconsistent with theory. However, as the responses of the FR are rather temporary, respondents might realize the short-lived effects of

MP shocks on interest rates and hence, it may be well accurate from this persepctive that the bulk of the distribution of the restricted posterior of the interest rate expectation is initially located around 0. Overall we conclude that respondents are rather uncertain about the effects of the monetary policy shock which is indicated by the generally large error bands. It appears plausible that the reason for that is that monetary policy shocks are rather exceptional and therefore, respondents are relatively inexperienced how to process them.

Across shocks, the generally most distinct and theory consistent responses in $h = 1$ are obtained for AD shocks. This appears plausible, since AD shocks are probably most intuitive to interpret since responses of the macroeconomic variables for an AD shock are relatively persistent and consistent with both, a Phillips curve type and a Taylor rule type relationship. Moreover, AD shocks are relatively frequent which may promote the understanding of these shocks. For AS shocks, we find that while respondents differentiate among AS and AD shocks and revise the unemployment and the inflation expectations in the same direction for the AS shock, interest rate expectations are, in contrast to what we would expect from theory, not revised upwards. There are at least two plausible reasons for this. First, it is probably more difficult to predict the reaction of the central bank since unemployment and prices go into the same direction which exerts opposing effects on the Taylor rule. Second, since the contractionary response of the FFR is relatively short-lived, respondents do accurately not expect an increase in interest rates over a one year horizon following the shock. For the MP it is quite striking that respondents are relatively more uncertain about the effects of the shock meaning that responses exhibit relatively wide error bands. Overall, despite the considerable degree of uncertainty involved in the responses to MP shocks, we conclude that respondents generally seem to understand how macroeconomic shocks influence macroeconomic variables, and therefore also the propagation mechanisms, quite accurately.

5 Additional Analysis

To generalize our findings and to explore the robustness of our results, we consider different specifications of the VAR model. While it is clear which survey questions to use for inflation and interest rate expectations, there are three candidate questions to proxy expectations over real economic activity. Above we used expectations about unemployment. In this section we consider the survey questions about business conditions and real income which are presented in Section 2. Also, we replace the unemployment rate by the industrial production index,

since it appears that it is a more natural counterpart for real income and business conditions expectations than the unemployment rate.[5]

The estimation approach is as in the baseline VAR. Table 2 lays out the identification scheme for the additional analysis. Note that in contrast to the baseline, sign restrictions on industrial production are reversed compared to unemployment. All other restrictions are unchanged and expectations about unemployment are replaced by expectation about business conditions and by expectations about real income respectively. For the estimation we again use only data from 1985m01–2007m06.

Figure 3 presents impulse responses for AD, AS and MP shocks. Please note that the variables in the first and the fourth row are exchanged compared to the baseline estimation. For the additional analysis we now have IP in the first row and real income expectations in the fourth row. Looking at the first column of Panel B in Figure 3 we can see that people apparently connect AD shocks less to their own income but rather to the probability of becoming unemployed as indicated by the baseline estimation shown in Figure 2. responses for the adverse AS shock are shown in the second column. In contrast to the AD shock the effects of AS shock are very eminently projected onto real income which is indicated by the drop in real income expectations. Responses for the monetary policy shock are similarly disperse compared to the baseline.

Responses for the VAR with industrial production and business condition expectations are shown in Figure 4. Considering the effects of an AD shock on expectations (first column in Panel B) it appears that respondents do not expect a worsening of the business conditions which is somewhat puzzling. Since expectations about business conditions might well be related to the interest rate, the decrease in the FFR due to the AD shock might be responsible for the rise in business conditions expectations. For the AS shock shown in the second column business conditions expectations clearly decrease which is line with what we would intuitively expect. The MP shock precipitates again responses with wide error bands.

6 Conclusion

Expectations are likely to play an important role for the propagation of macroeconomic shocks. Hence, it is important to evaluate to which extent people realize the adjustment of the economy precipitated by shocks. Our SVAR analysis allows us to assess the revision of expectations

[5]The industrial production index is obtained from the Federal Reserve Economic Data (FRED) database. We use the seasonally adjusted monthly industrial production index (INDPRO).

about economic activity, inflation and the interest rate due to exogenous aggregate demand, aggregate supply, and monetary policy shocks.

We find that macroeconomic shocks do shape expectations about future prospects of the economy. Interestingly, people appear to assess the effects of macroeconomic shocks in a way which is largely consistent with standard DSGE models. Notably, people differentiate among shocks taking the nature of the shocks into account. Nevertheless, the extent to which people realize how macroeconomic shocks affect the economy varies. As long as the effects of a shock are distinct and rather persistent, we observe clear and theory-consistent responses of macroeconomic expectations. This is in particular the case in the event of AD shocks where the revision of all three expectation variables precipitated by the shock is indeed consistent with theory. In case there are relatively weak responses of the macroeconomic variables precipitated by the shock, responses of the expectation variables tend to become relatively unsystematic. This is the case for the responses of interest rate expectations in the event of AS shocks where the AS shock brings about only a relatively short-lived steady state deviation of the FFR. Also, for the monetary policy shocks, where the responses of the macroeconomic variables are either relatively short-lived or exhibit wide error bands, people appear to be more uncertain about how to process the shock.

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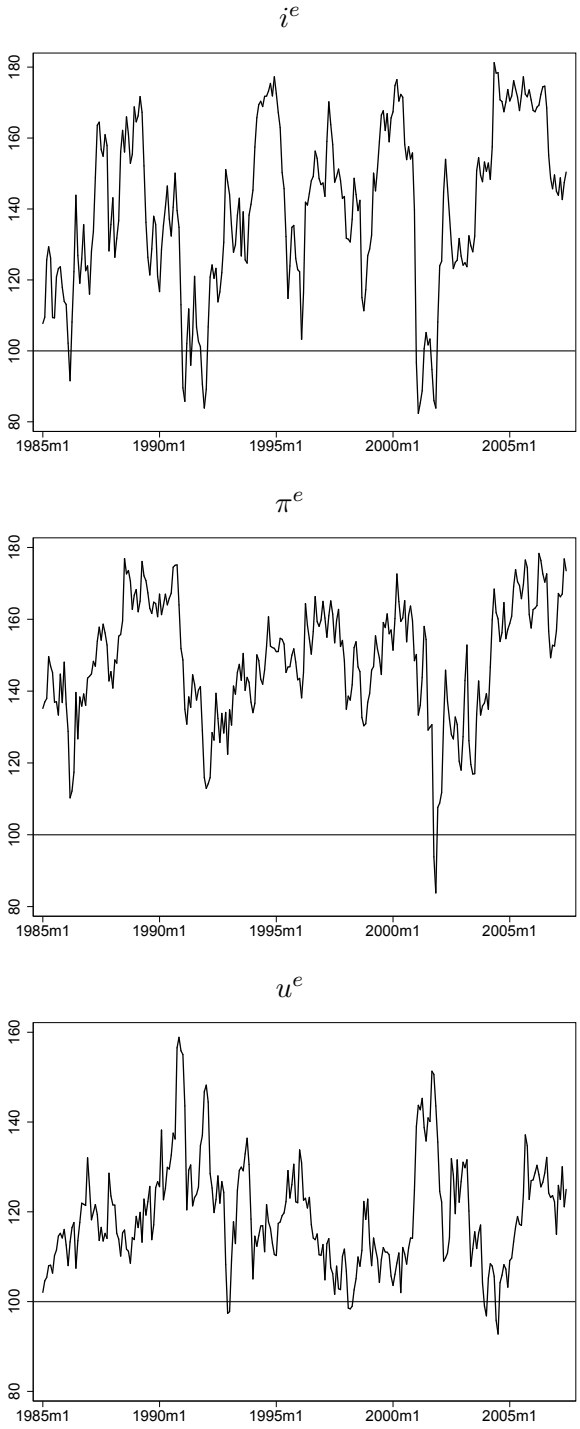
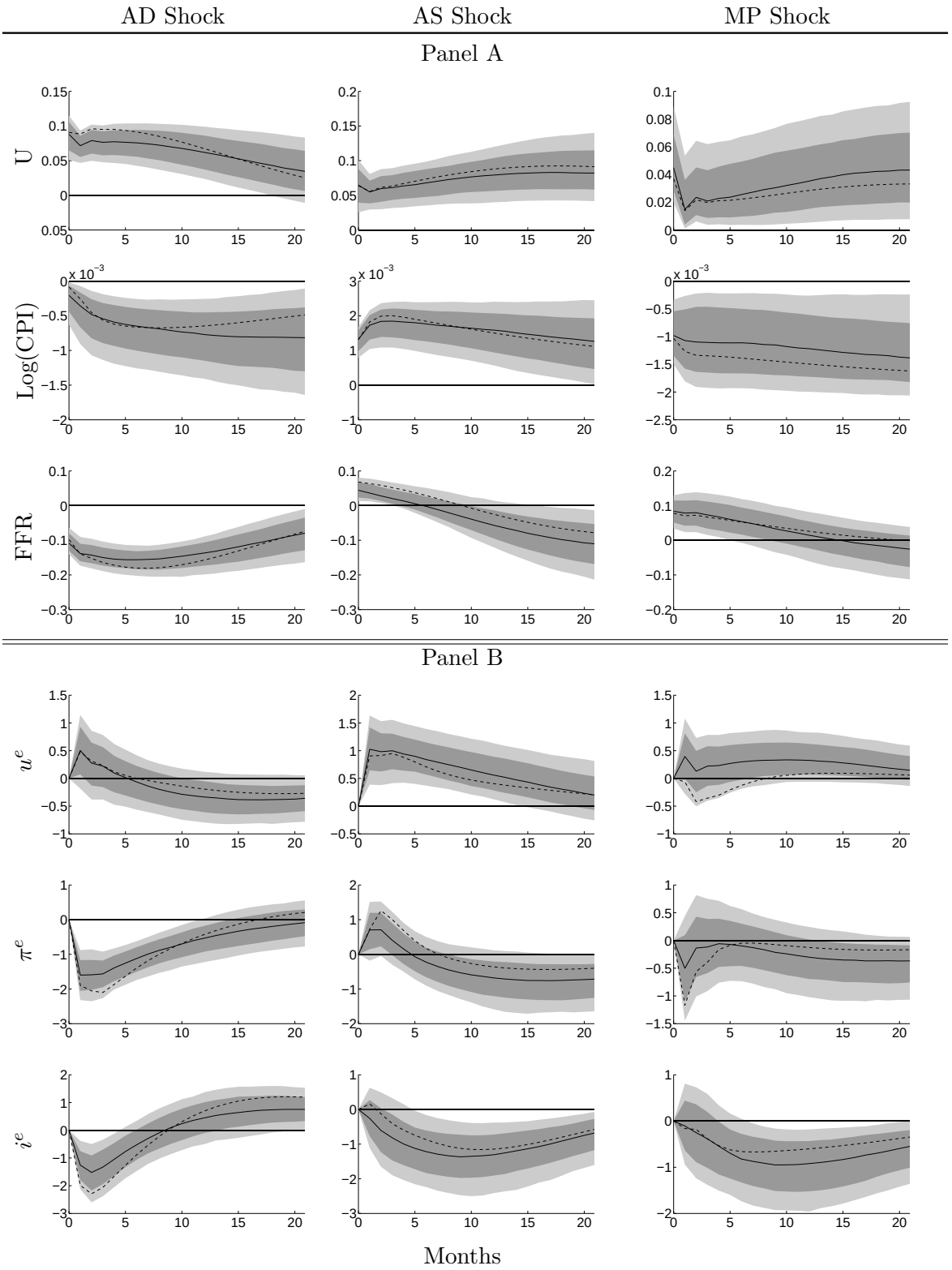
Figures

Figure 1: Aggregated Expectation Time Series



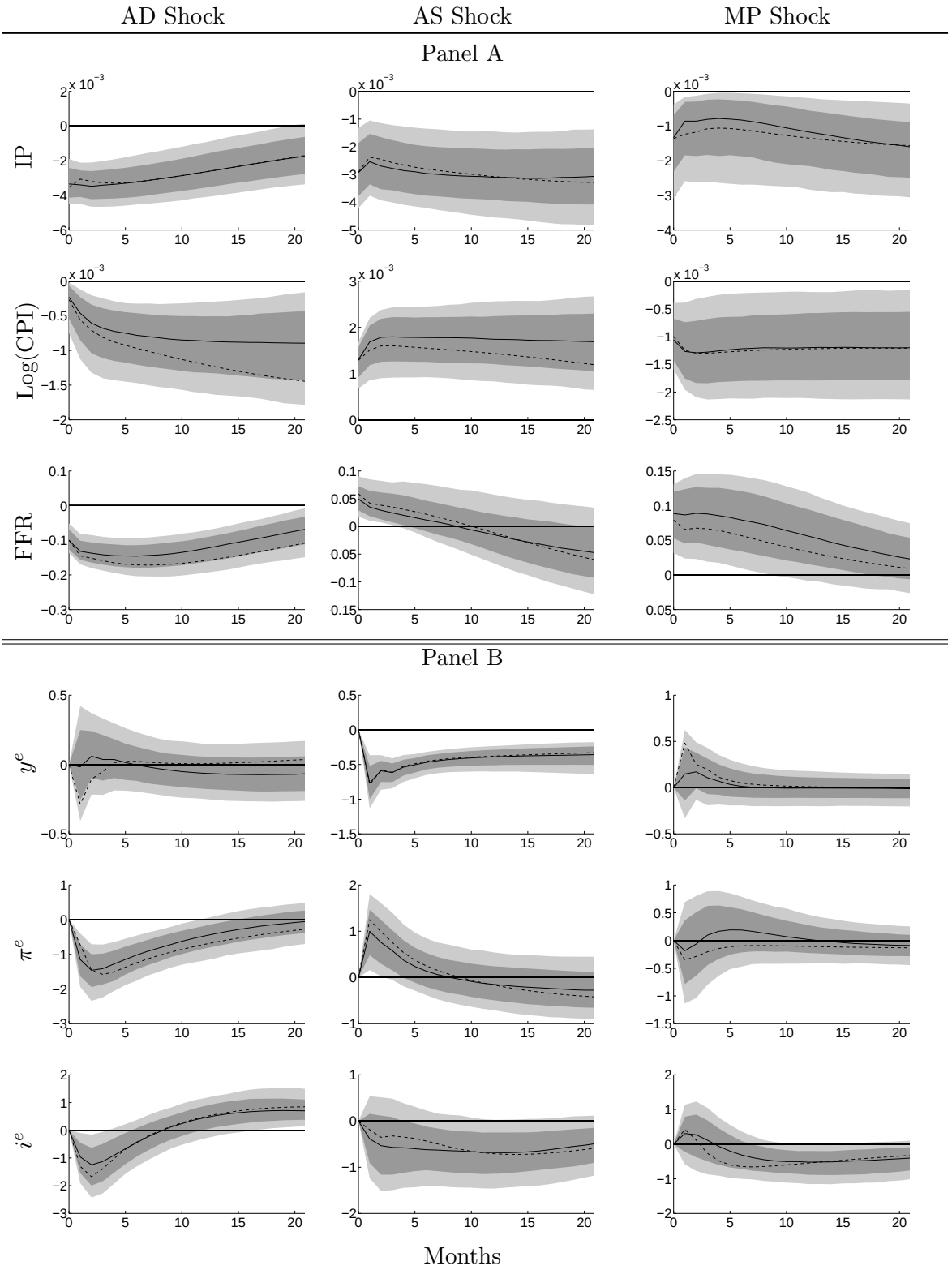
Notes: The figure shows time series for the balance scores for interest rate expectations, inflation expectations and unemployment expectations.

Figure 2: Baseline Estimation



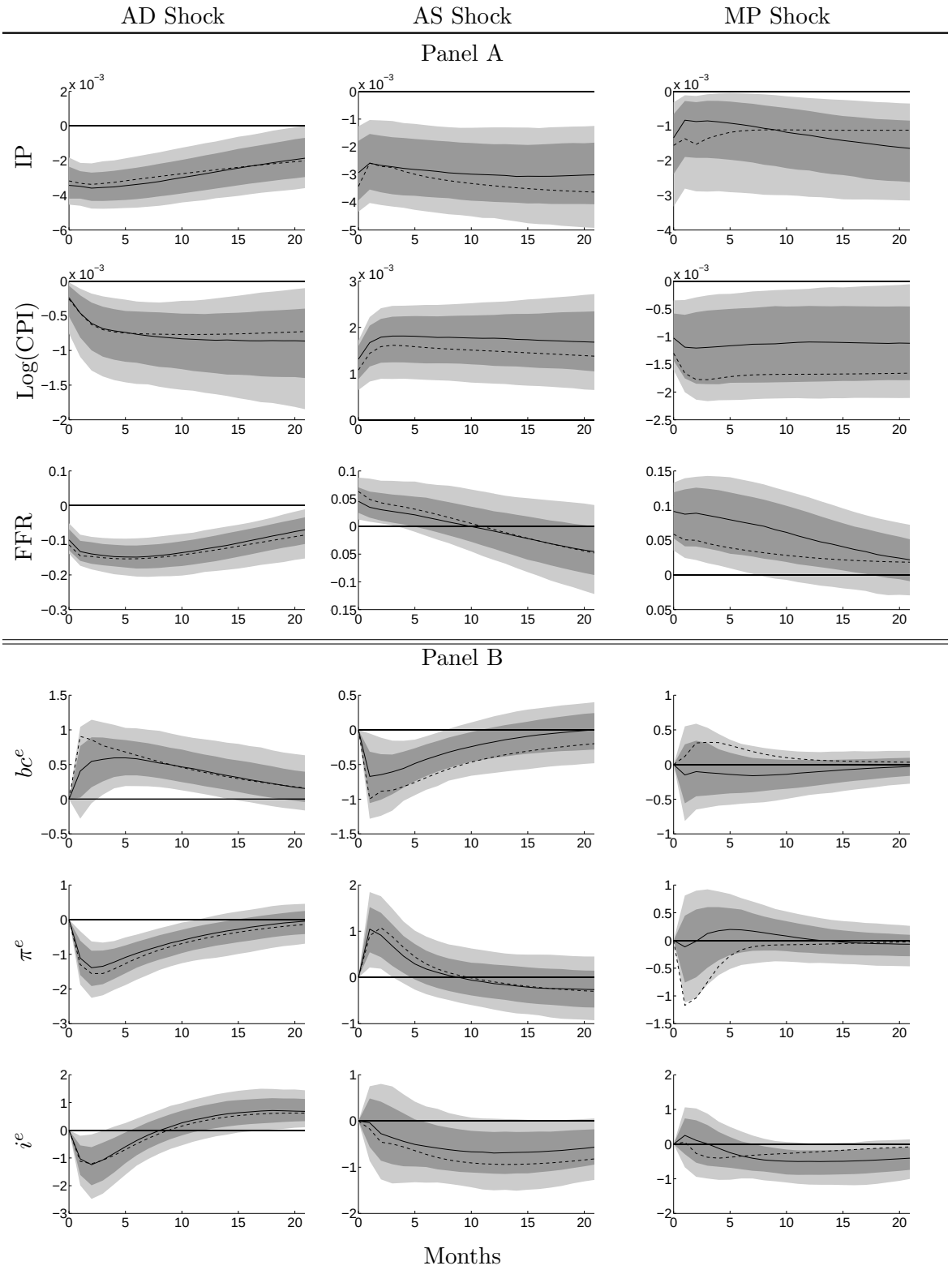
Notes: The solid lines represent the pointwise median response, whereas the dashed lines represent the closest to median response selected as proposed in Fry and Pagan (2011). The error bands represent the distribution of the restricted posterior (we indicate the 5th and 16th percentiles as well as the 86th and 95th percentiles).

Figure 3: VAR with IP and Real Income Expectations



Notes: The solid lines represent the pointwise median response, whereas the dashed lines represent the closest to median response selected as proposed in Fry and Pagan (2011). The error bands represent the distribution of the restricted posterior (we indicate the 5th and 16th percentiles as well as the 86th and 95th percentiles).

Figure 4: VAR with IP and Business Conditions Expectations



Notes: The solid lines represent the pointwise median response, whereas the dashed lines represent the closest to median response selected as proposed in Fry and Pagan (2011). The error bands represent the distribution of the restricted posterior (we indicate the 5th and 16th percentiles as well as the 86th and 95th percentiles).

Tables

Table 1: Combination of zero and sign restrictions on impulse response functions: Baseline

	u^e	π^e	i^e	U	Log(CPI)	FFR
Residual u^e						
Residual π^e	0					
Residual i^e	0	0				
AD Shock	0	0	0	$\uparrow$	$\downarrow$	$\downarrow$
AS Shock	0	0	0	$\uparrow$	$\uparrow$	$\uparrow$
MP Shock	0	0	0	$\uparrow$	$\downarrow$	$\uparrow$

Table 2: Combination of zero and sign restrictions on impulse response functions: Additional Analysis

	bc^e/y^e	π^e	i^e	Log(IP)	Log(CPI)	FFR
Residual y^e						
Residual π^e	0					
Residual i^e	0	0				
AD Shock	0	0	0	$\downarrow$	$\downarrow$	$\downarrow$
AS Shock	0	0	0	$\downarrow$	$\uparrow$	$\uparrow$
MP Shock	0	0	0	$\downarrow$	$\downarrow$	$\uparrow$