Improving Unemployment Rate Forecasts Using Survey Data

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Summary in Swedish

Denna arbetsrapport undersöker huruvida prognoser av svensk arbetslöshet kan förbättras genom att data från Konjunkturbarometern tas i beaktande. Detta sker genom att en modellbaserad prognosövning genomförs, där prognosförmågan hos en bayesiansk VAR-modell med endast makroekonomiska data jämförs med den från specifikationer där även konjunkturbarometerdata inkluderats. Resultaten indikerar att prognosförmågan på korta horisonter kan förbättras genom användandet av konjunkturbarometerdata. Förbättringen är störst när framåtblickande data från tillverkningsindustrin används.

Improving Unemployment Rate Forecasts Using Survey Data*

Pär Österholm#

Abstract

This paper investigates whether forecasts of the Swedish unemployment rate can be improved by using business and household survey data. We conduct an out-of-sample forecast exercise in which the performance of a Bayesian VAR model with only macroeconomic data is compared to that when the model also includes survey data. Results show that the forecasting performance at short horizons can be improved. The improvement is largest when forward-looking data from the manufacturing industry is employed.

JEL classification: E17, E24, E27

Keywords: Bayesian VAR, Labour market

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1. Introduction

The aggregate unemployment rate is a variable of fundamental interest to many economic agents. For example, for monetary policy makers, it both serves as an indicator of the stance of the macroeconomy in general and carries information regarding inflationary pressure. For fiscal policy makers, the unemployment rate is linked to government expenditure as well as income due to its relationship with, for example, unemployment benefits and income taxes. There is accordingly a widespread interest in being able to generate good forecasts of the unemployment rate. The literature dealing with unemployment rate forecasting is consequently large; for a number of different applications and methodological choices, see Funke (1992), Rothman (1998), Franses *et al.* (2004), Golan and Perloff (2004), Gustavsson and Österholm (2008) and Milas and Rothman (2008).

The purpose of this paper is to investigate whether Swedish unemployment rate forecasts can be improved by using business and household survey data. The National Institute of Economic Research (Konjunkturinstitutet; henceforth NIER) conducts the *Economic Tendency Survey* in which both businesses and households are asked questions which could be potentially useful for forecasting the aggregate unemployment rate. We assess the usefulness of these data by employing them in an out-of-sample forecast exercise. Specifically, we compare the out-of-sample forecasting performance of a Bayesian VAR model with only macroeconomic data to that when the model has had survey data added to it. This is a fairly common approach to test for Granger causality empirically and has been used in a range of applications; see, for example, Thoma and Gray (1998), Chao *et al.* (2001), Hale and Jorda (2007) and Berger and Österholm (2009). Methodologically, we believe that it is appropriate to rely on out-of-sample forecasts – rather than in-sample fit – when aiming to establish the usefulness of a variable for forecasting and can only agree with Ashley *et al.* (1980, p. 1149) that it is the "sound and natural approach" to investigate whether one variables Granger causes another.

The predictive power of survey data for the real economy has been investigated in a number of studies, both in- and out-of-sample; see, for example, Carroll *et al.* (1994), Ludvigson (2004), Hansson *et al.* (2005), Cotsomitis and Kwan (2006) and Kwan and Cotsomitis (2006). Often the survey data are expected to work as a leading indicator for the real variable in question. The forward-looking nature of some of the questions in the *Economic Tendency Survey* might therefore be particularly interesting. We employ five variables in this paper, each of which is based on a particular survey data question. Households are asked what their expectations are regarding the development of the unemployment rate over the coming twelve months. Businesses are asked both whether the number of employees has increased, decreased or been constant over the last three month period and what the outlook is for the coming three months. Since the survey data might incorporate information that is not reflected in other variables that are typically included in forecasting models, it does not seem unreasonable that forecasting performance could be improved by the inclusion of the survey data.

Our results suggest that both business and household survey data have predictive power for the Swedish unemployment rate. However, the usefulness of the data varies. The data describing the contemporaneous situation in businesses do not seem particularly valuable for forecasting. The forward-looking series, on the other hand, all appear to have predictive power for the unemployment rate at short horizons, with the improvement being largest when data from the manufacturing industry are used.

The remainder of this paper is organised as follows. Section 2 presents the survey data in some detail. In Section 3, we present the modelling framework and Section 4 presents the results from the out-of-sample forecast exercise. Finally, Section 5 concludes.

2. Data

Each quarter, the NIER asks representatives of Swedish firms and households about the present situation and the outlook for the near future. The information is compiled in the *Economic Tendency Survey* whose purpose is to be a quickly available source of indicators pertaining to outcome, present situation and expectations for important economic variables.

Stratified sampling of firms takes place through the business register of Statistics Sweden. More than 8 000 companies are included in the survey and they are divided into four categories: manufacturing industry, construction industry, retail trade and private service sector. The questionnaires are addressed to upper management and are designed to be filled out conveniently and quickly. For example, a company can be asked whether the inflow of new orders from abroad has increased, remained unchanged or decreased. Some questions refer to the outcome for the past three months, others to expectations or plans for the coming three months. Household data are obtained through telephone interviews with a random net sample of 1 500 individuals between 16 and 84 years of age. The questions asked refer both to the household's own economic situation and the aggregate economy. For each question, the responses are standardised so that the percentages of the response alternatives add up to 100. To facilitate presentation and analyses of outcomes, the concept of "net figures" is employed, where a net figure is the difference between the percentage of respondents reporting an increase and a decrease for a certain question.[1]

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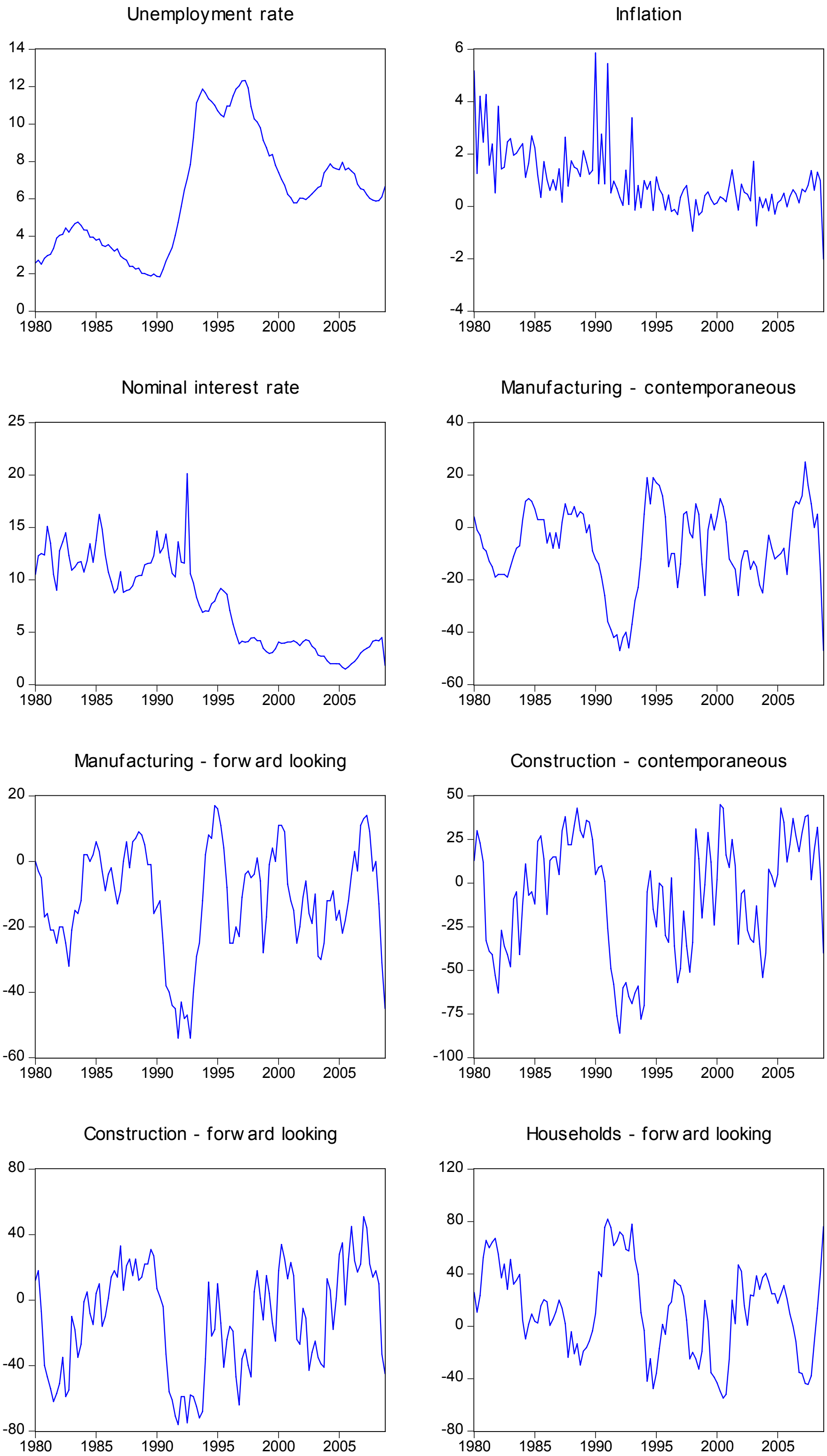
[1] This is a very common way to summarise survey data. In applied econometric work, a similar approach has been used by Carabenciov *et al*. (2008).

In this paper, we investigate whether the data from the *Economic Tendency Survey* can be used to improve forecasts of the Swedish unemployment rate. The benchmark model – a Bayesian VAR which we will return to in the next section – only makes use of three variables: the unemployment rate, CPI inflation and the three month treasury bill rate. VARs with these variables are standard tools in macroeconomic analysis and forecasting – see, for example, Cogley and Sargent (2001, 2005), Primiceri (2005) and Ribba (2006) – and a model based on these three variables therefore seems like a reasonable benchmark. Five questions in the survey were identified as particularly interesting to augment the benchmark model with.[2] Questions 116 and 207 are used for the manufacturing industry and 106 and 204 for the construction industry. Specifically, in questions 116 and 106, the respondents are asked about the firm's number of employees the last three months. This yields variables for the contemporaneous situation in the manufacturing and construction industries, s_t^{mc} and s_t^{cc} repectively. The expectations regarding the number of employees for the coming three months are addressed in questions 207 and 204; these forward-looking variables are denoted s_t^{mf} and s_t^{cf} for the manufacturing and construction industries respectively. For households, finally, question 7 is used. This asks how the household expects the aggregate unemployment rate to develop over the coming twelve months and the variable based on it is denoted s_t^{hf}. The sample available is 1980Q1 to 2008Q4 and all data are given in Figure 1.

[2] The survey contains other questions that could be of interest. Some of these, however, cannot be used since long enough time series not are available.

Figure 1. Data.



3. Model

For the empirical analysis in this paper, we will rely on Bayesian VAR models. The Bayesian VAR is typically considered a good forecasting tool and has been shown to forecast well out-of-sample in a number of studies; see, for example, Doan *et al.* (1984), Litterman (1986), Adolfson *et al.* (2007) and Villani (2008). The major benefit of the Bayesian VAR is that it reduces the problem of over-parameterisation – which hurts forecasting performance – but still allows a flexible description of the data generating process. By relying on a modelling framework that many forecasters argue is the best for forecasting time series, we believe that our out-of-sample forecast exercise will provide useful information.

Specifically, the forecasting model used in this paper is given by

$$\mathbf{G}(L)\mathbf{x}_t = \boldsymbol{\delta} + \boldsymbol{\theta} D_t + \boldsymbol{\eta}_t, \qquad (1)$$

where $\mathbf{G}(L) = \mathbf{I} - \mathbf{G}_1 L - \ldots - \mathbf{G}_m L^m$ is a lag polynomial of order *m*, $\mathbf{x}_t$ is an *n*x1 vector of economic variables, $\boldsymbol{\delta}$ is an *n*x1 vector of intercepts and $\boldsymbol{\eta}_t$ is an *n*x1 vector of *iid* error terms fulfilling $E(\boldsymbol{\eta}_t) = \mathbf{0}$ and $E(\boldsymbol{\eta}_t \boldsymbol{\eta}_t') = \boldsymbol{\Sigma}$. D_t is a dummy variable that takes on the value 1 between 1980Q1 and 1992Q4. This is included to account for the two different monetary policy regimes during the sample. While the shift to inflation targeting did not necessarily affect the time-series properties of the unemployment rate or the dynamic relationship between variables, it is typically assumed that it generated a level shift for both inflation and the nominal interest; see, for example, Adolfson *et al.* (2007) and Österholm (2008).

In all models, the lag length is set to $m = 4$. The priors on the dynamics of the model in equation (1) are given by a Minnesota-style prior: For variables in levels (first differences), the prior mean on the coefficient on the first own lag is one (zero); all other coefficients in $\mathbf{G}_i$ have a prior mean of zero. The overall tightness is set to 0.2, cross-equation tightness to 0.5 and we choose a lag decay parameter of 1. Following the standard in the literature, we employ diffuse normal priors for both $\boldsymbol{\delta}$ and $\boldsymbol{\theta}$. Finally, the prior for the covariance matrix is a mainstream diffuse prior, $p(\Sigma) \propto |\Sigma|^{-(n+1)/2}$. The numerical evaluation of the posterior distribution is conducted using the Gibbs sampler with the number of draws set to 10 000. Regarding the forecasts from the models, these are generated in a straightforward manner. At each point in time and for every draw from the posterior distribution, a sequence of shocks is drawn and used to generate future data. In this manner we generate 10 000 paths of the unemployment rate; the median forecast from this predictive density is used as point estimate.

As indicated above, the benchmark model is a three-variable Bayesian VAR with the unemployment rate (u_t), CPI inflation (Δp_t) and the three month treasury bill rate (i_t). We accordingly set $\mathbf{x}_t = (u_t \quad \Delta p_t \quad i_t)'$ in the benchmark model. When survey data are employed, the model is extended with survey data series. For example, when the usefulness of the household survey data are investigated, we set $\mathbf{x}_t = (u_t \quad \Delta p_t \quad i_t \quad s_t^{hf})'$.

The out-of-sample forecasts are generated the following way: We initially estimate the models using data from 1980Q1 to 1999Q4, and then use the estimated models to generate forecasts of the unemployment rate four quarters ahead. We then extend that sample with one period, re-estimate the models and generate new forecasts four quarters ahead and so on. The last evaluation is conducted on a model estimated from 1980Q1 to 2008Q3 and is forecasted one period ahead.

4. Results

We investigate the forecasting performance of the competing models by comparing the root mean square forecast errors (RMSFEs) at the different forecasting horizons. For a convenient presentation of the results, we show the *relative RMSFEs*. The relative RMSFE at horizon *h* is here defined as

$$RR_h = RMSFE_{S,h} / RMSFE_{NS,h} , \tag{2}$$

where $RMSFE_{S,h}$ and $RMSFE_{NS,h}$ are the RMSFEs of the model with survey data and without survey data respectively. A relative RMSFE smaller than one accordingly means that the model with survey data outperforms the model without survey data.

We choose to focus on (relative) RMSFEs and use them as the criterion for assessing model performance in line with the philosophy originally expressed by Armstrong (2007). That is, in choosing between a set of reasonable contender models, we prefer the model with the lowest RMSFE; whether the difference in forecasting performance is significant is of little consequence. We argue that this is a reasonable strategy when evaluating the addition of a variable to a model. In practice, when faced with a choice of whether or not to include a particular (reasonable) variable in a forecasting model, the forecaster would of course not choose the model with a larger RMSFE just because it was not significantly larger.[3]

[3] If one wanted to test whether the differences were significant, this would also be highly complicated since, to our knowledge, no valid test exists in the present setting; see the discussion in Clark and McCracken (2005).

The usefulness of the five survey data series is initially investigated by comparing the RMSFEs of the five four-variate BVARs to that of the benchmark trivariate BVAR. The relative RMSFEs are given in Table 1 and RMSFEs of all models are given in Table A1 in the Appendix. As can be seen, augmenting the model with s_t^{cc} or s_t^{mc} tends to push the relative RMSFE above unity; only at the one-quarter horizon when s_t^{mc} is used is it smaller than one. One explanation for this finding is that even though the BVAR reduces the problem of over-parameterisation, it is not immune to it. As variables with only a moderate additional informational content are added, this does not outweigh the cost in terms of lost precision in estimation.

Table 1. Relative RMSFEs for estimated models.

	Horizon in quarters			
	1	**2**	**3**	**4**
$\mathbf{x}_t = (u_t \quad \Delta p_t \quad i_t \quad s_t^{cc})'$	1.01	1.07	1.06	1.06
$\mathbf{x}_t = (u_t \quad \Delta p_t \quad i_t \quad s_t^{mc})'$	0.96	1.02	1.05	1.13
$\mathbf{x}_t = (u_t \quad \Delta p_t \quad i_t \quad s_t^{cf})'$	0.96	0.97	0.97	0.99
$\mathbf{x}_t = (u_t \quad \Delta p_t \quad i_t \quad s_t^{mf})'$	0.88	0.84	0.91	0.94
$\mathbf{x}_t = (u_t \quad \Delta p_t \quad i_t \quad s_t^{hf})'$	0.98	0.97	1.00	1.03
$\mathbf{x}_t = (u_t \quad \Delta p_t \quad i_t \quad s_t^{cf} \quad s_t^{mf})'$	0.89	0.85	0.92	0.95
$\mathbf{x}_t = (u_t \quad \Delta p_t \quad i_t \quad s_t^{cf} \quad s_t^{hf})'$	0.96	0.94	0.97	1.01
$\mathbf{x}_t = (u_t \quad \Delta p_t \quad i_t \quad s_t^{mf} \quad s_t^{hf})'$	0.91	0.88	0.95	1.00
$\mathbf{x}_t = (u_t \quad \Delta p_t \quad i_t \quad s_t^{cf} \quad s_t^{mf} \quad s_t^{hf})'$	0.92	0.89	0.96	1.00

Note: Trivariate model with only macroeconomic variables is benchmark model

Turning to the forward-looking variables instead, the relative RMSFE is smaller than one at all horizons for both s_t^{cf} and s_t^{mf}. For s_t^{hf}, it is smaller than unity only at the one- and two-quarter horizons.[4] Improvements using s_t^{cf} and s_t^{hf} are small though and indicate a reduction in the RMSFE of only a few percent at most. Relying on s_t^{mf}, on the other hand, the improvement in forecast accuracy is larger – at the one- and two-quarter horizons, the RMSFE is reduced by more than ten percent.

[4] The survey data series also all appear to have very reasonable properties in the system. Illustrative impulse response functions for two cases are shown in Figures A1 and A2 in the Appendix. Most importantly, a shock to a business survey series – that is, a positive shock to employment or employment plans – decreases future unemployment; see Figure A1. In a similar fashion, a shock to the household survey series – that is, an expectation about a higher unemployment rate in the future – raises future unemployment; see Figure A2.

The results so far indicate that the three forward-looking variables individually have predictive power for the unemployment rate. An empirical strategy that might pay off is of course to include more than one of these variables at a time in the system. The forecasting performance of four additional models is investigated accordingly, reflecting the three combinations of two forward-looking variables at a time, and the model with all three variables included at the same time. Results from this exercise show that the relative RMSFE from these four models all are below one at the one- to three-quarter horizons. But while all four models constitute improvements over the benchmark trivariate BVAR, the forecasting performance is not as good as for the four-variate model including s_t^{mf} as the only survey data variable.[5]

5. Conclusions

In this paper, it has been investigated whether Swedish unemployment rate forecasts can be improved by using business and household survey data. Results show that several of the survey data series employed have predictive power for the Swedish unemployment rate at short horizons. Though improvements are not dramatic, it is apparent that data from the *Economic Tendency Survey* can in a fruitful way can be incorporated in macroeconomic forecasting models. That our results support the use of forward-looking variables is not surprising; it seems reasonable that these variables contain more information that is not already reflected in the other variables included in the forecasting model.

Our findings are obviously model dependent but nevertheless suggest that survey data which can function as leading indicators for the real economy are readily available. That the information from the manufacturing industry – rather than the construction industry – has the largest value added in a macroeconomic model is also interesting to note. Discussions regarding which sector of the economy carries the largest informational content from a forecasting point of view are common among forecasters and policymakers. Being able to focus on the most relevant indicator(s) for a certain variable is useful, regardless of whether forecasts are generated by econometric models or judgemental methods.

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[5] Using combinations of forward-looking variables and s_t^{mc} was not a particularly successful strategy either in terms of reducing the RMSFE. In no case was forecasting performance better than when four-variate model including s_t^{mf} as the only survey data variable was used.

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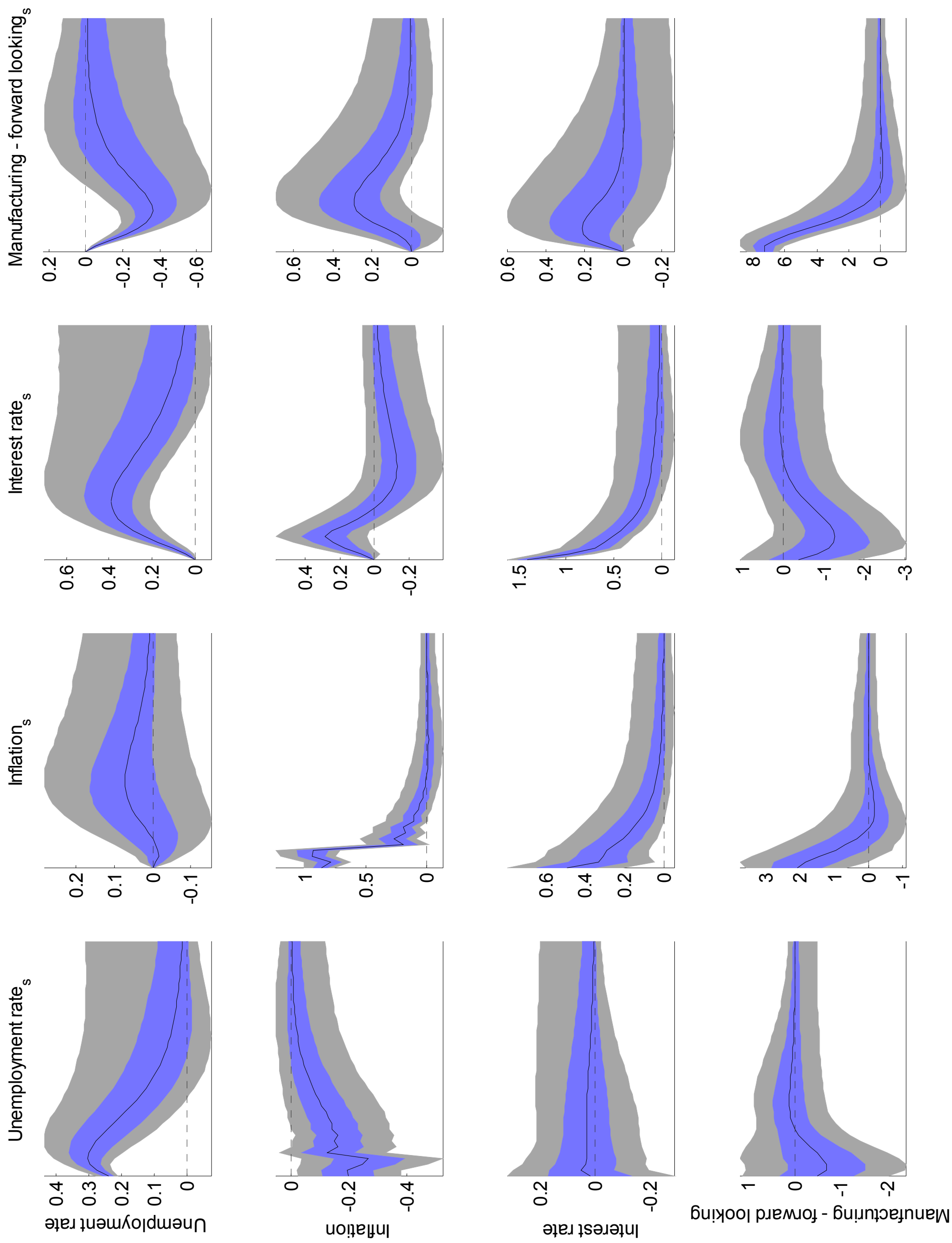
Appendix

Table A1. RMSFEs for estimated models.

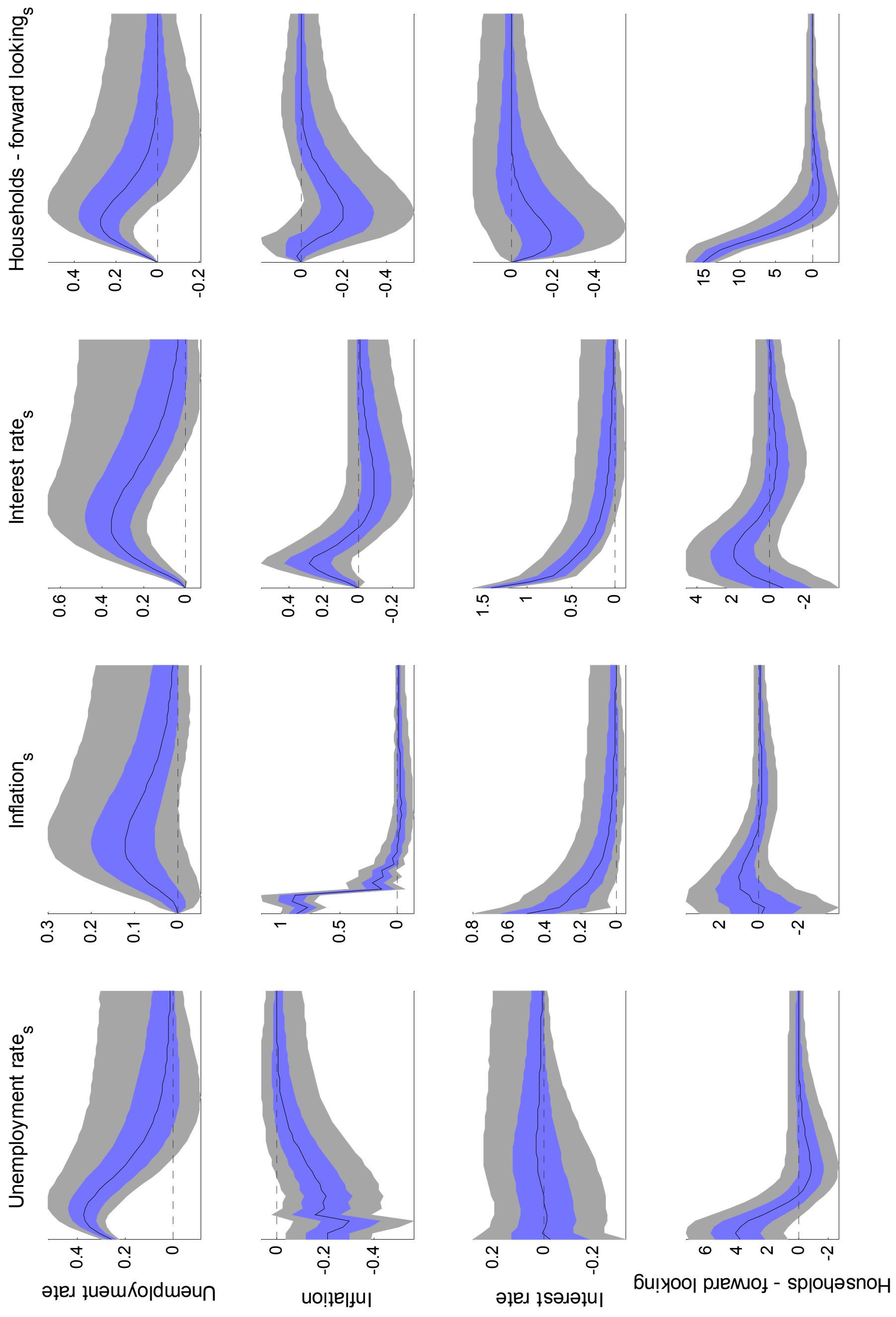
	Horizon in quarters			
	1	**2**	**3**	**4**
$\mathbf{x}_t = (u_t \quad \Delta p_t \quad i_t)'$	0.225	0.343	0.467	0.552
$\mathbf{x}_t = (u_t \quad \Delta p_t \quad i_t \quad s_t^{cc})'$	0.228	0.367	0.493	0.586
$\mathbf{x}_t = (u_t \quad \Delta p_t \quad i_t \quad s_t^{mc})'$	0.216	0.350	0.492	0.626
$\mathbf{x}_t = (u_t \quad \Delta p_t \quad i_t \quad s_t^{cf})'$	0.216	0.331	0.451	0.545
$\mathbf{x}_t = (u_t \quad \Delta p_t \quad i_t \quad s_t^{mf})'$	0.198	0.287	0.427	0.518
$\mathbf{x}_t = (u_t \quad \Delta p_t \quad i_t \quad s_t^{hf})'$	0.220	0.331	0.466	0.571
$\mathbf{x}_t = (u_t \quad \Delta p_t \quad i_t \quad s_t^{cf} \quad s_t^{mf})'$	0.200	0.293	0.430	0.524
$\mathbf{x}_t = (u_t \quad \Delta p_t \quad i_t \quad s_t^{cf} \quad s_t^{hf})'$	0.217	0.324	0.453	0.559
$\mathbf{x}_t = (u_t \quad \Delta p_t \quad i_t \quad s_t^{mf} \quad s_t^{hf})'$	0.217	0.324	0.453	0.559
$\mathbf{x}_t = (u_t \quad \Delta p_t \quad i_t \quad s_t^{cf} \quad s_t^{mf} \quad s_t^{hf})'$	0.206	0.304	0.449	0.554

Figure A1. Impulse response functions from four-variate model using forward-looking data from the manufacturing industry.



Note: Black line is the median. Coloured bands are 68 and 95 percent confidence bands. Maximum horizon is 40 quarters.

Figure A2. Impulse response functions from four-variate model using forward-looking data from households.



Note: Black line is the median. Coloured bands are 68 and 95 percent confidence bands. Maximum horizon is 40 quarters.

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