Mainly Employment: Survey-Based News and the Business Cycle

Riccardo M. Masolo[†]

July 29, 2022

Abstract

Surprises in survey responses on news heard about business conditions explain a large share of the business cycle variation in labor market variables and real macro aggregates. They produce strong comovement in unemployment, vacancies, consumption, investment, and output, and a muted response of inflation and measured Total Factor Productivity. Reports about changes in labor market conditions are the key driver of the overall business conditions index.

Vector Autoregression impulse-responses can be matched by a New-Keynesian DSGE in which individual risk is modeled explicitly and the assumption of free entry into vacancies is relaxed.

JEL Codes: C30, E31, E32.

Keywords: Consumer Surveys, Unemployment, Business Cycles, Search Frictions, Individual Risk.

1 Introduction

Survey responses distill lots of information about the economy that would otherwise be hard to capture. They provide an insight into "news consumers see but we do not see" (Cochrane, 1994, p. 296). I use data from the University of Michigan Survey of Consumers (UMSC) to identify the main driver of business cycles based on what consumers report.

Survey participants are asked whether they have heard of favorable or unfavorable changes in business conditions over the last few months. Responses are summarized in an index called *News Heard of Recent Changes in Business Conditions*. The survey also inquires about the nature

[†]Bank of England and Centre for Macroeconomics. Contact: rmmasolo@gmail.com

I am grateful to Tommaso Aquilante, Federico Di Pace, Michele Piffer, Ricardo Reis, Vincent Sterk, Francesco Zanetti, and various conference participants, for their comments and suggestions.

of the news. As a result, I do not have to restrict my attention *a priori* to a particular shock, e.g. Total Factor Productivity (TFP) news.

I identify *business conditions shocks* exploiting a simple timing restriction in a Vector Autoregression (VAR): as the survey asks about changes in business conditions over *the last few months*, the business conditions index is a naturally predetermined variable.

I establish three main empirical results. First, *business conditions shocks* explain a large share of business cycle fluctuations: about half of the variation in unemployment, and more than a third of the variation in output. However, they are largely unrelated to inflation and measured TFP (Fernald, 2014).
Second, they produce strong business-cycle like comovements. A positive *business conditions shock* leads to a contemporaneous increase in output, consumption, and investment. Unemployment falls, while vacancies increase, describing a movement along a Beveridge curve. However, inflation does not respond much at all. A shock to business conditions produces what looks like a non-inflationary aggregate demand shock. The muted response of inflation and TFP marks a clear difference relative to confidence shocks, a popular survey-based economic indicator. Barsky, Basu, and Lee (2014), using the measure of *consumer sentiment* from the UMSC, find that "to a large extent a news shock is a consumer confidence shock" (Barsky, Basu, and Lee, 2014, p. 239), where news refers to TFP news.[1]
Third, reports of changes in labor market conditions are the dominant driver of changes in the overall business conditions index.

Responses to *business conditions shocks* are in line with the so-called *business cycle anatomy* described by Angeletos, Collard, and Dellas (2020). Relative to Angeletos, Collard, and Dellas (2020), however, I can restrict the source of the shock to the labor market. A successful model will thus have to produce the observed comovement among macro aggregates in response to labor-market related shocks, orthogonal to TFP.

Labor-market disturbances, such as shocks to the job-destruction rate or matching efficiency, tend to drive output and inflation in opposite directions, and unemployment and vacancies in the same direction, in state-of-the-art representative-agent New Keynesian models with search frictions (Monacelli, Perotti, and Trigari, 2010).[2]

I thus consider two key modifications.[3] First, I model capitalists and workers separately, along

[1]Barsky, Basu, and Lee (2014) summarizes the key properties of a TFP news shock. First, TFP news anticipate future changes in TFP. In other words, measured TFP responds to TFP news. Second, positive TFP news cause a fall in inflation, in line with New-Keynesian logic: positive TFP news decreases future expected marginal costs, which in turn affect the pricing decision of forward-looking firms. Third, oftentimes identified TFP news shocks cause investment and consumption impact responses to have opposite signs (in line with the classic result in Barro and King, 1984).

[2]See Ravn and Sterk (2017) for an excellent discussion of the effects of job separation on vacancies and unemployment and the role played by unemployment risk.

[3]I defer a complete discussion of the model features, e.g. the decision to model capital and labor as complements,

the lines of Ravn and Sterk (2021). The former own firms and make the investment decision. The latter face unemployment risk. While employed, they live off wages and save in government bonds. When out of work, they live off savings and home production. An improved labor market outlook will reduce the need for precautionary savings and boost aggregate demand. The resulting inflationary pressure will compensate for the deflationary effects of a reduction in job separations. The end result is a muted inflation response to a surprise change in labor-market conditions, with no need for an unrealistically flat Phillips curve.

Second, I consider a reduced elasticity of vacancies to business conditions, in light of recent work (Coles and Moghaddasi Kelishomi, 2018; Broer, Druedahl, et al., 2021) that traces the counterfactual positive correlation between unemployment and vacancies in response to labor-market shocks to vacancies being infinitely elastic to the state of the economy. An idiosyncratic vacancy-opening cost will make for a procyclical response of vacancies to a reduction in job separations, in line with my VAR evidence.

The end product is a Tractable Heterogeneous Agent Model (THANK) in which two labor-market related shocks – a shock to job separation and one to the cost of vacancy opening – produce impulse responses in line with those from my VAR. The model does not require an overly flat Phillips curve, nor high investment-adjustment costs or consumption habits. Nor do I need a combination of a host of different shocks to match the observed covariances. It is thus robust to the criticism leveled by Angeletos, Collard, and Dellas (2020) to quantitative New Keynesian models (Justiniano, Primiceri, and Tambalotti, 2010; Christiano, Motto, and Rostagno, 2014): that they can reproduced observed empirical regularities only by relying on a constellation of shocks, flat Phillips curves, and a number of real frictions.

This paper supports the view that a single shock can explain a large fraction of business cycle variations in real variables (Angeletos, Collard, and Dellas, 2020). That shock is orthogonal to present and future TFP and to inflation. I trace its origin to the labor market and present a DSGE model with search-and-matching frictions that can reproduce the observed comovement.

Related Literature. The use of survey data in macroeconomics has long been considered an effective way to increase the information content of VARs (Beaudry and Portier, 2014). The business conditions index has been used by Barsky and Sims (2012) to study how it associates with consumer confidence. I retain the benefit of using the rich set of questions about business conditions, but my focus is different. Barsky and Sims (2012) study how business conditions news correlate with innovations from their VAR specifications. I focus on the effects that surprises in reports about business conditions have on the economy and show that, while correlated with

the modeling of the wealth distribution, and the wage-setting scheme, to section 3.

consumer confidence, they differ along some economically relevant dimensions, most notably their impact on inflation.

Barsky and Sims (2012) note that reports of news heard about the labor market and prices are the most frequent. From an economic perspective, however, the two produce markedly different effects. In particular, inflation responds immediately and significantly to the latter, but not to the former (details in Appendix B.1). Reports of changes in labor market conditions are the key driver of the overall business conditions index.

Business conditions shocks represent surprising reports by consumers about news heard over recent months, made orthogonal to past realizations of macro variables. They thus bear a similarity to news shocks (Barsky and Sims, 2012, section IV).

The extent to which TFP news can drive the business cycle is the subject of an open debate. Angeletos, Collard, and Dellas (2020) make a strong case for why it is not plausible that TFP news be an important driver of the business cycle. Chahrour, Chugh, and Potter (2021) argue that the max-share variance approach to identifying the *Main Business Cycle* shock, proposed by Angeletos, Collard, and Dellas (2020), produces long-term variations in measured TFP, if lower frequencies are also considered and the covariance of output and hours is targeted, as opposed to an individual variable. They interpret their findings as supportive of TFP news being an important determinant of the business cycle. Faccini and Melosi (2021) also make a case for noisy TFP news in an estimated DSGE.

I approach the problem from a different angle. My VAR analysis does not set off to necessarily explain a large share of the variance in macro aggregates and is completely agnostic with regards to TFP. Responses to *business conditions shocks* turn out not to correlate with TFP.[4] Rather, they associate with reports of changes in labor market conditions.

My paper is thus in line with work by Angeletos, Collard, and Dellas (2020), Barsky, Basu, and Lee (2014), and Shimer (2005), among others, who challenge the idea that TFP news have the potential to explain business cycles, in particular due to the weak comovement between TFP and labor market variables.

I also contribute to a relatively small literature that tries to isolate *which* type of news is most important. Schmitt-Grohé and Uribe (2012) and Miyamoto and Nguyen (2020) tackle this question using DSGE models. Schmitt-Grohé and Uribe (2012) find an important role for anticipated wage markup shocks, which, in turn, relate to the labor wedge (Shimer, 2009). My analysis points in the same direction, while taking full advantage of the flexibility of a VAR model, which is particularly popular in the news literature (Cochrane, 1994; Beaudry and Portier, 2006; Barsky and Sims, 2011; Barsky and Sims, 2012; Beaudry and Portier, 2014; Kurmann and Sims, 2021; Ramey, 2016).

[4]Even if I extend the IRF out to 60 quarters, the response of TFP is not significantly different from zero, even at the 68 percent level.

I then present a model in which labor-market related shocks can explain a substantial share of business cycle variation, if individual risk and the elasticity of vacancies are properly modeled. Angeletos, Collard, and Dellas (2020) show that state-of-the-art New Keynesian DSGEs can reproduce the observed covariance among macro variables only by a constellation of shocks, each of which would struggle to generate the observed pattern in isolation. In a companion paper, Angeletos, Collard, and Dellas (2018) propose a model with autonomous variations in higher-order beliefs that could match some of these key features, which do not however directly include unemployment and other labor-market aggregates.

Mapping reports of surprising changes in labor market conditions from the VAR into structural shocks in a DSGE poses a challenge – see Beaudry and Portier (2013) for a parallel discussion regarding demand shocks. I take the most conservative approach. I require my model to reproduce the observed comovements only relying on shocks that are directly related to the labor market but orthogonal to TFP. Moreover, I restrict the attention to the two labor-market shocks that are able to reproduce the salient features of the data in isolation. This ensures that the resulting fit cannot be the result of compensating effects from the two shocks. Moreover, the fact that these two shocks produce qualitatively similar responses means I do not have enough information to separately identify them. Hence the decision to use both for my baseline.

The model I propose takes, as a starting point, a long tradition of representative-agent New Keynesian DSGE with search-and-matching frictions (Mortensen and Pissarides, 1994), such as Monacelli, Perotti, and Trigari (2010), which in turn builds on Gertler and Trigari (2009). As mentioned above, these models are not consistent with my empirical findings, in particular with regards to the muted inflation response.[5]

The extension builds on a recent literature on Tractable Heterogeneous Agent Models (e.g. Bilbiie, 2019). The closest model to mine is Ravn and Sterk (2021). Oftentimes, tractability is obtained by assuming that there is no liquidity in the economy, i.e. every agent consumes her income every period. A degree of liquidity is not only realistic but helps the quantitative performance of the model. I thus consider a moderate degree of liquidity, in the sense of Cui and Sterk (2021), which retains a high degree of tractability. The reduced elasticity of vacancies to the state of the economy relates to recent work by Coles and Moghaddasi Kelishomi (2018) and Broer, Druedahl, et al. (2021), and the complementarity between capital and labor is in line with work by Gechert et al. (2021) among others.

I put the model to the test by conducting an impulse-response matching exercise, to have full control over the set of shocks the model can use to explain the observed relationship among macro

[5] Theodoridis and Zanetti (2016) show more comprehensively, that labor-market news do not produce realistic comovement among macro variables in a quantitative representative-agent model with search-frictions and labor-market news.

variables (Chahrour, Chugh, and Potter, 2021). A few papers estimate HANK models (Auclert and Rognlie, 2022; Acharya et al., 2021). The one I consider is amenable to standard solution and estimation techniques, so it is related to Bilbiie, Primiceri, and Tambalotti (2022) and, in particular, to Chahrour, Chugh, and Potter (2021) who opt for an impulse-response matching approach.

There have been various noteworthy attempts to model the propagation of news shocks in DSGEs, e.g. Jaimovich and Rebelo (2009). Den Haan and Kaltenbrunner (2009), as well as more recent related work by Chahrour, Chugh, and Potter (2021), focus on the propagation of news shocks in a model with search frictions, which implies a forward-looking behavior of labor-market participants. All these papers consider real models which, as such, have no implication for the behavior of inflation and nominal rates and focus on TFP news.

Beaudry and Portier (2013) are the first, to my knowledge, to move away from the representative-agent paradigm to explain news-driven, non-inflationary cycles. My work also relates to recent papers that model individual unemployment risk and agent heterogeneity: Den Haan, Rendahl, and Riegler (2018), Mckay and Reis (2020), Challe (2020) are prominent examples, when restricting the attention to those including a search-and-matching mechanism (HANK-SAM). Broer, Druedahl, et al. (2021) specifically focus on the importance of unemployment risk when modeling business-cycle fluctuations.

2 Empirical Analysis

I estimate a series of Bayesian Structural VARs. Their reduced-form counterpart can be expressed as:

$$Y_t = A(L) Y_{t-1} + u_t, \tag{1}$$

where Y_t is a vector of macro variables, $A(L)$ a matrix polynomial in the lag operator L, $\mathbb{E}[u_t] = 0$, $\mathbb{E}\left[u_t u_t'\right] = \Sigma$, $\mathbb{E}\left[u_t u_{t-j}'\right] = 0 \; \forall j \geq 1$.

The *business conditions shock* is an element of the vector ε_t, defined as $u_t = C\varepsilon_t$, such that $\mathbb{E}\left[\varepsilon_t \varepsilon_t'\right] = I$, and $CC' = \Sigma$. I exploit a key feature of the survey question under consideration to identify the column of C corresponding to the business conditions shock.

The survey asks: "During the last few months, have you heard of any favorable or unfavorable changes in business conditions?". The "last few months" qualification makes the resulting variable predetermined. Moreover, when the survey is administered, figures for the current-period macro variables are yet to be released, so clearly they do not form part of the responders' information set.[6] This simple timing restriction is all I need to identify business conditions shocks,

[6]An exception to this are the weekly releases of unemployment claims, which I will consider in one of my ro-

a standard Cholesky identification scheme. The business conditions index will not respond contemporaneously to any time-t macro variable, thus the corresponding column of C will be all zero except for the row corresponding to the index itself.

A timing identification assumption is more restrictive the longer the period under consideration. I will thus establish some key results in the context of a monthly VAR and also exploit intra-monthly information where possible. I will then consider quarterly specifications so that I can include a larger set of macro variables, easily compare my findings to the existing literature, and have a benchmark for the theoretical model.[7]

The survey question of interest becomes available at a monthly frequency from 1978 onwards. Monthly VARs are thus estimated over the 1978-2019 sample. Variables are in log-levels – with the exception of interest rates and unemployment – and I include 12 lags of each observable. Quarterly specifications extend back to 1965. For ease of comparison, quarterly VAR specifications primarily follow the variable definitions in Angeletos, Collard, and Dellas, 2020 and include four lags.

I adopt Minnesota priors with hyperparameters optimized as in Giannone, Lenza, and Primiceri (2015).[8]

2.1 Monthly VAR

My baseline monthly specification, includes the UMSC index of reported business conditions, alongside unemployment, industrial production, the Consumer Price Index (CPI) and the the 2-year interest rate.[9]

A positive *business conditions shock* induces a large, persistent, and significant reduction in unemployment (Figure 1). Industrial production increases and so do interest rates. This pattern would paint the picture of a standard demand shock, except for the fact that prices hardly move. A *business conditions shock* is strongly procyclical, explains about half of the variation in unemployment and industrial production (Figure 2), but is largely orthogonal to inflation. The response pattern is robust to estimating the VAR on shorter samples – either the post-1984 sample or the Great Moderation sample (Appendix B.1).[10]

bustness checks.

[7] I will also estimate some mixed-frequency specifications in which a core of monthly variables (the index of business conditions, and measures of unemployment, industrial production, prices, and interest rates) is complemented with some quarterly series, presented in Appendix B.1.

[8] I use the Matlab routine developed by Ferroni and Canova (2020).

[9] I use the 2-year rate in line with Gertler and Karadi (2015) and Swanson and Williams (2014), who suggest using one or two-year rates as a better indicator of the monetary policy stance. My results do not depend on this choice, as will become clear in the specifications which include Fed Funds Rates instead.

[10] The responses do not critically depend on the choice of priors either. In Appendix B.1 I overlay IRFs from an OLS estimation to my Minnesota prior baseline.

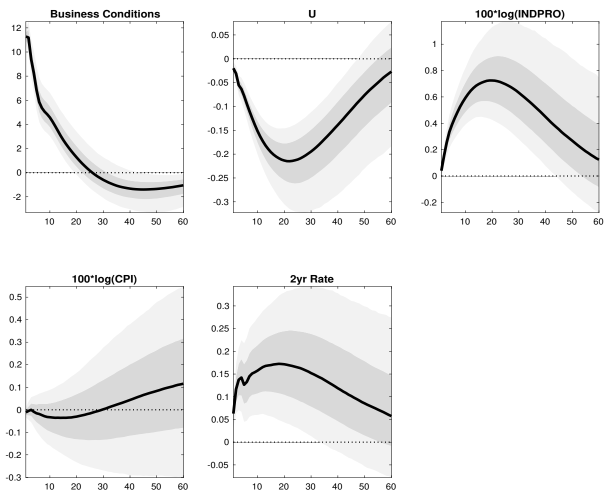


Figure 1: Monthly, 12-lag, Bayesian VAR including the business bonditions index, unemployment, industrial production, CPI and the 2-year interest rate. Median response in black with 68 and 95 percent credible sets in gray.

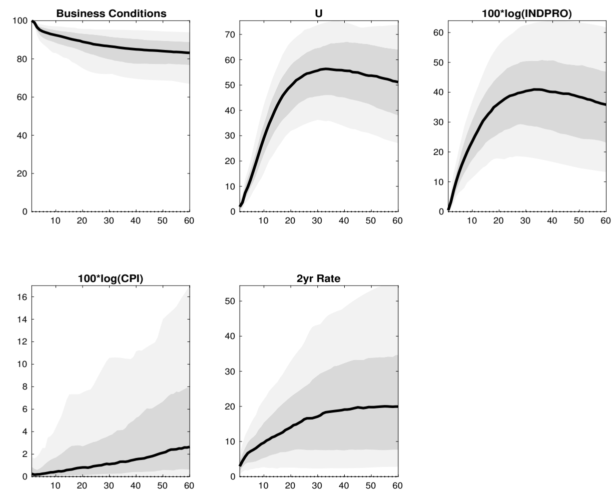


Figure 2: Share of forecast-error variance explained by a business condtions shock. Median response in black with 68 and 95 percent credible sets in gray.

In keeping with the macroeconomic literature, I also consider a specification in which the Cholesky ordering is reversed, and the business conditions shock is made orthogonal to current realizations of macro variables, in spite of the timing restriction implied by the question and the release schedule of macroeconomic indicators. The key findings are robust to this (Appendix B.1), a strong indication that the business conditions index genuinely Granger causes the other macro variables (Barsky and Sims, 2012).

What is a business conditions shock? By construction, the business conditions index summarizes reports of economic news of different nature. Respondents are also asked what kind of news they heard. There are 79 tabulated valid answers. Each responder can select up to two, which are aggregated into eight sub-indices: employment/unemployment, prices, demand conditions, government, credit conditions, stock markets, international trade, and energy crisis.

A principal-component analysis of the sub-indices reveals that the first principal component is almost perfectly correlated with the employment conditions index (correlation coefficient of .998), explains two thirds of the overall variance (66.5 percent) and, as a consequence, strongly correlates (.816) with the overall index. Figure 3, reports the time series plots of the overall index, the employment index and the first principal component. It visually confirms the strong comovement between the series.[11]

If I consider the 79 tabulated answers directly, two stand out. The ”Drop in employment, less

[11]By comparison, the second principal component, highly correlated with the prices sub-index (correlation coefficient of .867), explains only 11.3 percent of the overall variance. Details are presented in Appendix C.

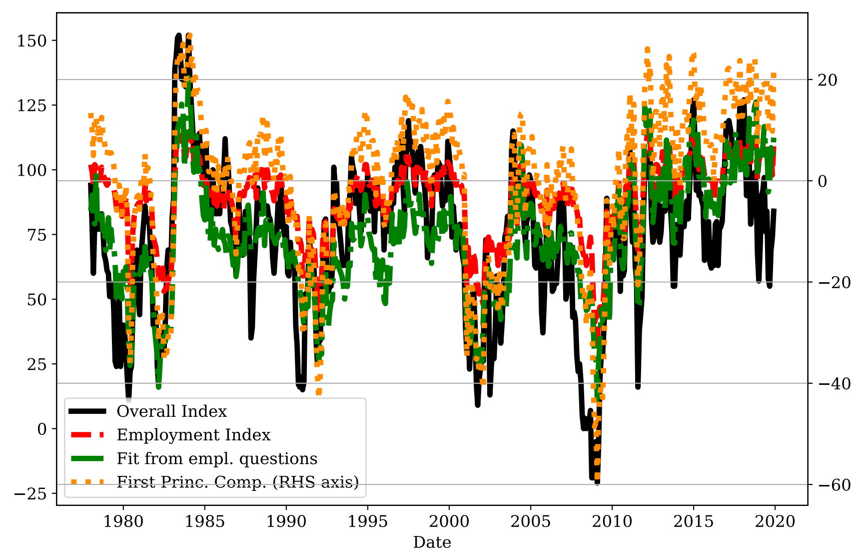


Figure 3: Overall business conditions index (black solid), employment index (red dashed), first principal component (orange dotted), fitted values from a regression of the overall index onto the two key tabulated answers (green dash-dotted).

overtime" answer represents about 9 percent of valid answers.[12] "Employment is high, plenty of jobs" is selected by 4.7 percent of responders. These two responses, combined, represent 13.7 percent of the total but explain close to 60 percent of the variation in the overall business conditions index, and 90 percent of the variation in the employment sub-index (Appendix C). Figure 3 illustrates how well the overall index can be fitted at business cycle frequencies using just two of the 79 possible answers.

News heard about employment conditions are clearly the main driver of the overall index and strong predictors of the business cycle. Figure 4 reports the impulse-responses to a shock in the employment sub-index. The responses mimic those to the overall index.[13]

2.1.1 Controlling for information

In line with the recommendation to combine stock prices and survey information to increase the informational content of a VAR (Beaudry and Portier, 2014), I consider specifications that include measures of consumer and professional expectations, stock prices and weekly information about unemployment claims. My findings do not depend on omitting relevant information.

[12]Discrepancies relative to the shares reported on the UMSC webpage are due to me considering the sample up to the end of 2019, to adding up answers to the first and second questions (NEWS1 and NEWS2), and to computing the shares relative to valid answers of responders who reported hearing of any change in business conditions at all.

[13]I report VAR specifications in which the first principal component replaces the business conditions index in Appendix C. The sign and magnitude of the responses are in line with those reported here.

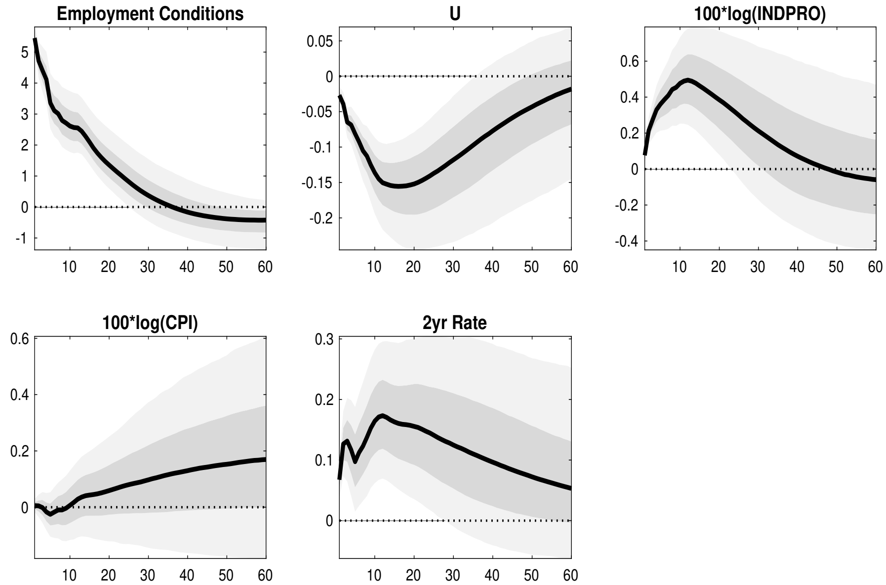


Figure 4: Monthly, 12-lag, Bayesian VAR including the employment sub-index, unemployment, industrial production, CPI and the 2-year interest rate. Median response in black with 68 and 95 percent credible sets in gray.

Consumer Sentiment and Inflation Expectations. The UMSC consumer sentiment series is a popular measure of consumer business cycle expectations. I include it, alongside the UMSC measure of inflation expectations and a measure of stock prices. Both sentiment and stock prices display a strong contemporaneous response to the business conditions shock, while inflation expectations hardly move (Figure 5). The responses of the main macro aggregates are largely unaffected.[14]

The business conditions index is positively correlated with consumer sentiment and yet there are clear differences in the propagation of surprises in these two survey indicators. As illustrated by Barsky, Basu, and Lee, 2014, confidence shocks are deflationary and anticipate future changes in TFP. Neither is true for business conditions - I will present the response of TFP in the next section.

Professionals' Unemployment Expectations. Professionals' forecasts are regarded as extremely accurate and timely (Ang, Bekaert, and Wei, 2007). Revisions to unemployment forecasts from the Survey of Professional Forecasters (SPF) can be considered a proxy for unemployment news (Ricco, Callegari, and Cimadomo, 2016). I thus add the revision, over a quarter, of the one-

[14]My key findings survive if I make the the business conditions shock orthogonal to the contemporaneous realization of all these variables (Figure B.8) and if I additionally include expectations about the 5-year economic outlook (Figures B.3).

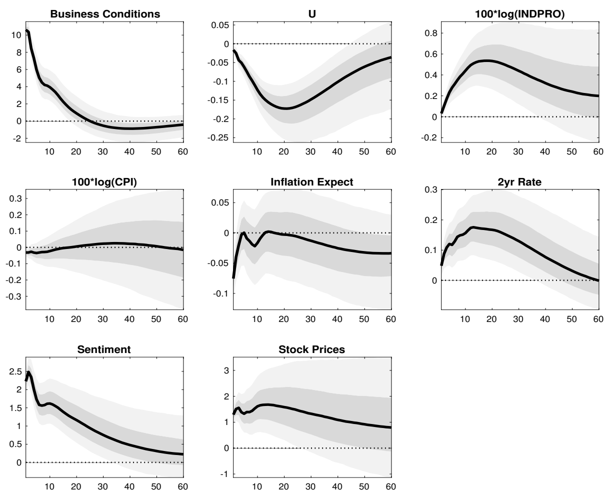


Figure 5: Impulse responses from a monthly VAR that includes consumer sentiment, inflation expectations and stock prices. Median response in black with 68 and 95 percent credible sets in gray.

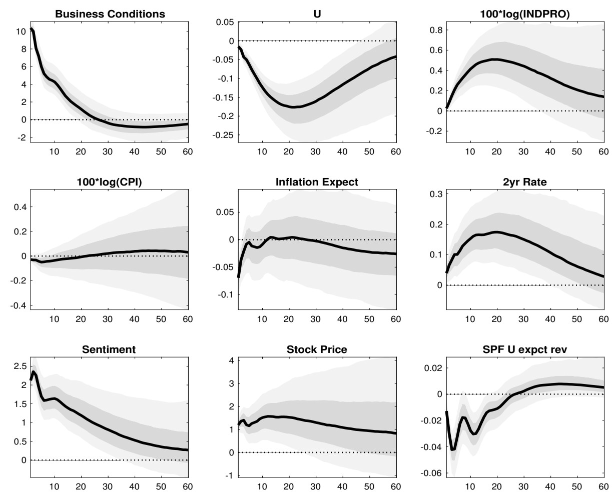


Figure 6: Impulse Responses from a mixed-frequency VAR that includes revisions of SPF unemployment forecasts. Median response in black with 68 and 95 percent credible sets in gray.

year ahead forecast for unemployment to my VAR.[15]

Reports of positive developments in business conditions associate with downward revisions in professionals' forecasts for unemployment (Figure 6). The responses of the other variables are in line with my baseline.[16]

Consumer responses capture genuine developments in labor market conditions, that are reflected in professional forecasters revising down their expectations for unemployment. Controlling for information from professionals, however, does not change the impulse responses in a meaningful way. Consumer reports retain their information content even controlling for professionals' expectations.

Weekly Information. Though the survey question explicitly asks about the "past few months", it could be that responses reflect economic developments for the current month. Having established the connection between the business conditions index and labor market conditions, I exploit the weekly frequency of the unemployment claims releases, a prominent intra-monthly

[15]The quarterly nature of the SPF survey makes for a mixed-frequency VAR. For mixed frequency VARs, I do not optimize over the prior hyperparameters. Rather I set them based on the optimized values for similar specifications which do not include quarterly variables.

[16]In the Appendix I show that these findings are robust even when I focus exclusively on employment news (Figure **??**). Making the monthly series for business conditions orthogonal to a quarterly series from the SPF is clearly unrealistic. However, for the sake of showing the robustness of the covariance between the business conditions index and the macro variables, I also report a specification in which business conditions are made orthogonal to contemporaneous realizations of the SPF forecast revisions (Figure B.7). Though smaller in magnitude, and less precisely estimated, responses of macro variables line up well with my baseline.

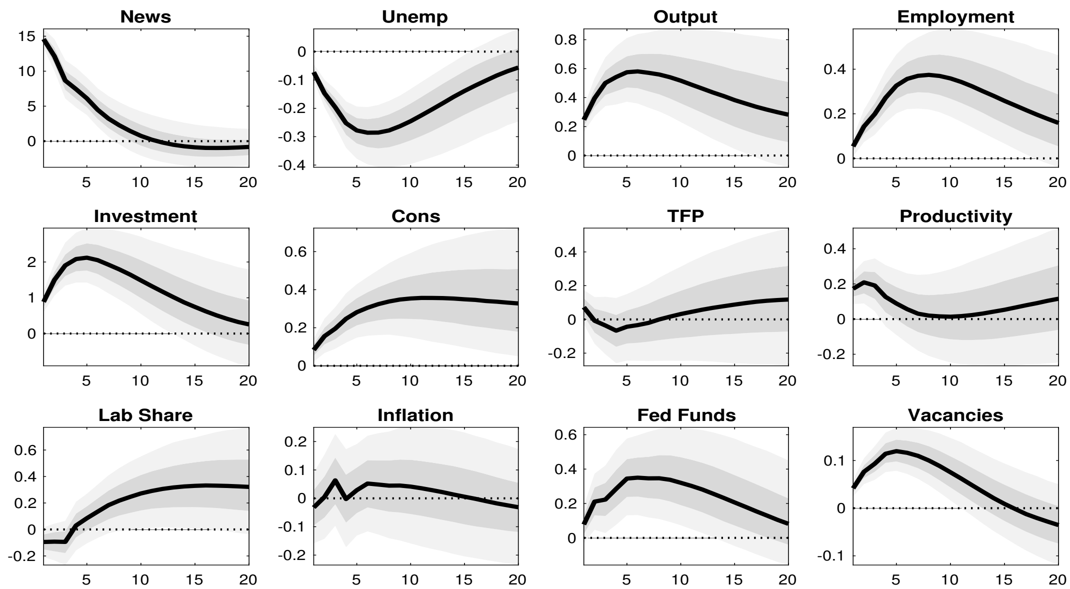


Figure 7: Impulse responses from my baseline quarterly VAR specification. Median response in black with 68 and 95 percent credible sets in gray.

labor market indicator. My findings are robust to controlling for unemployment claims for the second week of the month, which can be available to the most informed survey respondents (Appendix B.1).

2.2 Quarterly VAR

A quarterly specification allows me to consider a larger set of variables, to produce a benchmark for the theoretical model, and to compare my results to a wider literature.

The variable selection primarily follows Angeletos, Collard, and Dellas (2020) who include unemployment, output, hours, investment, consumption, TFP (Fernald, 2014), labor productivity, the labor share, inflation and the Fed Funds rates. I make two amendments. I replace hours with employment, which is immaterial for the results but more in line with the specification of my model. I add a measure of vacancies based on Barnichon (2010).[17]

Figure 7, reports the responses to a surprise in the business conditions index. Consistent with the findings from the previous section, output, hours and the interest rate all increase significantly and persistently, while unemployment falls and inflation hardly moves. Consumption and investment display a strong positive comovement, a well known business cycle regularity. Measured TFP does not respond instead.

[17] This limits the sample to 2016, but does not significantly affect my estimates, given the long sample starting in 1965.

Importantly, the response of vacancies is strongly procyclical. The *business conditions shock* causes unemployment and vacancies to move along a Beveridge curve. It behaves like a non-inflationary demand shock. This evidence is difficult to reconcile with TFP news (Barsky, Basu, and Lee, 2014) which typically imply deflationary pressures and negative comovement between investment and consumption in macro models (Barro and King, 1984).

The business conditions shock bears a striking similarity to the *Main Business Cycle* shock, identified by Angeletos, Collard, and Dellas (2020)[18] not only in terms of the signs of the responses, but also with regards to magnitudes and the timing of the peak effect.

Angeletos, Collard, and Dellas (2020) emphasize the agnostic nature of their identification scheme, the use of survey information enables me to characterize the source of the shock and disciplines the theoretical exercise I turn to next.

3 Model

My empirical analysis restricts the set of candidate structural shocks. Shimer (2005) sets the standard for search-and-matching models of the labor market aiming to explain business cycle fluctuations in unemployment. It considers two shocks, to TFP and to job-separation. My empirical analysis rules out the former. Standard DSGE models would not be able to match up to my VAR evidence with a job-separation shock either.

In a representative agent New-Keynesian model with search frictions, job-separation shocks are deflationary and induce a positive correlation between vacancies and unemployment (Monacelli, Perotti, and Trigari, 2010). This is primarily due to the representative-agent assumption and the excessive elasticity of vacancy creation to business conditions.

I do away with both. I model workers and capitalists separately. Capitalists own firms and capital. Workers are subject to uninsurable unemployment risk, which I model as in the Tractable HANK (THANK) literature (Ravn and Sterk, 2021 and Cui and Sterk, 2021).[19] In this economy, the reduction in unemployment brought about by a fall in job separations reduces the precautionary saving motive, thus boosting aggregate demand. This compensates for the otherwise deflationary

[18] In Appendix B.2 I present the exact comparison. I also report the quarterly counterpart to my baseline monthly specification. Moreover, I consider VARs in which I only use the labor-market conditions sub index, or limit the business conditions index to the survey responses collected in the first month of the quarter to make the timing restriction essentially monthly. The variance decomposition shows that the business conditions shock explains close to half of the variation in unemployment, about a third of the variation in output, employment, investment and vacancies, a quarter of the variation in consumption and some 15 percent of the variation in interest rates, but does not explain a significant proportion of the variation in TFP, labor productivity, and inflation. Finally, Appendix C features a mixed-frequency specification in which consumption and investment are added to an otherwise monthly VAR to provide further evidence with regards to their comovement.

[19] I assume that workers face a cost upon losing their job, equal, for simplicity, to the level of their quarterly home production. This enables me to increase the level of liquidity in the economy while maintaining tractability.

effects of the shock. Moreover, as capital productivity increases, capitalists finance a higher level of investment, which leads to positive comovement between consumption and investment.

Free entry into vacancies implies an infinite elasticity of vacancies to underlying economic conditions. I specify a stochastic cost of vacancy creation, along the lines of Coles and Moghaddasi Kelishomi (2018) and Broer, Druedahl, et al. (2021). Only firms drawing a sufficiently low vacancy-opening cost will open one. This makes the elasticity of vacancy creation more realistic and results in a pro-cyclical response of vacancies.

These two modifications make the responses to a job-separation shock consistent with my VAR evidence. My empirical analysis rules out TFP shocks and disturbances that are not directly related to the labor market. This leaves two more candidate shocks: a shock to matching efficiency and one to the cost of vacancy opening. Only the latter is able to match up to my VAR findings, while the former generates the wrong comovement between vacancies and unemployment.

Two minor changes, relative to a canonical New-Keynesian DSGE with search-and-matching frictions are also worth noting. Wealth heterogeneity would, in general, lead to wage heterogeneity.[20] This would make the comparison to a representative-agent model more involved. I thus assume that workers enter the labor market via an employment agency, whose bargaining problem compares directly to that of a representative agent. Also, I allow for complementarity between capital and labor inputs. A realistic degree of complementarity helps the quantitative performance of the model, especially with regards to the investment response, as it boosts capital productivity when employment rises.

3.1 Setup

The economy is populated by a continuum of measure one of households. A fraction $0 < \mathfrak{w} < 1$ are workers, the rest are capitalists. Workers, can be employed or unemployed. I maintain that a *moderate* level of liquidity (in the sense of Cui and Sterk, 2021) is provided by government debt. This means that employed workers will hold strictly positive levels of savings but will find it optimal to use up all their accumulated savings in the first period of unemployment. As a result, the number of periods of continuous employment, h, is a sufficient statistic for the wealth distribution.

3.1.1 Capitalists.

Households $i \in [\mathfrak{w}, 1]$ are capitalists. They do not supply labor but own a differentiated portfolio of all the firms in the economy. Just like all the other agents in the economy, they face a borrowing

[20]Discussions of the effects wealth heterogeneity on wage determination go back to Gomes, Greenwood, and Rebelo (1997), and, more recently, Krusell, Mukoyama, and Şahin (2010).

constraint, which is set to zero.
A capitalist solves the following optimization:

$$\max_{C_{i,t+j},H_{i,t+j+1},B_{i,t+j+1}} \quad \mathbb{E}_t \sum_{j=0}^{\infty} \beta^j \frac{C_{i,t+j}^{1-\sigma_\mathbf{k}}}{1-\sigma_\mathbf{k}}, \tag{2}$$

$$\text{s.t.} \quad C_{i,t} + p_t^H H_{i,t+1} + B_{i,t+1} = \frac{R_{t-1}}{\Pi_t} B_{i,t} + \left(p_t^H + d_t\right) H_{i,t} + T_{i,t}, \tag{3}$$

$$B_{i,t+1} \geq 0, \tag{4}$$

where $C_{i,t}$ is consumption for agent i in period t and $\sigma_\mathbf{k}$ governs the elasticity of intertemporal substitution for capitalists. $H_{i,t}$ are stock holdings,[21] $B_{i,t}$ bond holding, $T_{i,t}$ government transfers, p_t^H stock prices (in units of consumption); d_t are dividends, R_t the nominal short-term rate set the by the Central Bank, and Π_t consumption price inflation. Each capitalist starts off with stock holdings $H_{i,t} = \frac{1}{1-\mathfrak{w}}$ and bond holdings $B_{i,t} = 0$. They have no incentive to change their portfolio holdings over time, so their problem will be the same in every period and I can consider a representative capitalist.
The precautionary saving motive of employed workers will cause the real rate of interest to be smaller than $1/\beta$ in and around steady state. As a result, the capitalists' borrowing constraint will be binding and they will consume the income in each period.
So, the capitalists' problem can be characterized by the following two equations:

$$p_t^H = \beta \mathbb{E}_t \frac{C_{\mathbf{k},t+1}^{-\sigma_\mathbf{k}}}{C_{\mathbf{k},t}^{-\sigma_\mathbf{k}}} \left(p_{t+1}^H + d_{t+1}\right), \tag{5}$$

$$C_{\mathbf{k},t} = \frac{d_t}{1-\mathfrak{w}} + T_{\mathbf{k},t}, \tag{6}$$

where I define $C_{\mathbf{k},t}$ and $T_{\mathbf{k},t}$ as the consumption and transfers of the representative capitalist.

3.1.2 Workers

Workers' participation decision. At the start of the period, workers decide whether to participate in the labor market or live off their home production and any accumulated savings (autarky). To enter the labor market, they have to strike a deal with an employment agency that will cost them a fraction τ^A of their wage when employed and of their home production (ϑ) when unemployed.

I will focus on the limit case in which $\tau^a \rightarrow 0$. It avoids transfers or resources across agent types, which may have confounding effects for the analysis, while producing a wage-setting pro-

[21] More precisely, one could think of $H_{i,t}$ as shares in a mutual funds that owns all the firms in the economy.

cess that compares more directly to the representative-agent literature.

In equilibrium, no worker will opt for autarky, as she would forego the opportunity of current (if employed) or future (if unemployed) employment – I present the details in Appendix D.

Employed Workers' consumption-saving decision. The consumption-saving decision is made after matches have occurred. Employed workers supply labor $N_{i,t} = 1$. With probability $(1-\rho_t)$, their current employment contract will terminate at the end of the period. If so, with probability $\mathfrak{p}_{t+1}$ they will be matched to a new employer at the start of period $t+1$, else they will become unemployed. So $\mu_{t+1} \equiv \rho_t + (1-\rho_t)\,\mathfrak{p}_{t+1}$ is the probability of being employed in period $t+1$, conditional on being employed in period t. They face uninsurable unemployment risk, as they can only save in non-state contingent bonds.

The level of savings is the only source of heterogeneity among workers. If liquidity in the economy is sufficiently low, all newly unemployed will exhaust all their savings in their first period out of work. As a consequence, all newly employed workers will start off with zero wealth and make the same economic decisions. Ultimately, all workers having been in business employment for h periods will behave identically. I will refer to h as a cohort of workers. After a sufficiently long spell of uninterrupted employment, workers will have built up their saving buffer: their levels of consumption and savings will be all but the same across cohorts. So it is enough to keep track of a finite number of cohorts, H, with the understanding that cohort H includes all those that have been continually employed for H periods or longer.[22]

Defining $\mathbf{V_e}\left(B_{i,t}\right)$ as the value function of an employed worker entering period t with wealth $B_{i,t}$, and $\mathbf{V}_{\mathbf{u},0}\left(B_{i,t}\right)$ the corresponding value function of a *newly* unemployed worker, I can write the employed worker's problem as:

$$
\begin{aligned}
\mathbf{V_e}\left(B_{i,t}\right) \quad &= \quad \max_{C_{i,t},B_{i,t+1}} \frac{C_{i,t}^{1-\sigma_{\mathbf{w}}}}{1-\sigma_{\mathbf{w}}} + \beta \mathbb{E}_t \left\{\mu_{t+1}\mathbf{V_e}\left(B_{i,t+1}\right) + (1-\mu_{t+1})\,\mathbf{V}_{\mathbf{u},0}\left(B_{i,t+1}\right)\right\}, && (7)\\
\text{s.t.} \quad & C_{i,t} + B_{i,t+1} = \frac{R_{t-1}}{\Pi_t} B_{i,t} + w_t - T_{i,t} \text{ if employed}, && (8)\\
& C_{i,t} + B_{i,t+1} = \frac{R_{t-1}}{\Pi_t} B_{i,t} - T_{i,t} \text{ if } \textit{newly} \text{ unemployed}, && (9)\\
& B_{i,t+1} \geq 0, && (10)
\end{aligned}
$$

where w_t is the real wage and $T_{i,t}$ the transfer to employed workers - I will maintain that all workers are subject to the same transfers $T_{i,t} = T_{\mathbf{w},t}$.

Given the envelope condition, $\frac{\partial \mathbf{V_e}\left(B_{i,t}\right)}{\partial B_{i,t}} = \frac{R_{t-1}}{\Pi_t} C_{i,t}^{-\sigma_{\mathbf{w}}}$, and the fact that all workers in the same

[22] The determination of H is a numerical question. In my baseline specification keeping track of 40 cohorts is enough to obtain a well defined problem, in line with the findings of Cui and Sterk (2021).

cohort make the same decision, the Euler equation for cohort h reads:

$$C_{\mathbf{e},h,t}^{-\sigma_{\mathrm{w}}} = \beta\mathbb{E}_t\frac{R_t}{\Pi_{t+1}}\left\{\mu_{t+1}C_{\mathbf{e},h+1,t+1}^{-\sigma_{\mathrm{w}}} + (1-\mu_{t+1})\,C_{\mathbf{u},0,h+1,t+1}^{-\sigma_{\mathrm{w}}}\right\} \quad \forall\, h = 0, ..., H-1, \tag{11}$$

$$C_{\mathbf{e},H,t}^{-\sigma_{\mathrm{w}}} = \beta\mathbb{E}_t\frac{R_t}{\Pi_{t+1}}\left\{\mu_{t+1}C_{\mathbf{e},H,t+1}^{-\sigma_{\mathrm{w}}} + (1-\mu_{t+1})\,C_{\mathbf{u},0,H,t+1}^{-\sigma_{\mathrm{w}}}\right\} \quad h = H, \tag{12}$$

reflecting the fact that, in period $t+1$, a cohort-h agent from period t will belong to cohort $h+1$, either employed or newly unemployed. That is not the case for cohort H, which an agent will belong to, so long as she remains employed.

The Euler equations, alongside the budget constraints, pin down the consumption level and bond holdings of each cohort of employed workers.

Unemployed workers' consumption-saving decision. When making her consumption decision, an unemployed agent is no longer able to search for work in the current period ($N_{i,t} = 0$). Next period she will find occupation with probability $\mathfrak{p}_{t+1}$. In anticipation of higher future income, she would like to borrow. Her borrowing constraint will thus be binding and her consumption will be determined by her financial wealth, home production and any transfer.

There are two key differences between *newly* unemployed and all other unemployed workers. The former start the period with positive liquid wealth, but do not benefit from home production for the first period of unemployment. This can be rationalized as workers incurring a one-off expense upon losing their job, e.g. relocation expenses, corresponding to the value of home production, or simply needing time to become productive at home.[23] The latter have no bond-holdings left but can consume ϑ units of home-produced goods each period.

A *newly* unemployed worker with savings $B_{i,t}$, faces the following problem:

$$\mathbf{V}_{\mathbf{u},0}\left(B_{i,t}\right) = \max_{C_{i,t},B_{i,t+1}} \frac{C_{i,t}^{1-\sigma_{\mathrm{w}}}}{1-\sigma_{\mathbf{w}}} + \beta\mathbb{E}_t\left\{\mathfrak{p}_{t+1}\mathbf{V}_{\mathbf{e},0}\left(B_{i,t+1}\right) + (1-\mathfrak{p}_{t+1})\,\mathbf{V}_{\mathbf{u}}\left(B_{i,t+1}\right)\right\}, \tag{13}$$

$$\text{s.t.} \quad C_{i,t} + B_{i,t+1} = \frac{R_{t-1}}{\Pi_t}B_{i,t} + w_t - T_{i,t} \text{ if employed,} \tag{14}$$

$$C_{i,t} + B_{i,t+1} = \frac{R_{t-1}}{\Pi_t}B_{i,t} - T_{i,t} \text{ if newly unemployed,} \tag{15}$$

$$C_{i,t} + B_{i,t+1} = \frac{R_{t-1}}{\Pi_t}B_{i,t} + \vartheta - T_{i,t} \text{ if unemployed for more than one period,} \tag{16}$$

$$B_{i,t+1} \geq 0, \tag{17}$$

where $\mathbf{V}_{\mathbf{u}}$ is the value function for workers that have been out of work for more than a period.

[23]This assumption is not essential to deliver the qualitative insights of the models, but it enables me to calibrate the level of liquidity to a more realistic value while maintaining the tractability benefits that follow from unemployed workers consuming all their savings in the first period out of work.

A sufficient condition for newly unemployed workers using up all the savings in the first period out of work is:

$$C_{\mathbf{u},0,H,t}^{-\sigma_{\mathrm{w}}} > \beta \mathbb{E}_t \frac{R_t}{\Pi_{t+1}} \left\{ \mathfrak{p}_{t+1} C_{\mathbf{e},0,t+1}^{-\sigma_{\mathrm{w}}} + (1 - \mathfrak{p}_{t+1}) C_{\mathbf{u},t+1}^{-\sigma_{\mathrm{w}}} \right\}, \tag{18}$$

where $C_{\mathbf{u},0,H,t}$ is the consumption level of a newly unemployed worker that would have belonged to cohort H if he was still employed, and $C_{\mathbf{u},t}$ the consumption of an agent unemployed for more than one period. Cohort-H workers have the largest saving buffer and level of consumption. As a consequence, $C_{\mathbf{u},0,H,t}^{-\sigma_{\mathrm{w}}} < C_{\mathbf{u},0,h,t}^{-\sigma_{\mathrm{w}}}$, $\forall\, h$. So, it is sufficient to verify the inequality in equation (18) for cohort H.[24]

If (18) holds as an inequality, then consumption of the newly unemployed will equal:

$$C_{\mathbf{u},0,h,t} = \frac{R_{t-1}}{\Pi_t} B_{\mathbf{e},h-1,t} - T_{\mathbf{w},t} \quad \forall\, 0 \leq h \leq H. \tag{19}$$

Since newly unemployed do not carry any savings to the following period, the problem of those unemployed for more than one period trivially implies that:

$$C_{\mathbf{u},t} = \vartheta - T_{\mathbf{w},t}. \tag{20}$$

3.1.3 Firms

All firms are owned by capitalists, hence they will discount their cash flows by the capitalists' marginal utility of consumption.

Labor-service providers. A unit measure of labor service providers decide whether to open vacancies. A matched vacancy will result in the production of a unit of labor services to be sold to wholesale good firms. Unfilled vacancies get destroyed at the same rate $1-\rho_t$ as are jobs (Coles and Moghaddasi Kelishomi, 2018).

The real value of an unfilled vacancy is $v_t^0 = -\iota + \beta \mathbb{E}_t \frac{C_{\mathrm{k},t+1}^{-\sigma_{\mathrm{k}}}}{C_{\mathrm{k},t}^{-\sigma_{\mathrm{k}}}} \rho_t \left[\mathfrak{q}_t v_{t+1}^1 + (1 - \mathfrak{q}_t) v_{t+1}^0 \right]$, where $\mathfrak{q}_t = \frac{M_t}{V_t}$ is the proportion of vacancies filled in period t, v_t^1 is the real value of a matched vacancy, and ι is the flow cost of keeping a vacancy open – I have dropped the firm-specific subscript to save on notation.

The value of opening a vacancy derives from the possibility of it turning into a productive match. The real value of a filled vacancy is $v_t^1 = p_t^N - w_t + \beta \mathbb{E}_t \frac{C_{\mathrm{k},t+1}^{-\sigma_{\mathrm{k}}}}{C_{\mathrm{k},t}^{-\sigma_{\mathrm{k}}}} \rho_t v_{t+1}^1$, where p_t^N is the price (in units of the final consumption good) that a unit of labor services sells for.

Unfilled vacancies are created by firms who draw an opportunity cost $c \leq v_t^0$, where $c = F_t x,\ x \in$

[24] Which can be easily verified in steady state and thus in its neighborhood.

$[0,1]$, $Pr\{x \leq x_0\} = x_0^{\psi_V}$, a Power-law distribution, scaled by F_t. This distribution of the vacancy-creating cost, delivers a law of motion for vacancies in line with the literature (Coles and Moghaddasi Kelishomi, 2018, and Broer, Druedahl, et al., 2021): $V_t = \rho_{t-1}(V_{t-1} - M_{t-1}) + \tilde{F}_t v_t^{0\psi_V} \quad \tilde{F}_t \equiv F_t^{-\psi_V}$. The first term on the right-hand side represents the surviving unmatched vacancies from the previous period, the second term is the flow of new vacancies.
The law of motion for the supply of labor-services is thus $N_t = \rho_{t-1}N_{t-1} + M_t = \rho_{t-1}N_{t-1} + \mathfrak{q}_t V_t$. Labor-service providers will bargain over the marginal surplus of filling a vacancy as opposed to keeping it unmatched $v_t = v_t^1 - v_t^0$. Real dividends from labor-service providers are $d_t^l = -\iota V_t + \left(p_t^N - w_t\right) N_t - \int_0^{v_t^0} c \, df(c)$.

Employment agency. Workers access the labor market through a representative employment agency, as described above. The agency's discounted cash-flow is:

$$\tau^a \mathbb{E}_t \sum_{j=0}^{\infty} \beta^j \frac{C_{\mathbf{k},t+1}^{-\sigma_\mathbf{k}}}{C_{\mathbf{k},t}^{-\sigma_\mathbf{k}}} \left(w_{t+j} N_t + \vartheta \left(\Lambda_t - N_t\right)\right), \tag{21}$$

where Λ_t is the number of workers under contract with the agency and N_t the number of workers under contract with the agency that are currently employed.
The agency maximizes the discounted cash flow subject to the law of motion for employed workers, determined by the search friction, $N_t = \rho N_{t-1} + \mathfrak{p}_t \left(\Lambda_t - \rho_{t-1} N_{t-1}\right)$.[25] The agency bargains for wages, given the surplus it obtains from having an additional employed worker $\eta_t = (w_t - \vartheta) + \beta \mathbb{E}_t \frac{C_{\mathbf{k},t+1}^{-\sigma_\mathbf{k}}}{C_{\mathbf{k},t}^{-\sigma_\mathbf{k}}} \rho \left(1 - \mathfrak{p}_{t+1}\right) \eta_{t+1}$. The surplus takes the conventional form in this class of models (Monacelli, Perotti, and Trigari, 2010), and is independent of τ^a. So the wage determination will be comparable to that from representative-agent models.

Around the steady state I consider, all workers will participate in the labor market and $\Lambda_t = \mathfrak{w}$, $\forall\, t$.

Wholesale Good Firm. A representative competitive wholesale good firm combines labor services and capital to produce good Y_t with the following CES technology:[26]

$$Y_t = A_t \left[\alpha \left(\kappa_t K_t\right)^{\frac{\nu-1}{\nu}} + (1-\alpha) N_t^{\frac{\nu-1}{\nu}}\right]^{\frac{\nu}{\nu-1}}, \tag{22}$$

where K_t is physical capital, accumulated according to $K_{t+1} = (1-\delta) K_t + \left(1 - S\left(\frac{I_t}{I_{t-1}}\right)\right) I_t$, where $S(\cdot)$ represents an investment-adjustment cost. Finally, it chooses the level of capital utilization

[25] The employment agency internalizes the search friction as it knows it will never be convenient for workers to opt for autarky.

[26] A_t can enter this way because I will treat it as a constant (or at most a stationary disturbance).

κ_t subject to cost $a(\kappa_t) = \frac{r^K}{\bar{a}}\left[e^{\bar{a}(\kappa_t - 1)} - 1\right]$ (Christiano, Motto, and Rostagno, 2014).

The discounted sum of dividends $\mathbb{E}_t \sum_{j=0}^{\infty} \beta^j \frac{C_{\mathbf{k},t+j}^{-\sigma_{\mathbf{k}}}}{C_{\mathbf{k},t}^{-\sigma_{\mathbf{k}}}}\left(p_{t+j}^Y Y_{t+j} - p_{t+j}^N N_{t+j} - I_{t+j} - a(\kappa_t) K_t\right)$ is maximized subject to the production function, and the law of motion for capital.

Firm decisions are characterized by the following first-order conditions:

$$
\begin{aligned}
\varphi_t &= \beta \mathbb{E}_t \frac{C_{\mathbf{k},t+1}^{-\sigma_{\mathbf{k}}}}{C_{\mathbf{k},t}^{-\sigma_{\mathbf{k}}}}\left(r_{t+1}^K - a(\kappa_{t+1}) + (1-\delta)\varphi_{t+1}\right), && (23)\\
p_t^N &= \varrho_t, && (24)\\
1 &= \varphi_t\left[\left(1 - S\left(\frac{I_t}{I_{t-1}}\right)\right) - S'\left(\frac{I_t}{I_{t-1}}\right)\frac{I_t}{I_{t-1}}\right] + \beta \mathbb{E}_t \frac{C_{\mathbf{k},t+1}^{-\sigma_{\mathbf{k}}}}{C_{\mathbf{k},t}^{-\sigma_{\mathbf{k}}}} S'\left(\frac{I_{t+1}}{I_t}\right)\frac{I_{t+1}^2}{I_t^2}\varphi_{t+1}, && (25)\\
r_t^K &= a'(\kappa_t)\kappa_t, && (26)
\end{aligned}
$$

where φ_{t+j} is the Lagrange multiplier on the law of motion for capital, and I define
$r_t^K = p_t^Y \alpha (A_t \kappa_t)^{\frac{\nu-1}{\nu}}\left(\frac{Y_t}{K_t}\right)^{\frac{1}{\nu}}$ and $\varrho_t = p_t^Y (1-\alpha) A_t^{\frac{\nu-1}{\nu}}\left(\frac{Y_t}{N_t}\right)^{\frac{1}{\nu}}$.

Intermediate Good Firms. Each firm $i \in [0,1]$ buys $Y_{i,t}$ units of the wholesale good, and differentiates it into good $Z_{i,t}$ according to $Z_{i,t} = Y_{i,t}$. Intermediate-good firms receive a subsidy τ, so that their *net* real marginal cost is $MC_t = (1-\tau)p_t^Y$. They face a decreasing demand function $Z_{i,t} = \left(\frac{P_{i,t}}{P_t}\right)^{-\epsilon} Z_t$ in a monopolistically competitive market. They are subject to a nominal friction á la Rotemberg (1982) and maximize the discounted flow of future dividends, which results in the following Phillips-curve relationship:

$$
1 - \psi\left(\frac{\Pi_t}{\Pi^{1-\zeta}\Pi_{t-1}^{\zeta}} - 1\right)\frac{\Pi_t}{\Pi^{1-\zeta}\Pi_{t-1}^{\zeta}} + \psi\beta\mathbb{E}_t \frac{C_{\mathbf{k},t+1}^{-\sigma_{\mathbf{k}}} Z_{t+1}}{C_{\mathbf{k},t}^{-\sigma_{\mathbf{k}}} Z_t}\left(\frac{\Pi_{t+1}}{\Pi^{1-\zeta}\Pi_t^{\zeta}} - 1\right)\frac{\Pi_{t+1}}{\Pi^{1-\zeta}\Pi_t^{\zeta}} = \epsilon(1 - MC_t), \qquad (27)
$$

where I allow for indexation to past inflation according to $\Pi^{1-\zeta}\Pi_{t-1}^{\zeta}$.

Final Good Firm. A competitive firm buys intermediate goods and bundles them according to $Z_t = \left[\int_0^1 Z_{i,t}^{\frac{\epsilon-1}{\epsilon}} di\right]^{\frac{\epsilon}{\epsilon-1}}$. The cost-minimization problem, together with the zero-profit condition, results in the demand function $Z_{i,t} = \left(\frac{P_{i,t}}{P_t}\right)^{-\epsilon} Z_t$ and the price index $P_t = \left[\int_0^1 P_{i,t}^{1-\epsilon} di\right]^{\frac{1}{1-\epsilon}}$. The final good can be converted one for one into investment and consumption.

3.1.4 Matching

Employment and Unemployment. Matches are formed at the start of each period and resolved at the end, at an exogenous rate $1-\rho_t$. Aggregate employment thus evolves according to $N_t = \rho_{t-1}N_{t-1} + \mathfrak{p}_t J_t$, where $J_t = \mathfrak{w} - \rho N_{t-1}$ is the number of job seekers at the start of period t. Unemployment is defined as $U_t = \frac{\mathfrak{w}-N_t}{\mathfrak{w}}$.

Surplus and wage. The total surplus is defined as $S_t = \upsilon_t + \eta_t = \overline{w}_t - \underline{w}_t$. $\overline{w}_t = p_t^N + \iota + \beta \mathbb{E}_t \frac{C_{\mathrm{k},t+1}^{-\sigma_\mathrm{k}}}{C_{\mathrm{k},t}^{-\sigma_\mathrm{k}}} \rho \left(1-\mathfrak{q}_t\right) \upsilon_{t+1}$ is the maximum acceptable wage to labor-service providers, while $\underline{w}_t = \vartheta - \beta \mathbb{E}_t \frac{C_{\mathrm{k},t+1}^{-\sigma_\mathrm{k}}}{C_{\mathrm{k},t}^{-\sigma_\mathrm{k}}} \rho \left(1-\mathfrak{p}_{t+1}\right) \eta_{t+1}$, the minimum acceptable wage for the employment agency.
The Nash-bargained wage is $w_t^* = \omega \overline{w}_t + (1-\omega)\, \underline{w}_t$. Following the literature (Hall, 2005; Ravn and Sterk, 2017), I allow for a more flexible wage process that nests both pure Nash-bargaining, as well as fixed wages: $w_t = \psi_w w_{ss} + (1-\psi_w)\, w_t^*$. I will estimate ψ_w as part of my impulse-response matching exercise.

Matching. Matches are formed according to the following technology: $M_t = \Xi_t J_t^\gamma V_t^{1-\gamma} = \Xi_t V_t \theta_t^{-\gamma}$, where $\theta \equiv \frac{V_t}{J_t}$ is labor-market tightness. It follows then that $\mathfrak{q}_t = \frac{M_t}{V_t} = \Xi_t \theta_t^{-\gamma}$.

3.1.5 Government and Central Bank

For simplicity, I assume away government spending, and denote with a superscript S the supply of bonds. The government budget-constraint (in real terms) is $B_{t+1}^S = \frac{R_{t-1}}{\Pi_t} B_t^S + \tau p_t^Y Z_t - T_t$.
I maintain that the government will set $T_t = \left(\frac{R_{t-1}}{\Pi_t} - 1\right) B^S + \tau p_t^Y Z_t$ so as to maintain a constant level of debt.
Capitalists bear the cost of financing the production subsidy, as they are the only beneficiaries of it. All agents share the cost of government debt, as they all have access to the bond market. So the government will levy a lump-sum amount $T_{\mathrm{w},t} = \left(\frac{R_{t-1}}{\Pi_t} - 1\right) B^S$ on workers, and $T_{\mathrm{k},t} = \frac{\tau p_t^Y Z_t}{1-\mathfrak{w}} + \left(\frac{R_{t-1}}{\Pi_t} - 1\right) B^S$ on capitalists.
The central bank sets nominal rates according to $R_t = R_{t-1}^{1-\rho_{MP}} \left(R_t^{\text{flex}} \Pi_t^{1+\phi} \left(\frac{U_t}{U_t^{\text{flex}}}\right)^{-\phi_u} \right)^{1-\rho_{MP}}$, where I maintain that the inflation target equals steady state inflation and both equal 1. The *flex* superscript refers to the flexible-price counterpart to the corresponding variable. In the numerical exercise I will consider variations on this specification, in which the output gap replaces the unemployment gap, and in which the central bank does not respond to the flexible-price interest rate.

3.1.6 Market Clearing

Clearing on the stock market implies $H_{\mathbf{k},t} = \frac{1}{1-\mathfrak{w}}$, where the supply of stocks is normalized to 1. On the wholesale goods market it has to be that $\int_0^1 Y_{i,t}\, di = Y_t$, which implies $Z_t = Y_t$, in symmetric equilibrium, in which all firms set the same price.
Clearing on the bonds market requires $\int B_{i,t+1}\, di = B^S$. Only employed workers will hold positive amounts of bonds, so the integral can be expressed as a sum across cohorts $\mathfrak{w}\,(1-U_t)\sum_h \varkappa_{h,t} B_{\mathbf{e},h,t+1} = B^S$. $\varkappa_{h,t}$ is the share of cohort-h agents, within the the population of employed workers.
Shares are defined by computing the probability that an individual worker has been in a continued employment spell for the last h periods:

$$\begin{aligned} \varkappa_{0,t} &= \mathfrak{p}_t \frac{U_{t-1}}{(1-U_t)}, && (28)\\ \varkappa_{h,t} &= \mu_t \varkappa_{h-1,t-1} \quad \forall\, 1 \leq h \leq H-1, && (29)\\ \varkappa_{H,t} &= 1 - \sum_{h=0}^{H-1} \varkappa_{h,t}. && (30) \end{aligned}$$

The definition of $\varkappa_{H,t}$ is just a normalization.[27]
Total consumption equals:

$$C_t = \mathfrak{w} U_t \left(\varkappa_{\mathbf{u},0,t} C_{\mathbf{u},0,t} + \left(1-\varkappa_{\mathbf{u},0,t}\right) C_{\mathbf{u},t}\right) + \mathfrak{w}\,(1-U_t)\, C_{\mathbf{e},t} + (1-\mathfrak{w})\, C_{\mathbf{k},t}, \tag{31}$$

where $C_{\mathbf{e},h,t} = \sum_{h=0}^{H} \varkappa_{h,t} C_{\mathbf{e},h,t}$ is the average level of consumption by employed agents, $C_{\mathbf{u},0,t} = \sum_{h=1}^{H+1} \varkappa_{h-1,t-1} C_{\mathbf{u},h,0,t}$ the average level of consumption by newly unemployed agents,[28] and $\varkappa_{\mathbf{u},0,t} = \frac{(1-\rho)(1-\mathfrak{p}_t)N_{t-1}}{\mathfrak{w} U_t}$ is the share of newly unemployed, within the population of all unemployed workers.
Finally, the resource constraint is given by:

$$Z_t + \mathfrak{w} U_t \left(1-\varkappa_{\mathbf{u},0,t}\right) \vartheta = C_t + I_t + \iota V_t + \frac{\psi_V}{\psi_V+1}\left(\frac{v_t^0}{F_t}\right)^{\psi_V+1} + a(\kappa_t) K_t + \frac{\psi}{2}\left(\frac{\Pi_t}{\overline{\Pi}^{1-\zeta}\Pi_{t-1}^{\zeta}} - 1\right)^2 Z_t. \tag{32}$$

On the left-hand side is the production of goods by firms and in the form of home production. The final good is used for consumption and investment purposes, as well as to pay the flow cost of a

[27] As H increases, its value will mechanically decrease. But this is irrelevant so long as the bond-holdings of agents in neighboring cohorts are practically identical for agents having been continuously employed for a sufficiently long number of periods.
[28] Note that the there cannot be cohort-0 unemployed, as that means that would have never left the unemployment pool in the first place.

vacancy, the vacancy-opening cost, the capital-utilization cost, and the price-adjustment cost.[29]

3.2 Calibration

I calibrate the parameters that affect the model's steady state. I set the share of workers to .9, as in Lansing (2015), the relative risk-aversion coefficient for workers $\sigma_{\mathbf{w}} = 1$ (log preferences), and the discount factor $\beta = .99$. These calibrated parameters, alongside the effect of individual risk, result in a steady state value of the annualized real interest rate of about 1 percent (.98 percent).

I set $\nu = .5$, which makes labor and capital gross complements. This represents a moderate degree of complementarity according to estimates in the literature (Gechert et al., 2021; Klump, McAdam, and Willman, 2012; Cantore et al., 2015; Di Pace and Villa, 2016). I calibrate the depreciation rate to $\delta = .025$, and $\alpha = .4$. Given these parameters, I set the steady state value of A_t to 1.6 to get a labor share of two thirds (66.7 percent).

The bargaining power of the employment agency (ω) and the elasticity parameter of the matching function (γ) are both set to .5, as in Monacelli, Perotti, and Trigari (2010). I set $\psi_V = .3$, the parameter which governs the elasticity of vacancy creation to the value of vacancies, and $\iota = 0$, the flow cost of keeping a vacancy open. Both are in the line with the values proposed by Coles and Moghaddasi Kelishomi (2018).

I calibrate the steady-state value of the job-continuation rate ρ to .9, which implies that the average match lasts two and a half years (Shimer, 2005). I target a value of labor-market tightness of .5 (Monacelli, Perotti, and Trigari, 2010), and a labor-finding probability $\mathfrak{p} = .7$.[30] This value corresponds to a monthly job-finding probability of about a third, in between the value of 25.2 percent used in Ravn and Sterk (2021) and that of 45 percent reported in Shimer (2005). Importantly, it implies a realistic value for steady state unemployment, of about 4.1 percent.

The calibration of the supply of bonds B^S and of home production ϑ is key to determining the level of individual risk, that of the real rate of interest, and whether the *moderate* liquidity condition in equation (18) is satisfied. I set them so that the fall in consumption of the median worker losing her job is of the order of 20 to 25 percent (Chodorow-Reich and Karabarbounis, 2016; Cui and Sterk, 2021; Ravn and Sterk, 2021).[31] These calibrations imply that the bond holdings of a cohort-H employed worker amount to about 12 weeks of his labor income, in line with

[29] Clearing on the labor market is trivially verified by noting that $\mathfrak{w} U_t 0 + \mathfrak{w}(1 - U_t) 1 + (1 - \mathfrak{w}) 0 = N_t$, where the left-hand side represents the labor supply of workers (both employed and unemployed) and capitalists and the left-hand side the labor demand.

[30] These two restrictions pin down the steady state values of F and Ξ.

[31] I set $B^S = 1$, $\vartheta = 1.3$, which imply that the median worker, in terms of wealth (cohort 23 of 40), losing her job will see her consumption fall by about 21.5 percent in her first period out of work, relative to her last period in employment. The consumption of a worker unemployed for more than a period is about 22.8 percent lower than that of the median employed worker.

the evidence that liquid savings are of the order of a few weeks of income even for wealthier households (Cui and Sterk, 2021).

Finally, I set the elasticity of substitution between intermediate-good varieties to 11 implying a markup of 10 percent,[32] and gross steady-state inflation $\Pi = 1$.

3.3 Impulse-Response Matching

3.3.1 Setup

An impulse-response matching exercise gives me full control as to the shocks used to explain the observed comovement of macro variables (Chahrour, Chugh, and Potter, 2021). I select the shocks based on two considerations.

My VAR analysis shows that reports of unexpected changes in labor market conditions, orthogonal to TFP, are key drivers of the business cycle. There are three labor-market related shocks in my model: a shock to job separation, one to matching efficiency, and one to (the distribution of) the cost of opening a vacancy. I have no information from the survey to narrow down my selection further.

My second requirement is that each shock, taken in isolation, should have a limited impact on inflation, induce positive comovement between consumption and investment, and a negative relationship between unemployment and vacancies. This is to avoid my model matching up to the VAR impulse responses in virtue of different shocks producing compensating effects.

This second restriction rules out the matching efficiency shock, as it fails to generate a negative comovement between unemployment and vacancies.[33]

As a result, my baseline impulse-response matching exercise will allow for shocks to job destruction and shocks to the cost of vacancy creation. I consider an underlying process:

$$x_t = \rho_x x_{t-1} + (1 - \theta_x)\, u_t^x + \theta_x u_{t-1}^x, \tag{33}$$

where $u_t^x \sim \mathcal{N}\left(0, \sigma_{u^x}^2\right)$ and independent over time. This functional form is general enough so as to allow for the shock under consideration to produce its effects starting in the current period or only in the future one (I will estimate θ_x) and to have some persistence ρ_x.
The actual shocks are modeled as:

$$\log(\rho_t) = \left(1 - \rho_\rho\right) \log\left(\rho_{ss}\right) + \rho_\rho \log(\rho_{t-1}) + u_t^\rho + \theta_\rho x_t \tag{34}$$

$$\log(\tilde{F}_t) = (1 - \rho_F) \log\left(\tilde{F}\right) + \rho_F \log(\tilde{F}_{t-1}) + u_t^F + \theta_F x_t. \tag{35}$$

[32] The production subsidy is set to the optimal value of $\tau = 1/\epsilon$.

[33] This is common the literature (Furlanetto and Groshenny, 2016) and remains true even in the THANK model with limited elasticity of vacancy creation I consider.

I will estimate both θ_ρ and θ_F so that the impulse-response matching procedure can attach different weights to the two shocks.

All and all, this represents a fairly flexible specification for the shock processes, which I will use in my Bayesian impulse response matching procedure (Christiano, Trabandt, and Walentin, 2011[34]).

In my baseline, I estimate the parameters pertaining to the forcing process ($\theta_x,\ \rho_x,\ \theta_\rho,\ \rho_\rho,\ \theta_F,\ \rho_F$),[35] the parameters of the monetary policy rule (ϕ, ϕ_u, ρ_R), and those governing the risk-aversion of capitalists ($\sigma_{\mathbf{k}}$), the utilization, price and investment adjustment costs ($\overline{a},\ \psi,\ S''$) and the degree of price indexation (ζ). Finally I estimate ψ_w, which governs the degree of wage stickiness.

3.3.2 Discussion

Table 1 reports prior and posterior information for the estimated parameters. Capitalists are estimated to be almost risk-neutral, an assumption often made in the literature (Ravn and Sterk, 2021). Investment-adjustment costs are estimated to be essentially zero. This contrasts with comparable, representative-agent models, such as Monacelli, Perotti, and Trigari (2010), in which investment-adjustment costs play a prominent role. Also, this model does not require an excessively flat Phillips curve. The prior mean for ψ would translate into a price duration of four quarters in a Calvo setting. Despite a large prior standard deviation, the posterior mean would correspond to an average price duration of less that four-and-a-half quarters. The monetary policy rule parameter estimates imply that nominal rates respond 1.7 times the deviation of inflation from target, in line with Taylor (1993) and the extensive literature that followed.

Importantly, the posterior mean for ψ_w is .87, i.e. the matching procedure favors a wage process that does not depart much from its steady state value. That of constant wages is a common assumption in this literature (Broer, Harbo Hansen, et al., 2020) and dates back all the way to Hall (2005).[36]

Figure 8 presents the resulting model responses. They display a strong negative comovement between unemployment and vacancies, positive covariance between consumption and investment, a pro-cyclical response of Fed Funds rates and a negligible change in inflation.

The model responses match up well quantitatively to their VAR counterparts. The boost in aggregate demand resulting from the reduced risk of unemployment compensates the otherwise deflationary nature of these shocks to deliver a muted inflation response with no need for an unrealistically flat Phillips curve. It also explains the rise in consumption.

[34] As implemented in Dynare by Gauthier (2021).

[35] σ_{u^x} cannot be identified separately from θ_F and θ_ρ. I thus normalize it to .02.

[36] Gertler, Huckfeldt, and Trigari (2020) provides new empirical evidence for why this may be a reasonable assumption in macro models, while Christiano, Eichenbaum, and Trabandt (2016) provides a possible microfoundation for wage stickiness.

The rise in investment is financed by enterpreneurs who take advantage of the heightened capital productivity resulting from the increase in employment. Complementarity between capital and labor boosts the response of investment from a quantitative standpoint.

Vacancies increase for two reasons. The distribution of the cost of opening one shifts lefts so, on average, opening a vacancy becomes cheaper. Moreover, the chance of vacancy being filled and thus becoming productive increases.

The procyclical response of the policy rate, in the face of a small deviation of inflation from target, follows from the fall in unemployment and the response of the central bank to R_t^{flex}.

Including R_t^{flex} in the policy rule is not strictly necessary though. Nor is wage stickiness. In Appendix E, I present an IRF-matching exercise in which I remove R_t^{flex} from the monetary policy rule, I rule out wage stickiness, I calibrate the slope of the Phillips curve – so as to avoid an increase in price stickiness to compensate for more flexible wages –, and remove investment-adjustment costs altogether.[37] Finally, I eliminate the autocorrelation in the underlying forcing process x_t ($\rho_x = 0$) to reduce the persistence built into the forcing process.

Despite all these restrictions, the model performs well and delivers all the key empirical styl-

[37]Requiring an unrealistically flat Phillips curve and frictions such as habits and investment adjustment costs are the main criticisms that Angeletos, Collard, and Dellas (2020) level at state-of-the-art representative-agent New-Keynesian DSGEs.

	prior mean	post. mean	10th	90th	prior	prior stdev
ρ_ρ	0.500	0.8011	0.7437	0.8461	beta	0.2000
ρ_F	0.500	0.2960	0.1151	0.4733	beta	0.2000
θ_ρ	0.500	0.0630	0.0444	0.0816	beta	0.2000
θ_F	0.500	0.5043	0.3779	0.6150	beta	0.2000
θ_x	0.500	0.2943	0.1256	0.4590	beta	0.2000
ρ_x	0.500	0.3062	0.1194	0.4961	beta	0.2000
$\sigma_{\mathbf{k}}$	0.500	0.0308	0.0068	0.0530	beta	0.2000
$\overline{a}$	1.000	1.0948	0.7163	1.5290	gamm	0.2500
ψ_w	0.500	0.8743	0.7980	0.9528	beta	0.2000
ψ	120.000	143.3507	96.7798	182.8451	norm	30.0000
ζ	0.500	0.4615	0.1670	0.8214	beta	0.2000
S''	3.000	0.0992	0.0454	0.1554	gamm	2.0000
ϕ_u	0.010	0.0131	0.0044	0.0255	gamm	0.0050
ϕ	0.500	0.7114	0.1753	1.1689	gamm	0.3000
ρ_R	0.500	0.4171	0.2224	0.6030	beta	0.2000

Table 1: Prior and posterior statistics for my baseline IRF-matching exercise. The columns represent the prior and posterior mean, the 10th and 90th percentile of the posterior draws, the prior distribution, and the prior standard deviation.

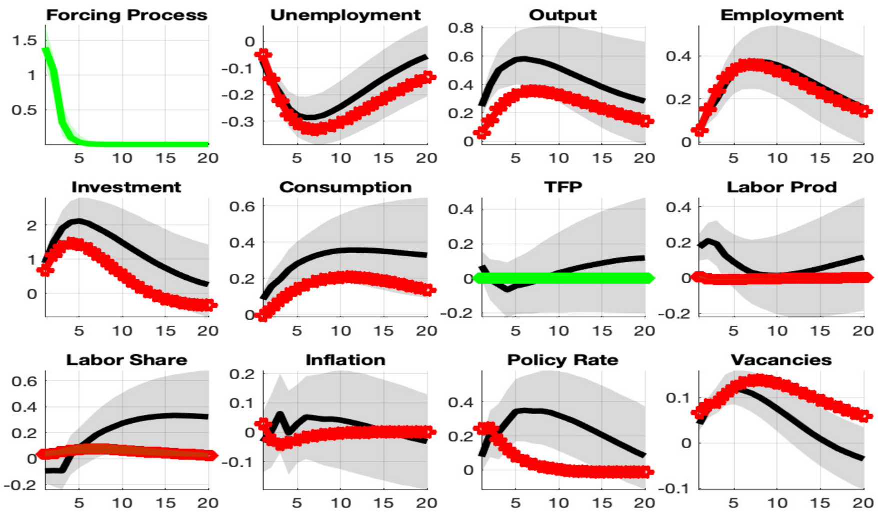


Figure 8: Impulse response matching to my quarterly VAR. Red lines represent impulse-responses from the model which are matched to the VAR responses, while green lines represent impulse responses that are not matched.

ized facts presented above.

Forcing the model to match up to the VAR responses using only one of the two shocks I consider in my baseline also works well (Appendix E). In particular, it is important to note that the comovement between unemployment and vacancies does not necessarily require a shock to the cost vacancies. A a shock to job-destructions also causes a pro-cyclical response of vacancies in this economy. The fact that the two shocks are largely isomorphic suggests that they are hard to identify separately, which is why I consider both in my baseline.

Finally, my findings are robust to using the VAR responses to a shock to the labor-market sub-index as a benchmark, and to a version of the monetary policy rule in which the unemployment gap is replaced by the output gap (Appendix E).

The model I propose can replicate the estimated comovement between macro variables using labor-market related shocks and without falling into Angeletos, Collard, and Dellas (2020) critique, i.e. using combinations of shocks, real frictions like investment-adjustment costs and consumption habits, and flat Phillips curves.

But what if shocks to TFP were the ultimate driver of the changes in business conditions reported by consumers and the muted response of *measured* TFP was only a form of mismeasurement? My model rules that out. I take my baseline estimates from Table 1 and calibrate the size and persistence of a TFP shock so that the responses for unemployment line up with those from my VAR.

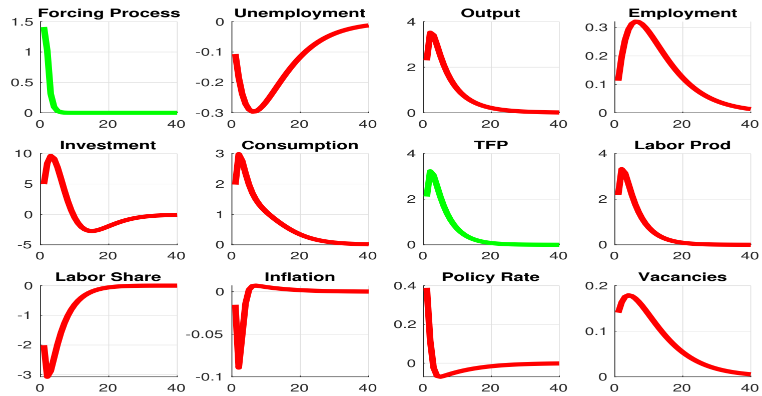


Figure 9: Responses to a TFP shock calibrated to match the peak response of unemployment. The model parameters are as in Table 1.

The resulting IRFs for labor market variables compare favorably to those from the VAR – Figure 9. The muted response of inflation and the procyclical response of the policy rate are also prima facie consistent with the empirical regularities.

However, this is not the case for the real macro aggregates. The profiles for output, consumption and investment are an order of magnitude larger than those I estimate. Correspondingly, the response of labor productivity is way too large. This is just another manifestation of the so-called *Shimer puzzle*: the volatility of labor productivity required to match up to business-cycle variations in unemployment and vacancies is unrealistically large (Shimer, 2005). Finally, the model would generate a strongly countercyclical response of the labor share, also inconsistent with the data.

4 Conclusion

Consumer reports about business conditions are strong predictors of the business cycle and informative with regards to its main driver. Surprising reports of improved labor market conditions associate with a boom in which consumption and investment both increase, while unemployment drops. Vacancies respond procyclically, while inflation and TFP do not.

The *business conditions shock* is consistent with the so-called business cycle anatomy, and explains a large share of the business cycle variation in unemployment and output. To that, it adds a clear indication as to the source of the shock: the labor market.

A New Keynesian DSGE can match up to these regularities with labor-market related shocks if it embeds unemployment risk and a realistic elasticity of vacancy creation to business conditions. Importantly, this model does not require a large number of shocks with compensating effects to explain the observed empirical regularities.

So ultimately this paper reconciles the idea that there is a main driver of business cycles, unrelated to measured TFP (Angeletos, Collard, and Dellas, 2020), with the importance of labor market disturbances in a search-and-matching model.

References

Acharya, Sushant et al. (2021). "Estimating HANK: Macro Time Series and Micro Moments". In: *mimeo*, p. 32.

Ang, Andrew, Geert Bekaert, and Min Wei (May 2007). "Do Macro Variables, Asset Markets, or Surveys Forecast Inflation Better?" In: *Journal of Monetary Economics* 54.4, pp. 1163–1212.

Angeletos, George-Marios, Fabrice Collard, and Harris Dellas (2018). "Quantifying Confidence". In: *Econometrica* 86.5, pp. 1689–1726.

— (2020). "Business-Cycle Anatomy". In: *American Economic Review* 110.10, pp. 3030–3070.

Auclert, Adrien and Matthew Rognlie (2022). "Estimatin HANK". In: *NBER Heterogeneous-Agent Macro Workshop*, p. 28.

Barnichon, Regis (2010). "Building a Composite Help-Wanted Index". In: *Economics Letters* 109.3, pp. 175–178.

Barro, Robert J. and Robert G. King (1984). "Time-Separable Preferences and Intertemporal-Substitution Models of Business Cycles". In: *Quarterly Journal of Economics*, pp. 154–177.

Barsky, Robert B and Eric R Sims (2012). "Information, Animal Spirits, and the Meaning of Innovations in Consumer Confidence". In: *American Economic Review* 102.4, pp. 1343–1377.

Barsky, Robert B., Susanto Basu, and Keyoung Lee (2014). "Whither News Shocks?" In: *NBER Macroeconomics Annual* 29.1.

Barsky, Robert B. and Eric R. Sims (2011). "News Shocks and Business Cycles". In: *Journal of Monetary Economics* 58.3, pp. 273–289.

Beaudry, Paul and Franck Portier (2006). "Stock Prices, News, and Economic Fluctuations". In: *American Economic Review* 96.4, pp. 1293–1307.

— (2013). "Understanding Non-Inflationary Demand Driven Business Cycles". In: *NBER Macroeconomics Annual* 28.

— (2014). "News Driven Business Cycles: Insights and Challenges". In: *Journal of Economic Literature* 52.4, pp. 993–1074.

Bilbiie, Florin (2019). "Monetary Policy and Heterogeneity". In: p. 73.

Bilbiie, Florin O., Giorgio E. Primiceri, and Andrea Tambalotti (2022). "Inequality and Business Cycles". In: *mimeo*.

Broer, Tobias, Jeppe Druedahl, et al. (2021). "The Unemployment-Risk Channel in Business-Cycle Fluctuations". In: *CEPR Discussion Paper*, p. 63.

Broer, Tobias, Niels-Jakob Harbo Hansen, et al. (2020). “The New Keynesian Transmission Mechanism: A Heterogeneous-Agent Perspective”. In: *The Review of Economic Studies* 87.1, pp. 77–101.

Cantore, Cristiano et al. (2015). “CES Technology and Business Cycle Fluctuations”. In: *Journal of Economic Dynamics and Control* 61, pp. 133–151.

Chahrour, Ryan, Sanjay K Chugh, and Tristan Potter (2021). “Anticipated Productivity and the Labor Market”. In: *mimeo*.

Challe, Edouard (2020). “Uninsured Unemployment Risk and Optimal Monetary Policy in a Zero-Liquidity Economy”. In: *American Economic Journal: Macroeconomics* 12.2, pp. 241–283.

Chodorow-Reich, Gabriel and Loukas Karabarbounis (2016). “The Cyclicality of the Opportunity Cost of Employment”. In: *Journal of Political Economy* 124.6.

Christiano, Lawrence J, Roberto Motto, and Massimo Rostagno (2014). “Risk Shocks”. In: *American Economic Review* 104.1, pp. 27–65.

Christiano, Lawrence J., Martin S. Eichenbaum, and Mathias Trabandt (2016). “Unemployment and Business Cycles”. In: *Econometrica* 84.4, pp. 1523–1569.

Christiano, Lawrence J., Mathias Trabandt, and Karl Walentin (2011). “DSGE Models for Monetary Policy Analysis”. In: *Handbook of Monetary Economics* 3.C.

Cochrane, John H. (1994). “Shocks”. In: *Carnegie-Rochester Conference Series on Public Policy* 41, pp. 295–364.

Coles, Melvyn G. and Ali Moghaddasi Kelishomi (2018). “Do Job Destruction Shocks Matter in the Theory of Unemployment”. In: *American Economic Journal: Macroeconomics* 10.3, pp. 118–136.

Cui, Wei and Vincent Sterk (2021). “Quantitative Easing”. In: *Journal of Monetary Economics* 123 (October), pp. 68–90.

Den Haan, Wouter J. and Georg Kaltenbrunner (2009). “Anticipated Growth and Business Cycles in Matching Models”. In: *Journal of Monetary Economics* 56.3, pp. 309–327.

Den Haan, Wouter J., Pontus Rendahl, and Markus Riegler (2018). “Unemployment (Fears) and Deflationary Spirals”. In: *Journal of the European Economic Association* 16.5, pp. 1281–1349.

Di Pace, Federico and Stefania Villa (2016). “Factor Complementarity and Labour Market Dynamics”. In: *European Economic Review* 82, pp. 70–112.

Faccini, Renato and Leonardo Melosi (2021). “Pigouvian Cycles”. In: *American Economic Journal: Macroeconomics* forthcoming.

Fernald, John G. (2014). “A Quarterly, Utilization-Adjusted Series on Total Factor Productivity”. In: *Federal Reserve Bank of San Francisco, Working Paper Series*, pp. 01–28.

Ferroni, Filippo and Fabio Canova (2020). “A Hitchhiker Guide to Empirical Macro Models”. In: *mimeo*.

Furlanetto, Francesco and Nicolas Groshenny (2016). “Mismatch Shocks and Unemployment During the Great Recession”. In: *J. Appl. Econ.*, p. 18.

Gauthier, David (2021). “Bank Shocks and the Debt Structure”. In: *SSRN Electronic Journal*.

Gechert, Sebastian et al. (2021). “Measuring Capital-Labor Substitution: The Importance of Method Choices and Publication Bias”. In: *Review of Economic Dynamics*.

Gertler, Mark, Christopher Huckfeldt, and Antonella Trigari (2020). “Unemployment Fluctuations, Match Quality, and the Wage Cyclicality of New Hires”. In: *Review of Economic Studies* 87.4, pp. 1876–1914.

Gertler, Mark and Peter Karadi (2015). “Monetary Policy Surprises, Credit Costs, and Economic Activity”. In: *American Economic Journal: Macroeconomics* 7.1.

Gertler, Mark and Antonella Trigari (2009). “Unemployment Fluctuations with Staggered Nash Wage Bargaining”. In: *Journal of Political Economy* 117.1, pp. 38–86.

Giannone, Domenico, Michele Lenza, and Giorgio E Primiceri (2015). “Prior Selection for Vector Autoregressions”. In: *The Review of Economic Studies*.

Gomes, Joao, Jeremy Greenwood, and Sergio Rebelo (1997). “Equilibrium Unemployment”. In: *NBER WORKING PAPER SERIES*.

Hall, Robert E (2005). “Employment Fluctuations with Equilibrium Wage Stickiness”. In: *American Economic Review* 95.1, pp. 50–65.

Jaimovich, Nir and Sergio Rebelo (2009). “Can News about the Future Drive the Business Cycle?” In: *American Economic Review* 99.4, pp. 1097–1118.

Justiniano, Alejandro, Giorgio E. Primiceri, and Andrea Tambalotti (Mar. 2010). “Investment Shocks and Business Cycles”. In: *Journal of Monetary Economics* 57.2, pp. 132–145.

Klump, Rainer, Peter McAdam, and Alpo Willman (2012). “The Normalized CES Production Function: Theory and Empirics”. In: *Journal of Economic Surveys* 26.5, pp. 769–799.

Krusell, Per, Toshihiko Mukoyama, and Ayşegül Şahin (Oct. 2010). “Labour-Market Matching with Precautionary Savings and Aggregate Fluctuations”. In: *Review of Economic Studies* 77.4, pp. 1477–1507.

Kurmann, André and Eric Sims (May 14, 2021). “Revisions in Utilization-Adjusted TFP and Robust Identification of News Shocks”. In: *The Review of Economics and Statistics* 103.2, pp. 216–235.

Lansing, Kevin J (2015). “Asset Pricing with Concentrated Ownership of Capital and Distribution Shocks”. In: *American Economic Journal: Macroeconomics* 7.4, pp. 67–103.

Mckay, Alisdair and Ricardo Reis (2020). “Optimal Automatic Stabilizers”. In: *Nber Working Paper Series* 22359 (June), pp. 1–65.

Miyamoto, Wataru and Thuy Lan Nguyen (2020). “The Expectational Effects of News in Business Cycles: Evidence from Forecast Data”. In: *Journal of Monetary Economics* 116, pp. 184–200.

Monacelli, Tommaso, Roberto Perotti, and Antonella Trigari (2010). "Unemployment Fiscal Multipliers". In: *Journal of Monetary Economics* 57.5, pp. 531–553.

Mortensen, D. T. and C. A. Pissarides (July 1, 1994). "Job Creation and Job Destruction in the Theory of Unemployment". In: *The Review of Economic Studies* 61.3, pp. 397–415.

Ramey, Valerie A (2016). "Macroeconomic Shocks and Their Propagation". In: *NBER*.

Ravn, Morten O. and Vincent Sterk (2017). "Job Uncertainty and Deep Recessions". In: *Journal of Monetary Economics* 90, pp. 125–141.

— (2021). "Macroeconomic Fluctuations with HANK & SAM: An Analytical Approach". In: *Journal of the European Economic Association* 19.2, pp. 1162–1202.

Ricco, Giovanni, Giovanni Callegari, and Jacopo Cimadomo (2016). "Signals from the Government: Policy Disagreement and the Transmission of Fiscal Shocks". In: *Journal of Monetary Economics* 82, pp. 107–118.

Rotemberg, Julio J. (1982). "Monopolistic Price Adjustment and Aggregate Output". In: *The Review of Economic Studies* 49.4, p. 517.

Schmitt-Grohé, Stephanie and Martín Uribe (2012). "What's News in Business Cycles". In: *Econometrica* 80.6, pp. 2733–2764.

Shimer, Robert (2005). "The Cyclical Behavior of Equilibrium Unemployment and Vacancies". In: *The American Economic Review* 95.1, pp. 25–49.

— (2009). "Convergence in Macroeconomics : The Labor Wedge". In: *American Economic Journal: Macroeconomics* 1.1, pp. 280–297.

Swanson, Eric T and John C Williams (2014). "Measuring the Effect of the Zero Lower Bound on Monetary Policy". In: *American Economic Review* 104.10, pp. 3154–3185.

Taylor, John B (1993). "Discretion Practice versus Policy Rules in Practice". In: *Carnegie-Rochester Conference Series on Public Policy* 39, pp. 195–214.

Theodoridis, Konstantinos and Francesco Zanetti (2016). "News Shocks and Labour Market Dynamics in Matching Models". In: *Canadian Journal of Economics* 49.3, pp. 906–930.

A Data

The key data series I use is question A6 in the University of Michigan Survey of Consumers, which asks: *During the last few months, have you heard of any favorable or unfavorable changes in business conditions?*

I also use data from from Table 23 and 24 of the UMSC. The other series are taken from Federal Reserve Bank of St. Louis' FRED database, with transformations following those in Angeletos, Collard, and Dellas (2020). Two exceptions are the vacancies series which is based on Barnichon (2010) and the Survey of Professional Forecasters series from the Philadelphia Fed.

B VAR Robustness checks

B.1 Monthly and Mixed-Frequency Specifications

OLS. Figure B.1 reports the estimates of my baseline monthly specification, with OLS estimates overlaid: the priors, while making the estimation more amenable to short samples and large sets of variables, do not affect my findings.

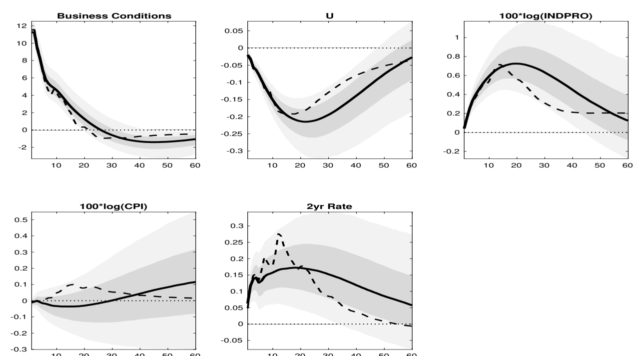


Figure B.1: Baseline specification of the monthly VAR, with OLS estimates overlaid.

Subsamples. Figure B.2 reports the estimates of my baseline monthly specification estimated over the post 1984 and over the 1984-2007 samples respectively, to verify that my key results do not depend neither on the "Volcker recession" of the early 1980s, nor on the Great Recession and the Zero-Lower Bound period.

Five-year outlook. The UMSC also includes a question about the economic outlook over the next five years (Barsky and Sims, 2012). Figure B.3 shows that including it alongside the other

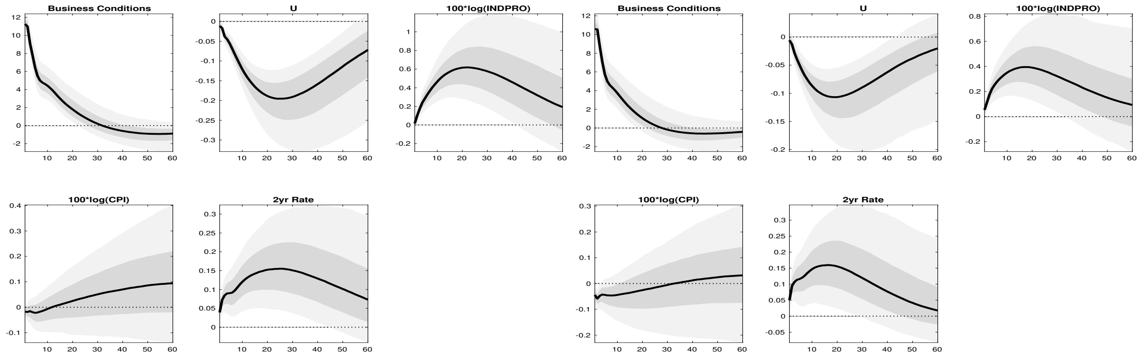


Figure B.2: Baseline specification of the monthly VAR estimated over the post-1984 sample (left pane) and the Great Moderation sample (1984-2007, right pane).

expectational variables does not affect my findings. And clearly the outlook improves in the wake of a positive surprise the the business conditions index.

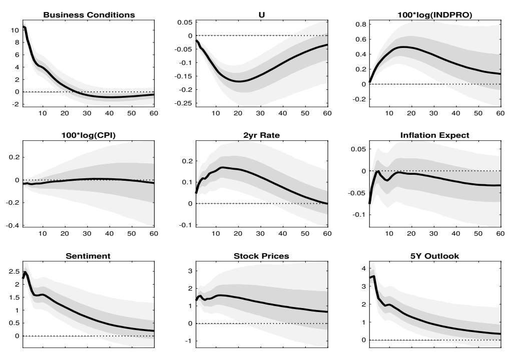


Figure B.3: Specification of the monthly VAR that also includes the 5-year Outlook variable.

Survey of Professional Forecasters. Figure 6 in the main body of the paper presents the IRFs from a specification in which I add unemployment revisions from the Survey of Professional Forecasters. Figure B.4 complements it by showing IRFs from a VAR in which only the labor-market sub-index of the overall business conditions index is included. The VAR has to be estimated with mixed-frequency techniques as the SPF survey is quarterly. Results are robust. Even restricting the attention to labor-market related news, the UMSC series retains its informativeness above and beyond information contained in the SPF series.

Weekly Unemployment Claims. Figure B.5 reports IRFs from a VAR in which the monthly business conditions index is made orthogonal to the key weekly unemployment indicators, initial and continued unemployment claims, relative to the second week of the month. The responses of

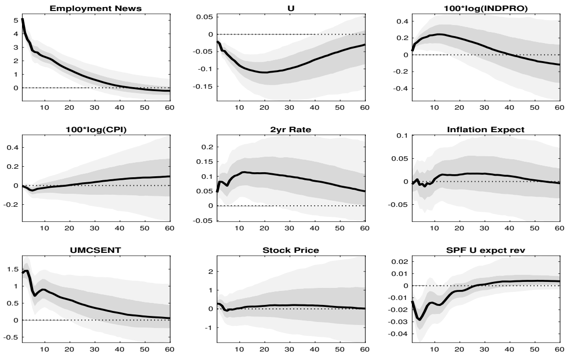


Figure B.4: Impulse Responses from a mixed-frequency VAR that includes revisions of SPF unemployment forecasts. The shock is given by surprises the labor-market conditions index.

unemployment, industrial production, CPI and the interest rate are hardly affected, the measures of claims respond as expected, negatively, to a positive business conditions shock.

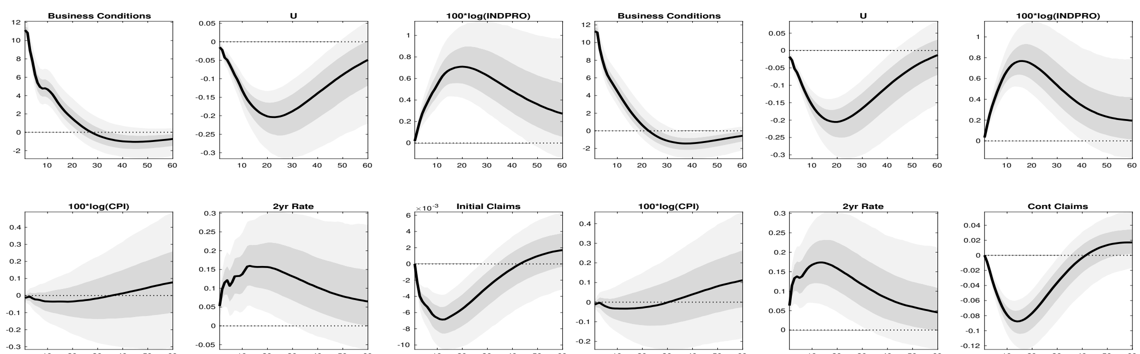


Figure B.5: Monthly VAR in which the shock is made orthogonal to the weekly series for Initial Unemployment Claims (left) and Continued Unemployment Claims (right).

Inverse Cholesky Ordering. The business conditions series is logically predetermined relative to the realization of current-period macro variables, as well as relative to forward-looking survey questions, such as inflation expectations or any question about the outlook for the future. However, it is a common robustness check to check the responses under an inversion of the Cholesky ordering, i.e. a situation in which shocks to the business conditions index are made orthogonal not only to past but also to current realizations of the other variables included in the VAR.

Figures B.6, B.7, B.8, B.9 report the IRFs under an "inverse" Cholesky ordering. The business cycle dynamics described by this set of IRFs is the same. The unemployment response remains highly significantly different from zero – with an abuse of frequentist parlance. The responses of output and the interest rate remain positive in any case and significant at least at the 68 percent level. CPI hardly ever moves.

Investment and Consumption. The comovement of consumption and investment in response to the business conditions shock is critical to the understanding of its properties and in guiding the development of a suitable model. A mixed-frequency specification allows me to maintain a weaker timing restriction, while observing the responses of consumption and investment, which are only observed at a quarterly frequency. A strong positive comovement can be observed in Figure B.10, with investment responding more than consumption, in line with quarterly specifications and long-established business-cycle regularities.

Sub Indices. Figure B.11 reports the IRFs for VAR specifications including the individual indices, one at a time. As discussed in the main text the employment conditions sub index is the key driver. Responses to price news are distinctly different, while those that fall into the demand sub-index bear some similarity to those from the employment index but are smaller and less precisely estimated. The other sub-indices do not play a big role (in a principal component sense) but it is reassuring to note that energy crisis news associate with an increase in inflation expectations, easier credit conditions with a countercyclical movement in interest rates, and stock price news with a distinct rise in stock prices. It shows that consumer reports capture genuine economic developments with distinct effect on the macroeconomy.

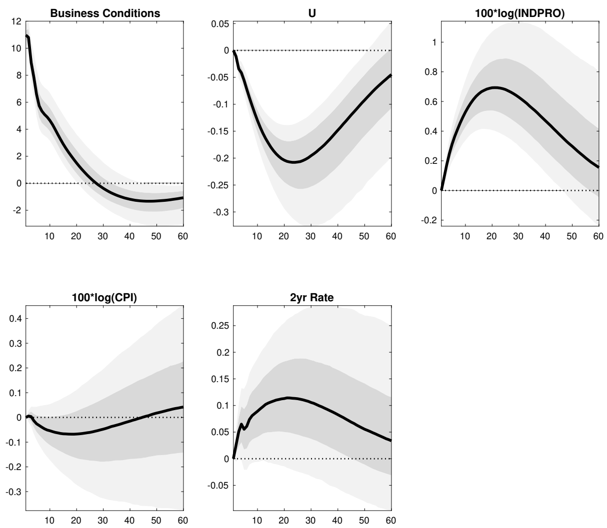


Figure B.6: Baseline specification of the monthly VAR, business bonditions index ordered last in the Cholesky decomposition.

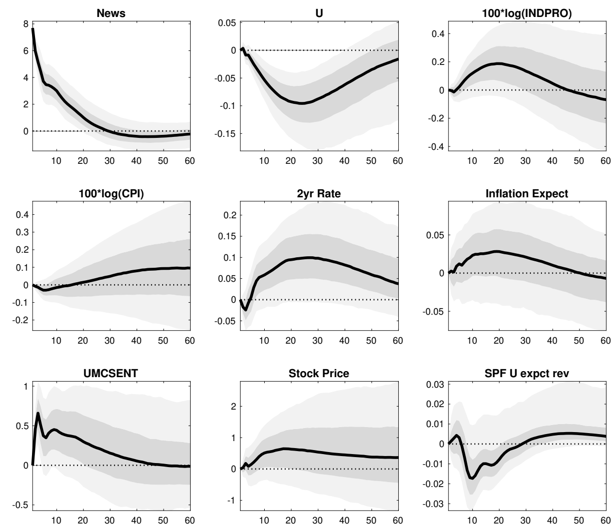


Figure B.7: Mixed-frequency specification with SPF revisions of unemployment forecasts. Inverse Cholesky ordering.

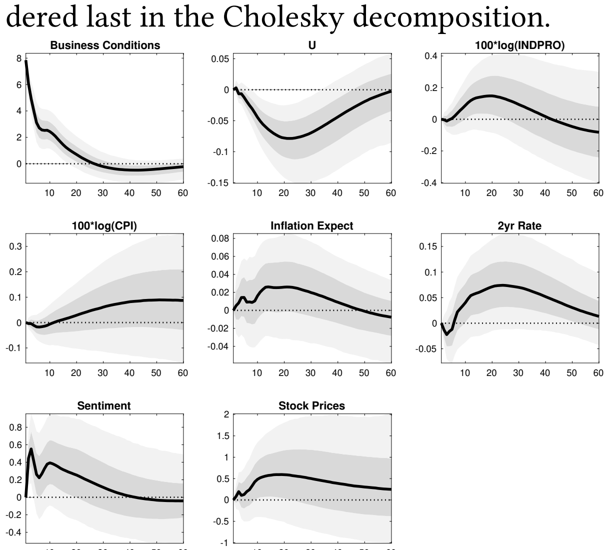


Figure B.8: Specification of the monthly VAR that includes consumer sentiment, inflation expectations and stock prices; business conditions index ordered last in the Cholesky decomposition.

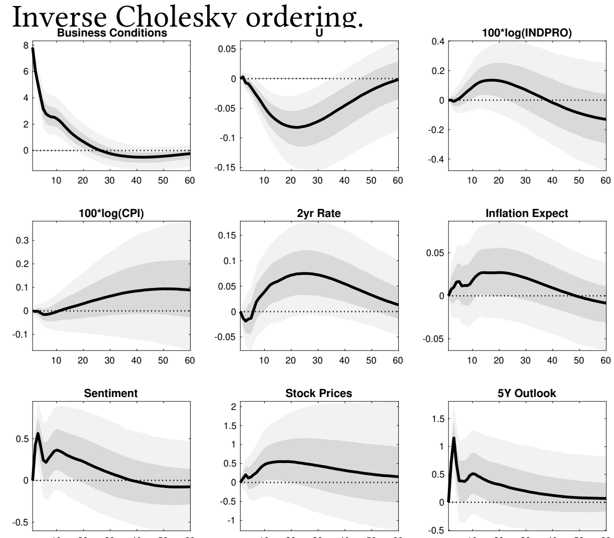


Figure B.9: Specification of the monthly VAR that also includes the 5-year Outlook variable; business conditions index ordered last in the Cholesky decomposition.

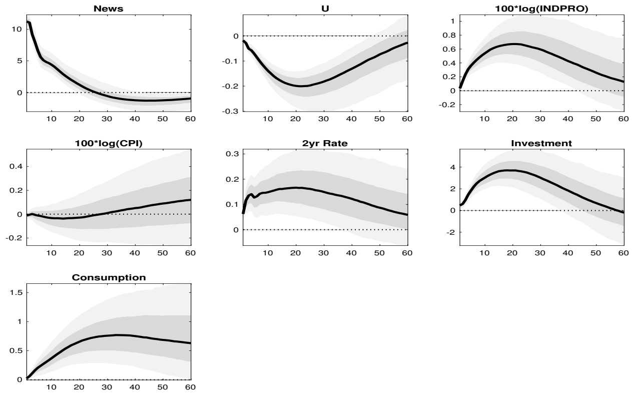


Figure B.10: Impulse Responses from a mixed-frequency VAR that includes investment and consumption.

B.2 Quarterly

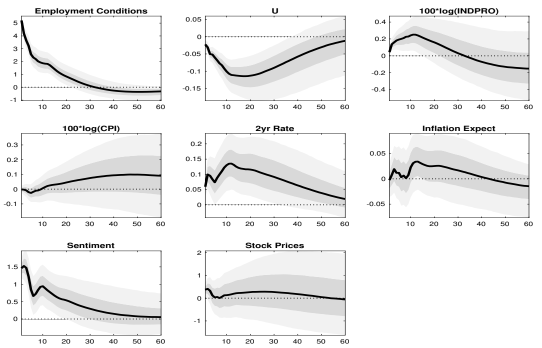
Five-variable specification. For ease of comparison, I start off by estimating the quarterly counterpart to the baseline monthly specification presented above. Figure B.12 presents the impulse responses and the FEVD decomposition. Both are in line with the findings from the monthly VAR.

A timing-identification scheme poses an inherently stronger restriction in a quarterly specification, than in a monthly one. For instance, it could be that survey responses in the third month of a quarter depended strongly on, say, unemployment in the first two months. To verify this phenomenon is not altering my findings, I present the IRFs to a VAR in which the quarterly series for the business conditions index is given by the level of the index in the first month of the quarter, as opposed to all three months as in the baseline, in Figure B.13. Responses are remarkably similar to the baseline in Figure B.12, also in terms of magnitudes.

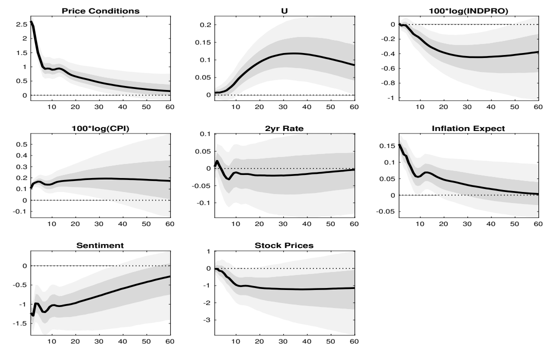
12-variable specification. Figure B.14 presents the Forecast-Error Variance Decomposition, corresponding to the shock presented in Figure 7 in the main body of the text. The shock explains between a third and a half of the variance in unemployment, output, employment, investment, and vacancies. The share of variance of consumption explained is around a quarter, for the Fed Funds rates of the order of 15 percent, and less than 10 percent for productivity, the labor share, inflation, and TFP.

My robustness checks include showing that inverting the Cholesky ordering of the variables does not affect the key results, Figure B.15; neither does restricting the attention to the business conditions news from the first month of the quarter, Figure B.16; or to news specific to the labor market, Figure B.17.

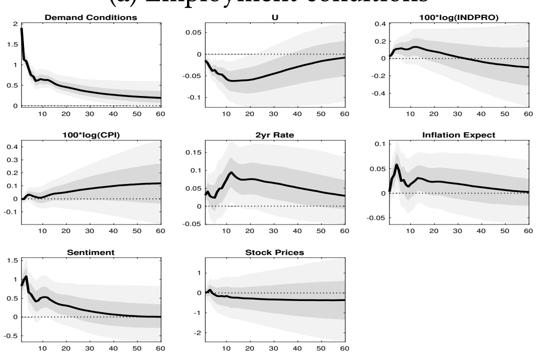
As explained in the main text, my 12-variable VAR specification uses primarily the variables



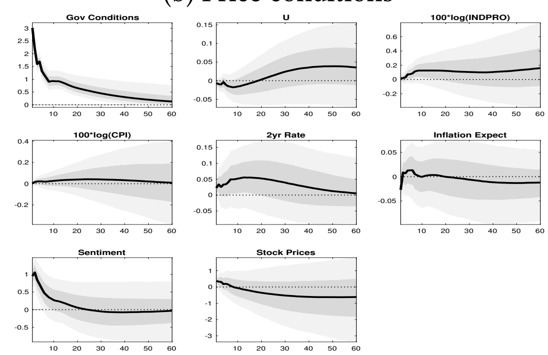
(a) Employment conditions



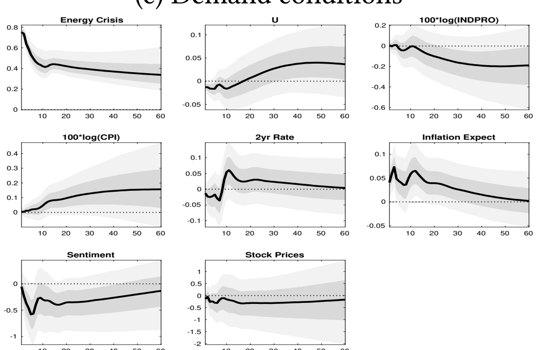
(b) Price conditions



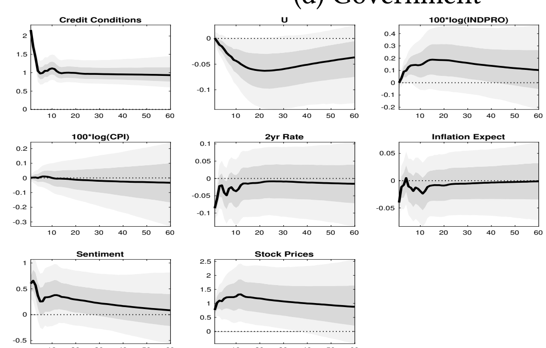
(c) Demand conditions



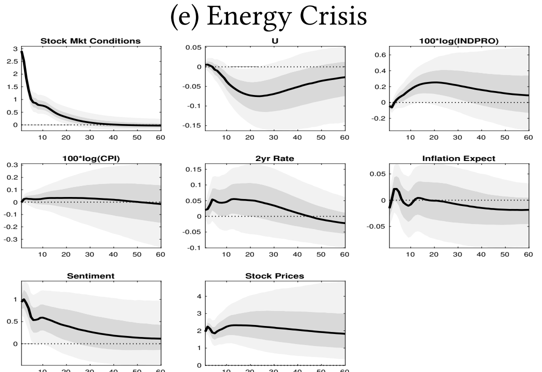
(d) Government



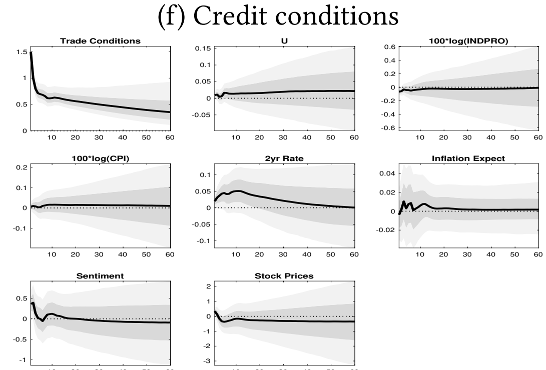
(e) Energy Crisis



(f) Credit conditions



(g) Stock market



(h) Trade

Figure B.11: Impulse responses to shocks to the sub indices of the business conditions index.

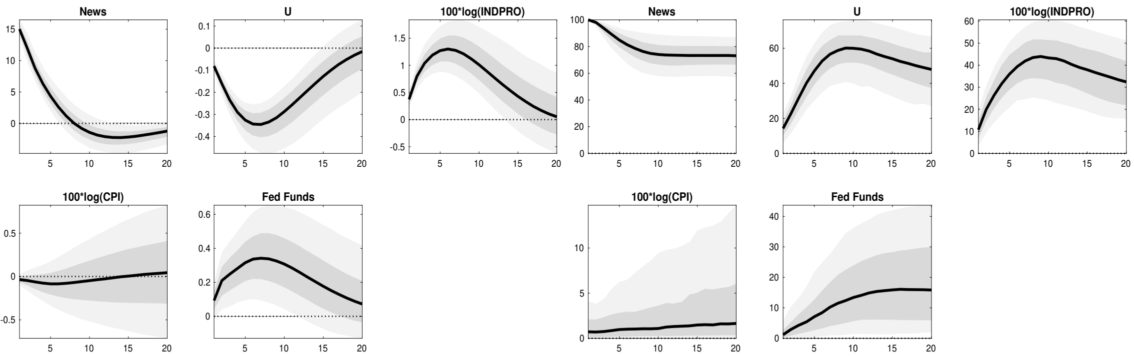


Figure B.12: Quarterly version of the 5-variable VAR I use as my baseline monthly VAR. IRF with credible sets (left), and share of variance explained by a business conditions shock (right).

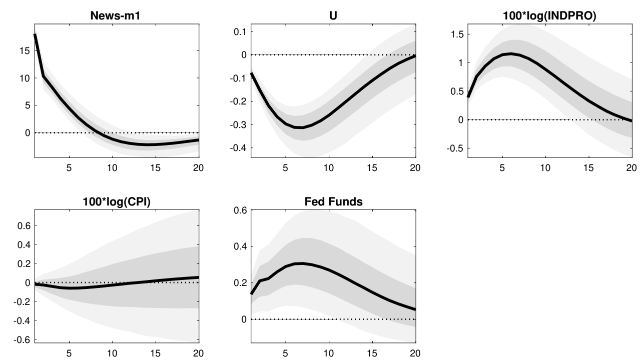


Figure B.13: Quarterly version of the 5-variable VAR I use as my baseline monthly VAR. The business conditions index series exclusively refers to the first month of the quarter.

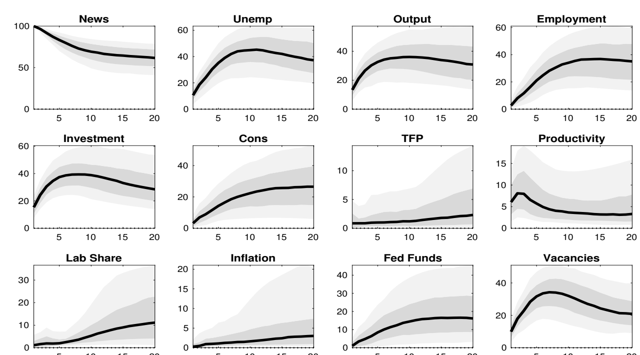


Figure B.14: Quarterly 12-variable specification, share of variance explained by the business conditions shock.

definitions from Angeletos, Collard, and Dellas (2020), except for the addition of the business conditions index and a measure of vacancies, and the replacement of hours with employment, as I do not explicitly model the intensive margin of labor. The specification presented in Figure B.18

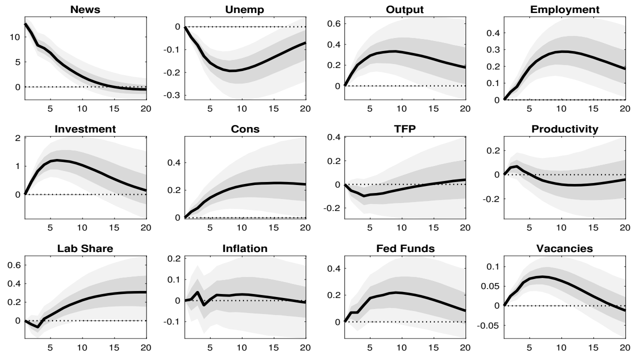


Figure B.15: Quarterly 12-variable specification, inverse Cholesky ordering.

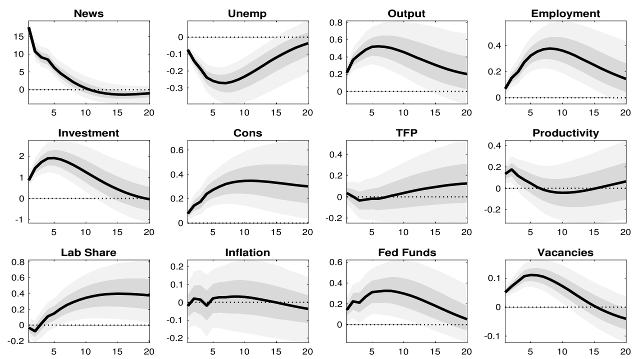


Figure B.16: Quarterly 12-variable specification, using only the news from the first month of the quarter.

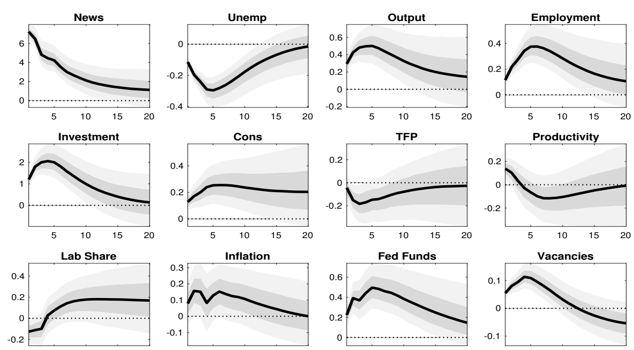


Figure B.17: Quarterly 12-variable specification, employment news only.

does not include vacancies, and replaces employment with hours. The dashed lines represent the responses to a shock – in a 10-variable specification that excludes the business conditions index as well to be as close as possible to Angeletos, Collard, and Dellas (2020) – identified with an agnostic max-share approach, as the shock explaining the maximum variance share of unemployment. The similarities in the responses are striking in terms of sign, magnitude and timing.

Finally, Figure B.19 shows that including 4 lags in my quarterly specifications, as opposed to 2 in the baseline specification in Angeletos, Collard, and Dellas (2020), is effectively immaterial.

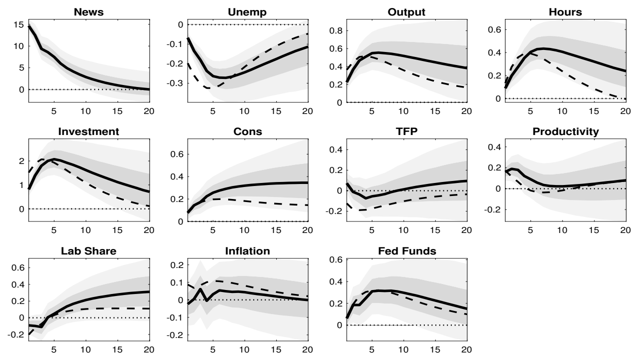


Figure B.18: VAR specification as in Angeletos, Collard, and Dellas (2020) with the addition of the business conditions index. The dashed lines are responses to the shock that maximizes the share of variance explained for unemployment in a specification that excludes the business conditions index.

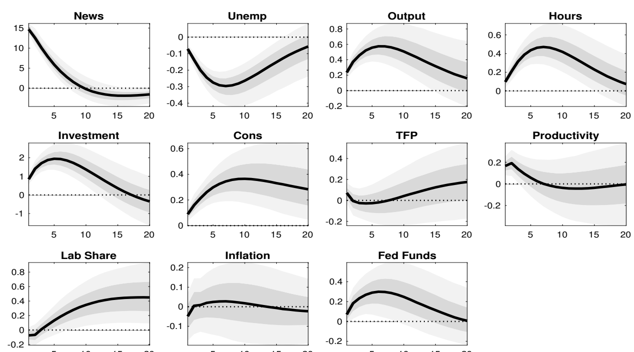


Figure B.19: Quarterly 12-variable specification including only 2 lags in line with Angeletos, Collard, and Dellas (2020).

C Principal Components and Individual Responses

Table C.2 reports the correlation between the overall business conditions index, the eight sub-indices, and the eight principal components (PC1 through PC8). The principal components are listed in decreasing order of importance (i.e. share of variance explained) and are identified up to sign.

Table C.1 reports the results from a simple regression of the overall business conditions index, the employment sub-index, and the first principal component, onto a constant and the two key tabulated answers. The coefficients are highly significant and of the expected sign - note that the principal component is identified up to sign and it represents negative economic news in this case. These two individual answers explain 59 percent of the variation in the overall index and 90 percent of the variation in the employment sub-index, and in the first principal component.

	Overall	Emp Index	PC1
c	70.07***	95.02***	-5.68***
	(2.22)	(0.57)	(0.58)
”Drop in empl., less overtime”	-0.28***	-0.26***	0.26***
	(0.02)	(0.01)	(0.01)
”Empl. is high, plenty of jobs”	0.65***	0.29***	-0.31***
	(0.04)	(0.01)	(0.01)
R^2	0.59	0.90	0.90

Table C.1: Regression of the overall business conditions index, the employment index, and the first principal component, onto a constant and two of the 79 possible valid answers to the question ’What did you hear?’.

Figure C.1 shows the responses to surprises in the first principal component defined above. Compared to including a sub index, including a principal component ensures the orthogonality between the component of the business conditions index included in the VAR and the one that is not. From an economic perspective, however, the IRFs paint the same picture as that in my baseline specification and reinforce the idea that it is reports about labor market conditions that are key to business conditions index.

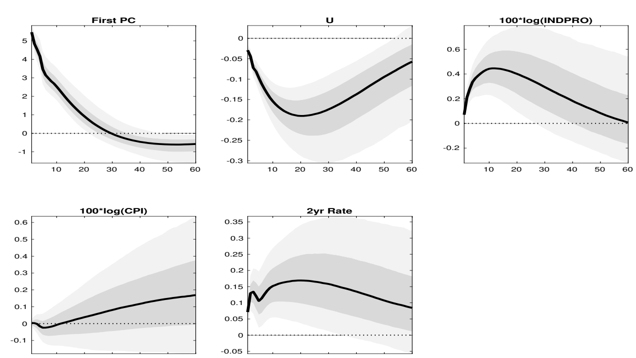


Figure C.1: Specification of the monthly VAR that replaces the business conditions index with the first principal component defined above.

Table C.2: Correlation coefficients between news indices and principal components. The sign of the principal components is not identified, so the correlation coefficients are identified up to sign as well.

	Overall	PriceNews	EmpNews	DemNews	GovNews	CredNews	StockNews	TradeNews	EnergyCrisisNews
Overall	1.000	-0.484	0.791	0.797	0.177	0.231	0.554	0.013	-0.178
PriceNews	-0.484	1.000	-0.139	-0.342	0.095	-0.390	-0.127	0.039	0.350
EmpNews	0.791	-0.139	1.000	0.668	-0.049	-0.126	0.326	-0.203	0.033
DemNews	0.797	-0.342	0.668	1.000	0.039	0.188	0.263	-0.063	-0.117
GovNews	0.177	0.095	-0.049	0.039	1.000	-0.039	0.002	0.169	-0.002
CredNews	0.231	-0.390	-0.126	0.188	-0.039	1.000	0.111	-0.072	-0.194
StockNews	0.554	-0.127	0.326	0.263	0.002	0.111	1.000	0.183	-0.007
TradeNews	0.013	0.039	-0.203	-0.063	0.169	-0.072	0.183	1.000	-0.000
EnergyCrisisNews	-0.178	0.350	0.033	-0.117	-0.002	-0.194	-0.007	-0.000	1.000
PC1	-0.816	0.171	-0.998	-0.695	0.055	0.108	-0.362	0.193	-0.020
PC2	-0.370	0.867	0.038	-0.298	0.295	-0.721	-0.228	0.034	0.344
PC3	-0.369	0.140	0.010	-0.193	-0.945	-0.191	-0.197	-0.212	0.096
PC4	-0.118	-0.242	0.025	0.087	0.116	-0.043	-0.870	-0.273	-0.114
PC5	-0.020	0.370	0.014	0.134	-0.018	0.645	-0.135	-0.202	0.098
PC6	0.111	0.056	-0.026	0.597	-0.043	-0.111	-0.008	0.293	-0.038
PC7	-0.043	0.001	-0.010	0.098	0.013	-0.051	0.051	-0.846	-0.022
PC8	-0.043	-0.021	-0.001	0.013	0.002	0.002	-0.001	-0.007	0.921

D Participation Decision

Workers need to decide whether to participate in the labor market by striking a contract with an employment agency. The alternative is autarky. Autarky is a permanent state. The worker pays a share τ^a of her income to the agency. I consider the limit case in which $\tau^a \to 0$ and workers have log preferences ($\sigma_{\text{w}} = 1$, which is the calibration I adopt).

A worker opting for autarky with strictly positive wealth $B_{i,t} > 0$, i.e. a newly unemployed worker or an employed worker, incurs a relocation cost ϑ in the first period, so his problem reads:

$$\max_{C_{i,t+j}, B_{i,t+j+1}} \mathbb{E}_t \sum_{j=0}^{\infty} \beta^j \log\left(C_{i,t+j}\right), \tag{D.1}$$

$$s.t. \quad C_{i,t} + B_{i,t+1} = \frac{R_{t-1}}{\Pi_t} B_{i,t} - T_{i,t} \quad j = 0, \tag{D.2}$$

$$C_{i,t+j} + B_{i,t+j+1} = \frac{R_{t+j-1}}{\Pi_{t+j}} B_{i,t+j} + \vartheta - T_{i,t+j} \quad j \geq 1, \tag{D.3}$$

$$B_{i,t+j+1} \geq 0. \tag{D.4}$$

I begin by focusing on the problem of worker entering the second period of autarky, with wealth B_1:

$$\max_{C_{i,t+j}, B_{i,t+j+1}} \mathbb{E}_t \sum_{j=1}^{\infty} \beta^{j-1} \log\left(C_{i,t+j}\right), \tag{D.5}$$

$$s.t. \quad C_{i,t+j} + B_{i,t+j+1} = \frac{R_{t+j-1}}{\Pi_{t+j}} B_{i,t+j} + \vartheta - T_{i,t+j}, \tag{D.6}$$

$$B_{i,t+j+1} \geq 0. \tag{D.7}$$

Around a steady state in which $\frac{R_t}{\Pi_t} = r$ and the transfer is constant, the solution for consumption, assuming the borrowing constraint is not binding, is $C_1 = (1-\beta)\left[rB_1 + \frac{r}{r-1}(\vartheta - T)\right]$. The steady state I consider is such that $1 < r < \frac{1}{\beta}$ so, under autarky, a worker, who does not face any individual risk, would have a non-increasing consumption profile, using up all his wealth B_1 until hitting the borrowing constraint. In principle, I would then need to keep track of various cohorts of workers indexed by the number of periods they have been in autarky for.

This is not necessary, since it is the case that $B_1 = 0$ in equilibrium. To see this consider the problem of worker just entering autarky with wealth B_0. His Euler equation and budget constraint imply the following (disregarding for now the borrowing constraint):

$$\frac{1}{rB_0 - T - B_1} = \beta r \frac{1}{rB_1 + \frac{r}{r-1}(\vartheta - T)} \Rightarrow B_1 = \frac{\beta}{1+\beta}\left[rB_0 - T - \frac{\vartheta - T}{\beta(r-1)}\right]. \tag{D.8}$$

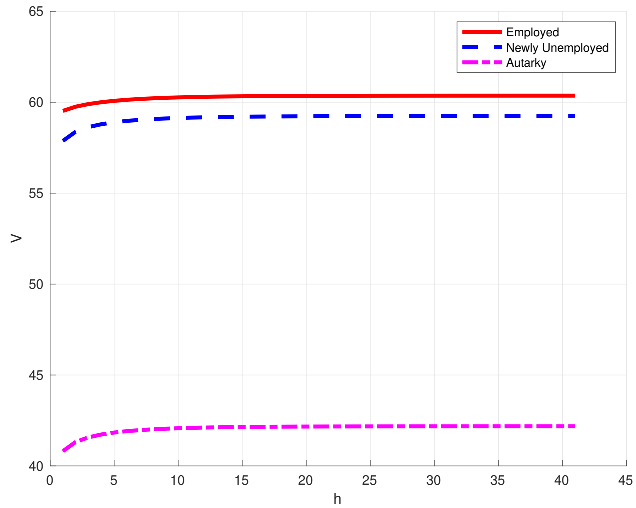


Figure D.1: Welfare for employed workers (solid red line), of newly unemployed workers (dashed blue line), and of workers entering autarky with positive wealth (dash-dotted magenta line) for each cohort h.

Since $0 \leq B_0 \leq B_H$, it is easy to verify that in the steady state I consider $B_1 < 0$ for any equilibrium level of bond holdings. This is equivalent to saying that $\frac{1}{C_0} > \beta r \frac{1}{C_1}$, that the borrowing constraint is binding starting in the first period, and that a worker will consume his income in each period in the autarky state.[38] As a result the welfare of a worker entering autarky with positive wealth is:

$$\mathbf{V_a}\left(B_0\right) = \log\left(rB_0 - T\right) + \sum_{j=1}^{\infty} \beta^j \log\left(\vartheta - T\right) = \log\left(rB_0 - T\right) + \frac{\beta}{1-\beta} \log\left(\vartheta - T\right). \quad \text{(D.9)}$$

Figure D.1 compares the welfare levels of employed, newly unemployed and autarkic workers (entering autarky with positive wealth) for each of h cohorts. Clearly nobody will opt for autarky.

A worker opting for autarky while already having been unemployed for at least one period (no wealth), would face the exact problem in equations (D.5)-(D.7), would want a decreasing consumption profile, given the relatively low real rate, and would end up being constrained and consuming his income each period. His welfare would be given by $\frac{1}{1-\beta}\log\left(\vartheta - T\right)$. In this case too, the welfare of the unemployed state exceeds that of autarky.

[38] Relative to an unemployed worker, under autarky a worker foregoes the opportunity of future employment. If newly unemployed workers did not incur the relocation cost ϑ we could immediately conclude that all allocations feasible under autarky are also feasible for an unemployed worker. However, the relocation cost implies that autarky can afford larger consumption than unemployment in the future state in which a worker was to lose his job with very little savings. As a result, I need to verify numerically that this effect is smaller than the opportunity of future employment an unemployed worker enjoys.

E Impulse-Response Matching

I complement the analysis in the main text reporting a number of additional impulse-response matching exercises.

Figure E.1 reports the IRFs estimated under a much more restrictive set of assumptions, namely:

i. x_t is restricted to being i.i.d. over time;

ii. R_t^{flex} is excluded from the monetary policy rule;

iii. wages are fully flexible;

iv. investment-adjustment cost are set to zero;

v. the Phillips curve is not estimated so as to avoid that wage flexibility could be compensated for by a flatter Phillips curve.

While the quantitative fit obviously deteriorates, the key comovement features remain the same. Table E.1 reports the parameter estimates. The main difference, relative to my baseline, is observed for the response coefficient to inflation. Nominal rates are estimated to respond by about 2.5 percent for every 1 percent deviation of inflation from target.

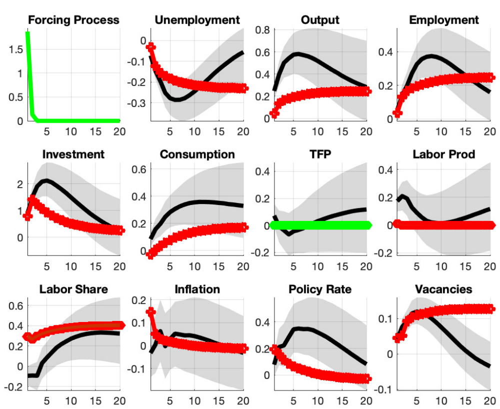


Figure E.1: Impulse response matching: R_t^{flex} not included in the policy rule, $\rho^x = 0$, wages are fully flexible, the Phillips Curve Parameters are not estimated and investment-adjustment costs are set to zero.

	prior mean	post. mean	10th	90th	prior	prior stdev
ρ_ρ	0.500	0.1554	0.0408	0.2663	beta	0.2000
ρ_F	0.500	0.9960	0.9928	0.9996	beta	0.2000
θ_ρ	0.500	0.0632	0.0463	0.0772	beta	0.2000
θ_F	0.500	0.4101	0.3856	0.4324	beta	0.2000
θ_x	0.500	0.0671	0.0172	0.1172	beta	0.2000
σ_k	0.500	0.2131	0.0661	0.4043	beta	0.2000
$\bar{a}$	1.000	0.9652	0.5541	1.2763	gamm	0.2500
ϕ_u	0.010	0.0102	0.0023	0.0176	gamm	0.0050
ϕ	0.500	1.5571	1.0628	2.1494	gamm	0.3000
ρ_R	0.500	0.4761	0.3113	0.6378	beta	0.2000

Table E.1: Prior and posterior statistics: R_t^{flex} not included in the policy rule, $\rho^x = 0$, wages are fully flexible, the Phillips Curve Parameters are not estimated and investment-adjustment costs are set to zero.

Figure E.2 reports the matched IRFs when I only include labor-market news in the VAR. The fit is better for real variables and a bit worse for inflation. Table E.2 reports the parameter estimates. Posterior estimates are in line with those found above in the baseline case. While I keep the prior mean the same, I somewhat reduce the prior standard deviation for five parameters, closely related to the determination of inflation: ψ_w, ψ, ζ, ϕ, ρ_R. With the original prior standard deviations the mode finding step would work flawlessly but the MCMC procedure would run into numerical issues.

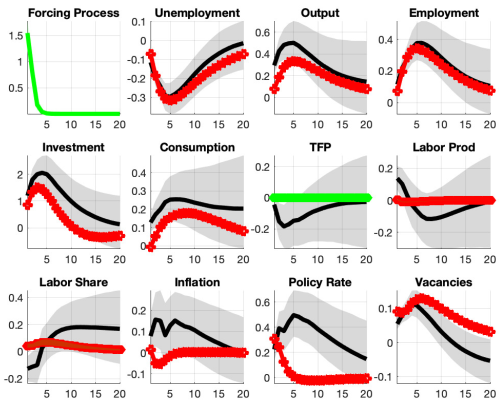


Figure E.2: Impulse response matching: The VAR includes only the labor-market component of the Business conditions index.

	prior mean	post. mean	10th	90th	prior	prior stdev
ρ_ρ	0.500	0.6299	0.5503	0.6963	beta	0.2000
ρ_F	0.500	0.2273	0.0589	0.3539	beta	0.2000
θ_ρ	0.500	0.0913	0.0682	0.1108	beta	0.2000
θ_F	0.500	0.6540	0.5488	0.7829	beta	0.2000
θ_x	0.500	0.2166	0.0681	0.3413	beta	0.2000
ρ_x	0.500	0.2231	0.0739	0.3514	beta	0.2000
σ_k	0.500	0.0310	0.0053	0.0538	beta	0.2000
$\bar{a}$	1.000	1.1330	0.7360	1.6214	gamm	0.2500
ψ_w	0.500	0.8810	0.8256	0.9309	beta	0.1000
ψ	120.000	127.7170	93.3148	156.6024	norm	20.0000
ζ	0.500	0.4857	0.3461	0.6390	beta	0.1000
S''	3.000	0.0441	0.0108	0.0751	gamm	2.0000
ϕ_u	0.010	0.0155	0.0030	0.0272	gamm	0.0050
ϕ	0.500	0.5862	0.4151	0.7732	gamm	0.1000
ρ_R	0.500	0.3877	0.2773	0.5086	beta	0.1000

Table E.2: Prior and posterior statistics: the VAR includes only the labor-market component of the Business conditions index.

Figure E.3 reports the IRFs in the case in which I replace the unemployment-gap in the monetary policy rule with the commonly-used output gap. Table E.3, reports the estimates. A coefficient on the output gap of .11 is in line with the literature. The fit is comparable to my baseline case.

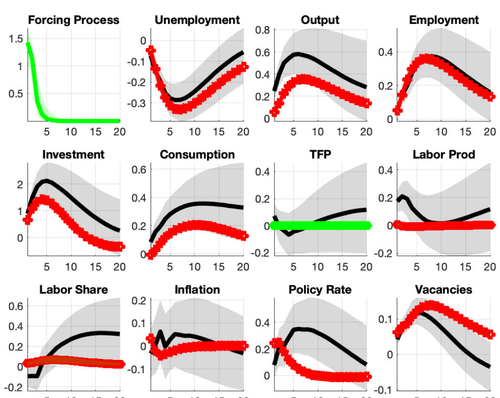


Figure E.3: Impulse response matching: the unemployment gap is replaced by the output gap in the policy rule.

	prior mean	post. mean	10th	90th	prior	prior stdev
ρ_ρ	0.500	0.7777	0.6915	0.8617	beta	0.2000
ρ_F	0.500	0.2817	0.0466	0.5068	beta	0.2000
θ_ρ	0.500	0.0624	0.0442	0.0834	beta	0.2000
θ_F	0.500	0.4642	0.3627	0.5734	beta	0.2000
θ_x	0.500	0.2981	0.1337	0.4775	beta	0.2000
ρ_x	0.500	0.3414	0.1080	0.5973	beta	0.2000
σ_k	0.500	0.0321	0.0065	0.0567	beta	0.2000
$\bar{a}$	1.000	1.0871	0.6039	1.4392	gamm	0.2500
ψ_w	0.500	0.8875	0.8159	0.9655	beta	0.2000
ψ	120.000	136.4337	92.4434	185.2885	norm	30.0000
ζ	0.500	0.5110	0.1831	0.8654	beta	0.2000
S''	3.000	0.1027	0.0129	0.1594	gamm	2.0000
ϕ_y	0.100	0.1125	0.0438	0.2065	gamm	0.0500
ϕ	0.500	0.8936	0.2473	1.4878	gamm	0.3000
ρ_R	0.500	0.4305	0.2249	0.6868	beta	0.2000

Table E.3: Prior and posterior statistics: the unemployment gap is replaced by the output gap in the policy rule.

Figures E.4, E.5, and E.6 report the IRF matching results when I only consider the shock to the cost of vacancy creation, when I only consider the shock to job destruction, and when, on top of these two shocks, I also allow for a shock to matching efficiency. The most important observation is that, as mentioned in the main text, both the shocks I use in my baseline setup can explain the comovement among the variables of interest even taken in isolation. This is important to reinforce the point that this model does not need a combination of shocks to reproduce the responses of the data to business-conditions.

Obviously, allowing for an extra shock, to matching efficiency, improves the quantitative fit of the model. Despite the matching efficiency shock not being able to capture the conditional covariance between unemployment and vacancies when considered in isolation. The key economic insights are unaffected.

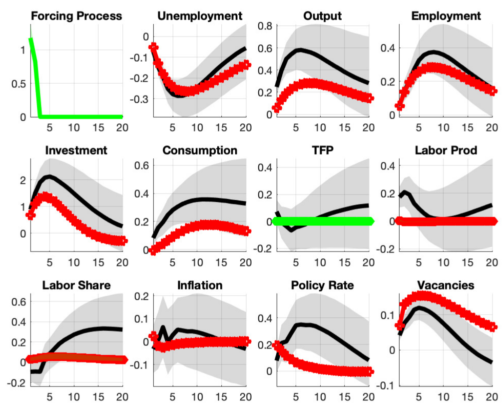


Figure E.4: Impulse response matching: using only shocks to the cost of opening new vacancies.

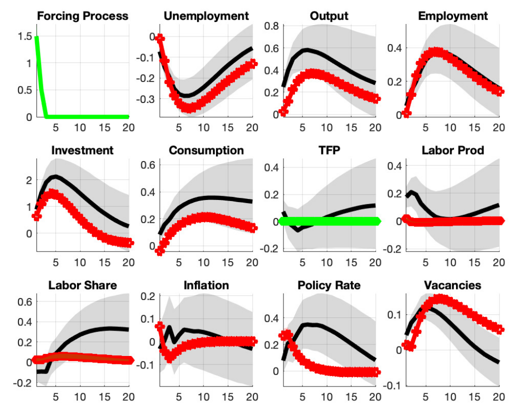


Figure E.5: Impulse response matching: using only shocks to the job-separation rate.

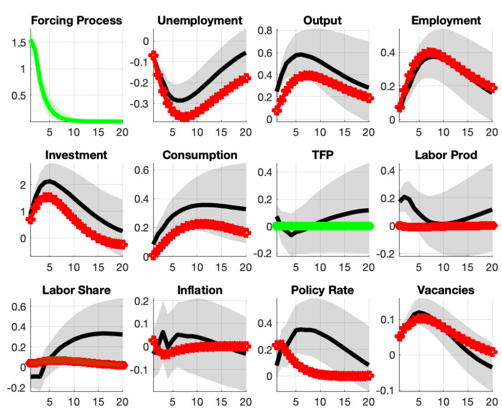


Figure E.6: Impulse response matching: I also allow for shocks to matching efficiency.