News Shocks, Precautionary Saving and Frictional Labour Markets*

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Abstract

This paper develops a theory of how TFP news shocks can impact the economy via a Keynesian supply channel. With frictional labour markets, bad TFP news reduces firms' incentive to post vacancies, worsening households' employment prospects. Households respond by accumulating liquid assets and cutting spending for precautionary reasons, triggering a recession that compounds the labour market downturn. This mechanism is outlined analytically and numerically in a heterogeneous agent New Keynesian model, with supporting local projection evidence. The combination of labour market frictions and precautionary saving is necessary to match the joint output and nominal interest rate dynamics observed empirically following a news shock. In contrast to previous theories, the transmission mechanism leaves room for policy to mitigate the shock's contractionary effects.

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1 Introduction

The idea that expectations matter for equilibrium outcomes has been a central principle in macroeconomics dating back at least to the work of Pigou and Keynes in the early 20th century. One possible source of such expectational shifts is news about future total factor productivity (TFP) — TFP news shocks. In a seminal paper, Beaudry and Portier (2006) investigated the prevalence of these shocks empirically, and found that they were instrumental in driving business cycle fluctuations. With this empirical result in mind, future work has focused on outlining a theoretical basis for the transmission of news shocks to the real economy. This has proved somewhat challenging in standard macroeconomic models. For example Beaudry and Portier (2004) find that in the one-sector real business cycle (RBC) model an adverse TFP news shock leads to a *increase* in output today since households supply more labour due to the wealth effect. Subsequent work has typically overturned this result by maintaining but modifying the RBC framework, which by construction has no role for aggregate demand as a conduit for news shocks. Consequently, in this class of models, there is usually little room for monetary or fiscal policy to mitigate the adverse impact of bad fundamental news.

In this paper, I outline a theory of news shocks whereby they operate via a Keynesian supply channel to borrow the language of Guerrieri et al. (2022). The mechanism relies on the interaction of two key frictions: i) incomplete markets, which generate an endogenous precautionary saving motive amongst households, and ii) labour market frictions, which make hiring workers a durable form of investment for firms and thus sensitive to expectations about future fundamentals. I first clearly illustrate this mechanism through the lens of a stylised heterogeneous agent New Keynesian (HANK) model (Ravn and Sterk, 2017; 2018). In the model, a bad TFP news shock causes firms to post fewer vacancies as they expect matches to be less profitable in the future, resulting in a lower chance of unemployed workers finding a job in the present period. Deteriorating labour market conditions result in increased precautionary saving among the employed households, since unemployment risk is now higher and it is not possible to purchase idiosyncratic state-contingent insurance contracts to hedge against this outcome. Price rigidity then causes this decline in goods demand to spill over to the firm side as they cut back further on the number of vacancies posted and unwittingly amplify the shock even more. The end product is a deep recession as the supply news shock is amplified by a further drop in aggregate demand.

I then show that the contractionary impact of a negative news shock is greatly alleviated when markets are effectively complete (eliminating the precautionary motive) or when labour markets do not feature search-and-matching frictions (eliminating the rise in unemployment risk). These results are established analytically in a two-period model and then numerically in a calibrated, fully dynamic framework. I also show in the latter that this proposed transmission mechanism of TFP news shocks has policy implications, with aggressive monetary policy and/or countercyclical unemployment benefits attenuating the impact of TFP news shocks by weakening the aggregate demand spillovers and reducing the precautionary saving motive of households respectively.

Next, I present empirical evidence which qualitatively supports the model's transmission mechanism. Results from local projections show that the model's key labour market variables exhibit a strong contractionary response to bad TFP news shocks in the data. Consumption and real GDP also both decrease precipitously upon impact, well before the change in TFP is realised. In the data, the nominal interest rate declines persistently. I show that only when both of the two key frictions are present can the model match this result, which speaks to their importance. In the standard New Keynesian model, I demonstrate that, in contrast to the data, the nominal rate declines on impact but then overshoots when TFP eventually falls.

While previous theoretical models, e.g. Jaimovich and Rebelo (2009), feature the supply side as the primary transmission process for TFP news shocks via labour supply effects and adjustment costs, I present suggestive survey-based evidence which suggests that the shock propagates forcefully via the demand side, consistent with a consumption-centric mechanism. This set of findings is shown to be robust to several extensions and robustness tests. Finally, I present further evidence which suggests that the precautionary savings channel encapsulates the transmission mechanism of news to aggregate fluctuations. I demonstrate this by examining the response of the price of volatile stocks - a proxy for aggregate precautionary saving developed by Pflueger et al. (2020). This drops immediately and substantially following bad news. In an extension of the two-period model with a risky asset, I discuss how this result can only be generated in the presence of the two key frictions.

Related literature

The seminal work of Beaudry and Portier (2004; 2006) marks a natural starting point when looking at the modern literature on TFP news shocks. They exploit the well-documented property that stock price innovations represent changes to the discounted sum of future dividends and hence can be used as a mechanism to gain information about TFP news shocks. A vector error correction model (VECM) with TFP and stock prices is estimated with two different methods used to determine TFP news shocks – long- and short-run restrictions. Their results suggest significant anticipation effects are present, running contrary to the view of 'surprise' technology shocks emphasized in the canonical RBC model, and that TFP news shocks are important for business cycles. Barsky and Sims (2011) identify TFP news shocks as those which explain the highest variance of future TFP but are orthogonal to TFP in the current period. Barsky and Sims find that consumption and output both move significantly after a TFP news shock and that these shocks can explain a reasonable amount of variation in these two variables.[1]

News-induced contractions have been studied in other distinct theoretical environments, and the vast majority of these have featured complete markets, frictionless labour markets and an absence of nominal rigidities in contrast to the model I develop. As Beaudry and Portier (2004) illustrate, the standard RBC model cannot generate Pigovian cycles due to the wealth effect on labour supply discussed above. Several papers have outlined conditions under which Pigovian cycles are possible. Jaimovich and Rebelo (2009) show that these can occur in an RBC model with variable capital utilisation, investment adjustment costs and a form of preferences which allows the strength of the wealth effect to be parameterised. They also consider a model extension where labour adjustment is costly, which is similar in spirit to the search-and-matching frictions I include. Den haan and Kaltenbrunner (2009), Faccini and Melosi (2018) and Chahrour et al. (2023) all study TFP news shocks in models with search-and-matching frictions modelled explicitly, and find that these environments are capable of generating contractionary movements in the labour market in response to a 'bad news' shock. Markets are complete in all of the preceding models, and the precautionary saving channel is not examined as a channel for TFP news shocks to feed through to real activity as is the case here. As such, there is little propagation of the

[1] Other papers which have demonstrated expansionary effects of TFP news shocks include Beaudry and Lucke (2009), Beaudry, Nam, and Wang (2011) and Miranda-Agrippino, Hoke, and Bluwstein (2018).

shock in these frameworks as the demand side does not play a significant role. Consequently, there is little role for policy to alleviate the contractionary impact of news shocks since output never falls below its potential level.

Several other papers emphasise the precautionary saving mechanism as being fundamental in amplifying different types of shocks. Ravn and Sterk (2017) focus on the impact of a shock to the job loss rate and show that the increased threat of becoming unemployed spurs employed workers to reduce their consumption, which triggers a contraction in economic activity when wages and prices are inflexible. Den haan, Rendahl, and Riegler (2018) look at a similar feedback mechanism between the goods market and the labour market which occurs via precautionary saving as a result of unemployment risk. Guerrieri and Lorenzoni (2017) develop a model where a tightening of credit causes a substantial recession via heightened precautionary saving and depressed aggregate demand. Heathcote and Perri (2018) look at the effects of liquid wealth levels on precautionary saving, and find that the effects of an expectations shock become strengthened when liquid wealth is low. Other papers such as McKay and Reis (2016; 2018), Ravn and Sterk (2018) and Bayer, Luetticke, Pham-Dao, and Tjaden (2019) also feature similar incomplete market models with heterogeneous agents but focus instead on exploring different issues.

The rest of the paper proceeds as follows: Section 2 develops a two-period model and a set of analytical insights which emerge from it. Section 3 generalises the model to an infinite horizon environment and presents results once it is calibrated. Section 4 presents empirical evidence on the response of key variables in the model to TFP news shocks and on the precautionary savings channel of TFP news shocks. Section 5 concludes.

2 Two-Period Model

In this section, I develop a two-period model to characterise some analytical results related to the transmission mechanism of TFP news shocks. The model has the key features of heterogeneity, nominal rigidities via sticky prices, incomplete financial markets in the form of a missing market for state-contingent unemployment insurance, and labour market frictions in the Diamond-Mortensen-Pissarides tradition. TFP news shocks represent the source of aggregate fluctuations.

Setup: There are two discrete periods, $t = 0$ and $t = 1$. Households are a unit mass group that is ex-ante homogeneous and are indexed by i. During each period, a household can either be employed or unemployed.[2] At the beginning of period 0, all households are employed but a fraction of them, $\rho \in [0, 1)$, separate from employment and enter the pool of job searchers, e_0. The same process occurs at the beginning of period 1. A job searcher finds a job with probability η_t which is endogenous. Employed households are paid a real wage W, which I assume is entirely rigid in the spirit of Hall (2005). This assumption is made for the purposes of maximising tractability, and is relaxed in the infinite-horizon version of the model. I also consider the alternative assumption of nominal wage rigidity in Appendix A. Unemployed households engage in home production and produce $b = \chi W$ units with $0 < \chi \leq 1$. This parameter determines the extent of insurance against job loss, with $\chi = 1$ representing the case where no income is lost and $\chi \in (0, 1)$ representing the case where job loss is only partially insured.

Households maximise the expected discounted sum of flow utility, which is characterised by:

$$U(C) = \frac{C^{1-\gamma} - 1}{1 - \gamma}$$

Where C represents consumption and $\gamma > 0$ is the coefficient of relative risk aversion. The subjective discount factor is given by $\beta \in (0, 1)$. Households make a consumption-saving decision at the start of period 0 after discovering their employment status. In period 1, they only engage in consumption given that it is the final period of the world. The savings vehicle is a one-period nominal bond in zero net supply with price q_0. There is a no-borrowing constraint for this asset. The consumption good is the numeraire and P_t is the price level in period t. C_t is a CES aggregator of a basket of differentiated consumption goods where $\mu > 1$ is the elasticity of substitution between the varieties:

$$C_t = \left(\int_j \left(C_t^j \right)^{1-1/\mu} dj \right)^{1/(1-1/\mu)}$$

The market clearing condition in the bond market is:

$$\int_i B_0(i) di = 0$$

[2] The model abstracts from the intensive margin of labour supply, since households inelastically supply one unit of labour. While this could easily be relaxed, this captures the fact that the extensive margin (transitions between employment statuses) is more important than the intensive margin (variation in hours worked conditional on employment) for explaining cyclical fluctuations in total hours worked.

The period 0 employed household problem is given by:

$$V_0^E = \max_{C_0^E, B_0^E} \frac{(C_0^E)^{1-\gamma} - 1}{1-\gamma} + \beta \mathbb{E}_0 \left[(1 - \rho(1-\eta_1)) V_1^{EE} + \rho(1-\eta_1) V_1^{EU} \right]$$

s.t.

$$P_0 C_0^E + q_0 B_0^E = P_0 W$$

$$P_1 C_1^{EE} = P_1 W + B_0^E$$

$$P_1 C_1^{EU} = P_1 b + B_0^E$$

$$B_0^E \geq 0$$

Where:

$$V_1^{EE} = \frac{(C_1^{EE})^{1-\gamma} - 1}{1-\gamma}$$

$$V_1^{EU} = \frac{(C_1^{EU})^{1-\gamma} - 1}{1-\gamma}$$

Where C_0^E represents the period 0 consumption of a household currently employed, C_1^{EE} represents the period 1 consumption of a household employed in both periods, while C_1^{EU} is the consumption of a household employed in period 0 and unemployed in period 1.

The period 0 unemployed household problem is given by:

$$V_0^U = \max_{C_0^U, B_0^U} \frac{(C_0^U)^{1-\gamma} - 1}{1-\gamma} + \beta \mathbb{E}_0 \left[(1-\eta_1) V_1^{UU} + \eta_1 V_1^{UE} \right]$$

s.t.

$$P_0 C_0^U + q_0 B_0^U = P_0 b$$

$$P_1 C_1^{UU} = P_1 b + B_0^U$$

$$P_1 C_1^{UE} = P_1 W + B_0^U$$

$$B_0^U \geq 0$$

Where:

$$V_1^{UU} = \frac{(C_1^{UU})^{1-\gamma} - 1}{1-\gamma}$$

$$V_1^{UE} = \frac{(C_1^{UE})^{1-\gamma} - 1}{1-\gamma}$$

Where C_0^U represents the period 0 consumption of a household currently unemployed, C_1^{UU} represents the period 1 consumption of a household unemployed in both periods, while C_1^{UE} is the period 1 consumption of a household unemployed in period 0 and employed in period 1. The first-order conditions yield a pair of Euler equations:

$$(C_0^E)^{-\gamma} \geq \beta \mathbb{E}_0 \left[(1-\rho(1-\eta_1))(C_1^{EE})^{-\gamma} + \rho(1-\eta_1)(C_1^{EU})^{-\gamma} \right] \frac{R_0^f}{\Pi_1}$$

$$(C_0^U)^{-\gamma} \geq \beta \mathbb{E}_0 \left[(1-\eta_1)(C_1^{UU})^{-\gamma} + \eta_1 (C_1^{UE})^{-\gamma} \right] \frac{R_0^f}{\Pi_1}$$

Where $R_0^f = 1/q_0$ and $\Pi_1 = P_1/P_0$. The Euler equations hold with equality when the no-borrowing constraint does not bind and strict inequality when it does. I also assume that there is a unit mass of capitalists who simply consume the dividends of the firms, D_t, and do not participate in the bond or labour market. Their consumption is given by:

$$P_t C_t^C = D_t$$

There is a continuum of final goods producers of mass M in both periods. These firms produce the final good using a linear production function with labour as the sole input:

$$Y_t(j) = A_t N_t(j)$$

Where $Y_t(j)$ is the output produced by firm j, $N_t(j)$ is the labour they employ, and A_t is TFP. I assume that $A_0 = 1$ and A_1 is known by all agents in the economy in period 0, meaning that there is a TFP news shock at this time that is common knowledge.

To acquire labour, firms must hire in frictional labour markets each period. To do so, they post vacancies $v_t(j)$ at a unit cost of $\kappa > 0$. The probability a vacancy posted leads to a successful hire is given by f_t, which is determined endogenously. The cost to hire a worker is then $\frac{\kappa}{f_t}$. The law of motion for firm j's employment is given by:

$$N_t(j) = (1-\rho)N_{t-1}(j) + f_t v_t(j)$$

The number of matches, m_t, is governed by a Cobb-Douglas matching function:

$$m_t = \sqrt{e_t}\sqrt{v_t}$$

Where $v_t = \int_j v_t(j)dj$ is aggregate vacancies. Labour market clearing produces conditions for the job finding and job filling rates:

$$\eta_t = \frac{m_t}{e_t} = \sqrt{\theta_t}$$
$$f_t = \frac{m_t}{v_t} = \frac{1}{\sqrt{\theta_t}} = \frac{1}{\eta_t}$$

Where $\theta_t = v_t/e_t$ is labour market tightness. Job separations occur at the beginning of each period. Firms then learn the realisation of TFP and choose their employment level, which requires posting a certain number of vacancies, before matching then occurs. The laws of motion for employment and job searchers are then given by:

$$N_t = (1-\rho)N_{t-1} + \eta_t e_t$$

$$e_t = 1 - N_{t-1} + \rho N_{t-1}$$

I assume that $N_{-1} = 1$ as all households enter period 0 employed. Firms are risk-neutral, operate in monopolistic competition and set their prices according to Rotemberg (1982) adjustment costs. I focus on a symmetric equilibrium throughout and also assume symmetry in period $t = -1$.

The firm problem in period 0 is:

$$\max_{P_0(j), N_0(j)} \frac{P_0(j)}{P_0} Y_0(j) - WN_0(j) - \kappa v_0(j) - \frac{\psi}{2}\left(\frac{P_0(j) - P_{-1}(j)}{P_{-1}(j)}\right)^2 Y_0$$
$$+ \beta \mathbb{E}_0 \left[\frac{P_1(j)}{P_1} Y_1(j) - WN_1(j) - \kappa v_1(j) - \frac{\psi}{2}\left(\frac{P_1(j) - P_0(j)}{P_0(j)}\right)^2 Y_1\right]$$

s.t.

$$Y_t(j) = A_t N_t(j)$$

$$N_t(j) = (1-\rho)N_{t-1}(j) + f_t v_t(j)$$

$$Y_t(j) = \left(\frac{P_t(j)}{P_t}\right)^{-\mu} Y_t$$

Where $Y_t = \int_j Y_t(j)dj$ and $P_t = (\int_j P_t(j)^{1-\mu}dj)^{\frac{1}{1-\mu}}$. I normalise $P_{-1}(j) = P_{-1} = 1$. This implies

$\Pi_0 = P_0/P_{-1} = P_0$.

The solution to the firm problem in period 1 yields the following conditions after imposing $\Pi_1 = 1$ here which, as we will see, is a consequence of the monetary policy rule::

$$\mu MC_1 = \mu - 1$$

$$MC_1 = \frac{1}{A_1}\left(W + \frac{\kappa}{f_1}\right)$$

$$Y_1 = A_1 N_1$$

Where MC_1 is real marginal cost. Given A_1, it is therefore straightforward to solve for f_1 and hence η_1. The solution to the firm problem in period 0 yields the following conditions after again imposing $\Pi_1 = 1$:

$$\mu MC_0 = \psi(P_0 - 1)P_0 + \mu - 1$$

$$MC_0 = W + \frac{\kappa}{f_0} - (1-\rho)\beta \mathbb{E}_0 \frac{\kappa}{f_1}$$

$$Y_0 = N_0$$

I close the model with a specification for monetary policy, which determines $\{R_0^f, P_1\}$. For maximum tractability, I assume that the monetary authority follows a Taylor rule:

$$\frac{R_0^f}{\overline{R}} = \Pi_0^\delta = P_0^\delta$$

Where $\delta \geq 1$ is the inflation responsiveness parameter. $\overline{R} > 0$. From now on I normalise $\overline{R} = 1$ without loss of generality. Secondly, the monetary authority commits to $P_1 = P_0$, which eliminates inflation risk in period 1.

I now define an equilibrium in a standard fashion.

Equilibrium Definition: Given A_1 and a set of state variables $\{P_{-1}, N_{-1}\}$, an equilibrium is a set of prices and policies such that i) policy functions $\{C_0^E, B_0^E, C_0^U, B_0^U\}$ solve the households' problem; ii) $\{N_0(j), v_0(j), P_0(j), N_1(j), v_1(j), P_1(j)\}$ solves the firm's problem; iii) goods and asset markets both clear; iv) aggregate labour market variables evolve according to the specified laws of motion; v) the monetary policy authority sets $\{R_0^f, P_1\}$ such that $P_1 = P_0$ and the monetary policy rule holds; vi) actual and perceived laws of motion coincide.

Analytical Solution: The two-period model is sufficiently tractable to have an analytical solution. As in Ravn and Sterk (2017), the no-borrowing constraint means that the Euler equation of employed households holds with equality, while the Euler equation of unemployed households holds with strict inequality. This occurs because employed households wish to save for precautionary reasons, while unemployed households want to smooth consumption by borrowing but are prevented from doing so by the no-borrowing constraint. As a result, there is a no-trade equilibrium in the bond market where $B_0^E = B_0^U = 0$ and $C_0^E = C_1^{EE} = C_1^{UE} = W$ and $C_0^U = C_1^{UU} = C_1^{EU} = b$. It is important to emphasise, as discussed by Auclert, Rognlie, and Straub (2018), that while holding no bonds is an equilibrium outcome, this does not imply that the marginal propensity to consume of all agents is equal to 1. While this is indeed the case for the period 0 unemployed agents as the constraint binds for them, it is not the case for the employed agents since they would like to save but cannot do so in equilibrium. In general, their MPC is not equal to 1. I relax the zero net-supply and complete wage rigidity assumptions in the full model of the next section.

By using the firm's period 1 optimality conditions and the relationship between f_1 and η_1, the model generates a solution for the period 1 job-finding rate that is affine in TFP:

$$\eta_1 = \theta_0 + \theta_1 A_1$$

Where:

$$\theta_0 = -\frac{W}{\kappa}$$

$$\theta_1 = \frac{1 - \frac{1}{\mu}}{\kappa}$$

Defining:

$$M_1^E = \frac{\beta\left[(1-\rho(1-\eta_1))(C_1^{EE})^{-\gamma} + \rho(1-\eta_1)(C_1^{EU})^{-\gamma}\right]}{(C_0^E)^{-\gamma}}$$

as the stochastic discount factor of the period 0 employed household, the analytical solution means that this is affine in A_1 after plugging in the no-trade equilibrium consumption values:

$$M_1^E = \lambda_0 - \lambda_1 A_1$$

Where:

$$\lambda_0 = \beta(1 + \rho(\chi^{-\gamma} - 1)(1 - \theta_0))$$

$$\lambda_1 = \beta\rho(\chi^{-\gamma} - 1)\theta_1$$

This then leads to the key proposition which characterises the response of output in period 0 to news about period 1 TFP:

Proposition 1. *The response of output in the present period to a TFP news shock is given by:*

$$\frac{dY_0}{dA_1} = \frac{\rho}{\kappa}\left(\underbrace{\frac{\psi}{\mu}\frac{\lambda_1}{\delta}\left[(R_0^f)^{\frac{2}{\delta}}\left(2R_0^f - (R_0^f)^{\frac{\delta-1}{\delta}}\right)\right]}_{\textit{Precautionary Saving Channel}} + \underbrace{(1-\rho)\beta\kappa\theta_1}_{\textit{Labour Market Channel}}\right)$$

Proof: See Appendix A.

I term the labour market frictional if $\rho > 0$ and κ is finite. If either of these two conditions are not satisfied, the above derivative is equal to zero and TFP news shocks have no impact on current output. The first condition is violated if there is no job loss, which means that all households are employed in both periods and eliminates both channels of the news shock I will subsequently discuss. The second condition is violated if vacancy posting is infinitely expensive for a firm. In this case, no vacancies are posted and the job rate is constant and independent of TFP. Therefore, a frictional labour market is necessary for TFP news to affect output in the model.

The TFP news shock affects output in period 0 through two channels which are illustrated in the above derivative: a labour market channel and a precautionary saving channel. The first of these is present in a standard Diamond-Mortensen-Pissarides model and operates because vacancies represent a form of investment. A firm that hires a worker in period 0 not only receives the output generated by that worker in period 0, but also receives the output they produce in period 1 provided they do not separate from the firm. Expectations of lower TFP in period 1 reduce the marginal benefit of hiring today as a worker is expected to be less productive in the future period, meaning fewer vacancies are posted and the job finding rate declines in period 0. This translates to a reduction in employment and output. This channel has no demand-side aspect, evident in the fact that its strength does not depend on monetary policy or the degree of nominal rigidities.

The second channel is novel and operates via Keynesian supply effects (Guerrieri, Lorenzoni, Straub, and Werning, 2022). This channel is only operative in the presence of nominal rigidities ($\psi > 0$) and the conditions which generate a precautionary saving motive for a household ($\lambda_1 > 0 \Leftrightarrow \chi < 1$, $\rho > 0$ and κ finite).[3] When these are satisfied, the fall in η_0 after a news shock is amplified because it causes an increase in the desire for precautionary saving by employed households. This in turn reduces the nominal interest rate via the employed household Euler equation, which ultimately leads to a lower price level as a consequence of the monetary policy rule. This is achieved via a fall in firms' marginal costs through a further reduction in hiring, which decreases the job finding rate, employment and output by an additional amount. The precautionary saving channel is stronger when prices are stickier (higher ψ), job loss is more poorly insured (lower χ), there is a greater risk of job loss (higher ρ), households are more risk averse (higher γ), the discount rate is lower (higher β), vacancy posting is less costly (lower κ), monetary policy is more hawkish (higher δ), or there is a greater degree of monopolistic competition (lower μ).

The output IRF expression in Proposition 1 contains the Taylor rule parameter δ, clearly highlighting the fact that there is a role for monetary policy to play in mitigating the impact of the news shock. Since the shock acts as a Keynesian supply shock, the divine coincidence holds and monetary policy that cuts interest rates more aggressively mitigates the fall in both output and inflation in period 0. It holds that, in the limit as $\delta \to \infty$, the precautionary saving channel disappears entirely, and the entirety of the output response results purely from the labour market channel. As a result, this is the optimal monetary policy under a standard welfare function. In the infinite horizon model I consider the impact of fiscal policy in response to the shock in the form of countercyclical unemployment benefits.

I now numerically evaluate Y_0 as a function of A_1. I normalise the mean of $A_1 = 1$ and consider a fine, evenly spaced grid around it. The two periods are treated as quarters, in line with the full infinite-

[3]Note that an additional necessary condition for the precautionary saving channel to be positive is that the term in round brackets is positive. This is the case if $R_0^f > \frac{1}{2}^{\delta}$. This would only be violated for an enormously large negative shock, which I do not consider.

horizon model. I calibrate $\beta = 0.97$, $\chi = 0.8$, $\rho = 0.05$, $\kappa = 1$, $\gamma = 3$, $\psi = 200$, $W = 0.52$, $\mu = 6$, $\delta = 1$. Although illustrative, many of these parameter values are used to calibrate the infinite-horizon model, and the rationale behind them is detailed at that point. This parameter configuration results in an average job-finding rate of 60% in period 0, an unemployment rate of around 5% in period 1 and a real risk-free rate of 0%. Vacancy posting costs are around 1% of output. Using the analytical expression derived by Auclert et al. (2018), I compute the MPC of the employed households in period 0 to be 0.23 when $A_1 = 1$, meaning the average MPC is 0.25 — firmly within the range of values estimated in the literature.[4]

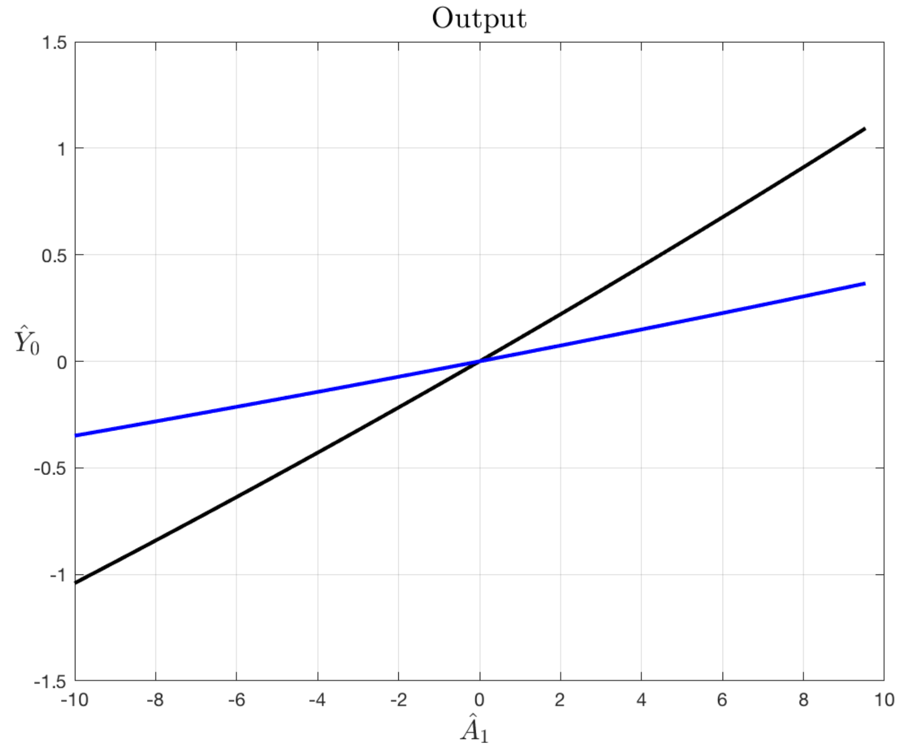
The black line in Figure 1 plots log deviations of Y_0 against A_1 from their respective mean values. The blue line repeats this for a calibration where the precautionary saving channel is shut off entirely by setting $\chi = 1$. This clearly illustrates the impact of TFP news shocks on current output in the two-period model, with lower expected period 1 TFP resulting in a recession in period 0. The effect is amplified significantly when the precautionary saving channel is present alongside the standard labour market channel, as evidenced by the steeper relationship between the two variables. I calculate that, for $A_1 = 1$, the precautionary saving channel comprises 64% of $\frac{dY_0}{dA_1}$ and so significantly amplifies the TFP news shock. In Appendix A I relax the assumption of a no-borrowing constraint and repeat the plot in Figure 1. Ultimately this makes little difference to the results, dampening the relationship very marginally.

Figure 2 displays this plot for four other period 0 variables in the model: the job finding rate, vacancies, the nominal interest rate and the inflation rate. All four are increasing in A_1 when the precautionary saving channel is present, and the response of the job finding rate and vacancies is amplified significantly. When the channel is muted entirely, the nominal interest rate and the inflation rate are not affected by the news shock at all. As we will see, the empirical evidence suggests this non-response is likely counterfactual for the nominal interest rate. For the job finding rate and vacancies, the news shock elasticity is also very small when the precautionary saving channel is absent. The empirical evidence supports the presence of the channel insofar as these two labour market variables both seem to respond quite strongly to a TFP news shock in the local projection evidence of Section 4.[5]

[4] See Appendix D.4 of Auclert, Rognlie, and Straub (2018) for details. The model here is a special case of their zero-liquidity model with two periods and two income states: employed and unemployed.

[5] The responses of the endogenous variables in the model during period 0 to a TFP news shock are very similar to a discount rate shock (a change in β) since both operate through changes in aggregate demand. What ultimately

Figure 1: The Impact of News Shocks on Output in the Two-Period Model.

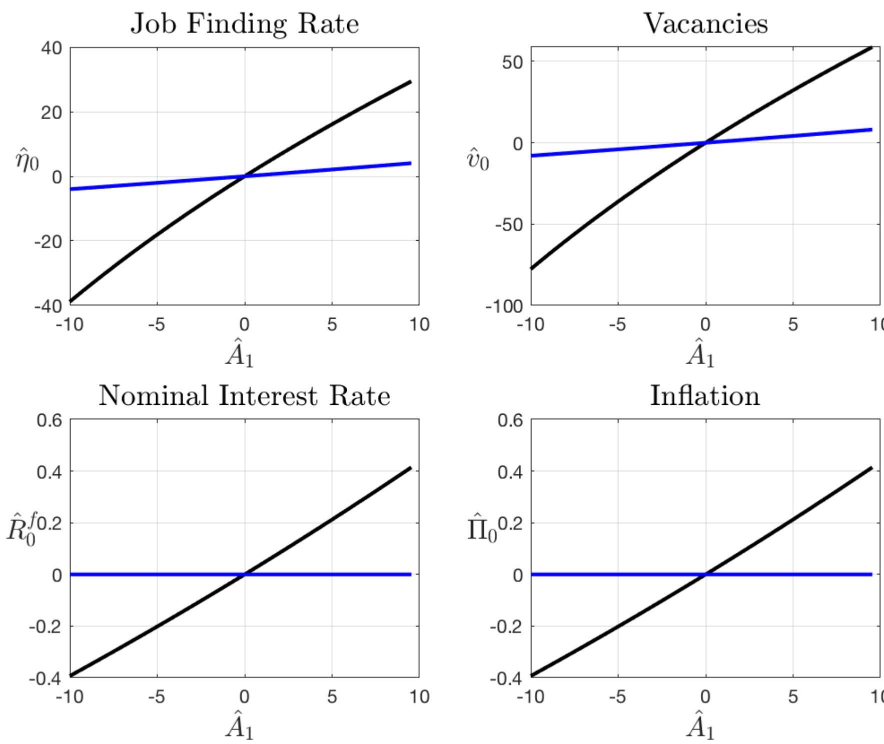


Note: The black line plots log deviations of Y_0 from its mean as a function of $\log A_1$ in the two-period model with both channels active. The blue line repeats this for the case where the precautionary saving channel is shut down by setting $\chi = 1$.

As a closing remark for this section, I note that the same mechanism for TFP news shocks described here would apply to a TFP noise shock in the spirit of Lorenzoni (2009) and Chahrour and Jurado (2018). By this, I mean a change in expectations about A_1 in period 0 that is not followed by the same realised change in period 1. These mistaken expectations would translate to the same dynamics of output in period 0, as firms change their vacancy posting in expectation and this spills over to the household demand side. A similar dynamic, albeit one that doesn't feature the amplification provided by the precautionary saving channel, is at play in Faccini and Melosi (2018).

discriminates between the two potential shocks is the eventual change in A_1. In the local projections of section 4 I verify that TFP does eventually fall after the shock. Through the lens of the model, it is possible that previous estimated DSGE models which found a prominent role for discount rate shocks (e.g. Smets and Wouters (2007)) were at least partially picking up TFP news shocks. I thank an anonymous reviewer for raising this point.

Figure 2: The Impact of News Shocks on Other Variables in the Two-Period Model.



Note: The black line plots log deviations of the respective variable from its mean as a function of $\log A_1$ in the two-period model with both channels active. The blue line repeats this for the case where the precautionary saving channel is shut down by setting $\chi = 1$.

2.1 Version of the Model Without Nominal Rigidities

As Figure 2 shows, when nominal rigidities are present in the benchmark model there is a fall in inflation after a contractionary TFP news shock. As I show in the empirical results of Section 4, the response of inflation to such a shock in the data is somewhat ambiguous. Cascaldi-Garcia and Vukotic (2022) find evidence of inflation falling, while other papers such as Barsky and Sims (2011) and Chahrour et al. (2023) find an increase albeit with wide confidence intervals that include a decrease. To address this, I now develop a purely real version of the model and therefore demonstrate that the interaction of precautionary saving and labour market frictions can still serve to amplify a TFP news shock in the absence of nominal rigidities.

This version of the model involves just one alteration besides the lack of nominal rigidities: rather than assuming that firms are risk-neutral I instead now assume that they use the prevailing SDF to discount future cash flows when making their hiring decision in period 0. This is akin to assuming that the firms are organised as worker cooperatives, or alternatively that their corporate governance objective is to maximise shareholder value.[6] The period 0 firm problem now becomes:

$$\max_{P_0(j),N_0(j)} \frac{P_0(j)}{P_0}Y_0(j) - WN_0(j) - \kappa v_0(j) + \mathbb{E}_0 M_1^E\left[\frac{P_1(j)}{P_1}Y_1(j) - WN_1(j) - \kappa v_1(j)\right]$$

s.t.

$$Y_t(j) = A_t N_t(j)$$

$$N_t(j) = (1-\rho)N_{t-1}(j) + f_t v_t(j)$$

$$Y_t(j) = \left(\frac{P_t(j)}{P_t}\right)^{-\mu} Y_t$$

This ultimately results in the following expression for the period 0 output response to period 1 TFP news:

$$\frac{dY_0}{dA_1} = \rho(1-\rho)\left(\underbrace{-\lambda_1\theta_0}_{\text{Precautionary Saving Channel}} + \underbrace{\theta_1\left(\lambda_0 - 2\lambda_1 A_1\right)}_{\text{Labour Market Channel}}\right)$$

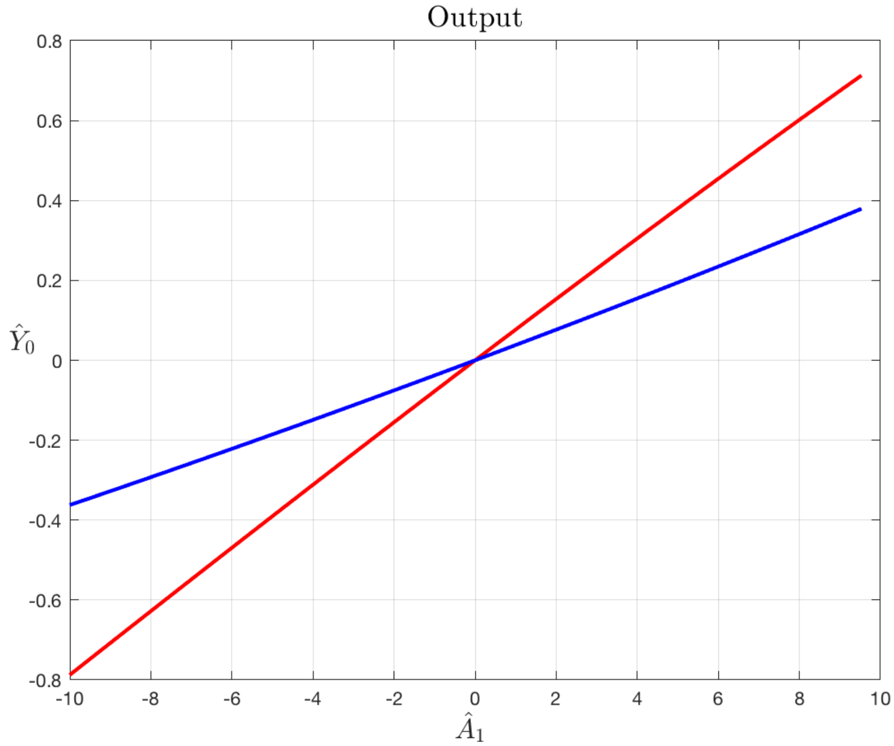
The transmission mechanism now operates via a feedback loop between unemployment risk and the hiring decision of firms. Bad TFP news reduces expectations of the period 1 job finding rate, which in turn spurs the precautionary saving motive of households if and only if $\lambda_1 > 0$ i.e. if unemployment is not fully insured in de facto terms. This causes an increase in the SDF with discount rates now rising in response to the shock. As in Hall (2017), this rise in discounts reduces the vacancy posting of firms which raises unemployment and lowers output in period 0.[7] If $\lambda_1 = 0$ then the only channel present is the same labour market channel present in the benchmark model outlined above. Importantly, the presence of incomplete markets now impacts the two channels since terms from the SDF appear in both.

The key to the TFP news shock having a large effect on output and other endogenous variables is

[6] This follows because, when discounting future cash flows, the equilibirum SDF is the only discount factor which aligns the market's valuation of cash flows with the firm's private valuation.

[7] The precautionary saving channel is weakly positive since $\lambda_1 \geq 0$ and $\theta_0 < 0$. The labour market channel is typically positive since $\theta_1 > 0$ and $\lambda_0 > 2\lambda_1 A_1$ under reasonable parameter values. The latter inequality holds whenever $A_1 < \frac{1+\rho\left(\chi^{-\gamma}-1\right)}{2\rho\left(\chi^{-\gamma}-1\right)\theta_1}$.

Figure 3: The Impact of News Shocks on Output in the Two-Period Model Without Nominal Rigidities.



Note: The red line plots log deviations of Y_0 from its mean as a function of $\log A_1$ in the two-period model without nominal rigidities, with risk-averse firms, and with both channels active. The blue line repeats this for the case where the precautionary saving channel is shut down by setting $\chi = 1$.

now the strength of this discount rate channel. As in Preston (2025), to achieve this quantitatively it is necessary to increase the risk aversion parameter (γ) and the degree of consumption loss upon unemployment $(1 - \chi)$. An alternative way of achieving this without raising risk aversion would be to use habit preferences, which are common in the asset pricing literature e.g. Campbell and Cochrane (1999). Figure 3 repeats the plot of log period 0 output deviations against log period 1 TFP deviations in this version of the model. I set $\gamma = 10$, which is consistent with the upper end of estimates of this parameter from the literature, and $\chi = 0.7$, in line with the more severe estimates of consumption loss upon unemployment from Chodorow-Reich and Karabarbounis (2016). All other parameters are kept the same as previously. As previously, the precautionary saving channel amplifies the output response by a factor of around 2.

I now extend the benchmark two-period model to an infinite horizon environment with several additional features to enrich the model.

3 Infinite Horizon Model

The full model naturally generalises the benchmark two-period case, and as such I relegate full details of the model to Appendix B. The infinite horizon model relaxes the assumption of rigid wages, instead allowing for the real wage to respond to TFP with some degree of inertia. The zero net supply assumption for the nominal bond is also relaxed, generating a non-degenerate wealth distribution. I also allow a more general functional form for the matching function and the monetary policy rule that allows these both to be explicitly parameterised. Finally, TFP follows an AR(1) process that features news shocks with an anticipation horizon of four quarters. There are five key equations which comprise the model's equilibrium:

$$
\begin{aligned}
C_t^E(i)^{-\gamma} &= \beta \mathbb{E}_t \frac{R_t}{\Pi_{t+1}} \left\{ (1-\rho(1-\eta_{t+1})) C_{t+1}^E(i)^{-\gamma} + \rho(1-\eta_{t+1}) C_{t+1}^U(i)^{-\gamma} \right\} \\
MC_t &= \left(\frac{1}{A_t}\right) \left(W_t + \frac{\kappa}{f_t} - \beta \mathbb{E}_t \left[(1-\rho) \frac{\kappa}{f_{t+1}} \right] \right) \\
1 - \mu + \mu MC_t &= \psi(\Pi_t - 1)\Pi_t - \psi \beta \mathbb{E}_t (\Pi_{t+1} - 1)\Pi_{t+1} \frac{Y_{t+1}}{Y_t} \\
R_t &= \overline{R} \left(\frac{\Pi_t}{\overline{\Pi}} \right)^{\delta} \\
\log(A_t) &= \phi_A \log(A_{t-1}) + \varepsilon_t^A + \varepsilon_{t-4}^{A,N}
\end{aligned}
$$

All notation aligns with the two-period model. The first of these equations is the Euler equation of an employed household i. The second equation is the firms' real marginal cost. The third equation is the New Keynesian Phillips curve. The fourth equation is the Taylor rule. The fifth equation specifies the stochastic process for TFP which features both unanticipated shocks and news shocks with an anticipation horizon of four periods. ϕ_A represents the persistence of TFP.

To illustrate the response of TFP news shocks, I calibrate and solve the model before generating impulse response functions (IRFs) to a negative TFP news shock. I make use of the solution method for HANK models outlined in Cui and Sterk (2018) to solve the model, which allows for a non-degenerate wealth distribution in equilibrium. See Appendix B for further details. The time-frequency in the model is quarterly to facilitate direct comparison with the subsequent empirical results. The model is calibrated to either match a steady-state target or according to microeconomic evidence. The discount factor, β, is set at 0.99, which implies a subjective discount rate of 4 percent per annum. The steady-state interest rate is below $\frac{1}{\beta}$ due to the presence of idiosyncratic income risk. I set the supply of liquid assets to target a steady-state real interest rate of 0%. This results in households on average holding a limited amount of liquid assets in equilibrium, in line with US data which shows that the liquid asset holdings of most households are reasonably low.[8] The monetary authority targets a stable price level, resulting in $\overline{\Pi} = 1$. The semi-elasticity of the nominal interest rate to deviations of inflation from target, δ, is set at 1.5, which is standard.

The coefficient of relative risk aversion is set to 2 — a standard value in the literature. The vacancy posting cost κ is set such that total vacancy posting costs are 1% of output in steady-state. This implies that the cost to hire a worker is 3% of the quarterly wage in steady-state, near the estimate of 4.5% from Silva and Toledo (2009). A key parameter in the model is b, which enters the budget constraint of the unemployed as the level of their home production. This influences the amount by which consumption decreases upon the transition from employment to unemployment on average. Chodorow-Reich and Karabarbounis (2016) estimate this decrease to be 21 percent empirically, and I set b such that the average consumption loss upon unemployment matches this value. The wage rigidity parameter, ρ_W, is set to 0.9 as in Dupraz et al. (2019). The price adjustment parameter, ψ, is set to 58.7, which implies that prices adjust on average every 4 quarters. The elasticity of substitution, μ, is set at 6 which produces a steady-state markup of 20%. The elasticity of the matching function (with respect to unemployment) is set at 0.65 which is in the range estimated by Pissarides and Petrongolo (2001). The TFP persistence parameter, ϕ^A, is set to 0.99, which is a standard value. The separation rate, ρ, is set to 0.044 which corresponds to a monthly unemployment inflow rate of approximately 1.5% which is the average in the Current Population Survey. A steady state unemployment rate of 4.5% is targeted. Table 1 provides a full summary of the model's calibrated parameters.

Figure 4 presents IRFs for a -1% TFP news shock anticipated four quarters in advance. This clearly shows the Pigovian cycle which emerges, as output falls before the change in TFP. Unemployment risk, defined as the probability of a worker becoming unemployed within the next year, increases substantially. This occurs due to the decline in vacancy posting that leads to a sustained fall in the job finding rate. Heightened labour market risk represents a key part of the transmission mechanism, as this triggers the rise in precautionary saving amongst the employed which subsequently results in a drop

[8] See Kaplan et al. (2018) for more detail on this point.

Table 1: Parameter values

Parameter	Value	Target/Source
β	0.99	Subjective discount rate of 4% per year
γ	2	Standard value
b	0.59	Consumption loss of 21% upon unemployment
ρ_W	0.9	Dupraz et al. (2019)
ψ	58.7	Average price duration of 4 quarters
μ	6	Steady-state markup of 20%
κ	1.2	Hiring costs 1% of output in steady state
ρ	0.044	Monthly unemployment inflow rate of 1.5% from CPS
α	0.65	Pissarides and Petrongolo (2001)
δ	1.5	Standard value
B	0.06	Real interest rate of 0%
$\overline{\Pi}$	1	Zero steady-state inflation
ϕ^A	0.99	Standard value

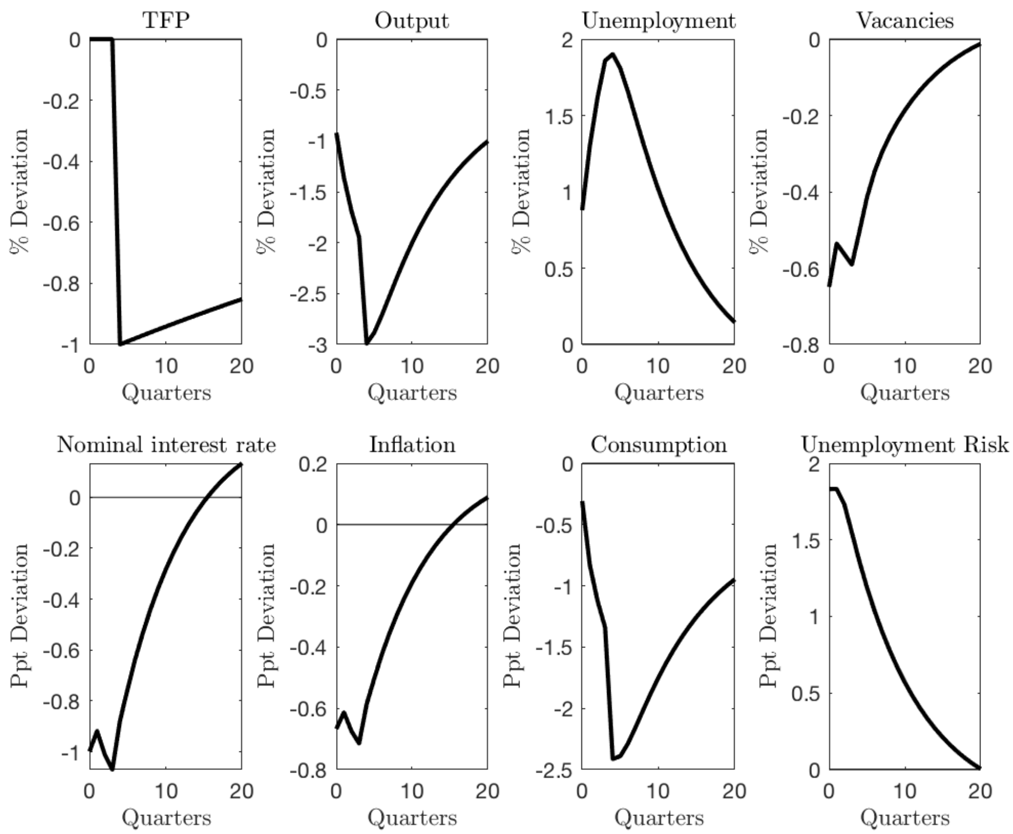
in consumption. Vacancies and the nominal interest rate both sharply decline in response to the news shock, before reverting to steady-state gradually, closely matching the analogous empirical dynamics of these variables which is illustrated in Section 4.[9] In Appendix D I consider an alternative news shock process which more closely resembles the slow diffusion seen in the empirical estimates for the IRF of TFP. This results in model IRFs that largely look very similar to those estimated empirically quantitatively and qualitatively.[10]

To isolate the roles of the precautionary saving and labour market channels outlined analytically in the two-period model, it is instructive to look at two counterfactual economies. In the first, there are complete markets which eliminate all idiosyncratic risk, effectively switching off the precautionary saving mechanism while search frictions remain present in the labour market. In the second, there is a spot labour market where the transition rates between employment and unemployment are fixed and exogenous, but markets are incomplete. This eliminates the labour market channel. Full details of these models can be found in Appendix C, but the respective Euler equations are:

[9] The infinite-horizon model features an additional permanent income effect because real wages are no longer fixed, and consumption can differ from the income of households due to the ability to accumulate liquid assets. Given that real wages are inert in the calibration, this channel likely plays a small role. Repeating the analysis with a fixed real wage (eliminating any changes in permanent income) confirms this, generating very similar IRFs to those in the benchmark case.

[10] In principle, the response of the endogenous variables to a TFP news shock could be asymmetric due to the presence of the borrowing constraint, which introduces a non-linearity into the model. I investigated this and found almost no difference between the responses to positive and negative shocks. The likely reason for this is that policy functions are relatively linear and so a form of approximate aggregation holds as in Krusell and Smith (1998), making the non-linearities quite weak in practice.

Figure 4: Model IRFs for a -1% shock to $\varepsilon_t^{A,N}$.

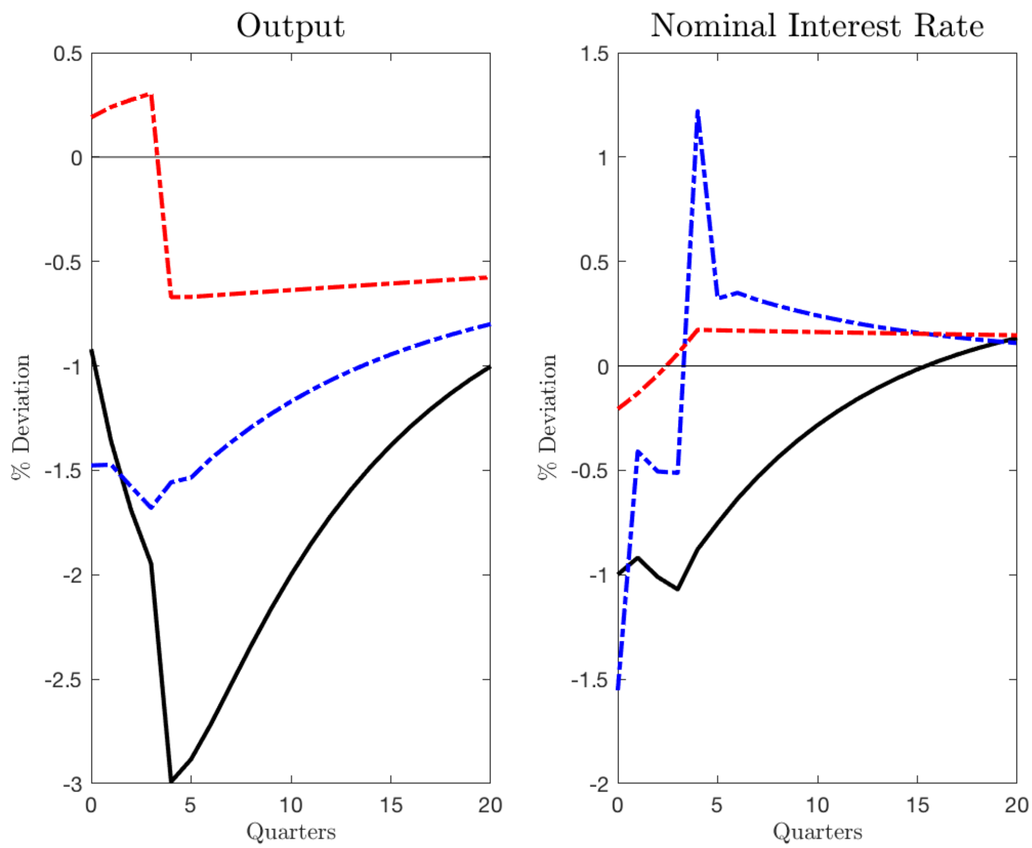


$$C_t^{-\gamma} = \beta \mathbb{E}_t \frac{R_t}{\Pi_{t+1}} C_{t+1}^{-\gamma}$$
$$C_t^E(i)^{-\gamma} = \beta \mathbb{E}_t \frac{R_t}{\Pi_{t+1}} \left\{ (1 - P^{EU}) C_{t+1}^E(i)^{-\gamma} + P^{EU} C_{t+1}^U(i)^{-\gamma} \right\}$$

In the first economy, there is full risk-sharing, which means that deteriorating labour markets do not directly affect the consumption-saving decision, and as a result, there is a de facto representative agent. In the second economy, idiosyncratic risk is entirely exogenous (P^{EU} denotes the probability of transitioning to unemployment a worker faces each period), meaning there is still a precautionary saving motive but it is invariant to the state of the economy due to the absence of labour market frictions.

The left panel of Figure 5 compares the IRFs for output in these two economies to the baseline results. In the complete market economy, labour market frictions mean that firms still have a reduced incentive to post vacancies after a bad TFP news shock, as their labour demand falls in response to poor expected

Figure 5: Comparison of the IRFs of output and the nominal interest rate to a -1% shock to $\varepsilon_t^{A,N}$ in the baseline economy (black line), the complete market economy (blue line) and the frictionless labour markets economy (red line).



future conditions. This leads to a lower level of employment, reducing output and consumption via indirect general equilibrium effects. The shock is not amplified beyond the firm's vacancy posting decision, as the lower job finding rate does not have a spillover effect on the consumption-saving decision of households as they are insured against the risk of joblessness. For this reason, the magnitude of the output drop is dramatically lower than in the baseline economy, serving to highlight the crucial role played by precautionary saving.

In the economy which features frictionless labour markets but retains idiosyncratic risk, the sign of the output response is reversed as a bad TFP news shock leads to a counterfactual boom in the periods before TFP changing. This is because of the effect the shock has on labour supply; bad news makes today a relatively efficient time for households to work, shifting the labour supply curve outwards. This increases employment and output subsequently from the production function. As firms can hire and fire workers costlessly each period, the labour demand decision is not forward-looking and is not influenced by expectations of future productivity. It is not until TFP falls that firms reduce their labour demand and output falls. This lack of an immediate downturn in the labour market means that levels of idiosyncratic risk do not change for households, and the strength of the precautionary motive stays constant. This economy is very similar to a standard New Keynesian model and thus serves to illustrate the lack of news-induced fluctuations in this framework.

The right panel examines the dynamics of the nominal interest rate. The benchmark economy features an immediate and prolonged decline in the nominal interest rate, as the rise in unemployment risk stimulates a precautionary saving motive. This aligns with the empirical response of the Fed Funds rate in Section 4. The rise in precautionary saving is absent from the economy with complete markets, meaning that after the initial fall in the interest rate, there is a rebound as the rate quickly increases above steady state and remains elevated. The lack of an increase in unemployment risk in the spot labour market economy translates to a muted response of the nominal interest rate over the impulse response horizon. To summarise, the results of the counterfactual exercise illustrate that the combination of endogenous unemployment risk and incomplete markets is key to generating a sizeable and persistent decline in output before any change in TFP, as well as a realistic, prolonged decline in the nominal interest rate. Neither of the two counterfactual models can simultaneously match the dynamics of both output and the nominal interest rate, illustrating the importance of the combination of the two key frictions at work in the benchmark model.

For completeness, in Appendix E I also consider the response of output and the nominal rate in the standard three-equation New Keynesian model. This model features complete markets and a frictionless labour market. Output does fall upon the shock's impact, but employment displays a rebound that is inconsistent with the empirical evidence presented in the following section.

3.1 Policy Implications of the News Shock Transmission Mechanism

Can policy respond in such a way that attenuates the fall in output after a bad news shock? Given the fact that, in the complete markets counterfactual seen previously, output fell significantly less after a negative news shock, this suggests that there is a natural role for automatic stabilisers in the form of time-varying unemployment benefits. This then cushions the blow of unemployment and reduces the precautionary saving motive of households which ultimately limits the emergence of the Pigovian cycle in the first place. In the model, this can be thought of as a rule for the level of home production (akin to an unemployment benefit), b_t, which makes it a function of the unemployment rate:

$$b_t - \overline{b} = \delta_b (U_t - \overline{U})$$

The parameter δ_b then controls how home production responds to changes in the unemployment rate. To evaluate the effectiveness of this automatic stabiliser, I compare the IRFs in the model with $\delta_b = 1$ to the benchmark model with $\delta_b = 0$ in Figure 6.[11] This captures the empirical tendency in the US of the unemployment insurance replacement rate to increase with the unemployment rate, see for example Kroft and Notowidigdo (2016). This policy is very effective at dampening the Pigovian cycle, with the reduction in output roughly halved relative to the benchmark economy during the news shock anticipation window. This is achieved by significantly reducing the precautionary saving motive of households, as seen by the fall in the nominal interest rate being greatly reduced. This lowers the spillover to the labour market, resulting in an attenuated rise in unemployment and unemployment risk, and a much smaller fall in vacancy posting.

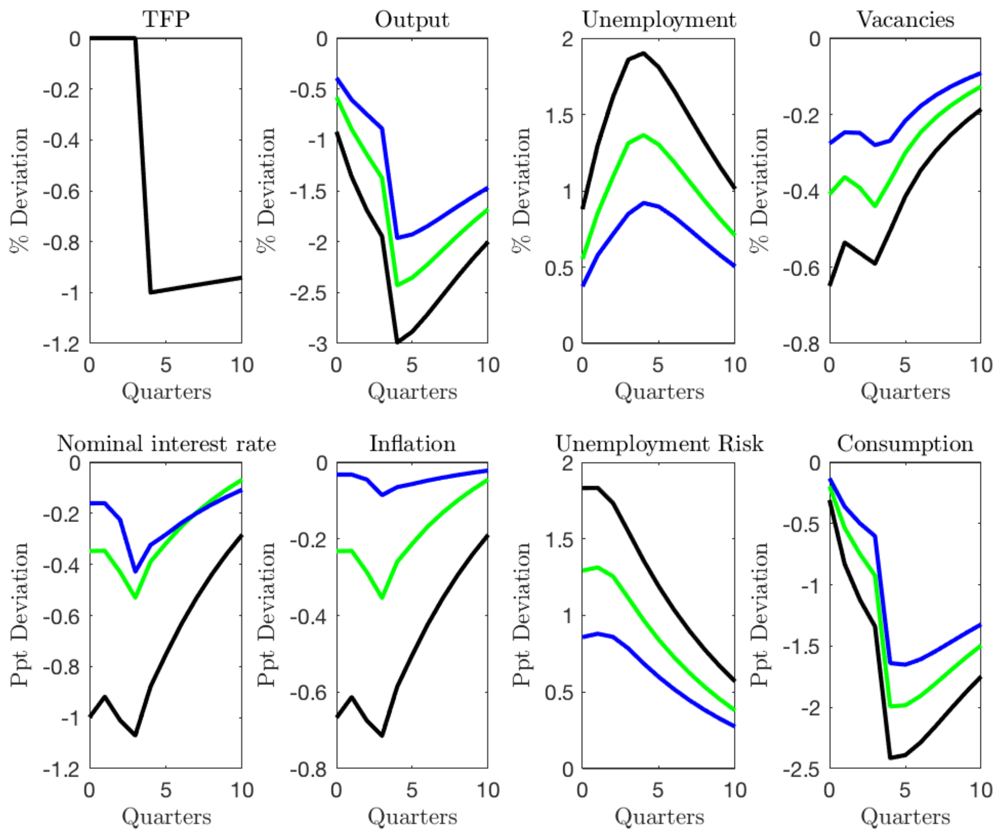
I also consider the effect of more aggressive monetary policy by setting $\delta = 5$. Much like in the output IRF derived in Proposition 1 for the two-period model, a higher value of this parameter effectively limits the contraction in output and the labour market. This is evident in the IRFs of Figure 6, and occurs because monetary policy effectively disrupts the demand-based amplification of the shock by stifling the precautionary savings channel.

3.2 Model Extensions

In Appendix D, I consider a number of extensions to the model. These include: i) A diffusion process for the TFP news shock; ii) Nominal wage rigidities instead of real wage rigidities; iii) Endogenous job separations; iv) A well-defined labour supply decision for employed households; v) An unemployment benefit financed by labour income taxation rather than home production. The core mechanism is shown

[11] This coefficient value is roughly in line with the response of the average change in the log of the statutory maximum UI weekly benefit to a change in the national unemployment rate depicted in Figure 4 of Kroft and Notowidigdo (2016).

Figure 6: The IRFs in the baseline economy (black line), the economy with a time-varying level of home production with $\delta_b = 1$ (green line), and the economy with more aggressive monetary policy ($\delta = 5$, blue line).



to be robust to or strengthened by these. I also investigate the degree of asymmetry in the IRFs to positive and negative TFP news shocks. The presence of the borrowing constraint injects a source of non-linearity into the model, since a negative shock pushes more agents towards this point. Ultimately, output is shown to respond more strongly to negative vs positive TFP news shocks for this reason.[12]

4 Empirical Evidence

In this section, I present empirical evidence for the effects of TFP news shocks on key labour market variables, output, consumption, inflation and the Federal Funds rate to assess the qualitative plausibility of the model's transmission mechanism.

[12] I thank an anonymous reviewer for raising this point.

4.1 Local Projections

To assess either the effect of TFP news shocks on the variable set or their relative importance over the business cycle, a measure of identified TFP news shocks is necessary. I choose the Barsky and Sims (2011) shocks, and I extend them to end in 2019:IV. The sample period is thus 1960:I - 2019:IV. In Appendix G I show that the results for the original series of the shock looks very similar. I also present results for the Beaudry and Portier (2006) shocks, which look broadly comparable on the whole.

To estimate the IRFs, I use a local projection (LP) setup as in Jorda (2005) and estimate the IRFs directly over a range of horizons. Let ε_t denote the identified TFP news shock in period t, Y_i the relevant variable of interest, X a vector of controls and h the horizon length. The LP is then:

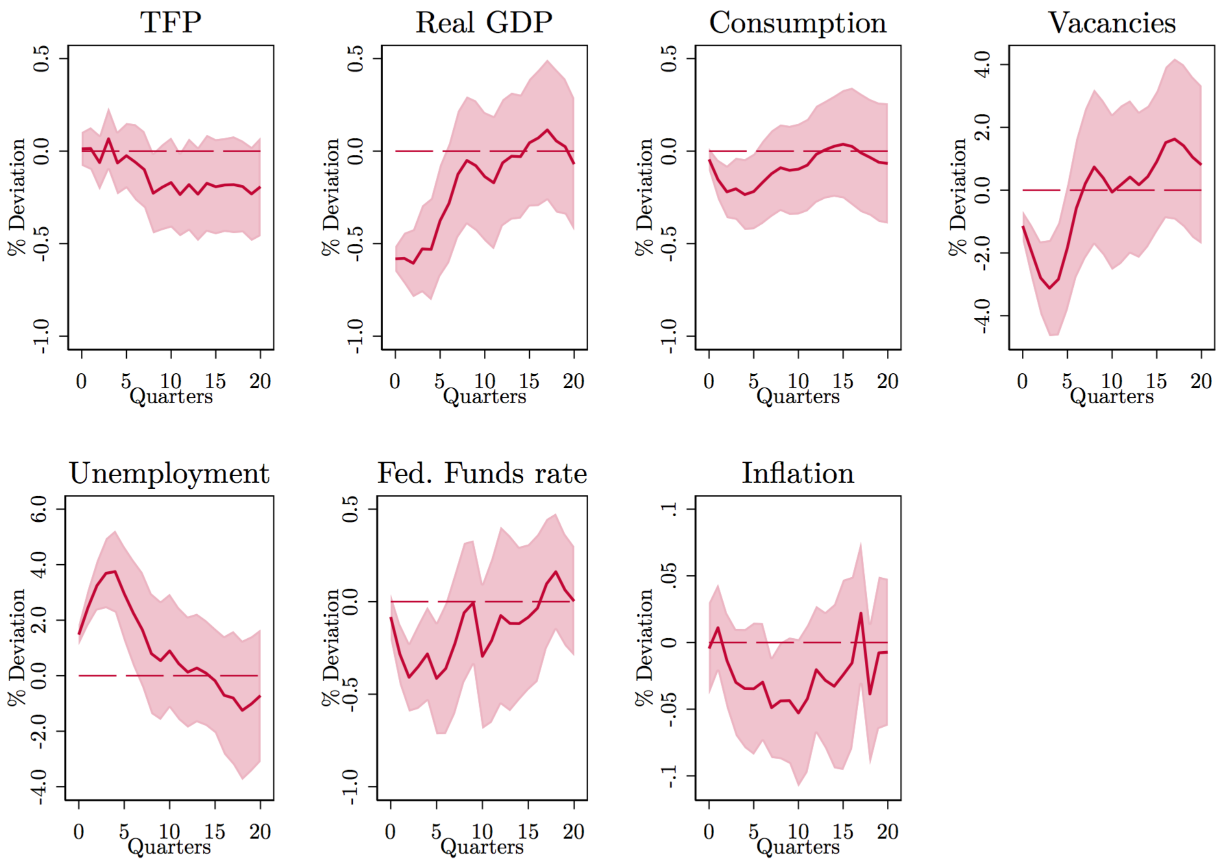
$$Y_{i,t+h} = \alpha_i^h + \beta_i^h \varepsilon_t + \gamma_i^{h\prime} X_t + \omega_{i,t+h} \tag{1}$$

The $h+1$ equations are then estimated by OLS for each variable in the set, with β_i^h giving the estimated impulse response of Y_i, h periods after a shock to ε_t.[13] The parameter estimates are then plotted as a function of h to produce the IRF. The vector of controls consists of a linear trend, four lags of the dependent variable (Y_i), four lags of log real GDP and four lags of log utilisation-adjusted TFP from Fernald (2012). Since lags of the dependent variable are included, it is sufficient to use heteroskedasticity-robust standard errors as shown by Olea and Plagborg-Møller (2021). The IRFs are multiplied by -1 in each case to obtain results for a bad news shock to allow comparison with the model. In Appendix G I use an LP-IV approach as a robustness test and demonstrate that results are quantitatively very similar.

I now consider how the empirical counterparts of the model's key variables respond to a TFP news shock. Specifically, I look at the response of TFP, real GDP, real consumption (non-durables and services), unemployment, vacancies, the inflation rate and the Federal Funds rate. All variables, apart from the last two, are included in logs. See the appendix for a description of how each of these series is constructed. Figure 7 plots the estimated IRFs for each of these alongside stock prices and utilisation-adjusted TFP.

[13] It may be tempting to be concerned about the generated regressor problem here, but as Pagan (1984) shows, generated residuals do not pose any complications for inference under the null hypothesis that the coefficients are equal to zero, meaning there is no need for an adjustment to the standard errors

Figure 7: The IRFs of key variables to a Barsky and Sims (2011) TFP news shock.



Note: The shaded areas are the 90% confidence intervals.

The IRFs qualitatively match those produced from the model in Section 3 by and large. Output and consumption both decline upon impact, and I can reject the null hypothesis that $\beta_i^0 = 0$ for both at the 1% level. The strong impact response of consumption provides initial suggestive evidence of a precautionary saving channel through which the shock propagates. They continue to decline for around two years before beginning to revert back to trend. Just like the key mechanism in the model, the labour market response is very strong. Vacancies fall on impact and continue to decline, which is reflected in a gradual rise in unemployment that looks very similar to the pattern present in the model IRFs. The fall in the Fed Funds rate is consistent with a heightened precautionary saving motive placing downward pressure on nominal interest rates. As was the case in the two-period and infinite-horizon model, a persistent decrease in the nominal interest rate only occurred when the precautionary saving channel was present. Finally, the response of inflation is more ambiguous with wide confidence intervals that do not rule out a decline on the impact of the shock. The inflation IRF is consistent with the model after a diffusion news shock as illustrated in Appendix D.

Next, I perform a historical decomposition exercise within the framework of the local projection. This allows me to estimate how instrumental the TFP shock was for the cyclical dynamics of output over the sample period. In turn it then enables the assessment of whether or not the shock played a major, minor or negligible role in the set of recessions considered. Through the lens of the local projection, the historical decomposition of variable i in period t can be expressed as:

$$\mathrm{HD}_{i,t} = \sum_{h=0}^{H} \beta_i^h \, \varepsilon_{t-h},$$

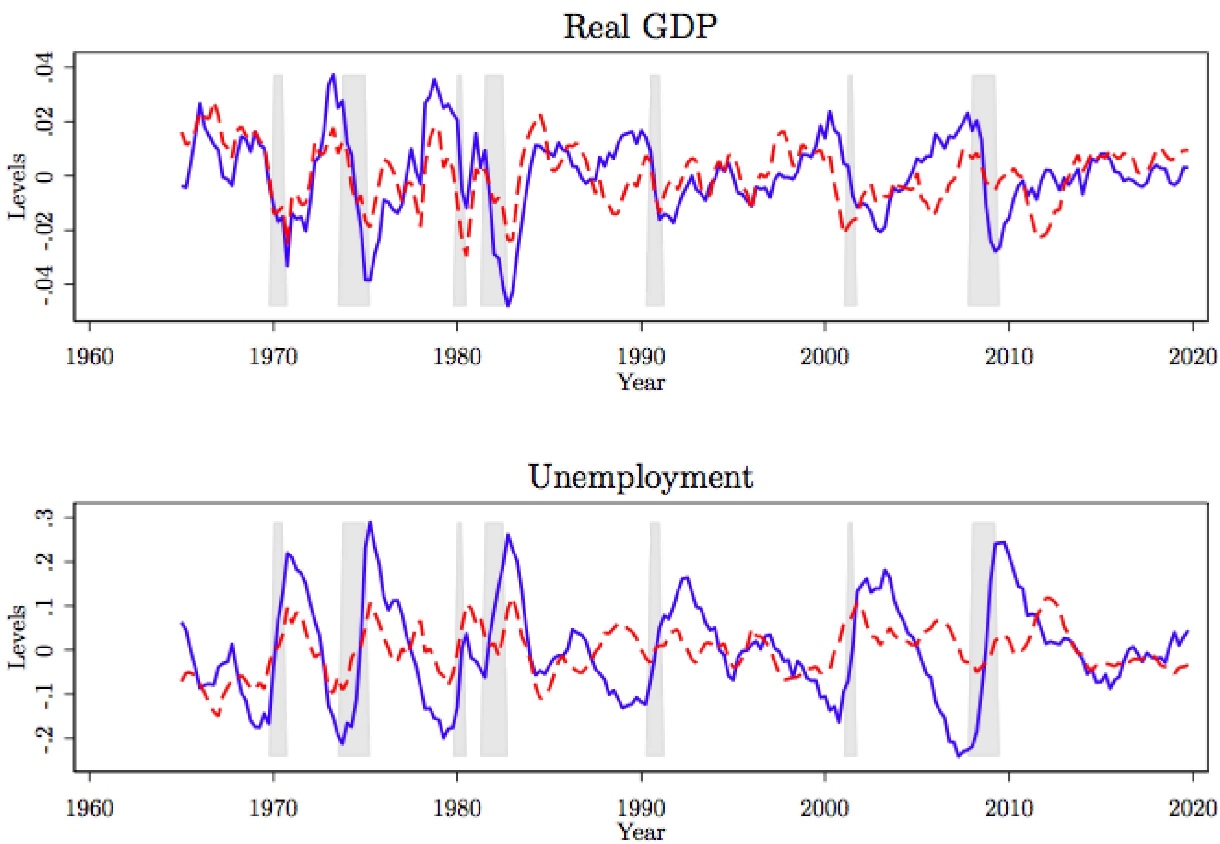
where $\mathrm{HD}_{i,t} = Y_{i,t} - Y_{i,t|\varepsilon_{t-j}=0 \forall j=0,\ldots,H}$. This gives the contribution of a shock to an endogenous variable at a current point in time by differencing out the counterfactual path of Y_i had no shocks realised. The closer this is to zero, the less important the shock is for the dynamics of the given variable.

Figure 8 plots this for output and unemployment, after a Hodrick-Prescott filter has been applied to them. The blue lines represent the evolution of the detrended variables, while the red line captures the contribution of the Barsky and Sims (2011) TFP news shock. As the plot illustrates, the shock has been highly influential in determining the cyclical dynamics of both output and unemployment over the post-1960 period. It has also been instrumental in contributing to the majority of recessions in the sample, playing a particularly outsized role in the pair of recessions in the 1970s, the 1990-91 recession, and also the 2001 tech bubble downturn. The shock was particularly important for the sharp increase in unemployment during the 1970s recessions.

4.2 Survey-Based Measures

A key distinction between the proposed transmission mechanism presented here and others outlined in the literature is that the demand side is crucial for the propagation of the shock, whereas the supply channel is normally the key conduit for news. For example, in Jaimovich and Rebelo (2009) bad TFP news shocks are shown to generate recessions in a model which is an extension of the RBC framework to include three additional supply side factors: variable capital utilisation, investment adjustment costs and preferences which allow the wealth effect on labour supply to be calibrated. Any kind of demand

Figure 8: The historical decomposition of output and unemployment for a Barsky and Sims (2011) TFP news shock.



Note: The blue line plots the detrended variable, while the red line plots the contribution of the Barsky and Sims (2011) TFP news shock. The grey shaded areas denote NBER recessions.

channel is conspicuously absent and consumption only falls as a product of general equilibrium rather than as a direct response to the shock. It is essentially firms rather than households for whom the news is most relevant.

To provide empirical evidence on the relevance of the demand side of the macroeconomy for TFP news shocks, I look at the response of a survey-based measures of household expectations. The Michigan Survey of Consumers is a US-wide, representative survey of 500 respondents each month, who are each asked 50 questions about their attitudes towards current and future economic conditions. The forward-looking element makes it well-suited to the context of TFP news shocks, and a number of the questions asked have particular relevance to the concepts of precautionary saving and attitudes towards labour market conditions. First, I include the responses to a question in the Michigan survey regarding whether or not the respondent would consider the present period a good or bad time to purchase durable goods.[14] This is particularly informative about the demand channel since, as is well-known, durable goods demand is more sensitive to changes in aggregate demand (see for example Barsky et al. (2007) or Bils et al. (2012)). Second, I include the unemployment expectations index, constructed in the same way as Carroll and Dunn (1997) — the share of surveyed consumers who believe unemployment will rise over the next year minus the share who anticipate it falling. This provides a useful measure of labour market expectations. If this variable were to exhibit a non-response, this would cast doubt on the model's core mechanism since it is crucial that households anticipate worsening conditions in the labour market. Each of the two variables is rescaled to have zero mean and unit standard deviation. The sample period is governed by when each of the questions was included in the survey and is 1978:I-2010:IV for both variables.

Figure 9 displays the estimated impulse responses for the two survey-based variables in response to a negative TFP news shock. Both respond upon impact to the news, as the two measures become more pessimistic with impact coefficients that are significant at the 1% level. Consumers correctly anticipate higher unemployment in the subsequent year — recall from the benchmark results that unemployment rises in a gradual fashion and peaks around 5 quarters after the shock. This change in expectations is a key part of the transmission mechanism, as consumers are unsurprised by the eventual deterioration of labour market conditions when this does occur. Durable purchase sentiment also responds upon impact. Consumers immediately believe that the current period becomes a worse time to make durables purchases, indicative of a fall in aggregate demand. These sizeable responses from these surveys are suggestive of two things: expectations respond strongly to the news and household demand adjusts substantially to reflect this. Both of these are akin to the behaviour of households in the HANK model.[15]

[14] The wording of the question is: "About the big things people buy for their homes-such as furniture, a refrigerator, stove, television, and things like that. Generally speaking, do you think now is a good or bad time for people to buy major household items?"

[15] The model could be extended to explicitly include durable goods and fixed costs for durable adjustment as in Berger and Vavra (2015). In this case, when the precautionary saving channel is present, the increase in future income uncertainty triggered by a bad TFP news shock would lead currently employed households to postpone their present durable purchases due to the presence of the fixed adjustment cost leading to a 'wait-and-see' effect. Therefore, we would expect durable consumption to be particularly sensitive to TFP news shocks only if the precautionary saving channel was present.

Figure 9: Estimated IRFs for the survey-based variables to a negative TFP news shock.

Note: The shaded areas are the 90% confidence intervals.

4.3 The Precautionary Saving Channel of TFP News Shocks

I briefly attempt to directly assess the empirical impact of a TFP news shock on the precautionary saving motive. While it should be noted that it is challenging to measure the degree of precautionary saving present empirically, Pflueger, Siriwardane, and Sunderam (2020) develop a proxy. The time-varying strength of the precautionary saving motive is measured by looking at the price of volatile stocks (PVS). They exploit the fact that, when perceived levels of risk are high, the subsequent precautionary saving motive pushes down the price of high-volatility stocks relative to low-volatility ones, and thus this price ratio can be informative for our purposes. A potential concern of using asset market data to investigate variation in the precautionary motive is that participation in these markets is limited, and disproportionately weighted towards richer individuals (see for example Poterba and Samwick (1995) or Melcangi and Sterk (2020)) who may be much less exposed to unemployment risk than non-participants. This would potentially make movements in asset prices a poor indicator of fluctuations in labour market risk. However, Mueller (2017) overturns popular wisdom by showing that the job finding rates of high-wage workers, who participate disproportionately in asset markets, are just as cyclical as they are for low-wage workers. Thus, asset market participants are likely to be just as exposed to labour market risk as non-participants.

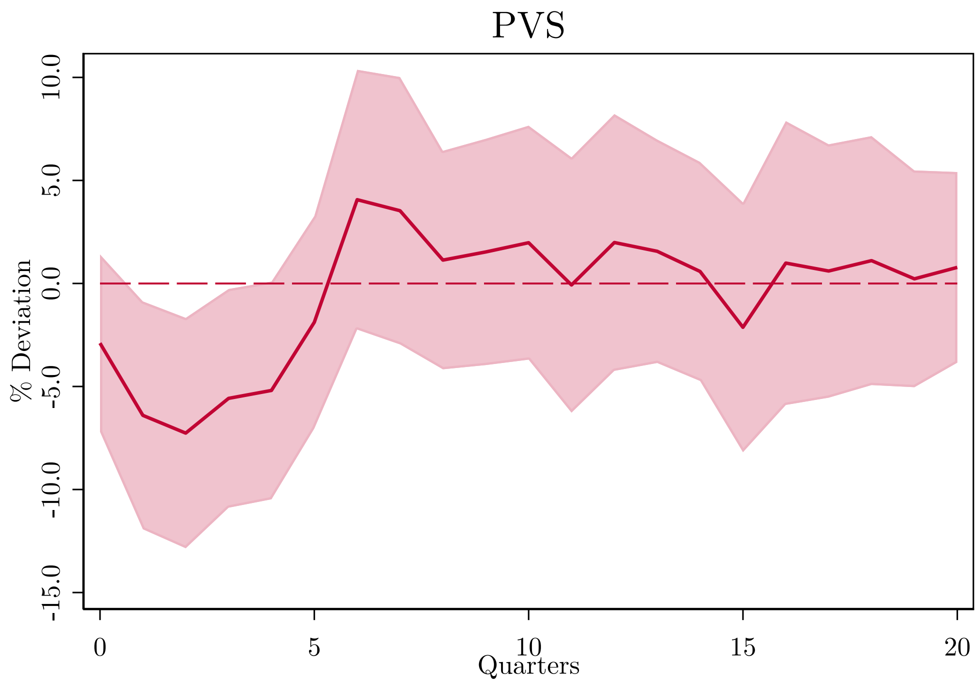
The estimated IRFs in Figure 10 show that PVS exhibits a sharp decline in response to the shock, consistent with a triggering of the precautionary saving motive. In Appendix H, I introduce a risky asset in the two-period model and relax the no-trade equilibrium. I show that the demand for the risky asset from employed households decreases after a negative TFP news shock if and only if there is the combination of labour market frictions and incomplete insurance against unemployment risk. When these frictions are both present, the employed household is less willing to take risk after receiving the bad news, since the amount of background unemployment risk has increased. The demand for the risky asset from unemployed households also decreases since they realise they are more likely to remain unemployed in the future. The news shock also increases period 0 unemployment, raising the proportion of agents with a lower marginal propensity to take risk (Kekre and Lenel, 2022). This compositional shift further depresses the demand for the risky asset. Consequently, the reduction in demand triggers a decline in the price of the risky asset relative to the risk-free asset, mirroring the IRFs for PVS. This mechanism highlights an additional aspect of precautionary saving — households exhibit a flight towards safer assets and away from risky assets after an adverse shock — that is not present in the benchmark model with just one asset.[16]

4.4 Estimating the Model

I now estimate the model directly in order to provide additional empirical validation of the mechanism. I impose a zero net supply of the bond, which in turn yields a no-trade equilibrium and a degenerate wealth distribution. This makes the model much faster to solve, rendering estimation feasible. I also add a cost-push shock to the Phillips curve equation as well as a monetary policy shock. Following Schmitt-Grohé and Uribe (2012), I assume that there are two TFP news shocks. One has a one year anticipation horizon ($\varepsilon_{t-4}^{A,N_4}$), while the other has a two year horizon ($\varepsilon_{t-8}^{A,N_8}$). As Schmitt-Grohé and Uribe (2012) note, this process is flexible enough to capture expectational revisions amongst households and firms. I use four observable series during the estimation: the growth rate of real GDP, the unemployment rate,

[16] This highlights one mechanism, consistent with the model, which explains why the PVS falls after a negative news shock. In reality the PVS may also refelct changes to financial conditions but these are beyond the scope of the model.

Figure 10: Estimated IRFs for the Pflueger et al. (2020) price-of-volatile stocks (PVS) series to a negative TFP news shock.

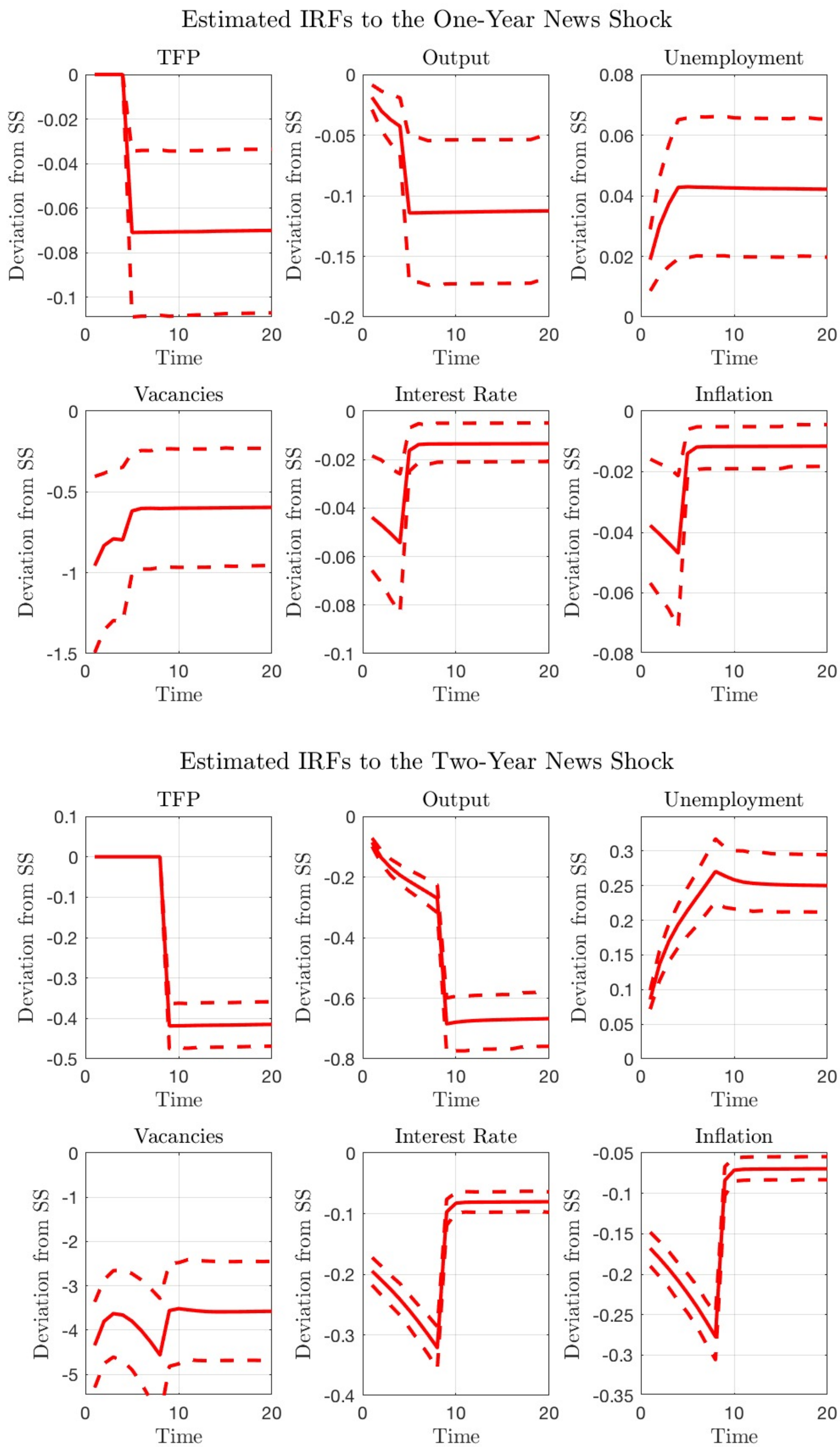


Note: The shaded areas are the 90% confidence intervals.

the nominal interest rate and the CPI inflation rate. The sample is 1954:III - 2019:IV. The model is estimated via Bayesian methods, and full details (including parameter priors and posteriors) can be found in Appendix G.

The model estimates imply that TFP news shocks play a significant role, accounting for 27.4% of the unconditional variation in TFP and 27.7% for output. Interestingly, it is the news shock with a two-year anticipation horizon that is estimated to play a substantially larger role. Figure 11 below plots the IRFs with the parameters at their posterior mean, and respective 90% HPD intervals. They illustrate that the news shocks are estimated to have a strong contractionary effect on output and the labour market variables.

Figure 11: IRFs for the TFP news shocks at the posterior mean of the estimated model.



Note: The dashed lines are the 90% HPD intervals.

5 Conclusion

The key message of this paper is that two channels are potentially pivotal to the transmission mechanism of TFP news shocks: precautionary savings and frictional labour markets. After a bad TFP news shock, the labour market experiences a pronounced downturn, operating through the forward-looking vacancy channel. This increase in uninsurable idiosyncratic unemployment risk causes households to hedge against the anticipated loss of income by increasing their saving and reducing their consumption immediately which causes further retrenchment by firms, in turn worsening the recession. Empirical results support this mechanism, as vacancy posting and consumption both fall precipitously upon the impact of the shock. Suggestive asset market evidence further points towards the existence of this precautionary saving transmission mechanism. The HANK model presented was able to match the responses of key variables in the data. The combination of incomplete markets and labour market frictions was shown to be crucial for news to generate aggregate fluctuations and match the empirical dynamics of the nominal interest rate.

The novel theoretical mechanism depicted here has clear policy implications, namely that monetary and fiscal policy can be effective in mitigating the contractionary effect of an adverse TFP news shock. Due to the Keynesian supply channel via which the shock propagates, the divine coincidence holds and aggressive monetary policy shrinks the output response towards the natural output level. Countercyclical unemployment benefits were also shown to be effective, since they serve to reduce the precautionary saving motive which in turn mutes the negative feedback loop that ultimately leads to a deep recession. This stands in contrast with most previous models of the shock's transmission mechanism where policy had little to no role play in counteracting such a shock.

This paper opens up several areas for possible future exploration. While the model was kept simple and tractable to clearly illustrate the key mechanism at play, several salient features could be added to further understand how news affects agents' behaviour. Firstly, the model abstracted from the zero lower bound on interest rates, which was a defining characteristic of the Great Recession. As both the empirical and theoretical results demonstrate, bad news puts substantial downward pressure on interest rates due to the inter-temporal substitution by households and the central bank's abidance by a Taylor rule. This acts as a dampener on the shock. When rates cannot fall any further and this shock absorber is not active, the magnitude of the impacts would be greater. Secondly, the model does not incorporate an explicit role for firm entry and exit. An abundance of recent research, e.g. Sedlacek and Sterk (2017) has shown that this is an important element of the business cycle. Intuitively, there are many reasons to believe that the firm entry/exit decision has a strong forward-looking component to it. Its sensitivity to news would be an interesting avenue to explore in further research.

References

Auclert, A., M. Rognlie, and L. Straub (2018): "The Intertemporal Keynesian Cross," NBER Working Papers 25020, National Bureau of Economic Research, Inc.

Barsky, R. B., C. L. House, and M. S. Kimball (2007): "Sticky-Price Models and Durable Goods," *American Economic Review*, 97, 984–998.

Barsky, R. B. and E. R. Sims (2011): "News shocks and business cycles," *Journal of Monetary Economics*, 58, 273–289.

Bayer, C., R. Luetticke, L. Pham-Dao, and V. Tjaden (2019): "Precautionary Savings, Illiquid Assets, and the Aggregate Consequences of Shocks to Household Income Risk," *Econometrica*, 87, 255–290.

Beaudry, P. and B. Lucke (2009): "Letting Different Views about Business Cycles Compete," in *NBER Macroeconomics Annual 2009, Volume 24*, National Bureau of Economic Research, Inc, 413–455.

Beaudry, P., D. Nam, and J. Wang (2011): "Do Mood Swings Drive Business Cycles and is it Rational?" NBER Working Papers 17651, National Bureau of Economic Research, Inc.

Beaudry, P. and F. Portier (2004): "An exploration into Pigou's theory of cycles," *Journal of Monetary Economics*, 51, 1183–1216.

——— (2006): "Stock Prices, News, and Economic Fluctuations," *American Economic Review*, 96, 1293–1307.

Berger, D. and J. Vavra (2015): "Consumption Dynamics During Recessions," *Econometrica*, 83, 101–154.

Bils, M., P. J. Klenow, and B. A. Malin (2012): "Reset Price Inflation and the Impact of Monetary Policy Shocks," *American Economic Review*, 102, 2798–2825.

Blanchard, O. and J. Galí (2010): "Labor Markets and Monetary Policy: A New Keynesian Model with Unemployment," *American Economic Journal: Macroeconomics*, 2, 1–30.

Broer, T., J. Druedahl, K. Harmenberg, and E. Öberg (2025): "The Unemployment-Risk Channel in Business-Cycle Fluctuations," Working Paper BDHO-25, Center for Economic Behavior and Inequality, University of Copenhagen, preliminary version.

Campbell, J. Y. and J. Cochrane (1999): "Force of Habit: A Consumption-Based Explanation of Aggregate Stock Market Behavior," *Journal of Political Economy*, 107, 205–251.

Carroll, C. and W. Dunn (1997): "Unemployment Expectations, Jumping (S,s) Triggers, and Household Balance Sheets," in *NBER Macroeconomics Annual 1997, Volume 12*, National Bureau of Economic Research, Inc, 165–230.

Cascaldi-Garcia, D. and M. Vukotic (2022): "Patent-Based News Shocks," *The Review of Economics and Statistics*, 104, 51–66.

Cesarini, D., E. Lindqvist, M. J. Notowidigdo, and R. Östling (2017): "The Effect of Wealth on Individual and Household Labor Supply: Evidence from Swedish Lotteries," *American Economic Review*, 107, 3917–46.

Chahrour, R., S. K. Chugh, and T. Potter (2023): "Anticipated productivity and the labor market," *Quantitative Economics*, 14, 897–934.

Chahrour, R. and K. Jurado (2018): "News or Noise? The Missing Link," *American Economic Review*, 108, 1702–1736.

Chetty, R., A. Guren, D. Manoli, and A. Weber (2011): "Are Micro and Macro Labor Supply Elasticities Consistent? A Review of Evidence on the Intensive and Extensive Margins," *American Economic Review*, 101, 471–75.

Chodorow-Reich, G. and L. Karabarbounis (2016): "The Cyclicality of the Opportunity Cost of Employment," *Journal of Political Economy*, 124, 1563–1618.

Cui, W. and V. Sterk (2018): "Quantitative Easing," Discussion Papers 1830, Centre for Macroeconomics (CFM).

Den haan, W., P. Rendahl, and M. Riegler (2018): "Unemployment (fears) and deflationary cycles," *Journal of the European Economic Association*.

Den haan, W. J. and G. Kaltenbrunner (2009): "Anticipated growth and business cycles in matching models," *Journal of Monetary Economics*, 56, 309–327.

Devereux, M. B. and A. Sutherland (2011): "COUNTRY PORTFOLIOS IN OPEN ECONOMY MACRO-MODELS," *Journal of the European Economic Association*, 9, 337–369.

Dupraz, S., E. Nakamura, and J. Steinsson (2019): "A Plucking Model of Business Cycles," NBER Working Papers 26351, National Bureau of Economic Research, Inc.

Faccini, R. and L. Melosi (2018): "Pigouvian Cycles," CEPR Discussion Papers 13370, C.E.P.R. Discussion Papers.

Fernald, J. (2012): "A quarterly, utilization-adjusted series on total factor productivity," *Federal Reserve Bank of San Francisco Working Paper Series*.

Fieldhouse, A. J., K. Mertens, and M. Ravn (2018): "The Macroeconomic Effects of Government Asset Purchases: Evidence from Postwar U.S. Housing Credit Policy," *The Quarterly Journal of Economics*, 133, 1503–1560.

Galí, J. (2015): *Monetary Policy, Inflation, and the Business Cycle: An Introduction to the New Keynesian Framework and Its Applications Second edition*, no. 10495 in Economics Books, Princeton University Press.

Guerrieri, V. and G. Lorenzoni (2017): "Credit Crises, Precautionary Savings, and the Liquidity Trap," *The Quarterly Journal of Economics*, 132, 1427–1467.

Guerrieri, V., G. Lorenzoni, L. Straub, and I. Werning (2022): "Macroeconomic Implications of COVID-19: Can Negative Supply Shocks Cause Demand Shortages?" *American Economic Review*, 112, 1437–74.

Hall, R. (2017): "High Discounts and High Unemployment," *American Economic Review*, 107, 305–30.

Hall, R. E. (2005): "Employment Fluctuations with Equilibrium Wage Stickiness," *American Economic Review*, 95, 50–65.

Heathcote, J. and F. Perri (2018): "Wealth and Volatility," *Review of Economic Studies*, 85, 2173–2213.

Jaimovich, N. and S. Rebelo (2009): "Can News about the Future Drive the Business Cycle?" *American Economic Review*, 99, 1097–1118.

Jorda, O. (2005): "Estimation and Inference of Impulse Responses by Local Projections," *American Economic Review*, 95, 161–182.

Kaplan, G., B. Moll, and G. L. Violante (2018): "Monetary Policy According to HANK," *American Economic Review*, 108, 697–743.

Kekre, R. and M. Lenel (2022): "Monetary Policy, Redistribution, and Risk Premia," *Econometrica*, 90, 2249–2282.

Kroft, K. and M. J. Notowidigdo (2016): "Should Unemployment Insurance Vary with the Unemployment Rate? Theory and Evidence," *The Review of Economic Studies*, 83, 1092–1124.

Krusell, P. and A. Smith (1998): "Income and Wealth Heterogeneity in the Macroeconomy," *Journal of Political Economy*, 106, 867–896.

Lorenzoni, G. (2009): "A Theory of Demand Shocks," *American Economic Review*, 99, 2050–2084.

McKay, A. and R. Reis (2016): "The Role of Automatic Stabilizers in the U.S. Business Cycle," *Econometrica*, 84, 141–194.

——— (2018): "Optimal Automatic Stabilizers," Tech. rep., Working Paper.

Melcangi, D. and V. Sterk (2020): "Stock Market Participation, Inequality, and Monetary Policy," Staff Reports 932, Federal Reserve Bank of New York.

Merton, R. C. (1969): "Lifetime Portfolio Selection under Uncertainty: The Continuous-Time Case," *The Review of Economics and Statistics*, 51, 247–257.

Miranda-Agrippino, S., S. H. Hoke, and K. Bluwstein (2018): "When Creativity Strikes: News Shocks and Business Cycle Fluctuations," Discussion Papers 1823, Centre for Macroeconomics (CFM).

Mueller, A. I. (2017): "Separations, Sorting, and Cyclical Unemployment," *American Economic Review*, 107, 2081–2107.

Olea, J. L. M. and M. Plagborg-Møller (2021): "Local Projection Inference Is Simpler and More Robust Than You Think," *Econometrica*, 89, 1789–1823.

Pagan, A. (1984): "Econometric Issues in the Analysis of Regressions with Generated Regressors," *International Economic Review*, 25, 221–47.

Pflueger, C., E. Siriwardane, and A. Sunderam (2020): "Financial Market Risk Perceptions and the Macroeconomy," *The Quarterly Journal of Economics*.

Pissarides, C. and B. Petrongolo (2001): "Looking into the Black Box: A Survey of the Matching Function," *Journal of Economic Literature*, 39, 390–431.

Poterba, J. M. and A. A. Samwick (1995): "Stock Ownership Patterns, Stock Market Fluctuations, and Consumption," *Brookings Papers on Economic Activity*, 26, 295–372.

Preston, A. (2025): "Risky Jobs, Risky Assets and Risky Business Cycles," Working paper, 2025.

Ramey, V. (2016): *Macroeconomic Shocks and Their Propagation*, Elsevier, vol. 2 of *Handbook of Macroeconomics*, chap. 0, 71–162.

Ravn, M. O. and V. Sterk (2017): "Job uncertainty and deep recessions," *Journal of Monetary Economics*, 90, 125–141.

——— (2018): "Macroeconomic Fluctuations with HANK & SAM: An Analytical Approach," *Working Paper*.

Rotemberg, J. (1982): "Monopolistic Price Adjustment and Aggregate Output," *Review of Economic Studies*, 49, 517–531.

Schmitt-Grohé, S. and M. Uribe (2012): "What's News in Business Cycles," *Econometrica*, 80, 2733–2764.

Sedlacek, P. and V. Sterk (2017): "The Growth Potential of Startups over the Business Cycle," *American Economic Review*, 107, 3182–3210.

Silva, J. and M. Toledo (2009): "Labor Turnover Costs and the Cyclical Behaviour of Vacancies and Unemployment," *Macroeconomic Dynamics*, 13, 76–96.

Sims, E. (2024): "Graduate Macro Theory II: The Basic New Keynesian Model," https://sites.nd.edu/esims/files/2024/03/notes_new_keynesian_2024-1.pdf, accessed: July 5th 2024.

Smets, F. and R. Wouters (2007): "Shocks and Frictions in US Business Cycles: A Bayesian DSGE Approach," *American Economic Review*, 97, 586–606.

Stock, J. and M. Watson (2018): "Identification and Estimation of Dynamic Causal Effects in Macroeconomics Using External Instruments," NBER Working Papers 24216, National Bureau of Economic Research, Inc.

Stock, J. and M. Yogo (2002): "Testing for Weak Instruments in Linear IV Regression," NBER Technical Working Papers 0284, National Bureau of Economic Research, Inc.

News Shocks, Precautionary Saving and the Labour Market

Appendix

Andrew Preston

A Additional Material for the Two-Period Model

A.1 Proof of Proposition 1

Using the Euler equation of the period 0 employed household, bond market clearing, the solution for η_1, the firm's optimality conditions in period 0, the monetary policy rule and the commitment to $\Pi_1 = 1$, I obtain a solution for the period 0 job finding rate as a non-linear function of A_1:

$$\eta_0 = \frac{1}{\kappa}\left[\frac{\psi}{\mu}\left(\left[\frac{1}{\lambda_0 - \lambda_1 A_1}\right]^{\frac{1}{\delta}} - 1\right)\left[\frac{1}{\lambda_0 - \lambda_1 A_1}\right]^{\frac{1}{\delta}} + \frac{\mu - 1}{\mu} - W + (1-\rho)\beta\kappa(\theta_0 + \theta_1 A_1)\right]$$

Finally, using the law of motion for e_0 and N_0, the above solution for η_0 and the production function gives us a solution for output in period 0:

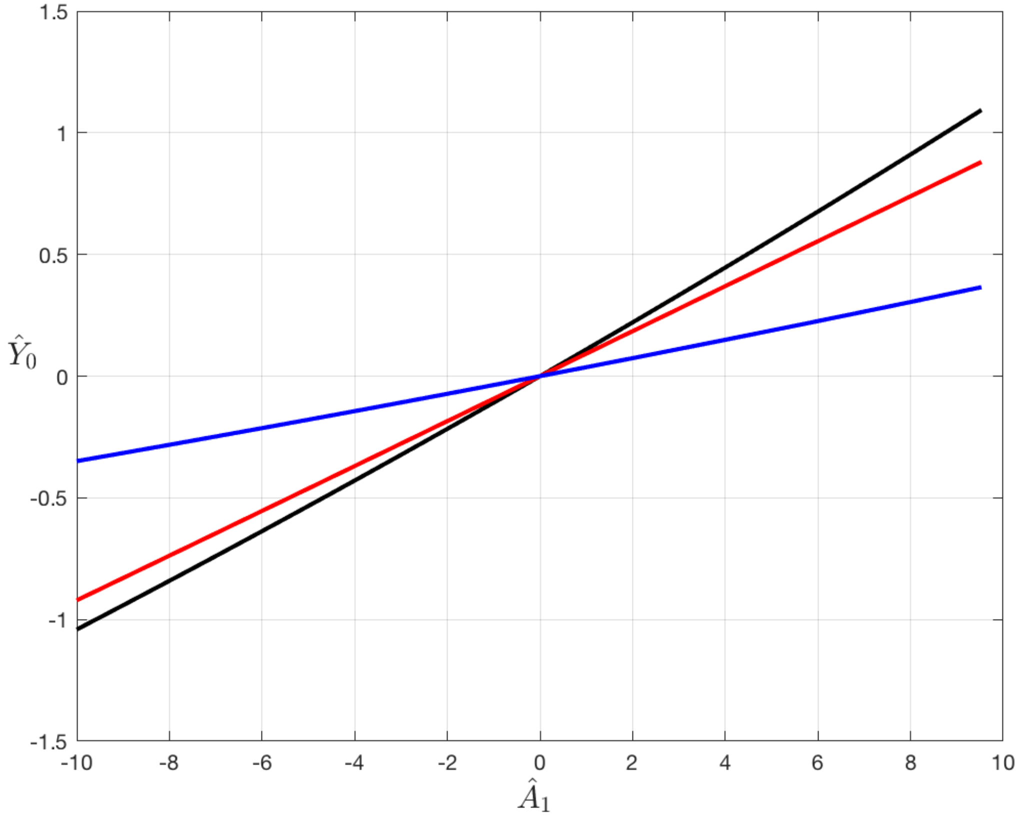
$$Y_0 = 1 - \rho + \rho\left(\frac{1}{\kappa}\left[\frac{\psi}{\mu}\left(\left[\frac{1}{\lambda_0 - \lambda_1 A_1}\right]^{\frac{1}{\delta}} - 1\right)\left[\frac{1}{\lambda_0 - \lambda_1 A_1}\right]^{\frac{1}{\delta}} + \frac{\mu - 1}{\mu} - W + (1-\rho)\beta\kappa(\theta_0 + \theta_1 A_1)\right]\right)$$

I now find the conditions under which Y_0 is increasing in A_1, i.e. when TFP news shocks generate a Pigovian cycle in the sense of impacting current output. Taking the derivative of Y_0 with respect to A_1 and using the fact that $R_0^f = \frac{1}{\lambda_0 - \lambda_1 A_1}$ leads to the expression in Proposition 1.

A.2 Non-Degenerate Wealth Distribution in the Two-Period Model

I now relax the assumption that the position all households take in the nominal bond has to be non-negative. This means that the households in period 0 who are employed optimally hold positive quantities of the asset for precautionary reasons, while those who are unemployed effectively go short to smooth their consumption over time. The model now no longer has an analytical solution and so I evaluate it numerically. Under the baseline calibration, neither type of household takes a large position in the asset. The figure below plots the log deviation of Y_0 from its value when $A_1 = 1$ against the log deviation of A_1 (the news shock) under three cases: i) $\chi = 0.8$, no-borrowing constraint imposed (black line) ii) $\chi = 0.8$, no-borrowing constraint not imposed (red line) iii) $\chi = 1$, no-borrowing constraint inconsequential (blue line). This shows that the response of output in period 0 to news about period 1 TFP is muted very slightly when households are allowed to borrow in the case where the precautionary

Figure A1: The Impact of News Shocks on Output in the Two-Period Model Under Different Assumptions On the No-Borrowing Constraint.



Note: The black line plots log deviations of Y_0 from its mean as a function of $\log A_1$ in the two-period model with both channels active and the no-borrowing constraint imposed. The red line repeats this with both channels active and the no-borrowing constraint not imposed. The blue line repeats this for the case where the precautionary saving channel is shut down by setting $\chi = 1$.

saving channel is active. It is still significantly larger than the case when the precautionary saving channel is switched off entirely.

A.3 Nominal Wage Rigidity

I now consider an alternative wage process in the two-period model: a fixed nominal wage $P_t W_t$ where W_t denotes the (now endogenous) real wage in period t. I also assume that $\delta = 1$ to maximise tractability. All other parts of the environment remain the same.

The nominal wage rigidity implies that:

$$P_1 W_1 = P_0 W_0 = P_{-1} W_{-1}$$

Using the monetary policy rule which sets $P_1 = P_0$, and normalising $P_{-1} = 1$, $W_{-1} = \overline{W}$, this implies that:

$$W_0 = W_1 = \frac{\overline{W}}{P_0}$$

The real wage now features variation due to fluctuations in the inflation rate in period 0. Solving for the employed household's SDF now yields:

$$M_1^E = \alpha_0 + \alpha_1 \eta_1$$

Where:

$$\alpha_0 = \beta[1 + \rho(\chi^{-\gamma} - 1)]$$
$$\alpha_1 = \beta\rho(\chi^{-\gamma} - 1)$$

From the monetary policy rule, we have that $P_0 = R_0^f = (\alpha_0 + \alpha_1\eta_1)^{-1}$. Solving for the job-finding rate in period 1 by following the same approach as previously gives:

$$\eta_1 = \widetilde{\theta}_0 + \widetilde{\theta}_1 A_1$$

Where:

$$\widetilde{\theta}_0 = -\frac{\overline{W}\alpha_0}{\kappa(1 + \overline{W}\alpha_1)}$$
$$\widetilde{\theta}_1 = \frac{1 - \frac{1}{\mu}}{\kappa(1 + \overline{W}\alpha_1)}$$

Plugging this into the solution for the SDF then yields an expression that is again affine in A_1:

$$M_1^E = \widetilde{\lambda}_0 - \widetilde{\lambda}_1 A_1$$

Where:

$$\widetilde{\lambda}_0 = \alpha_0 - \alpha_1\widetilde{\theta}_1$$
$$\widetilde{\lambda}_1 = \alpha_1\widetilde{\theta}_1$$

The period 0 job finding rate can now be solved for:

$$\eta_0 = \frac{1}{\kappa}\left[\frac{\mu - 1}{\mu} - \overline{W}\widetilde{\lambda}_0 + \frac{\psi}{\mu}(P_0 - 1)P_0 + (1-\rho)\beta\kappa\widetilde{\theta}_0 + \overline{W}\widetilde{\lambda_1}A_1 + (1-\rho)\beta\kappa\widetilde{\theta}_1 A_1\right]$$

Output in period 0 is then given by:

$$Y_0 = 1 - \rho + \frac{\rho}{\kappa}\left[\frac{\mu - 1}{\mu} - \overline{W}\widetilde{\lambda}_0 + \frac{\psi}{\mu}(P_0 - 1)P_0 + (1-\rho)\beta\kappa\widetilde{\theta}_0 + \overline{W}\widetilde{\lambda_1}A_1 + (1-\rho)\beta\kappa\widetilde{\theta}_1 A_1\right]$$

Taking the derivative with respect to future TFP:

$$\frac{dY_0}{dA_1} = \frac{\rho}{\kappa}\left(\underbrace{\frac{\psi}{\mu}\widetilde{\lambda}_1(R_0^f)^2(2R_0^f - 1) + \overline{W}\widetilde{\lambda}_1}_{\text{Precautionary Saving Channel}} + \underbrace{(1-\rho)\beta\kappa\widetilde{\theta}_1}_{\text{Labour Market Channel}}\right)$$

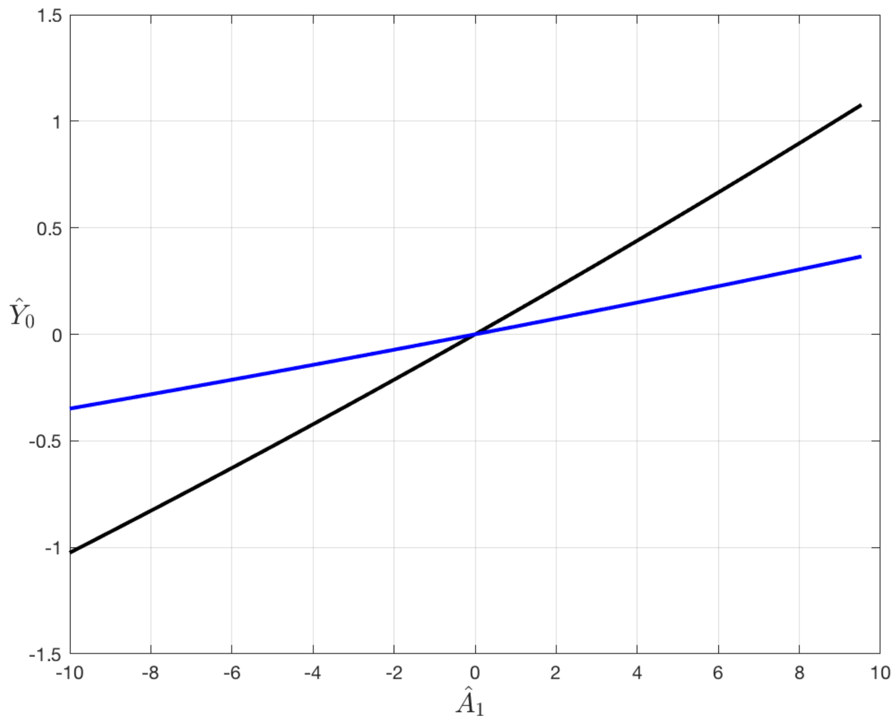
Once again, a fractional labour market ($\rho > 0$, κ finite) is a necessary condition for the TFP news shock to affect output in period 0. The news shock once again transmits to output via two channels: a labour market channel and a precautionary saving channel.

As previously, the labour market channel is still present under complete markets, since $\chi = 1 \rightarrow \alpha_1 = 0 \rightarrow \widetilde{\theta_1} = \theta_1 > 0$. Higher expected TFP next period increases the returns to vacancy posting in this period, meaning more vacancies are posted and the job finding rate rises. Incomplete markets ($\chi < 1$) now directly interacts with this channel, however. To see this, note that a poorer degree of consumption insurance upon unemployment (a lower value of χ) leads to an increase in α_1, which appears on the denominator of $\widetilde{\theta_1}$. The intuitive reason for this effect is that, with nominal wage rigidity, an adverse TFP news shock not only reduces the period 1 expected cash flow from hiring a worker by reducing their expected productivity but also by raising the real wage that they must be paid ($W_1 = \frac{\overline{W}}{P_0}$) since the shock lowers P_0 if the precautionary channel is present.

The precautionary channel also features an additional term relative to the rigid real wage case, $\frac{\rho}{\kappa}\overline{W}\widetilde{\lambda_1}$. This captures the fact that the lower period 1 real wage further strengthens the incentive for the household to save this period in order to smooth their consumption. Notably, this aspect of the precautionary saving channel is present even with no nominal price rigidities, i.e. if $\psi = 0$.

The Figure below plots the log deviation of Y_0 against the log deviation of A_1 from both of their steady state values, in the case where the precautionary saving channel is active ($\chi < 1$, black line) and the case where this channel is switched off ($\chi = 1$, blue line). The calibration is the same as in section 2. This looks very similar to Figure 1, with the precautionary saving channel amplifying the TFP news shock significantly with the alternative assumption of nominal wage rigidity.

Figure A2: The Impact of News Shocks on Output in the Two-Period Model with Nominal Wage Rigidity.



Note: The black line plots log deviations of Y_0 from its mean as a function of $\log A_1$ in the two-period model with both channels active. The blue line repeats this for the case where the precautionary saving channel is shut down by setting $\chi = 1$.

B Full Model Exposition

The model is a heterogeneous agents model with search-and-matching frictions in the labour market, nominal rigidities in the goods market and financial market frictions in the form of incomplete markets (Ravn and Sterk, 2017).

Households. There is a unit continuum of single-member households, indexed by $i \in (0, 1)$, who are risk averse, have an infinite horizon, and are either employed or unemployed in a given period t. Their objective is to maximise the expected present value of their utility streams according to their discount factor β. They gain utility from consumption.

If a household is employed they earn a real wage W_t and lose their jobs with an exogenous probability ρ in each period. Unemployed individuals produce b units of the aggregate consumption good via home production. This is strictly less than the real wage, and so unemployed workers seek employment by searching in the frictional labour market. An unemployed worker successfully finds a job with endogenous probability η_t.

At the start of each period, new matches are formed between unemployed workers and vacant firms as hiring takes place. Production and consumption then occur. Following this, a fraction (ρ) of employed workers lose their jobs, and this constitutes the source of idiosyncratic income risk. It is not possible to purchase insurance against unemployment, and households must self-insure via liquid assets in order to smooth consumption. Let $B_t(i)$ denote worker i's holding of liquid assets in period t and $\Pi_t = P_t/P_{t-1}$ the gross inflation rate. The worker maximises utility subject to a budget constraint and a borrowing constraint in each period. The full household problem is then:

$$\max \mathbb{E}_t \textstyle\sum_{t=0}^{\infty} \beta^t \left[\frac{C_t(i)^{1-\gamma}-1}{1-\gamma}\right]$$

s.t.

$$C_t(i) + B_t(i) \leq 1_t^E(i)W_t + (1 - 1_t^E(i))b + \frac{R_{t-1}}{\Pi_t}B_{t-1}(i)$$

$$B_t(i) \geq B^{limit}$$

Substituting into the budget constraint $1_t^E(i) = 0$ if worker i is unemployed in period t, or $1_t^E(i) = 1$ if worker i is employed in period t.

The borrowing limit is given by B^{limit}, the gross nominal interest rate by R and finally the net inflation rate by π. $C_t(i)$ represents a CES aggregator of differentiated consumption goods:

$$C_t(i) = \left(\int_j (C_t(i,j))^{1-1/\mu} dj\right)^{\frac{1}{1-1/\mu}}$$

The elasticity of substitution between varieties of the consumption goods is given by μ and is strictly greater than one.

The problem of both employed and unemployed worker's can be summarised by a Bellman equation for each group. The Bellman equation for employed workers is:

$$V^e(B(i),\Gamma) = \max_{C(i),B^{'}(i)} \left\{U(C(i)) + \beta E(1-\rho(1-\eta^{'}))V^e(B^{'}(i),\Gamma') + \beta E\rho(1-\eta^{'})V^u(B^{'}(i),\Gamma^{'})\right\}$$

subject to the budget constraint and borrowing constraint with $1_t^E(i) = 1$. Γ is the aggregate state vector. The Bellman equation for unemployed workers is:

$$V^u(B(i),\Gamma) = \max_{C(i),B^{'}(i)} \left\{U(C(i)) + \beta E\eta^{'}(i)V^e(B^{'}(i),\Gamma') + \beta E(1-\eta^{'})V^u(B(i)^{'},\Gamma^{'})\right\}$$

subject to the budget constraint and borrowing constraint with $1_t^E(i) = 0$.

Production. There is a continuum of capitalists, indexed by $j \in (0, F)$, $F < 1$, who are risk neutral and own firms which operate in monopolistic competition. Firms produce a differentiated good with linear production technology:

$$Y_t(j) = A_t N_t(j)$$

where $Y_t(j)$ is the output of firm j in period t, A_t is aggregate TFP and $N_t(j)$ is the number of workers employed by firm j in period t. Aggregate TFP is exogenous and stochastic, with anticipated and unanticipated components. It follows the stochastic process:

$$\log(A_t) = \phi_A \log(A_{t-1}) + \Psi_t^A$$

$$\Psi_t^A = \varepsilon_t^A + \varepsilon_{t-4}^A$$

where $\phi^A \in (-1, 1)$, $\varepsilon_{t-k}^A \sim N(0, \sigma_k^2)$ for $k = 0, 4$.

The firm's employment evolves according to the law of motion:

$$N_t(j) = (1 - \rho) N_{t-1}(j) + H_t(j)$$

with $H_t(j)$ denoting firm j's hires in period t. In order to hire workers, firms choose their number of vacancies, $v_t(j)$, which have a positive unit cost of κ. Any given vacancy is filled with endogenous, time-varying probability f_t and firms are large enough that this corresponds to the proportion of vacancies which result in hires. This leads to the following condition:

$$H_t(j) = v_t(j) f_t$$

Real marginal costs for firm j are given by:

$$MC_t = \left(\frac{1}{A_t}\right)\left(W_t + \frac{\kappa}{f_t} - \beta \mathbb{E}_t \left[(1 - \rho)\frac{\kappa}{f_{t+1}}\right]\right)$$

Price and wage setting. It is costly for firms to adjust the price of their good,$P_t(j)$, as they face Rotemberg-style quadratic price adjustment costs. Prices are set such as to maximise:

$$\max \mathbb{E}_t \sum_{t=0}^{\infty} \beta^t \left[\frac{P_t(j)}{P_t} Y_t(j) - W_t N_t(j) - \kappa v_t(j) - \frac{\psi}{2}\left(\frac{P_t(j) - P_{t-1}(j)}{P_{t-1}(j)}\right)^2 Y_t\right]$$

s.t

$$Y_t(j) = A_t N_t(j)$$

$$Y_t(j) = \left(\frac{P_t(j)}{P_t}\right)^{-\mu} Y_t$$

$$N_t(j) = (1 - \rho) N_{t-1}(j) + H_t(j)$$

Where P_t is the aggregate price level, $Y_t = \left(\int_j Y_t(j)dj\right)$ is aggregate output and W_t is the real wage. The parameter ψ determines the extent of nominal rigidities present. The demand constraint emerges from the consumer's decision problem.

In symmetric equilibrium, relative prices are equal to 1 and marginal cost is equal across all firms, meaning the j index can now be dropped. The first-order condition for the firm's problem is:

$$1 - \mu + \mu MC_t = \psi(\Pi_t - 1)\Pi_t - \psi\beta\mathbb{E}_t(\Pi_{t+1} - 1)\Pi_{t+1}\frac{Y_{t+1}}{Y_t}$$

Wages are set according to the following function as in Dupraz et al. (2019) and similar to Blanchard and Galí (2010):

$$\log\left(\frac{W_t}{\overline{W}}\right) = \rho_W \log\left(\frac{W_{t-1}}{\overline{W}}\right) + (1-\rho_W)\log\left(\frac{A_t}{\overline{A}}\right)$$

Capitalists. The capitalists simply consume the firm dividends, D_t, each period: $C_t^c = D_t$.

Labour market matching. The labour market features matching frictions a la Diamond-Mortensen-Pissarides. Timing is as follows in each period:

1. The aggregate labour market shocks realise.

2. Unemployed workers match with firms who post vacancies.

3. Production and consumption occur.

4. Job separations take place.

This timing structure implies that workers have the opportunity to search for a new job immediately after being separated from their previous one. Aggregate hires are determined by a Cobb-Douglas matching function:

$$M_t = e_t^{\alpha} v_t^{1-\alpha}$$

with $\alpha \in (0,1)$, $v_t = \left(\int_j v_t(j)dj\right)$ and $e_t = 1 - (1-\rho)\left(\int_j N_t(j)dj\right)$. The job finding rate and vacancy filling rate are given by:

$$\eta_t = \frac{M_t}{e_t} = \left(\frac{v_t}{e_t}\right)^{1-\alpha}$$

$$f_t = \frac{M_t}{v_t} = \left(\frac{v_t}{e_t}\right)^{-\alpha}$$

Monetary policy. Monetary policy follows a standard inflation-targeting Taylor rule:

$$R_t = \overline{R}\left(\frac{\Pi_t}{\overline{\Pi}}\right)^{\delta}$$

Where $\overline{R}$ and $\overline{\Pi}$ denote the steady state interest rate and inflation target respectively, while δ is a parameter reflecting how responsive the monetary authority is to inflation.

Equilibrium. Following Ravn and Sterk (2017), Heathcote and Perri (2018), McKay and Reis (2016) and much of the literature, the following borrowing constraint is imposed:

$$B^{limit} = 0$$

I now introduce some additional notation. Let $C_t^E(k)$ and $B_t^E(k)$ denote the consumption and liquid asset holdings respectively of a currently employed household who has been employed for k quarters. Let $C_t^{EU}(k)$ and $B_t^{EU}(k)$ denote the consumption and liquid asset holdings respectively of a household who has just become unemployed after being employed for a duration of k quarters. Let C_t^{UU} and B_t^{UU} denote the consumption and liquid asset holdings respectively of an unemployed household who is not in their first period of unemployment. As in Cui and Sterk (2018), I assume there is an upper bound on employment duration, $\overline{k}$, after which all households behave identically. I set $\overline{k} = 80$ but note that this is not restrictive since households of employment durations beyond around 20 quarters behave almost identically in practice.

If the following condition holds:

$$\left(C_t^{EU}(\overline{k})\right)^{-\gamma} > \beta \mathbb{E}_t \left(\frac{R_t}{\Pi_{t+1}} \left[\eta_{t+1} \left(C_{t+1}^E(0)\right)^{-\gamma} + (1 - \eta_{t+1}) \left(C_{t+1}^{UU}\right)^{-\gamma} \right] \right)$$

Then the households who have been employed the longest find it optimal to liquidate all of their liquid asset holdings upon job loss. Since they are wealthier than all households of a lower employment duration, the condition will subsequently hold for all k and all employed households reach the borrowing constraint upon job loss. This then implies that all households begin employment with zero asset holdings and, as such, all behave identically within an employment duration cohort. I verify this condition holds in steady state and thus, under the local perturbations I consider, also holds in the neighbourhood of the steady state.

I then obtain the following set of equations that describes the employed household problem:

$$C_t^E(0) + B_t^E(0) = W_t$$

$$C_t^E(k) + B_t^E(k) = W_t + \frac{R_{t-1}}{\Pi_t} B_{t-1}^E(k-1) \qquad \forall k > 0$$

$$\left(C_t^E(k)\right)^{-\gamma} = \beta \mathbb{E}_t \left(\frac{R_t}{\Pi_{t+1}} \left[(1 - \rho(1-\eta_{t+1})) \left(C_{t+1}^E(k+1)\right)^{-\gamma} + \rho(1-\eta_{t+1}) \left(C_{t+1}^{EU}(k)\right)^{-\gamma} \right] \right) \quad \forall k > 0$$

$$C_t^E(\overline{k}) + B_t^E(\overline{k}) = W_t + \frac{R_{t-1}}{\Pi_t} B_{t-1}^E(\overline{k})$$

$$\left(C_t^E(\overline{k})\right)^{-\gamma} = \beta \mathbb{E}_t \left(\frac{R_t}{\Pi_{t+1}} \left[(1 - \rho(1-\eta_{t+1})) \left(C_{t+1}^E(\overline{k})\right)^{-\gamma} + \rho(1-\eta_{t+1}) \left(C_{t+1}^{EU}(\overline{k})\right)^{-\gamma} \right] \right)$$

We have the following conditions for the newly unemployed and remaining unemployed households:

$$C_t^{EU}(k) + B_t^{EU}(k) = \frac{R_{t-1}}{\Pi_t} B_{t-1}^E(k-1) + b \qquad \forall k \geq 1$$

$$B_t^{EU}(k) = 0 \qquad \forall k \geq 1$$

$$C_t^{UU} + B_t^{UU} = b$$

$$B_t^{UU} = 0$$

The asset market clearing condition is given by:

$$B = \sum_{k=0}^{\overline{k}} B_t^E(k) \psi_t^E(k)$$

Where $\psi_t^E(k)$ is the population share of employed households who have been employed for k quarters. For k = 0 it is given by:

$$\psi_t^E(0) = M_t$$

For $k \in (0, \overline{k})$ it is given by:

$$\psi_t^E(k) = M_{t-k} \prod_{j=1}^{k} (1 - \rho(1 - \eta_{t+1-j}))$$

For $k = \overline{k}$ it is given by:

$$\psi_t^E(\overline{k}) = N_t - \sum_{k=0}^{\overline{k}-1} \psi_t^E(k)$$

The model equilibrium is additionally comprised of the following equations:

$$\begin{aligned}
Y_t &= A_t N_t \\
N_t &= (1-\rho)N_{t-1} + M_t \\
e_t &= 1 - (1-\rho)N_{t-1} \\
MC_t &= \left(\frac{1}{A_t}\right)\left(W_t + \frac{\kappa}{f_t} - \beta\mathbb{E}_t\left[(1-\rho)\frac{\kappa}{f_{t+1}}\right]\right) \\
1 - \mu + \mu MC_t &= \psi(\Pi_t - 1)\Pi_t - \psi\beta\mathbb{E}_t(\Pi_{t+1} - 1)\Pi_{t+1}\frac{Y_{t+1}}{Y_t} \\
\log\left(\frac{W_t}{\overline{W}}\right) &= \rho_W \log\left(\frac{W_{t-1}}{\overline{W}}\right) + (1-\rho_W)\log\left(\frac{A_t}{\overline{A}}\right) \\
M_t &= e_t^{\alpha} v_t^{1-\alpha} \\
\eta_t &= \frac{M_t}{e_t} \\
f_t &= \frac{M_t}{v_t} \\
R_t &= \overline{R}\left(\frac{\Pi_t}{\overline{\Pi}}\right)^{\delta} \\
\log(A_t) &= \phi_A \log(A_{t-1}) + \varepsilon_t^A + \varepsilon_{t-4}^{A,N}
\end{aligned}$$

C Expostion of Counterfactual Models

C.1 Model with Complete Markets

Households are organised as large families, meaning they are insured against idiosyncratic unemployment risk and labour market conditions do not directly influence the consumption-saving decision. They maximise expected discounted lifetime utility subject to budget and borrowing constraints:

$$\max \mathbb{E}_t \sum_{t=0}^{\infty} \beta^t \left[\frac{C_t^{1-\gamma}}{1-\gamma}\right]$$

s.t.

$$C_t + B_t \leq N_t W_t + (1-N_t)b + \frac{R_{t-1}}{\Pi_t}B_{t-1}$$

$$B_t \geq B^{limit}$$

where N_t is the fraction of the household who are employed. The first order conditions for C_t and B_t yield the standard complete markets Euler equation:

$$C_t^{-\gamma} = \beta \mathbb{E}_t \frac{R_t}{\Pi_{t+1}} C_{t+1}^{-\gamma}$$

The absence of the job finding and job loss rates from the right hand side of this equation illustrate the lack of idiosyncratic risk in the economy, which causes the precautionary saving motive of household to disappear. Labour market frictions remain present, however. The remainder of the model is the same as the baseline, and equilibrium is therefore characterised by the same conditions as well as the above condition and the following goods market clearing condition:

$$C_t + \kappa v_t + \frac{\psi}{2}(\Pi_t - 1)^2 Y_t = Y_t$$

All calibrated parameters remain the same as in Table 1. The model is again solved with a first-order perturbation method around the deterministic steady state.

C.2 Model with Frictionless Labour Markets

Households are single-membered and can be either employed or unemployed in each period. Employed households face an exogenous probability of losing their job each period, p^{EU}, meaning there is an idiosyncratic risk that they face. This labour market risk is exogenous due to there being a spot labour market, with no search-and-matching frictions. The unemployment rate is constant and given by $U = \frac{P^{EU}}{P^{EU}+P^{UE}}$. The households maximise expected discounted lifetime utility subject to a budget and a borrowing constraint:

$$\max \mathbb{E}_t \textstyle\sum_{t=0}^{\infty} \beta^t [\frac{C_t(i)^{1-\gamma}}{1-\gamma} - \psi_0 \frac{N_t(i)^{1+\psi_1}}{1+\psi_1}]$$

s.t.

$$C_t(i) + B_t(i) \leq N_t(i)W_t + 1_t^U(i)b + \frac{R_{t-1}}{\Pi_t} B_{t-1}(i)$$

$$B_t(i) \geq B^{limit}$$

setting $N_t(i) = 0$ and $1_t^U(i)$ if they are unemployed. Employed households can choose the number of hours they work, $N_t(i)$. The employed household Bellman equation is:

$$V^E(B(i), \Gamma) = \max_{C(i),N(i),B'(i)} \Big\{ U(C(i), N(i)) + \beta E(1 - P^{EU}) V^E(B'(i), \Gamma') + \beta E P^{EU} V^U(B'(i), \Gamma') \Big\}$$

s.t.

$$C(i) + B(i) \leq N(i)W + \frac{R_{-1}}{\Pi} B_{-1}(i)$$

$$B(i) \geq B^{limit}$$

The unemployed Bellman equation is:

$$V^U(B(i),\Gamma) = \max_{C(i),B'(i)} \left\{ U(C(i)) + \beta E(1-P^{UE})V^U(B'(i),\Gamma') + \beta E P^{UE} V^E(B'(i),\Gamma') \right\}$$

s.t.

$$C(i) + B(i) \leq b + \frac{R_{-1}}{\Pi} B_{-1}(i)$$

$$B(i) \geq B^{limit}$$

I again consider $B^{limit} = 0$ and utilise the solution method of Cui and Sterk (2018) to solve the model with $\overline{k} = 80$. The set of equilibrium conditions for the employed households is given by the following:

$$\begin{aligned}
C_t^E(0) + B_t^E(0) &= W_t \\
C_t^E(k) + B_t^E(k) &= W_t + \frac{R_{t-1}}{\Pi_t} B_{t-1}^E(k-1) \qquad \forall k > 0 \\
\left(C_t^E(k)\right)^{-\gamma} &= \beta \mathbb{E}_t \left(\frac{R_t}{\Pi_{t+1}} \left[(1-P^{EU}) \left(C_{t+1}^E(k+1)\right)^{-\gamma} + P^{EU} \left(C_{t+1}^{EU}(k)\right)^{-\gamma} \right] \right) \quad \forall k > 0 \\
W_t \left(C_t^E(k)\right)^{-\gamma} &= \psi_0 \left(N_t^E(k)\right)^{\psi_1} \quad \forall k \geq 0 \\
C_t^E(\overline{k}) + B_t^E(\overline{k}) &= W_t + \frac{R_{t-1}}{\Pi_t} B_{t-1}^E(\overline{k}) \\
\left(C_t^E(\overline{k})\right)^{-\gamma} &= \beta \mathbb{E}_t \left(\frac{R_t}{\Pi_{t+1}} \left[(1-P^{EU}) \left(C_{t+1}^E(\overline{k})\right)^{-\gamma} + P^{EU} \left(C_{t+1}^{EU}(\overline{k})\right)^{-\gamma} \right] \right)
\end{aligned}$$

The set of equilibrium conditions for the newly unemployed and remaining unemployed households is given by the following:

$$\begin{aligned}
C_t^{EU}(k) + B_t^{EU}(k) &= \frac{R_{t-1}}{\Pi_t} B_{t-1}^E(k-1) + b \qquad \forall k \geq 1 \\
B_t^{EU}(k) &= 0 \qquad \forall k \geq 1 \\
C_t^{UU} + B_t^{UU} &= b \\
B_t^{UU} &= 0
\end{aligned}$$

The asset market clearing condition is given by:

$$B = \sum_{k=0}^{\overline{k}} B_t^E(k) \psi_t^E(k)$$

Where $\psi_t^E(k)$ is the population share of employed households who have been employed for k quarters. It is given by:

$$\psi_t^E(k) = P^{UE}(1-P^{EU})^k U \qquad \forall k < \overline{k}$$

$$\psi_t^E(\overline{k}) = 1 - U - \sum_{k=0}^{\overline{k}-1} \psi_t^E(k)$$

The labour market clearing condition is given by:

$$N_t = \sum_{k=0}^{\overline{k}} N_t^E(k)\psi_t^E(k)$$

Firms produce a good with the production function:

$$Y_t(j) = A_t N_t(j)$$

where A_t follows the same stochastic process as in the baseline model:

$$\log(A_t) = \phi_A \log(A_{t-1}) + \varepsilon_t^A + \varepsilon_{t-4}^{A,N}$$

Real marginal costs for firm j are given by:

$$MC_t = \frac{W_1}{A_t}$$

Each firms face Rotemberg price adjustment costs. Prices are set such as to maximise:

$$\max \mathbb{E}_t \sum_{t=0}^{\infty} \beta^t \left[\frac{P_t(j)}{P_t} Y_t(j) - W_t N_t(j) - \frac{\psi}{2} \left(\frac{P_t(j) - P_{t-1}(j)}{P_{t-1}(j)} \right)^2 Y_t \right]$$

s.t

$$Y_t(j) = A_t N_t(j)$$

$$Y_t(j) = \left(\frac{P_t(j)}{P_t} \right)^{-\mu} Y_t$$

The first order condition for this problem is:

$$1 - \mu + \mu MC_t = \psi \pi_t(\Pi_t) - \psi \beta \mathbb{E}_t \left[\pi_{t+1}(\Pi_{t+1}) \frac{Y_{t+1}}{Y_t} \right]$$

Monetary policy follows the same inflation-targetting framework:

$$R_t = \overline{R} \left(\frac{\Pi_t}{\overline{\Pi}} \right)^{\delta}$$

Aggregate output in symmetric equilibrium is given by:

$$Y_t = A_t N_t$$

The parameters β, μ, δ, γ and ψ are kept the same is in Table 1, while b is once again set such that the average consumption loss upon unemployment is 21%. The parameter ψ_1, the inverse Frisch elasticity, is set to one following much of the literature, while ψ_0 is set such that employed households spend 1/3 of their time working in steady state on average. I set $P^{EU} = \rho(1-\overline{\eta}) = 0.023$ from the benchmark model. p^{UE} is set to 0.48 to target a steady state unemployment rate of 4.5%. The supply of liquid assets is set such that the real interest rate is 0% once again, which entails setting $B = 0.08\overline{Y}$. The model is solved with a first-order perturbation method around the deterministic steady state. I verify that all households do indeed reach the borrowing constraint upon job loss.

D Model Extensions

D.1 Diffusion News Process

The empirical IRF for utilisation-adjusted TFP after a news shock does not feature a sharp change at a certain horizon, but rather instead resembles a slow diffusion process where TFP gradually decreases over time. To capture this in the model, I consider an alternative process for TFP, given by:

$$\log A_t = X_t^1$$

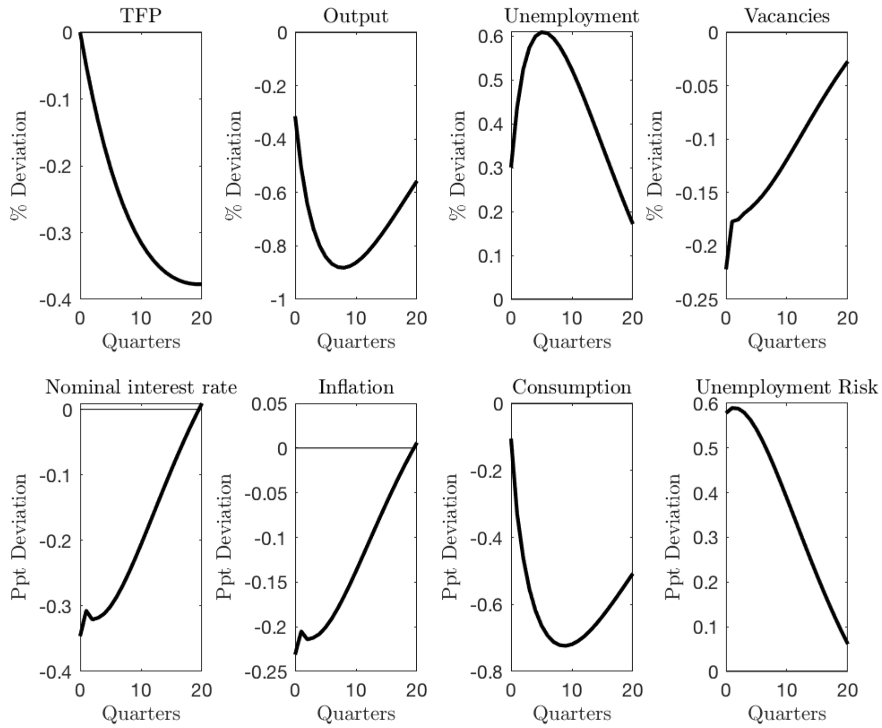
$$X_t^1 = \phi_1 X_{t-1}^1 + (1-\phi_1) X_{t-1}^2$$
$$X_t^2 = \phi_2 X_{t-1}^2 + \varepsilon_t^N$$

Where $\phi_1, \phi_2 \in (0,1)$. The first of these parameters, roughly speaking, controls the persistence of log TFP, while the second governs the speed of diffusion. The closer ϕ_2 is to 1, the slower the shock diffuses. I set $\phi_1 = \phi_2 = 0.95$, providing a reasonably good approximation of the estimated IRF for TFP. The IRFs of key variables in the model are plotted below following a shock to ε_t^N.

TFP does not respond on impact, but then gradually declines, reaching a trough at around 20 quarters.[17] All of the endogenous variables considered do respond on impact, as output, vacancies and consumption all decline in a hump-shaped fashion. They reach a trough before TFP however, as eventually households and firms begin to correctly anticipate an improvement in fundamentals which causes the contraction to end prematurely. A very similar pattern is present in the empirical IRFs, as output, consumption and vacancies reach a trough/peak between 5-10 quarters after the shock while TFP continues to decline after this point. The magnitudes of the output and consumption IRFs are also a good fit for their empirical counterparts. Unemployment risk is highest upon impact of the shock, and then falls gradually, in line with the empirical IRF of unemployment expectations. Inflation and the nominal interest rate on the other hand drop upon impact of the shock and then monotonically converge back to the steady state. This is not replicated exactly in the data, which features a slightly sluggish response of the interest rate and a delayed fall in the price level. Adding some degree of inertia in monetary policy could potentially allow the model to more closely match the empirical IRFs for these two variables.

[17] When the local projections are estimated for longer horizons, I find that TFP reaches a trough at a very similar point after the shock.

Figure A3: IRFs in the Model with the Diffusion Process for the News Shock



D.2 Nominal Wage Rigidities

I consider an extension of the model where there is rigidity in the *nominal* rather than the real wage. The nominal wage is given by $W_t^n = P_t W_t$. The process for the nominal wage is as follows with $\rho_w \in (0,1)$:

$$W_t^n = (W_{t-1}^n)^{\rho_w}(P_t A_t)^{1-\rho_w}$$

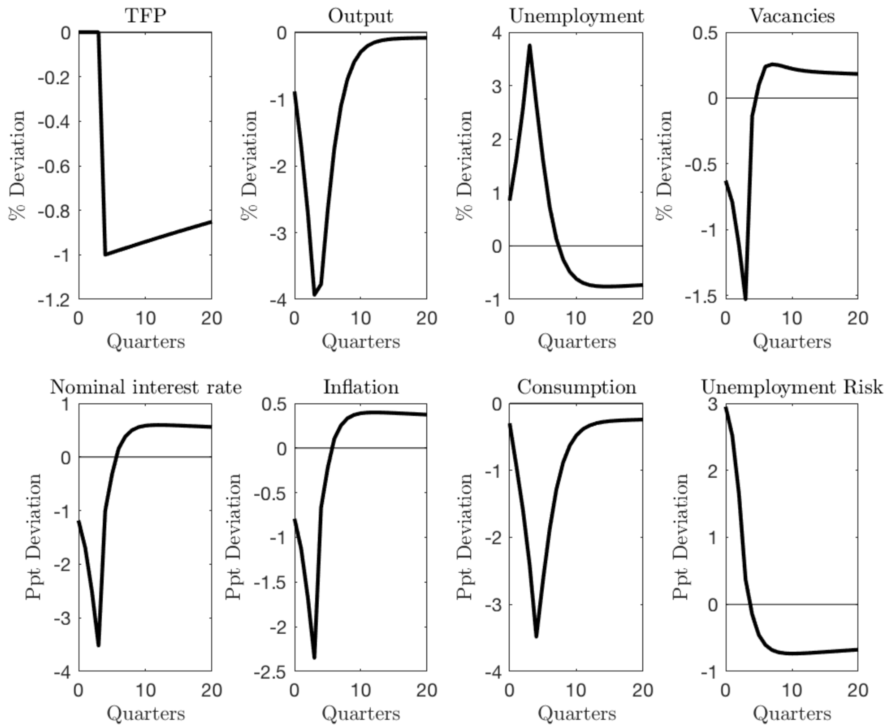
This implies that when there is no rigidity, $\rho_w = 0$, the real wage is equal to TFP. This accords with the baseline wage rule. Using the definition of the real wage and inflation, the nominal wage rule can be re-written in log deviations from steady state as:

$$w_t = \rho_w w_{t-1} + (1-\rho_w)a_t - \rho_w \pi_t$$

When nominal wage rigidity is present, higher inflation erodes the value of the real wage since nominal wages do not adjust immediately.

I set $\rho_w = 0.3$, which implies that there is a moderate degree of nominal wage rigidity, and keep all parameters the same. Figure A4 displays the IRFs from this version of the model, illustrating that the presence of nominal wage rigidity serves to further amplify the TFP news shock during the anticipation period.

Figure A4: IRFs in the Model with Nominal Wage Rigidity



D.3 Endogenous Job Separations

In the benchmark version of the model, the job separation rate is constant and exogenous, equal to ρ. I now consider a variant of the model where this is time-varying and endogenous.

I closely follow Broer et al. (2025), and assume that firms have to pay a continuation cost $\lambda_t \sim G$ in order to prevent the destruction of a job match. Consequently, there is a threshold rule for whether a firm chooses to separate or not. When G is chosen in a sufficiently judicious manner, Broer et al. (2025) demonstrate that the separation rate follows the process:

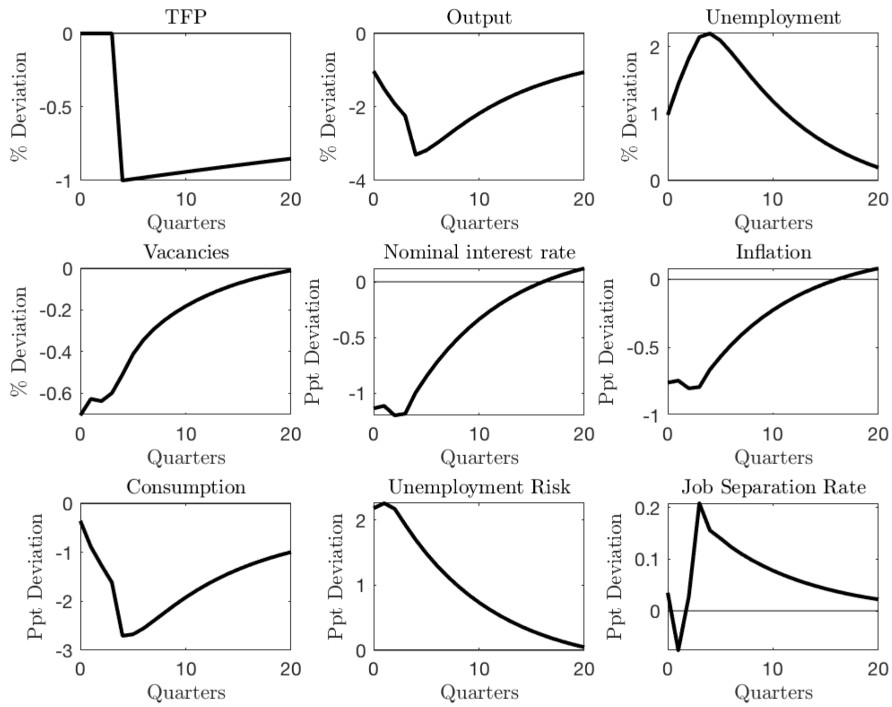
$$\rho_t = \overline{\rho} \left(\frac{MC_t}{\overline{MC}} \right)^{-\iota}$$

Where:

$$MC_t = \left(\frac{1}{A_t} \right) \left(W_t + \frac{\kappa}{f_t} - \beta \mathbb{E}_t \left[(1 - \rho_{t+1}) \frac{\kappa}{f_{t+1}} - \Omega_{t+1} \right] \right)$$

$$\Omega_t = \int_0^{MC_t} \lambda_t dG(\lambda_t)$$

Figure A5: IRFs in the Model with Endogenous Job Separations



I set $\iota = 3$, meaning the separation elasticity is relatively high. As Figure A5 below illustrates, the presence of endogenous job separations amplifies the news shock in the periods which precede the realisation of the change in TFP. This is because firms anticipate that workers will be less productive in the future and so the threshold for separation is lowered, meaning a higher fraction of jobs are destroyed. This increases job loss risk for households, raising their precautionary saving motive and strengthening the demand-based negative feedback loop.

D.4 Labour Supply Decision

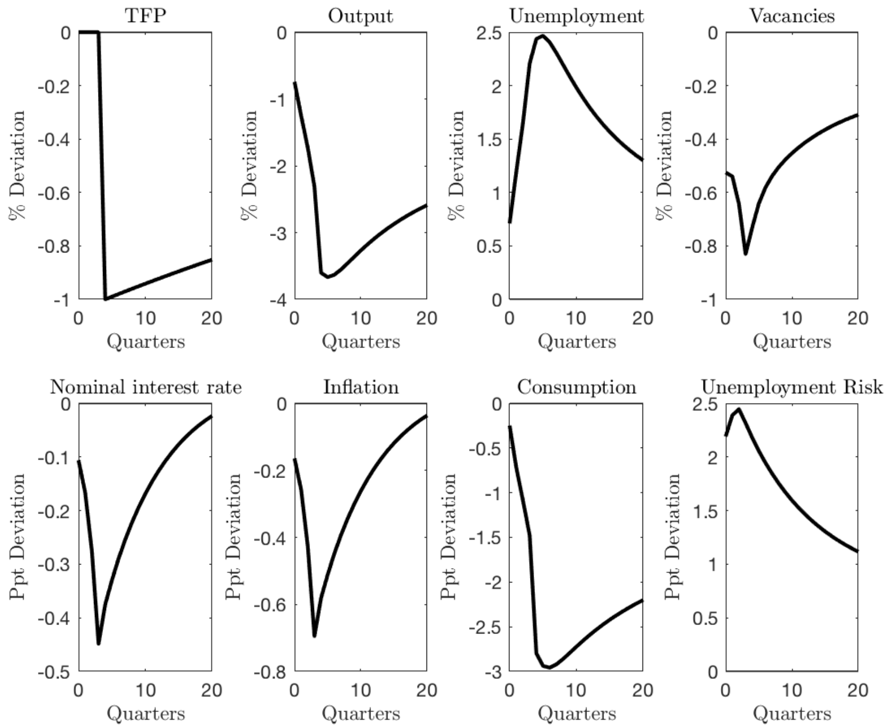
The baseline model assumes that employed households inelastically supply one unit of labour. I now relax this assumption and allow for households to make a well-defined labour supply choice.

Utility is assumed to be of the Greenwood–Hercowitz–Huffman (GHH) variety:

$$U(C_t(i), h_t(i)) = \frac{1}{1-\gamma}\left(C_t(i) - \Psi_0 \frac{h_t(i)^{1+\Psi_1}}{1+\Psi_1}\right)^{1-\gamma}$$

Where $h_t(i)$ is the number of hours supplied by household i, and Ψ_0, Ψ_1 are parameters. $h_t(i) = 0$

Figure A6: IRFs in the Model with Labour Supply Decision



if household i is unemployed in period t. GHH preferences mean there is no wealth effect on labour supply. This is roughly consistent with the empirical evidence (e.g. Cesarini et al. (2017)), but also means that there is no heterogeneity in hours worked which simplifies the computation considerably.

The production function of firm j now becomes:

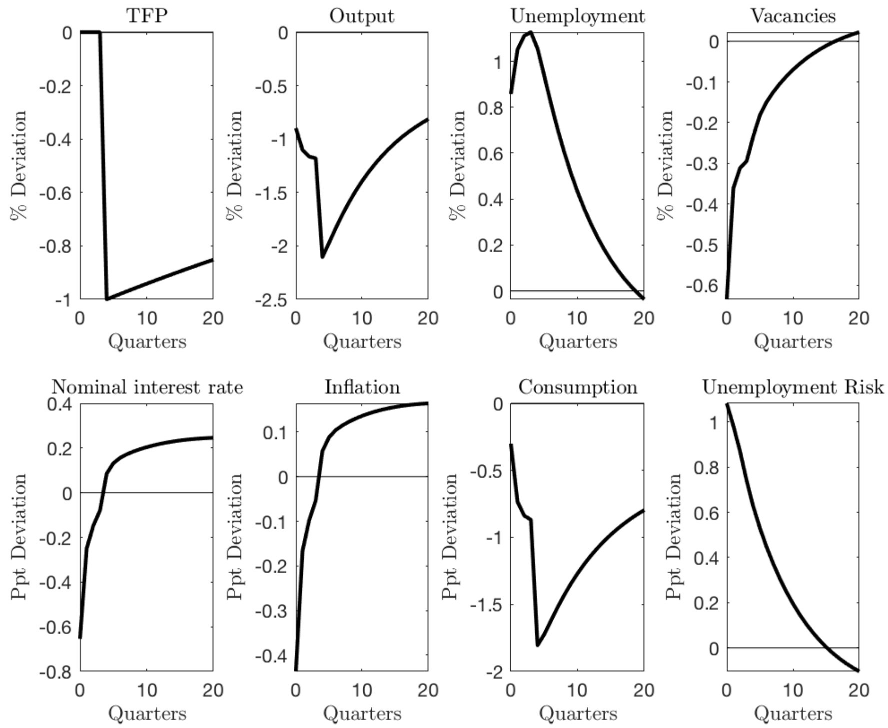
$$Y_t(j) = A_t N_t(j) h_t(j)$$

The firm takes the number of hours that an employee will work as given.

I calibrate Ψ_0 such that $\overline{h} = 1$, meaning that the steady state is unchanged. I calibrate $\Psi_1 = 2$, in line with Frisch elasticity estimates of ≈ 0.5 from Chetty et al. (2011).

Figure A6 depicts the IRFs from this version of the model, illustrating that elastic labour supply amplifies the shock slightly. This is because the intensive margin now responds as well as the extensive margin. It is the latter which continues to do much of the heavy lifting however.

Figure A7: IRFs in the Model with an Unemployment Benefit Financed by Income Taxation



D.5 Unemployment Benefit Financed by Labour Income Tax

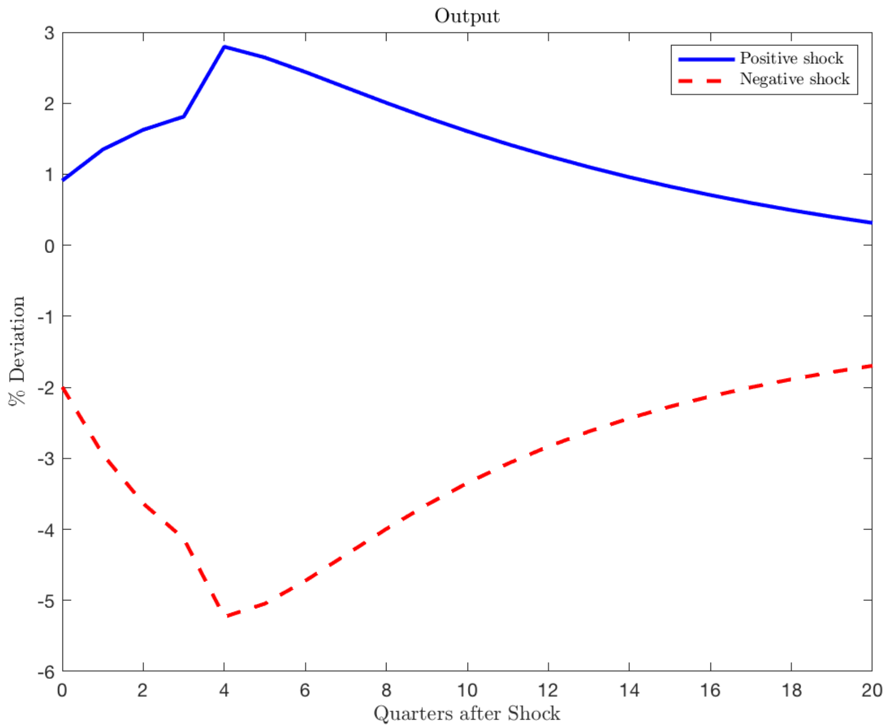
The baseline model assumes that unemployed individuals engage in home production, abstracting away from an unemployment benefit and the financing this would require. I now relax this by assuming that there is a government who taxes labour income to fund an unemployment benefit which remains constant in real terms. They run a balanced budget each period. b now represents the unemployment benefit rather than home production, and τ_t is the labour income flat tax rate. The after-tax real earnings of employed individuals is thus given by $(1-\tau_t)W_t$. The government budget constraint is characterised by:

$$(1 - N_t)b = N_t W_t \tau_t$$

I set b to produce the same average consumption loss that is present in the baseline model.

Figure A7 displays the IRFs from this version of the model. These make it apparent that the unemployment benefit system mitigates the impact of the TFP news shock slightly. The reason for this is that, because unemployment rises after a bad TFP news shock, the unemployment benefit bill also increases. This necessitates a rise in the rate of income tax, which is exacerbated by the decrease in the tax base due to the reduction in employment. The rise in the tax rate reduces the gap between after-tax labour income and the unemployment benefit, which reduces the precautionary saving motive all else equal. This acts as an automatic stabiliser.

Figure A8: Asymmetry in the IRFs



D.6 Asymmetric IRFs

The presence of the borrowing constraint introduces a natural source of non-linearity in the model. Negative shocks push more households toward the borrowing constraint, and into unemployment where this borrowing constraint binds. Consequently, I investigate the degree of asymmetry in the IRF of output to positive and negative TFP news shocks. To do this, it is necessary to solve the model with a third-order perturbation method.[18] Figure A8 displays the IRF of output for a 1% (blue line) and -1% (red line) TFP news shock. The output response to the negative shock is roughly twice as large in magnitude.

E News Shocks in the Standard New Keynesian Model

Full exposition for the standard New Keynesian model with productivity shocks can be found in Galí (2015) and Sims (2024). The linearised model with a news shock added consists of the following

[18]For this to be computationally feasible, I need to reduce $\overline{k}$ from 80 to 40 during the solution. I verify that such a reduction does not change the results when the model is solved at first-order.

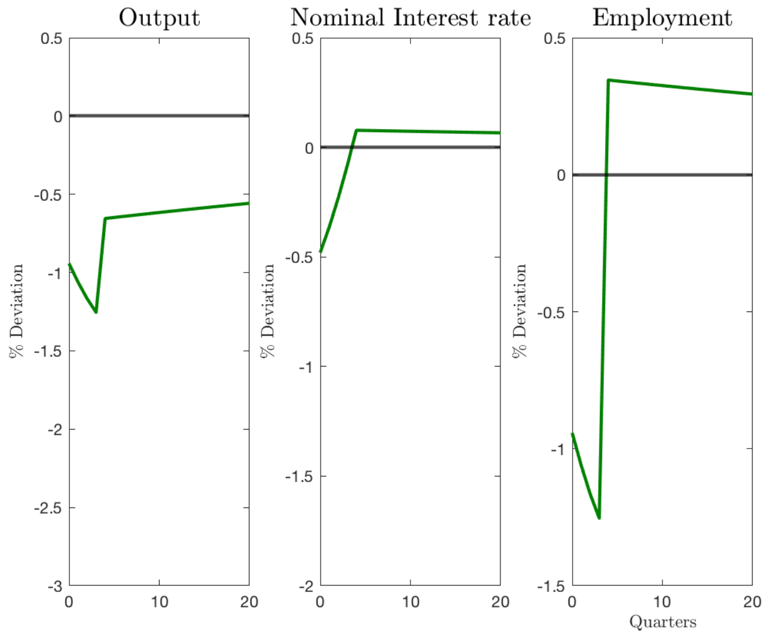
equations, with lower case variables denoting deviations from steady state:

$$
\begin{aligned}
y_t &= a_t + n_t \\
y_t^{nat} &= \frac{1+\psi_1}{\gamma+\psi_1} a_t \\
y_t^{gap} &= y_t - y_t^{nat} \\
w_t &= \gamma y_t + \psi_1 n_t \\
y_t &= \mathbb{E}_t[y_{t+1}] - \frac{1}{\gamma}(r_t - \mathbb{E}_t[\pi_{t+1}] - r_t^n) \\
r_t^n &= \gamma(\mathbb{E}_t[y_{t+1}^{nat}] - y_t^{nat}) \\
\pi_t &= \beta \mathbb{E}_t[\pi_{t+1}] + \kappa_y y_t^{gap} \\
r_t &= \delta \pi_t \\
a_t &= \rho_a a_{t-1} + \varepsilon_t^a + \varepsilon_{t-4}^n
\end{aligned}
$$

y^{nat} is the natural rate of output, y^{gap} is the output gap and r^n is the natural rate of interest. The parameter κ_y is the slope of the Phillips curve. I calibrate all shared parameters to the same values as in Table 1, and set $\kappa_y = 0.085$ to generate the same value for the slope of the Phillips curve. Finally, I set $\psi_1 = 1$ for a unit Frisch elasticity.

Figure A9 displays the IRFs for output, the nominal rate and employment. All three variables fall upon impact. The drop in output is quantitatively lower than the benchmark model by a considerable margin. The nominal interest rate rebounds when TFP decreases, in contrast to the persistent decline seen in the empirical IRFs. Finally, employment also displays a similar reversal upon the change in TFP. This is also not seen in the data.

Figure A9: IRFs in the standard New Keynesian model for a -1% shock to $\varepsilon_t^{a,n}$.



F Data Description and Sources

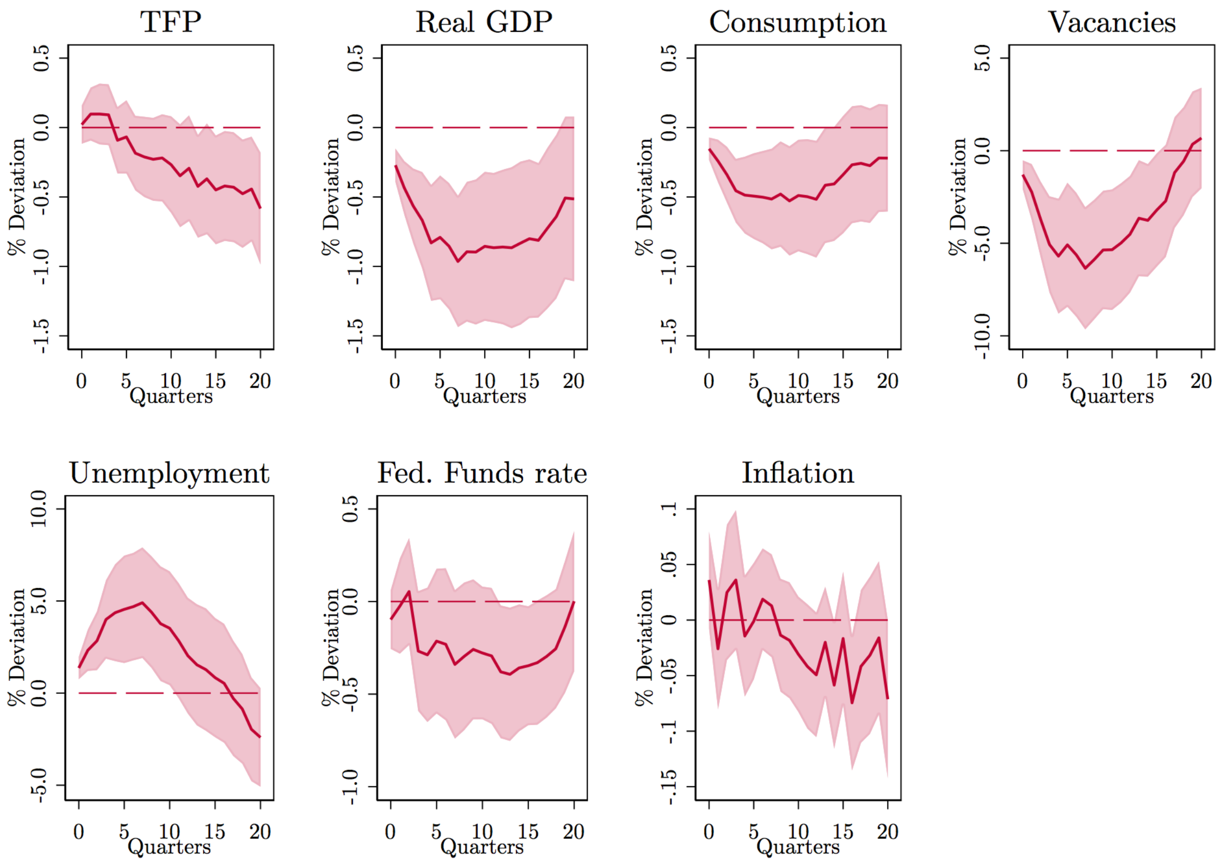
- *Utilisation-adjusted TFP* is obtained from John Fernald's website.
- *Real GDP* is obtained from FRED (FRED code: GDPC1).
- *Consumption* is obtained from FRED and is the sum of nondurable consumption (FRED code: PCND) and services (FRED code: PCES) deflated with the GDP deflator.
- *Unemployment* is obtained from FRED (FRED code: UNEMPLOY).
- *Vacancies* are obtained from the help-wanted index available on Regis Barnichon's website.
- *Inflation* is the inflation rate of the GDP deflator and is obtained from FRED (FRED code: GDPDEF).
- *Federal Funds rate* is obtained from FRED (FRED code: FEDFUNDS).

G Additional Empirical Material

G.1 Using the Original Barsky and Sims (2011) Shock

I present results using the original series for the Barsky and Sims (2011) shock, reproduced by Cascaldi-Garcia and Vukotic (2022) over the period 1962:I - 2010IV. Figure A10 depicts the results when the

Figure A10: The IRFs of key variables to a Barsky and Sims (2011) TFP news shock estimated in the local projection specification, with the original shock series.



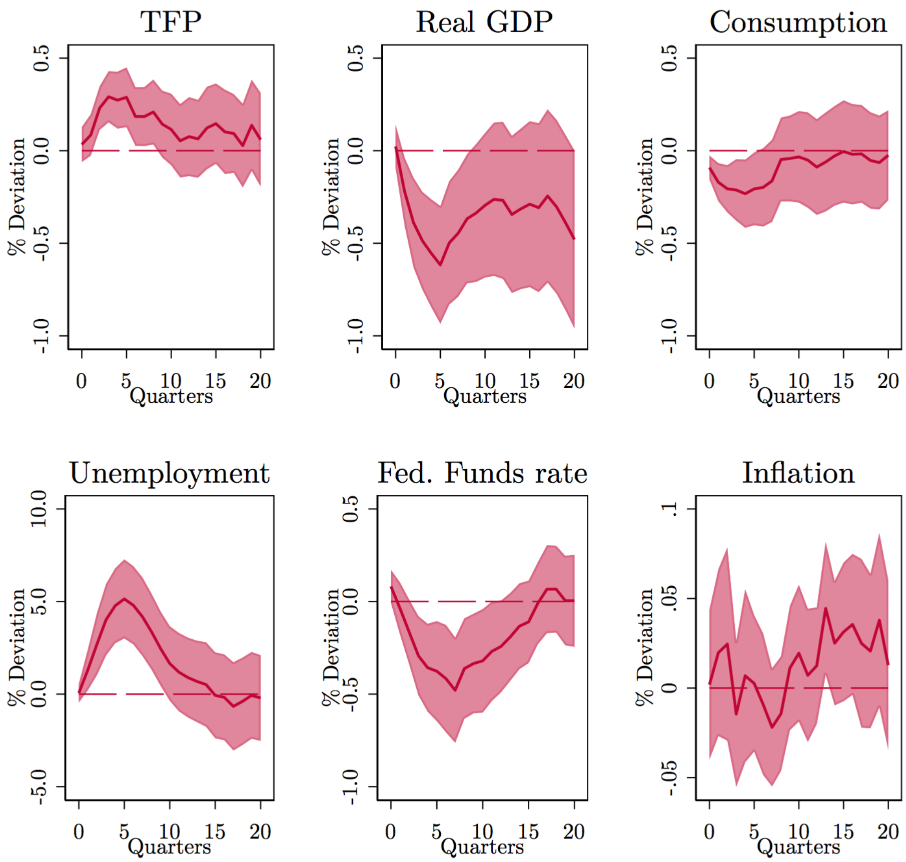
Note: The shaded areas are the 90% confidence intervals.

extended shock is included in the local projection. These look very similar to Figure 7.

G.2 IRFs for the Beaudry and Portier (2006) Shock in the Local Projection

I use the Beaudry and Portier (2006) shocks, updated by Ramey (2016) to end in 2015:II. The sample period is thus 1949:II - 2015:II. I use the shocks identified with short-run restrictions by Ramey (2016). The IRFs for the main variables are displayed below. These look qualitatively very similar to those for the Barsky and Sims (2011) shock. One puzzling IRF is that of utilisation-adjusted TFP, however, which rises rather than falls for this shock. This is perhaps an artifice of the utilisation adjustment procedure by Fernald (2012), as I verify that non-utilisation adjusted TFP does indeed fall after the shock as would be expected

Figure A11: The IRFs of key variables to a Beaudry and Portier (2006) TFP news shock estimated in the local projection specification.



Note: The shaded areas are the 90% confidence intervals.

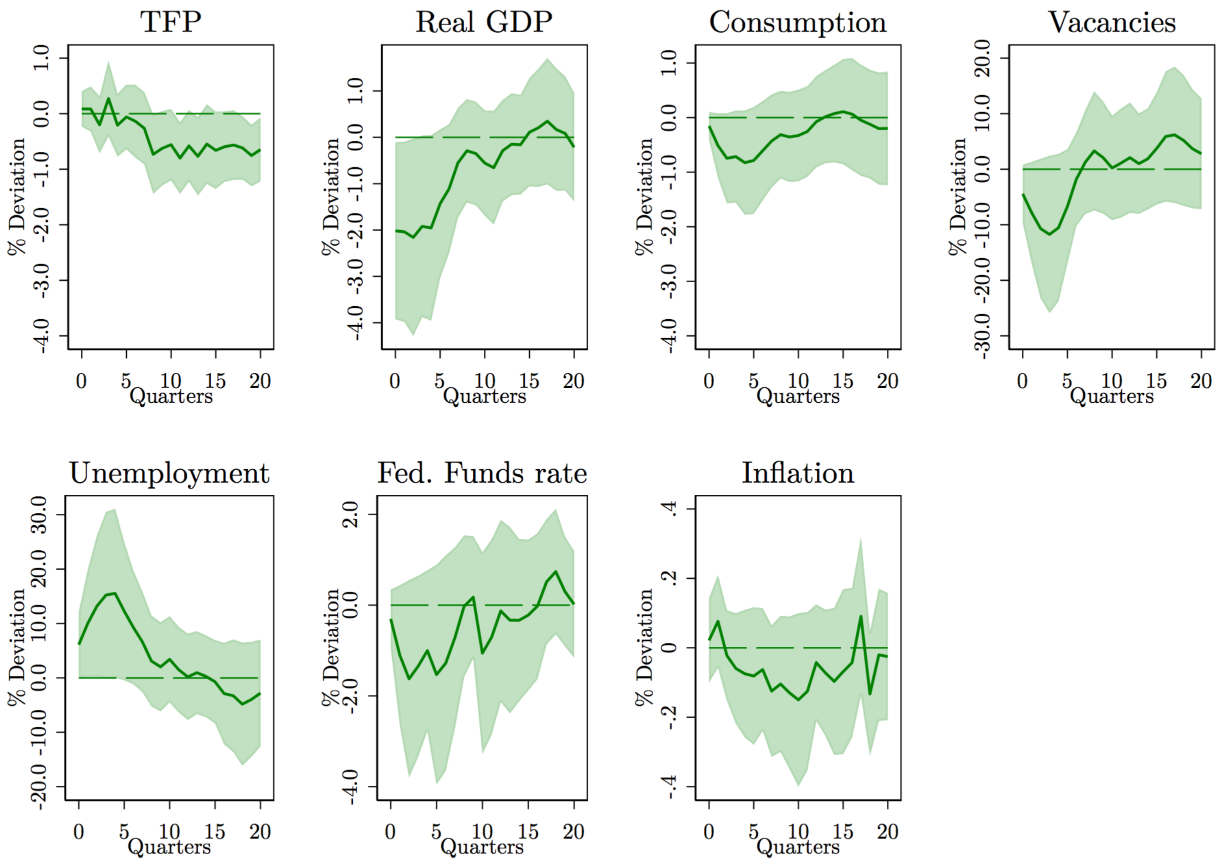
G.3 Local Projection-IV

As a robustness test, I now consider a local projection-IV (LP-IV) framework following Stock and Watson (2018). Here, the shock is treated as an instrument for the true TFP news shock in our estimation, which is advantageous primarily because it allows for the shock to contain measurement error as long as it is correlated with the true TFP news shock and uncorrelated with other shocks. The LP-IV is implemented via 2SLS in a procedure that follows Fieldhouse, Mertens, and Ravn (2018), who estimate the impacts of news shocks to federal housing agency purchasing activity. The first stage is given by:

$$TFP_{t+k} = \mu + \psi \varepsilon_t + \widetilde{\gamma}' X_t + u_{t+k}$$

Here I utilise the Barsky and Sims (2011) TFP news shock to produce an instrument for future utilisation-adjusted TFP at the k-quarter horizon. I set $k = 4$ as in the model, which yields an F-statistic of 12.1, above the rule-of-thumb threshold of 10 from Stock and Yogo (2002). The second stage

Figure A12: The IRFs of key variables to a Barsky and Sims (2011) TFP news shock estimated in an LP-IV specification.



Note: The shaded areas are the 90% confidence intervals.

regression then takes the form:

$$Y_{i,t+h} = \alpha_i^h + \delta_i^h \widehat{TFP}_{t+k} + \gamma_i^{h'} X_t + \omega_{i,t+h}$$

Where I use the predicted values of TFP in k-quarters time from the first stage as a regressor, and the controls used in the first stage. The coefficient δ_i^h gives the estimated impulse response of Y_i, h periods after a TFP news shock.

Figure A12 plots the IRFs from the LP-IV specification, and they look very similar to those from the local projection. The decline of output is estimated to be slightly more pronounced than in the baseline results.

G.4 Additional Details on the Estimation of the Model

The log-linearised model is as follows, with all lower case letters denoting log deviations from steady state:

1. Euler equation:

$$-\gamma w_t = \mathbb{E}_t \left[r_t - \pi_{t+1} - \gamma\beta\overline{R}(1-\rho(1-\overline{\eta}))w_{t+1} + \beta\overline{R}\rho\overline{\eta}(1-\chi^{-\gamma})\eta_{t+1} \right]$$

2. Production function:

$$y_t = a_t + n_t$$

3. Law of motion for employment:

$$n_t = (1-\rho)n_{t-1} + \rho m_t$$

4. Law of motion for job searchers:

$$e_t = -\frac{(1-\rho)\overline{N}}{\overline{e}} n_{t-1}$$

5. Matching function:

$$m_t = \alpha e_t + (1-\alpha)v_t$$

6. Job filling rate:

$$f_t = m_t - v_t$$

7. Job finding rate:

$$\eta_t = m_t - e_t$$

8. Marginal cost:

$$mc_t = -a_t + \frac{\overline{W}}{\overline{MC}} w_t - \frac{\kappa}{\overline{fMC}} f_t + \beta(1-\rho)\frac{\kappa}{\overline{fMC}} \mathbb{E}_t f_{t+1}$$

9. New Keynesian Phillips curve:

$$\pi_t = \beta \mathbb{E}_t \pi_{t+1} + \frac{\mu - 1}{\psi} mc_t + u_t^{\Pi}$$

10. Wage rule:

$$w_t = \rho_W w_{t-1} + (1-\rho_W)\rho_A a_t$$

11. Monetary policy rule:

$$r_t = \delta \pi_t + u_t^R$$

12. TFP process:

$$a_t = \phi_A a_{t-1} + \varepsilon_t^A + \varepsilon_{t-4}^{A,N_4} + \varepsilon_{t-8}^{A,N_8}$$

13. Monetary disturbance process:

$$u_t^R = \phi_R u_{t-1}^R + \varepsilon_t^R$$

14. Cost push disturbance process:

$$u_t^\Pi = \phi_\Pi u_{t-1}^\Pi + \varepsilon_t^\Pi$$

We have the following steady state relationships, after normalising $\overline{N}$:

1. Matches:

$$\overline{M} = \rho \overline{N}$$

2. Job searchers:

$$\overline{e} = 1 - (1-\rho)\overline{N}$$

3. Vacancies:

$$\overline{v} = \left(\frac{\overline{M}}{\overline{e}^\alpha}\right)^{\frac{1}{1-\alpha}}$$

4. Job filling rate:

$$\overline{f} = \frac{\overline{M}}{\overline{v}}$$

5. Job finding rate:

$$\overline{\eta} = \frac{\overline{M}}{\overline{e}}$$

6. Marginal cost

$$\overline{MC} = 1 - \frac{1}{\mu}$$

7. Real wage:

$$\overline{W} = \overline{MC} - \frac{\kappa}{\overline{f}} + \beta(1-\rho)\frac{\kappa}{\overline{f}}$$

8. Interest rate:

$$\overline{R} = \frac{\overline{W}^{-\gamma}}{\beta\left[(1-\rho(1-\overline{\eta}))\overline{W}^{-\gamma} + \rho(1-\overline{\eta})b^{-\gamma}\right]}$$

I calibrate the following parameters prior to estimation: $b = 0.8\overline{W}$, $\mu = 6$, $\rho = 0.044$, $\beta = 0.99$. The remaining parameters are estimated via Bayesian methods. The prior and posterior disributuions of these can be found in the tables below.

Table A1: Results from Bayesian Estimation (Parameters)

	Prior			Posterior			
	Dist.	Mean	Stdev.	Mean	Stdev.	HPD inf	HPD sup
α	beta	0.500	0.1000	0.552	0.0421	0.4835	0.6231
γ	gamm	2.000	0.5000	1.349	0.1080	1.1690	1.5210
ψ	gamm	75.000	25.0000	22.885	5.9177	12.7824	31.8352
κ	gamm	1.000	0.3000	3.095	0.3613	2.5305	3.7103
δ	norm	1.500	0.2000	1.161	0.0154	1.1350	1.1853
ϕ_A	beta	0.500	0.2000	0.999	0.0005	0.9984	0.9998
ϕ_Π	beta	0.500	0.2000	0.854	0.0131	0.8331	0.8763
ϕ_R	beta	0.500	0.2000	0.123	0.0239	0.0828	0.1610
ρ_W	beta	0.500	0.2000	0.069	0.0287	0.0215	0.1136
ρ_A	norm	0.500	0.2000	0.430	0.0372	0.3679	0.4905

Table A2: Results from Bayesian Estimation (Standard Deviation of Structural Shocks)

	Prior			Posterior			
	Dist.	Mean	Stdev.	Mean	Stdev.	HPD inf	HPD sup
ε^A	invg	0.001	0.1000	0.007	0.0003	0.0064	0.0075
ε^{A,N_4}	invg	0.001	0.1000	0.001	0.0002	0.0003	0.0011
ε^{A,N_8}	invg	0.001	0.1000	0.004	0.0003	0.0037	0.0048
ε^Π	invg	0.001	0.1000	0.008	0.0022	0.0049	0.0114
ε^R	invg	0.001	0.1000	0.006	0.0003	0.0057	0.0067

H Price of a Risky Asset in the Two-Period Model

I introduce a volatile, risky asset into the two-period model. TFP now has an anticipated, news shock component and an unanticipated component:

$$A_1 = \widetilde{A}_1 + \varepsilon_1$$

Where $\widetilde{A}_1$ is known by all agents in period 0 and $\varepsilon_1 \sim \mathrm{N}(0, \sigma^2)$. This implies that $\mathbb{E}_0(A_1) = \widetilde{A}_1$. The households can trade a risky asset in addition to the risk-free nominal bond, which has a payoff that loads entirely on the unanticipated component of TFP:

$$x_1 = 1 + \beta_A \varepsilon_1$$

I assume that $\beta_A > 0$ so the asset pays off well in good states and poorly in bad states. The risky asset thus has the same payoff in unconditional expectation as the risk-free asset, but exhibits volatility. The risky asset has a price of Q_0 and is in zero net supply. S_0^i denotes household i's holdings of the risky asset.

As a simplifying assumption made for the purposes of traceability, I assume that monetary policy sets $P_1 = P_0 = P_{-1} = 1$ and so the model is entirely real with perfectly rigid prices. I relax the assumption of a no-borrowing constraint meaning that the households will engage in the trading of assets in equilibrium. The problem of the period 0 employed household now becomes:

$$V_0^E = \max_{C_0^E, a_0^{E,r}, a_0^{E,f}} \frac{(C_0^E)^{1-\gamma} - 1}{1-\gamma} + \beta \mathbb{E}_0 \left[(1 - \rho(1-\eta_1)) V_1^{EE} + \rho(1-\eta_1) V_1^{EU} \right]$$

s.t.

$$C_0^E + a_0^{E,f} + a_0^{E,r} = W$$
$$C_1^{EE} = W + R_1^r a_0^{E,f} + R_0^f a_0^{E,r}$$
$$C_1^{EU} = b + R_1^r a_0^{E,f} + R_0^f a_0^{E,r}$$

Where $a_0^{E,r} = Q_0 S_0^E$, $a_0^{E,f} = q_0 B_0^E$ and $R_1^r = x_1/Q_0$.

The period 0 unemployed household's problem is:

$$V_0^U = \max_{C_0^U, a_0^{U,r}, a_0^{U,f}} \frac{(C_0^U)^{1-\gamma} - 1}{1-\gamma} + \beta \mathbb{E}_0 \left[(1-\eta_1) V_1^{UU} + \eta_1 V_1^{UE} \right]$$

s.t.

$$C_0^U + a_0^{U,f} + a_0^{U,r} = b$$
$$C_1^{UE} = W + R_1^r a_0^{U,f} + R_0^f a_0^{U,r}$$
$$C_1^{UU} = b + R_1^r a_0^{U,f} + R_0^f a_0^{U,r}$$

These yield a pair of Euler equations:

$$(C_0^E)^{-\gamma} = \beta \mathbb{E}_0 \left[(1 - \rho(1-\eta_1))(C_1^{EE})^{-\gamma} + \rho(1-\eta_1)(C_1^{EU})^{-\gamma} \right] R_1^x$$
$$(C_0^U)^{-\gamma} = \beta \mathbb{E}_0 \left[(1-\eta_1)(C_1^{UU})^{-\gamma} + \eta_1 (C_1^{UE})^{-\gamma} \right] R_1^x$$

Where $R_1^x = R_1^r - R_0$. Following Devereux and Sutherland (2011), I take a second-order Taylor approximation of the Euler equation around the riskless steady state, i.e. the limit as $\sigma \to 0$. Let $\overline{Z}$ denote the value of Z in this riskless steady state. Notably, $\overline{R_1^x} = 0$ as both assets become riskless in this limit and so both earn the same return. Working through a good deal of algebra yields the following solution for the employed risky asset holdings:

$$a_0^{E,r} = \delta^E \left[\phi_{R,\eta}^E \frac{\beta_A \theta_1}{Q_0} \sigma^2 + \phi_R^E \mathbb{E}_0 R_1^x \right]$$

Where:

$$\begin{aligned}
\delta^E &= \frac{\overline{C_1}^{EE}}{\gamma \mathbb{E}_0[(R_1^x)^2][1 + \rho(1-\overline{\eta}_1)(\tilde{\chi_U}^{-\gamma-1} - 1)]} > 0 \\
\phi_{R,\eta}^E &= \rho(1 - \tilde{\chi}_U^{-\gamma}) \leq 0 \\
\phi_R^E &= 1 + \rho(1-\overline{\eta}_1)(\tilde{\chi}_U^{-\gamma} - 1) > 0 \\
\tilde{\chi}_U &= \frac{\overline{C_1}^{EU}}{\overline{C_1}^{EE}} \leq 1
\end{aligned}$$

We have that $\phi_{R,\eta} < 0$ if $\rho > 0$ and $b < W$. If $b < W$ it also holds that $\tilde{\chi}_U < 1$. It was previously established that $\theta_1 > 0$ if κ is finite. Importantly, $\overline{\eta}_1 = \mathbb{E}_0 \eta_1 = \theta_0 + \theta_1 \widetilde{A}_1$. The news shocks thus impact the demand for the risky asset if and only if the above parameter restrictions are satisfied, i.e. if there are labour market frictions and unemployment insurance is incomplete. In the absence of these, the solution is constant and (after dividing by wealth) coincides with the Merton (1969) optimal risky portfolio choice formula, scaled by the consumption-wealth ratio which accounts for the presence of labour income.

Repeating this for the Euler equation of the period 0 unemployed household yields:

$$a_0^{U,r} = \delta^U \left[\phi_{R,\eta}^U \frac{\beta_A \theta_1}{Q_0} \sigma^2 + \phi_R^U \mathbb{E}_0 R_1^x \right]$$

Where:

$$\begin{aligned}
\delta^U &= \frac{\overline{C_1}^{UE}}{\gamma \mathbb{E}_0[(R_1^x)^2][\overline{\eta}_1 + (1-\overline{\eta}_1)\widehat{\chi}_U^{-\gamma-1}]} > 0 \\
\phi_{R,\eta}^U &= 1 - \widehat{\chi}_U^{-\gamma} \leq 0 \\
\phi_R^U &= \overline{\eta}_1 + (1-\overline{\eta}_1)\widehat{\chi}_U^{-\gamma} \geq 0
\end{aligned}$$

It is the case that $\phi_R^U > 0$ if κ is finite since this means that $\overline{\eta_1} > 0$. We then have that $\phi_{R,\eta}^U < 0$ if $b < W$. If $b = W$ or $\kappa \to \infty$, the standard Merton solution also emerges for this type of household. Therefore, the portfolio choice of the unemployed household is also only affected by the news shock if the two crucial frictions are present.

The asset market clearing conditions are given by:

$$N_0 a_0^{E,r} + (1 - N_0) a_0^{U,r} = 0$$

$$N_0 a_0^{E,f} + (1 - N_0) a_0^{U,f} = 0$$

Using the first of these along with the expressions for risky asset demand pins down the expected excess return on the risky asset:

$$\mathbb{E}_0(R_1^x) = -\frac{N_0 \delta^E \phi_{R,\eta}^E + (1 - N_0)\delta^U \phi_{R,\eta}^U}{N_0 \delta^E \phi_R^E + (1 - N_0)\delta^U \phi_R^U} \left(\frac{\beta_A \theta_1 \sigma^2}{Q_0} \right)$$

This is strictly positive if $\rho > 0$, $b < W$ and κ is finite. Because the risky and risk-free assets have the same expected payoff, this implies that under these conditions the price of the risky asset is below the price of the risk-free asset, $Q_0 < q_0$.

We have that employment in period 0 is given by:

$$N_0 = 1 - \rho + \eta_0 \rho$$

And the equilibrium period 0 job finding rate is given by:

$$\eta_0 = \frac{1}{\kappa} \left(\frac{\mu - 1}{\mu} - W + \beta(1 - \rho)\overline{\eta}_1 \right)$$

A one unit news shock thus increases N_0 by $\frac{\beta\rho(1-\rho)\theta_1}{\kappa}$, and this in turn also affects the risk premium since N_0 appears in the expression above. The reason for this is that, in the presence of the two key frictions, employed and unemployed households have a differential marginal propensity to take risk (Kekre and Lenel, 2022). This is higher for employed agents, meaning that a decrease in period 0 employment due to a bad news shock will decrease the overall demand for the risky asset via this composition effect, decreasing its price. A news shock thus changes the total demand by a demand composition effect (changes in N_0) and changes in individual demand ($a_0^{E,r}$ and $a_0^{U,r}$). An additional complicating factor is that the bad news shock changes the target wealth level for employed households by affecting the precautionary wealth accumulation motive. This force potentially serves to increase the demand for both types of assets. As a result of the two opposing effects of a news shock on asset demand, I evaluate the effect on the asset price differential numerically.

I normalise $\beta_A = 1$ and use the same set of parameter values as in the main text: $\beta = 0.97$, $\chi = 0.8$, $\rho = 0.05$, $\kappa = 1$, $\gamma = 3$, $W = 0.52$, $\mu = 6$. I set $\sigma = 0.5$ to target an annualised risk premium of around 5.5% when $\widetilde{A}_1 = 1$. I use a fine grid for $\widetilde{A}_1 \in [0.9, 1.1]$ and ultimately evaluate $PVS_0 = \log(Q_0/q_0)$ for each grid point, solving for equilibrium asset prices using a numerical procedure.[19] The Figure below plots PVS_0 as a function of $\widetilde{A}_1$ and demonstrates that, as in the IRFs, PVS decreases after a negative TFP news shock under the calibration.

[19] To be specific, I first solve for N_0 and $\overline{\eta}_1$ for each grid point. I then guess a vector of prices (q_0, Q_0) and financial wealth levels (w_0^E, w_0^U) where $w_0^i = a_0^{i,r} + a_0^{i,f}$. I then solve for risky asset demand for each type of household given these guesses, and then for equilibrium prices, before solving for risk-free asset demand using a first-order Taylor approximation to each household's Euler equation for this asset. If the guesses are correct, I stop, and if they are incorrect I update the new guesses and return to this step. This is then iterated until convergence, which typically occurs in less than five iterations.

Figure A13: PVS in the Two-Period Model