Risk shocks and monetary policy in the new normal

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Motivation

- Pre-crisis consensus that ZLB episodes are rare and short (Reifschneider and Williams JMCB 2000, Schmitt-Grohé and Uribe 2011)
- Post-crisis revision in light of incoming data (Chung et al. JMCB 2012, Williams 2014, Kiley and Roberts BPEA 2017)
- Optimistic view that unconventional policy can stand in after the economy returns to normal (Reifschneider 2016)
- But how should monetary policy be conducted if the 'new normal' is one in which the public worry that policymakers may not always be able to provide sufficient stimulus?

This paper

- Study of the implications for monetary policy of risk and variation in risk in a 'new normal' close to the zero lower bound (ZLB)
- Two key differences from pre-crisis prescriptions
  - Policymakers should operate the economy above potential in normal times, but accept that inflation settles below target
  - Changes in the perception of risk lead to trade-offs for monetary policy between inflation and real stability
- Mechanism is a negative skew in expectations when risk is high relative to the available monetary policy space
  - Inability to respond to large adverse shocks with sufficient stimulus
  - ...but not with contractionary action when needed

Literature

- Follows studies of the implications of the *presence* of risk with a ZLB under optimal discretionary policy
  - Mechanism: Adam and Billi JMCB 2007, Nakov IJCB 2008
  - Applications: Nakata and Schmidt 2014, Evans et al. BPEA 2015
- Complements analysis of risk shocks in a non-linear model with instrument rule by Basu and Bundick 2015 by featuring
  - Dynamics away from the ZLB
  - Optimal discretionary policy
  - Quasi-linear model (solution and interpretation)
- Contemporaneous work on the stochastic steady state in non-linear model by Hills, Nakata and Schmidt 2016.
- More broadly related literature on uncertainty and macroeconomic dynamics

New Keynesian model with ZLB and risk shock

- Quasi-linear model

$$\pi_t = \beta E_t \pi_{t+1} + \kappa x_t + u_t$$

$$x_t = E_t x_{t+1} - \frac{1}{\varsigma}\left(i_t - E_t \pi_{t+1} - r_t^*\right)$$

$$i_t + i^* \geq 0$$

- Shock processes with $r_t^* = \rho_t + \varepsilon_t$

$$\varepsilon_t = \mu_\varepsilon \varepsilon_{t-1} + \nu_{\varepsilon,t}; \quad \nu_{\varepsilon,t} \sim N(0, \sigma_{\varepsilon,t}^2)$$

$$u_t = \mu_u u_{t-1} + \nu_{u,t}; \quad \nu_{u,t} \sim N(0, \sigma_{u,t}^2)$$

- Baseline risk shock process with $\varsigma^{-1}\sigma_{\varepsilon,t} = \sigma_{u,t} = \sigma_t$

$$\sigma_t = \sigma + \mu_\sigma \left(\sigma_{t-1} - \sigma\right) + \nu_{\sigma,t}$$

Monetary policy

- Optimal policy under unconstrained discretion minimises

$$L = \pi_t^2 + \lambda x_t^2$$

subject to

$$\pi_t = \beta E_t \pi_{t+1} + \kappa x_t + u_t$$

- Targeting rule

$$\pi_t = -\frac{\lambda}{\kappa} x_t$$

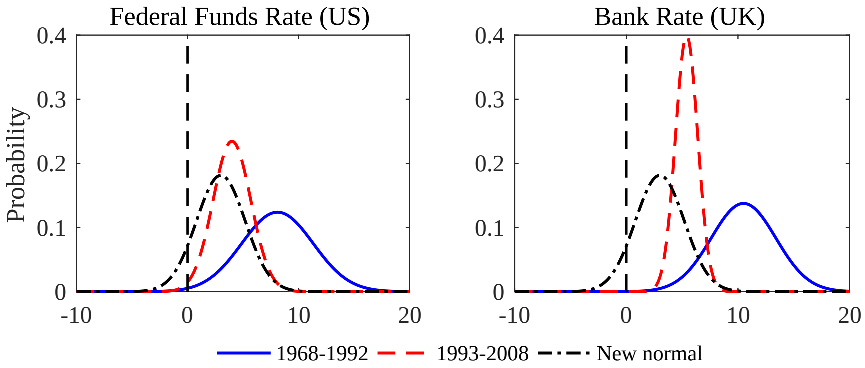
- Interest rate

$$i_t = \max\{-i^*, i_t^{opt}\}$$

Solution algorithm

- Approximate the shock processes by independent Markov processes using the Rouwenhorst (*Frontiers*, 1995) method
- Solve model backwards from distant future period T with $E_t\pi_t = E_t x_t = 0$ for all $t > T$
  - Take expectations as given and calculate the unconstrained outcome for a state grid of values for the shock processes
  - Take as solution for each node where ZLB doesn't bind
  - Calculate outcomes from the model equations with $i_t = -i^*$ imposed for all other nodes
  - Update the *ex ante* expectations using the Markov transition matrices
  - Progress to previous period
- Solution if convergence in period $t = 0$

The new normal



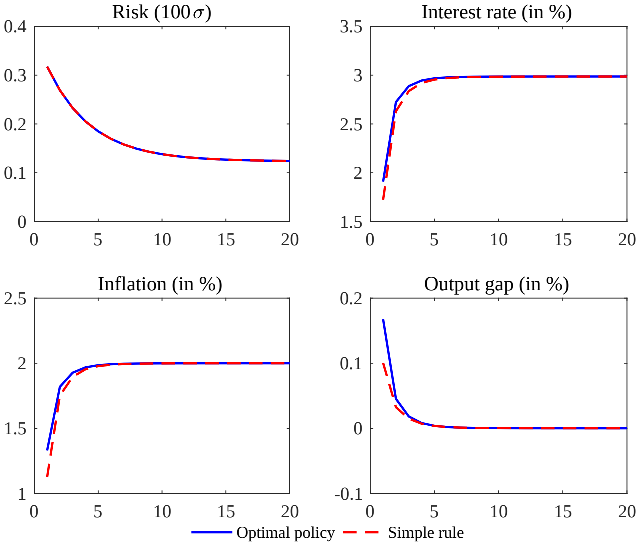
Baseline parameterisation

Parameter	Description	Value
π^*	Inflation target	0.02
r^*	Normal real interest rate	0.01
β	Discount factor	0.995
κ	Slope of Phillips curve	0.02
ς	Relative risk aversion	1
μ_ε	Persistence of equilibrium rate	0.75
μ_u	Persistence of cost-push shock	0.25
μ_σ	Persistence of risk shock	0.75
λ	Weight on output gap in loss function	0.02
σ	Underlying risk	0.0027
n_ε, n_u	Grid size for shock processes	25
T	Uncertainty horizon	1000

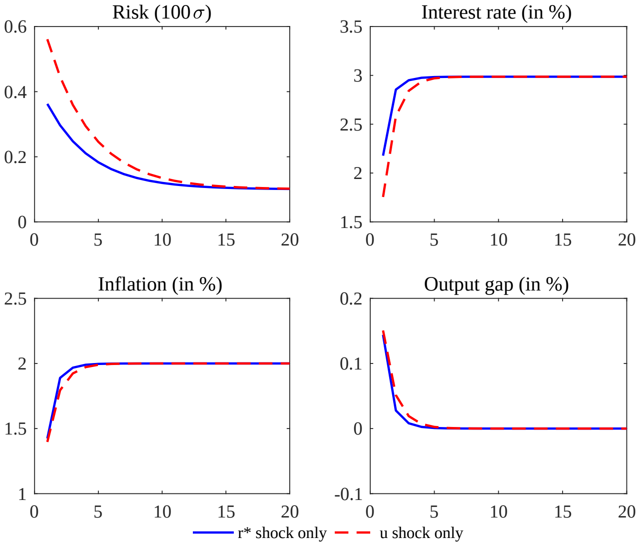
Alternative calibrations

	Data				Unconstrained model					
Episode	$E(i)$	$\sigma(i)$	$E(\pi)$	$\sigma(\pi)$	$E(i)$	$\sigma(i)$	$E(\pi)$	$\sigma(\pi)$	100σ	$P(i<0)$
New normal	–	–	–	–	3.02	2.20	2.00	2.48	0.27	0.09
Low risk	–	–	–	–	3.02	1.00	2.00	2.11	0.12	0.00
US 1968-1992	8.07	3.16	5.96	3.73	8.07	3.16	4.16	4.66	0.39	0.01
US 1993-2008	3.97	1.74	2.55	3.59	3.97	1.74	2.00	2.31	0.22	0.01
UK 1968-1992	10.59	2.86	8.77	6.83	10.59	2.86	6.59	6.86	0.35	0.00
UK 1993-2008	5.36	1.03	1.93	2.09	5.36	1.03	2.00	2.11	0.13	0.00

Risk shock around low-risk steady state



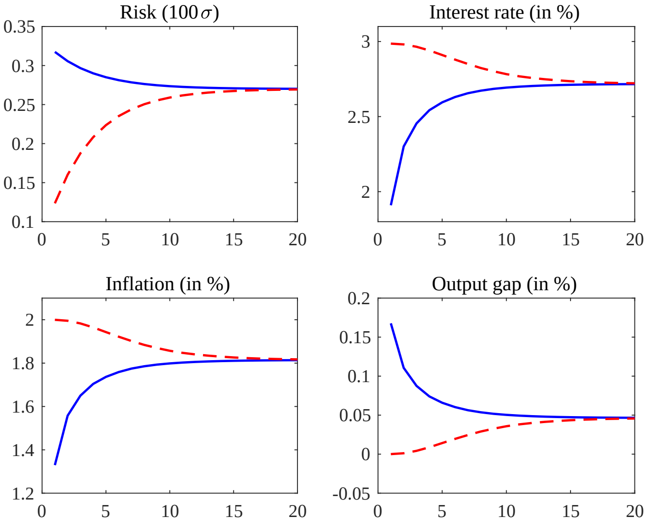
Risk shocks around low-risk steady state



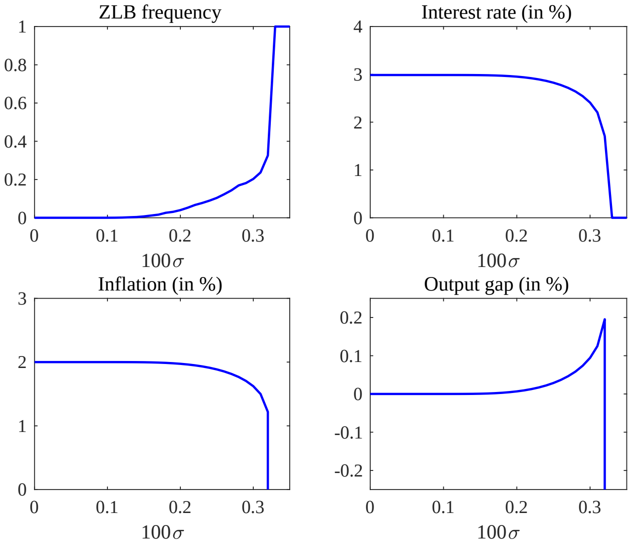
Stochastic steady state

		Interest rate			Inflation			Output gap			
	Episode	i^*	i	$E(i)$	π^*	π	$E(\pi)$	x^*	x	$E(x)$	$P(ZLB)$
1)	New normal	3.02	2.73	2.81	2.00	1.80	1.79	0.00	0.05	−0.01	0.14
2)	r^* shocks only	3.02	2.94	2.94	2.00	1.93	1.92	0.00	0.02	0.00	0.07
3)	u shocks only	3.02	2.98	2.99	2.00	1.98	1.97	0.00	0.01	0.00	0.04
4)	Large r^* shocks	3.02	2.78	2.82	2.00	1.81	1.80	0.00	0.05	−0.01	0.13
5)	Large u shocks	3.02	2.64	2.82	2.00	1.81	1.80	0.00	0.05	−0.01	0.15
6)	Lower r^*	2.77	2.24	2.41	2.00	1.66	1.64	0.00	0.09	−0.01	0.20
7)	Lower π^*	2.77	2.27	2.43	1.75	1.43	1.41	0.00	0.08	−0.01	0.20
8)	Higher r^*	3.28	3.10	3.14	2.00	1.88	1.87	0.00	0.03	−0.01	0.10
9)	Higher π^*	3.27	3.09	3.14	2.25	2.12	2.11	0.00	0.03	0.00	0.10
10)	High π^*	5.04	5.03	5.03	4.00	3.99	3.99	0.00	0.00	0.00	0.01

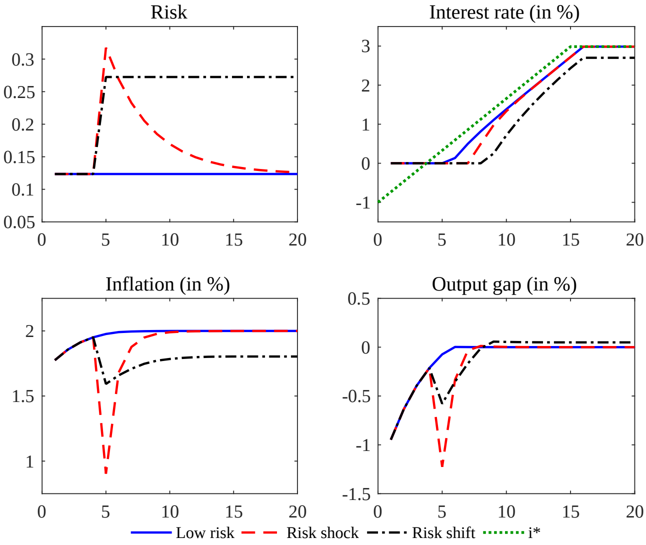
Risk shocks in new normal



Risk and economic outcomes



Normalisation with risk shock



Conclusion

- Risk affects outcomes in the New Keynesian model close to the ZLB
- In uncertain times, inflation may settle materially below target even when the policy rate is well above the ZLB
- Even if nothing happens, variation in the perception of risk affects the economy through expectations
- Risk shocks that are large relative to the available monetary policy space give rise to cost-push effects
- Stochastic volatility gives rise to occasional trade-offs
- When underlying risk is high, variation in risk has both negative and positive cost-push effects