Cyclical Attention to Saving

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Motivation

If there are intertemporally optimizing households, then the interest rate matters:

$$u'(c_t) = \beta \boldsymbol{R_t} \mathbb{E}_t u'(c_{t+1})$$

Shopping around affects your interest rate:

> *There was a substantial proportion of [saving] balances that could, by switching balances to another product or provider, benefit from higher interest rates. (FCA 2015)*

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Q1: Does attention to saving product choice vary systematically with macro variables?

Q2: Does that matter for shock propagation?

Roadmap

Simple Theory: novel interaction of heterogeneous banks and inattentive households.

Empirics: novel combination of data on UK savings markets.

Related Literature

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Result 1: Attention rises in contractions, falls in expansions.

Result 2: That amplifies the business cycle.

Related Literature

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Result 2: That amplifies the business cycle.

Quantitative Model: estimate with macro and savings data, find variable attention increases $Var(C)$ by 17% (not today).

Related Literature

Model: Banks

N banks. Each bank n:

- Period t: buy b_t^n bonds from the government, sell to households, both at price $= 1$.
- Period $t+1$: receive $1 + i_t^{CB}$ interest per bond bought in period t, pay the household $1 + i_t^n$.
- Pay a transaction cost per bond χ_t^n

Bank n chooses i_t^n to max profit from period t sales:

$$\text{Profit}_t^n = \Pr(\text{saver chooses } n | i_t^n, i_t^{-n}) \cdot (i_t^{CB} - i_t^n - \chi_t^n)$$

Model: Households

Composed of many individuals. Redistribution after each period.

- Net saver, so prefers higher interest rates.
- Don't observe realised χ_t^n.

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$$\max_{c_t, b_t, \mathcal{I}_t} \mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \big(u(c_t) - \mu \mathcal{I}_t\big)$$

subject to

$$c_t + b_t = b_{t-1}(1 + i_{t-1}^e) + y_t$$

$$\text{Information constraint: } \frac{\partial i_t^e}{\partial \mathcal{I}_t} > 0, \frac{\partial^2 i_t^e}{\partial \mathcal{I}_t^2} < 0$$

- Individuals face a discrete choice rational inattention problem (Matějka & McKay, 2015) when choosing a bank.
- Higher attention $\mathcal{I}_t \Rightarrow$ higher probability an individual chooses a high interest rate bank. RI problem detail

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FOCs: Euler equation + **FOC on attention**

Model: Implications

Attention FOC:

$$\underbrace{\beta b_t \mathbb{E}_t u'(c_{t+1})}_{\text{MU interest rate next period}} \quad = \underbrace{\mu \mathcal{I}'(i_t^e)}_{\text{MC}}$$

Two reasons for attention to rise:

1) MU income $\uparrow$
2) $\mathcal{I}'(i_t^e) \downarrow$

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1) MU income $\uparrow$
2) $\mathcal{I}'(i_t^e) \downarrow$

- i.e. when the same $i_t^e \uparrow$ requires less attention to achieve: when $\sigma(i_t^n) \uparrow$

Model: Implications

$$\beta b_t \mathbb{E}_t u'(c_{t+1}) = \mu \mathcal{I}'(i_t^e) \qquad \text{(Attn FOC)}$$

$$\big(1 - P(n|s_t)\big) \cdot (i_t^{CB} - i_t^n - \chi_t^n) = (\mathcal{I}'(i_t^e))^{-1} \qquad \text{(Bank FOC)}$$

Suppose $c_t \downarrow$ (persistent):

- $u'(c_{t+1}) \uparrow \Rightarrow \mathcal{I}_t \uparrow$ through attention FOC.
- $i_t^n \uparrow$ through bank FOC ($\mathcal{I}_t \uparrow \Rightarrow$ bank demand is more interest rate elastic)

So household moves $\uparrow$ within the rate distribution, *and* the distribution shifts up.

- Two channels push $i_t^e \uparrow$, so $c_t \downarrow\downarrow$ (through Euler)

Burdett-Judd comparison

Data: Moneyfacts magazine

Rates and product characteristics for the universe of savings products from mainstream UK financial institutions, monthly 1996-2009.

Fixed Rate Savings Bonds:

- 20% of all UK cash savings, held by $\approx$ 12% of population.
- Simple: composed of rate, term, min. investment, frequency of rate payments.
- Little bundling or geographic segmentation.

Data: Moneyfacts magazine

Focus on products with: 1 year term, £5000 investment, interest paid annually.

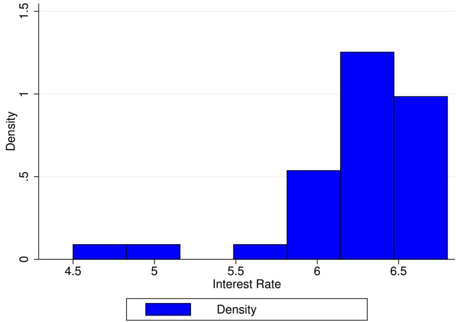
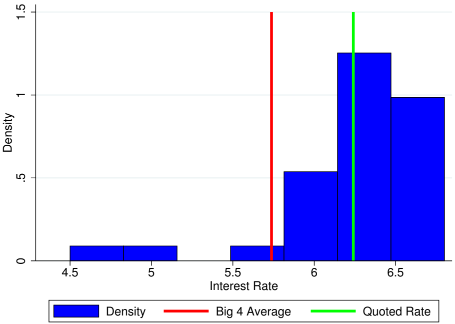


Figure: Histogram of interest rates for the products in October 2000 qualifying for inclusion in the Quoted Household Interest Rates data.

Ben-David et al (2017), Chavaz and Slutzky (2019): $Corr(risk, i) \approx 0$ Bank Risk

Household Performance

$$\varphi = \frac{\mathbb{E}_h i - i^b}{\sigma(i)}$$



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Countercyclical φ

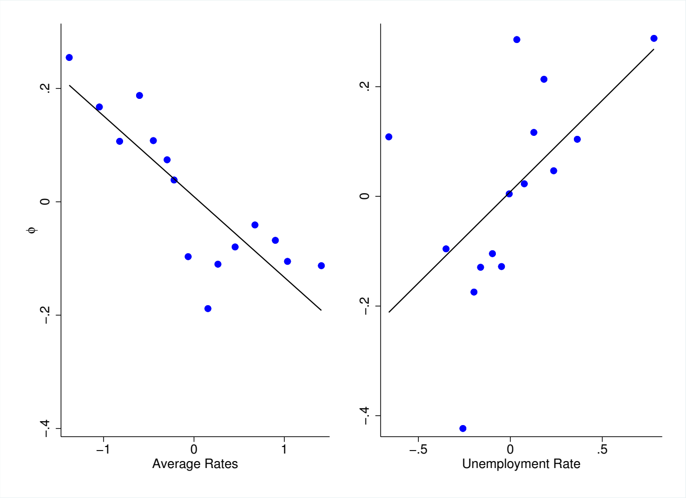

Figure: $Corr(\varphi, \bar{i}) = -0.277^{***}$, $Corr(\varphi, u) = 0.273^{***}$

All data Time series

Potential Explanations

Endogenous attention:

- Diminishing MU(income)
- $Corr(\sigma, \bar{i}) < 0$

Alternatives:

Risk:

- Deposit insurance
- Chavaz and Slutzky (2019): $Corr(risk, i) \approx 0$

Variable market composition:

- Characteristics of households with fixed-rate bonds constant over Great Recession in Wealth and Assets Survey.

WAS detail

Conclusion

Significant dispersion in interest rates means it matters how households choose saving products.

Attention to this choice is countercyclical:

- This amplifies the effect of shocks on consumption.
- Amplification is substantial in estimated quantitative model: increases $Var(C)$ by 17%.
- Policies that reduce cost of information μ (e.g. financial education) could stabilise business cycle, by weakening this amplification.

Quant model detail

Related Literature/Contributions

Empirics:

- Groceries: Coibion, Gorodnichenko, and Hong (2015), Kaplan and Menzio (2015)
- Single period: Martin-Oliver et al (2009), Branzoli (2016)

Model:

- Simple Burdett-Judd models: Kaplan and Menzio (2016), Yankov (2018)
- Steady state with Burdett-Judd: McKay (2013)

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Model: Individuals

Discrete choice RI problem (Matějka & McKay, 2015):

- Start with uninformative prior beliefs.
  - Requires χ_t^n rankings are i.i.d.
- Choose what kind of signals to obtain s.t. HH $\mathcal{I}$ constraint.
- Signal realized, then choose a bank.

Formally, choose $P(n|s_t)$ to max $\mathbb{E}(i_t)$ subject to

$$\mathcal{I}_t = \log N + \mathbb{E}_{s_t} \sum_{n=1}^{N} P(n|s_t) \log(P(n|s_t)) \tag{IC}$$

$$\Rightarrow P(n|s_t) = \frac{\exp(\frac{i_t^n}{\lambda_t})}{\sum_{k=1}^{N} \exp(\frac{i_t^k}{\lambda_t})}$$

Where λ_t is the Lagrange multiplier on information constraint (IC).

Persistent costs | Rank persistence in the data | Back

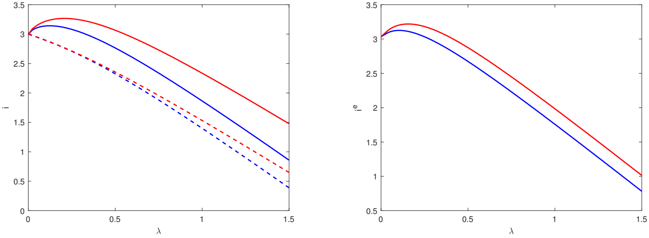
Persistent Bank Costs

Case with $N = 2$ banks. Individuals know bank 1 was low cost yesterday, bank 2 high cost.

If bank 1 low cost again today:

- High Pr choose low cost bank ($\mathcal{P}_1 > 0.5$).
- But banks react to $\mathcal{P}_1$, so that high rate is *lower* than if costs switched.

So i^e changes when costs switch - ambiguous direction. Here effect 2 dominates, so $i^e(\text{no switch}) < i^e(\text{switch})$.



(a) i^1 (blue), i^2 (red), for low (solid) and high (dashed) costs

(b) i^e if bank 1 low (blue) or high (red) cost

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Bank Transition Matrices

If no persistence, $\Pr(\text{quintile } m_t | \text{quintile } n_{t-1}) = 0.2 \forall n, m$

	1	2	3	4	5
1	0.36	0.23	0.15	0.13	0.13
2	0.25	0.31	0.22	0.13	0.09
3	0.15	0.25	0.25	0.21	0.14
4	0.09	0.19	0.21	0.28	0.23
5	0.06	0.15	0.19	0.25	0.36

Table: Cell (n, m) indicates the probability of transitioning from the nth quintile to the mth quintile in the following year.

LR test of this equal to no-persistence matrix: p-value 0.99
More persistence month-to-month: p-value 0.17

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Comparison to Burdett-Judd

Burdett and Judd (1983):

- Large number of firms.
- Households randomly match with one firm a period for free, but can also pay to search for a second match. More effort $\Rightarrow$ greater probability of a second match before choose which firm to buy from.
- Mixed strategy equilibrium $\Rightarrow$ price dispersion from identical firms. High price, few customers as profitable as low price, more customers.
- Key properties: search effort $\uparrow \Rightarrow$ average price $\downarrow$, price dispersion $\downarrow$.

Inattention model: need some firm heterogeneity, but retains key properties of price dispersion from Burdett-Judd.

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Bank Risk

1. If deposit insurance is credible, risk shouldn't matter.
2. Ben-David et al (2017): in normal times, US bank interest rates are uncorrelated with bank risk.
3. Chavaz and Slutzky (2019): banks only change interest rates in response to Δrisk perceptions in variable rate products.
4. Add bank fixed effects: median $\sigma(i^n)$ still 29bp - most variation in interest rates remains even when controlling for persistent bank characteristics, such as risk.
   - Crude exercise, as risk can change over time, and this also takes out persistence in bank interest rates due to $\mathcal{P}_n$.

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Countercyclical φ: all data

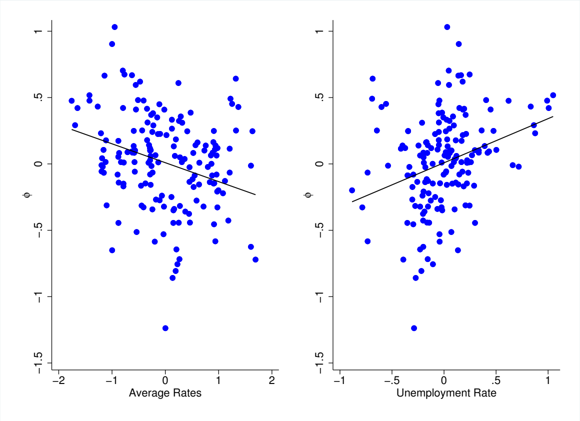

Figure: φ against (unweighted) average interest rates among products considered in the Quoted Household Interest Rate data and unemployment. All series are cyclical components after HP filtering. Black solid lines are from linear regressions, which give $\hat{\varphi} = -0.142\hat{\bar{i}}$ (t-statistic on slope coefficient -3.24) and $\hat{\varphi} = 0.333\hat{u}$ (t-statistic on slope coefficient 4.33).

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Time Series

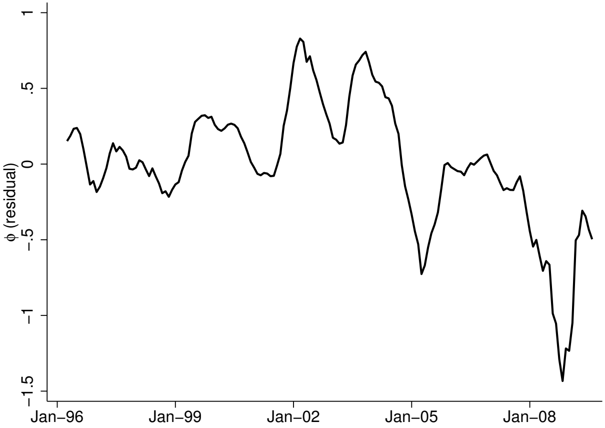

Figure: Time series of the residual of φ after regressing on pos_t^b (the position of the average big four interest rate within the interest rate distribution), 6 month moving averages.

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Market composition through the Great Recession

Table: Regressions on variables related to financial literacy among holders of fixed term savings bonds. Wave 1 (2006) is the baseline. Waves 2 and 3 took place in 2008 and 2010.

	Income decile	Some qualification	Degree qualification	Aged 45-54
Wave 2	-0.0336	0.00734	0.0156	-0.0172
	(-0.34)	(0.59)	(1.01)	(-1.49)
Wave 3	-0.322**	-0.0197	0.00135	-0.0116
	(-3.29)	(-1.54)	(0.09)	(-0.98)
Constant	4.897***	0.833***	0.305***	0.140***
	(78.06)	(102.50)	(30.69)	(18.36)
Observations	6860	6856	6856	6860

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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Quantitative Model

Starting point: medium-scale NK from Harrison and Oomen (2010) "Evaluating and Estimating a DSGE Model for the UK".

- Small open economy version of Smets and Wouters (2007)

Add heterogeneous banks ($N = 2$) and attention problem:

- Info problem applies to the market for domestic government bonds only.
- No info problem for foreign bonds or capital.

Bayesian estimation using standard macro series + 3 series from empirical section: mean and s.d. of interest rates in Moneyfacts, and φ_t.

Complete model details

Estimation

Set number of banks $N = 2$, period=1 quarter

- Assume 'good' bank has $\chi_t^g = \zeta_t^\chi$, 'bad' has $\chi_t^b = \chi_1 + \chi_2(i_t^{CB} - \bar{i}^{CB}) + \zeta_t^\chi + \zeta_t^{\chi^b}$
- Set some parameters at standard values or to long run values in data

Follow Bayesian estimation from Harrison and Oomen (2010), plus estimate μ, χ_2, using:

- standard macro series (domestic and foreign)
- mean and s.d. of interest rates in Moneyfacts
- φ_t

Wide priors on μ, χ_2.

New shocks: attention cost, ζ_t^χ, $\zeta_t^{\chi^b}$, $3\times$ measurement error on new observables.

Calibrated Parameters | Priors | Estimated Parameters

Results: Variable attention amplifies most shocks

Table: Cumulative consumption response to shocks if $\mathcal{I}$ held at steady state, relative to variable attention baseline. Shocks displayed are those that explain $\geq 2\%$ of consumption variance.

Shock	Fixed Attention
Risk premium	0.764
TFP	0.837
Govt spending	0.726
Markup	1.132
Monetary policy	1.124
Bank costs (level)	0.734

Overall, Var(C) is 17% larger with variable attention than without.

- Attention $\uparrow$ analogous to contractionary risk premium shock (& explains $\approx$ 30% of rp-driven fluctuations).
- But attention is **endogenous**, so affected by policy: $\mu \downarrow 50\%$ $\Rightarrow Var(C) \downarrow 12\%$

Risk Premium Shocks

Smets and Wouters (2007): 'risk premium shock' drives a wedge between policy rate and interest rate faced by households.

- Accounts for large share of business cycle volatility. But what is it?
- Fisher (2015): *could be* shocks to utility of holding safe assets.
- This paper: or could be attention fluctuations! And we have data to check.

	Share Var(C)		**Share Var**(Y)	
Shock	**FI**	**RI**	**FI**	**RI**
ε_t^{rp}	0.53	0.35	0.18	0.13
ε_t^{χ}	0	0.03	0	0.02

So what is driving more of C and Y in RI? More fluctuations from TFP, Markup, G.

Estimated Parameters: RI Estimated Parameters: FI Full shock decomposition

Model Description 1

Households:

- Consume (home and imports), monopolistically supply labour, save in domestic bonds, foreign bonds, capital, choose K utilisation.
- s.t. External c habits, K adjustment costs, foreign bond share adjustment costs, nominal wage adjustment costs (with partial indexation)

Home Firms:

- Hire K services and L to monopolistically produce intermediate goods, aggregated by perfectly competitive final goods firm, supply home and export markets.
- Intermediate firms face price adjustment costs with partial indexation, potentially different adjustment costs for home and export market.

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Model Description 2

Monetary & Fiscal Policy:

- MP follows Taylor Rule with persistence. FP finances government spending and debt with lump sum taxes such that debt follows an AR(1) shock process.
- Ricardian Equivalence makes debt policy irrelevant in full info model, not with RI as debt supply affects attention - debt shock isomorphic to μ shock.

Foreign Variables:

- Foreign demand, inflation, interest rates and relative export prices follow a VAR estimated outside model.

Shocks:

- Govt spending, labour disutility, monetary policy, TFP, risk premium, home markup, capital adjustment cost, 4 foreign variables, attention cost, common bank cost, idiosyncratic bank cost.

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Calibrated Parameters

All from Harrison and Oomen (2010):

Parameter	Value	Parameter	Value
α	0.3	ψ^m	0.248
β	0.99	$\sigma^{hb}, \sigma^{mb}, \sigma^{xb}$	9.67
χ^{bf}	0.01	σ^m	1.77
χ^z	0.035	σ^w	8.3
δ	0.025	σ^x	1.5
κ^{hv}	0.935	σ^y	0.5
κ^{xv}	0.748		

Then set χ_1 so steady state $\sigma(i)$ = average $\sigma(i)$ in Moneyfacts.

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Estimated Parameters: priors 1

Observables: GDP, C, I, H, W, Π, i^{CB}, $\mathbb{E}_n i^n$, $\sigma(i^n)$, φ, Π^*, i^{CB*}, Y^*, PXF

Parameter	Description	Prior Distribution
σ^c	Intertemporal elasticity of substitution	$N(0.66, 0.198)$
ψ^{hab}	Consumption habit parameter	$\text{Beta}(0.69, 0.05)$
σ^h	Labour supply elasticity	$N(0.43, 0.108)$
χ^k	Capital adjustment cost constant	$N(201, 60.3)$
ϵ^k	Capital adjustment cost indexation	$\text{Beta}(0.5, 0.25)$
σ^z	Capital utilization cost elasticity	$N(0.56, 0.168)$
χ^{hv}	Domestic goods price adjustment cost	$N(326, 97.8)$
ϵ^{hv}	Domestic goods inflation indexation	$\text{Beta}(0.26, 0.1)$
χ^{xv}	Export goods price adjustment cost	$N(43, 12.5)$
ϵ^{xv}	Export goods inflation indexation	$\text{Beta}(0.14, 0.05)$
ψ^{pm}	Imported goods Calvo parameter	$\text{Beta}(0.40, 0.15)$
ϵ^m	Imported goods inflation indexation	$\text{Beta}(0.17, 0.05)$
ψ^w	Wage Calvo parameter	$\text{Beta}(0.21, 0.05)$
ϵ^w	Wage inflation indexation	$\text{Beta}(0.58, 0.145)$
θ^p	Taylor Rule inflation weight	$N(1.87, 0.131)$

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Estimated Parameters: priors 2

Observables: GDP, C, I, H, W, Π, i^{CB}, $\mathbb{E}_n i^n$, $\sigma(i^n)$, φ, Π^*, i^{CB*}, Y^*, PXF

Parameter	Description	Prior Distribution
θ^y	Taylor Rule output weight	$N(0.11, 0.028)$
θ^{rg}	Taylor Rule persistence	Beta$(0.87, 0.05)$
μ	Marginal cost of information	InvGamma$(0.005, 0.5)$
χ_2	Elasticity of χ_t^b to i_t^{CB}	$N(0, 0.2)$
ρ_{tfp}	Persistence of TFP shock	Beta$(0.89, 0.05)$
σ_{tfp}	s.d. TFP shock	InvGamma$(0.006, 2)$
ρ_g	Persistence of government spending shock	Beta$(0.96, 0.025)$
σ_g	s.d. government spending shock	InvGamma$(0.009, 2)$
ρ_x	Persistence of shock x	$U(0.5, 0.289)$
$\sigma_{\zeta^{\kappa h}}$	s.d. labour disutility shock	InvGamma$(0.01, 2)$
σ_{ζ^c}	s.d. monetary policy shock	InvGamma$(0.025, 2)$
$\sigma_{\zeta^h b}$	s.d. price markup shock	InvGamma$(0.006, 2)$
σ_{ζ^k}	s.d. capital adjustment cost shock	InvGamma$(0.06, 2)$
σ_y	s.d. shock y	InvGamma$(0.001, 2)$
$\sigma_{\nu z}$	s.d. measurement error on z	InvGamma$(0.01, 2)$

$x = \zeta^c, \zeta^{hb}, \zeta^k, \zeta^\mu, \zeta^\chi, \zeta^{\chi^b}$ refers to the shock to the risk premium, price markups, capital adjustment costs, information costs, interest rate level and dispersion. All other shocks are assumed i.i.d.

$y = \zeta^{rg}, \zeta^\mu, \zeta^\chi, \zeta^{\chi^b}$. z contains the mean and standard deviation of bank deposit rates, and φ.

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Estimated Parameters: baseline

Observables: GDP, C, I, H, W, Π, i^{CB}, $\mathbb{E}_n i^n$, $\sigma(i^n)$, φ, Π^*, i^{CB*}, Y^*, PXF

Parameter	Mean	5%	95%	Parameter	Mean	5%	95%
σ^c	0.235	0.174	0.294	$\rho_{\zeta^{hb}}$	0.276	0.048	0.489
ψ^{hab}	0.744	0.679	0.814	ρ_{ζ^k}	0.797	0.601	0.976
σ^h	0.448	0.282	0.601	$\rho_{\zeta\chi}$	0.921	0.862	0.978
χ^k	148.258	46.917	236.721	$\rho_{\zeta\chi^b}$	0.785	0.700	0.877
ϵ^k	0.132	0.001	0.269	μ	0.035	0.025	0.044
σ^z	0.549	0.280	0.829	χ_2	-0.264	-0.476	-0.066
χ^{hv}	415.793	277.100	553.532	σ_g	0.033	0.028	0.038
ϵ^{hv}	0.228	0.088	0.375	$\sigma_{\zeta^{\kappa h}}$	1.743	0.764	2.817
χ^{xv}	34.691	10.374	57.552	$\sigma_{\zeta^{rg}}$	0.001	0.001	0.002
ϵ^{xv}	0.135	0.058	0.206	σ_{tfp}	0.007	0.006	0.008
ψ^{pm}	0.639	0.362	0.882	σ_{ζ^c}	0.009	0.006	0.011
ϵ^m	0.162	0.075	0.238	$\sigma_{\zeta^{hb}}$	0.007	0.005	0.008
ψ^w	0.260	0.193	0.328	σ_{ζ^k}	0.248	0.056	0.503
ϵ^w	0.339	0.185	0.510	σ_{ζ^μ}	0.002	0.000	0.004
θ^p	1.812	1.586	2.021	$\sigma_{\zeta\chi}$	0.003	0.002	0.004
θ^y	0.149	0.109	0.190	$\sigma_{\zeta\chi^b}$	0.003	0.002	0.004
θ^{rg}	0.910	0.890	0.931	$\sigma_{\nu\varphi}$	0.094	0.076	0.109
ρ_{tfp}	0.957	0.934	0.980	$\sigma_{\nu s}$	0.007	0.003	0.013
ρ_g	0.957	0.928	0.984	$\sigma_{\nu m}$	0.002	0.001	0.002
ρ_{ζ^c}	0.908	0.853	0.963				

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Estimated Parameters: full info

Observables: GDP, C, I, H, W, Π, i^{CB}, Π^*, i^{CB*}, Y^*, PXF

Parameter	Mean	5%	95%	Parameter	Mean	5%	95%
σ^c	0.186	0.105	0.268	$\rho_{\zeta^{hb}}$	0.272	0.050	0.487
ψ^{hab}	0.725	0.654	0.793	ρ_{ζ^k}	0.703	0.500	0.921
σ^h	0.440	0.289	0.616	$\rho_{\zeta\chi}$	NA	NA	NA
χ^k	170.175	66.864	268.994	$\rho_{\zeta\chi^b}$	NA	NA	NA
ϵ^k	0.175	0.001	0.370	μ	NA	NA	NA
σ^z	0.511	0.219	0.777	χ_2	NA	NA	NA
χ^{hv}	414.783	272.223	554.419	σ_g	0.033	0.028	0.038
ϵ^{hv}	0.217	0.065	0.360	$\sigma_{\zeta^{\kappa h}}$	2.127	0.746	3.430
χ^{xv}	33.942	3.837	56.226	$\sigma_{\zeta^{rg}}$	0.001	0.001	0.002
ϵ^{xv}	0.140	0.056	0.221	σ_{tfp}	0.007	0.006	0.008
ψ^{pm}	0.656	0.422	0.901	σ_{ζ^c}	0.013	0.007	0.018
ϵ^m	0.165	0.083	0.240	$\sigma_{\zeta^{hb}}$	0.007	0.005	0.008
ψ^w	0.241	0.163	0.307	σ_{ζ^k}	0.193	0.073	0.300
ϵ^w	0.321	0.178	0.471	σ_{ζ^μ}	NA	NA	NA
θ^p	1.851	1.656	2.077	$\sigma_{\zeta\chi}$	NA	NA	NA
θ^y	0.148	0.107	0.188	$\sigma_{\zeta\chi^b}$	NA	NA	NA
θ^{rg}	0.913	0.892	0.934	$\sigma_{\nu\varphi}$	NA	NA	NA
ρ_{tfp}	0.962	0.938	0.986	$\sigma_{\nu s}$	NA	NA	NA
ρ_g	0.951	0.914	0.988	$\sigma_{\nu m}$	NA	NA	NA
ρ_{ζ^c}	0.889	0.834	0.951				

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Shock Decomposition

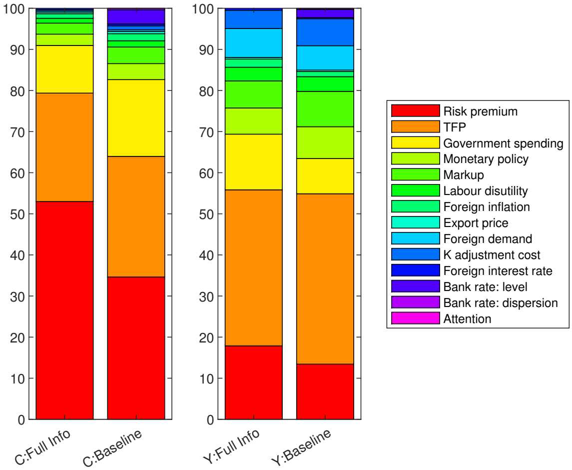

Figure: Variance decomposition of consumption and output in the full information and variable attention models.

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