A Progress Report on Long-Run Risk, Labor Market Dynamics and Asset Prices

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Research Question

What role do search and matching frictions play for asset price dynamics?

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What role do search and matching frictions play for asset price dynamics?

- Introduce stochastic growth (Bansal and Yaron (2004); Croce (2014)) in a general equilibrium search and matching framework with frictional capital markets
- Explain wide range of asset market facts
- Long-run neutrality of employment to growth?

Road Map

1. Motivation
2. Model
3. Results
4. Discussion and potential way out
5. Conclusion

Motivation

Mutual discipline

Asset pricing theory:

- Endowment economy setup with exogenous streams of consumption and dividends (Bansal and Yaron (2004))

Macro:

- Economic choices endogenous
- DSGE models widely used in central banks and policy
- Information contained in asset prices + implications for preferences?

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Joint production-based models encounter difficulties:

- Rouwenhorst (1995); Jermann (1998); Boldrin et al. (2001)
- Tallarini (2000); Kaltenbrunner and Lochstoer (2010); Croce (2014)

Agents insulate risk via production sector

Motivation

Aggregate labor risks affect the economy in its entirety

- Golden Oldies: Search & Matching
  - Mortensen and Pissarides (1994)
  - Merz (1995); Andolfatto (1996)

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  - Zhang et al. (2013)
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- Unemployment vs. leisure:
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- Unemployment vs. leisure:
  - Search and Matching disentangle dual role of leisure
- Role of capital
  - Merz and Yashiv (2007)

Motivation

Fully endogenous dividends

- Matches data $Corr(D_t, GDP) = 0.55$
- True GE setup requires endogenous dividends
  - Kaltenbrunner and Lochstoer (2010): Countercyclical payout

$$D_t = Y_t - \underbrace{W_t}_{=MPL} N_t - \underbrace{I_t}_{procyclical}$$

  - Low riskiness of dividend claim
  - Dividends negative

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- Labor market frictions (operating leverage)

$$\underbrace{D_t = Y_t - \underbrace{W_t}_{inelastic} N_t - \kappa V_t - I_t}_{procyclical}$$

  - Look at d-p-ratio, correlations of dividends etc.

Motivation

Stochastic Productivity Growth

- Long-run risk models abstract from frictional labor markets

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- Effect of long-run risk on labor

Motivation

Stochastic Productivity Growth

- Long-run risk models abstract from frictional labor markets
- Effect of long-run risk on labor
- Weak understanding of long-run growth and employment
  - Creative destruction: Aghion and Howitt (1994)
  - Capitalization: Mortensen and Pissarides (1998)
  - Labor supply and returns to experience: Elsby and Shapiro (2012)

Motivation

Labor market tightness forecasts excess returns

	Forecast Horizon in Quarters H					
	1	2	4	6	8	16
Slope β^θ	-2.54	-4.78	-7.61	-8.81	-8.86	-12.06
t-stat	-3.20	-3.15	-2.66	-2.10	-1.57	-1.10
$\bar{R}^2$	0.03	0.05	0.06	0.05	0.04	0.04

Table: Forecasts of Excess Returns

OLS regressions of log excess returns from CRSP, and labor market tightness, $\theta_t \equiv V_t/U_t$. Sample period: 1951Q1 – 2013Q2. *Not displayed: regression constant.*

Key Results

Endogenous risk

- Matching macro-financial facts:
  - Countercyclical equity premium

	Data	Model
$E[r_t - r_{f,t}]$	5.6%	4.5%
$\sigma[\Delta c]$	1.72%	1.58%
$SR(r_t)^Q$	0.169	0.149
$\sigma[r_{f,t}]$	0.3%	0.2%

- Long-run neutrality of employment to growth?

Model

Four main ingredients

- Long-run risk
- Recursive preferences
- Search and matching in the labor market
- Capital adjustment costs

Model

Dynamics

Capital dynamics ▸ Jermann (1998) setup

$$K_{t+1} = (1 - \zeta^k)K_t + \phi\left(\frac{I_t}{K_t}\right)K_t.$$

Model

Dynamics

Capital dynamics ▸ Jermann (1998) setup

$$K_{t+1} = (1 - \zeta^k)K_t + \phi\left(\frac{I_t}{K_t}\right)K_t.$$

Employment dynamics:

$$N_{t+1} = (1 - \zeta^s)N_t + M(V_t, U_t).$$

Model

Search and matching frictions

Matching process (den Haan et al. (2000))

$$M(U_t, V_t) = \frac{U_t V_t}{(U_t^\varsigma + V_t^\varsigma)^{1/\varsigma}}$$

Model

Search and matching frictions

Matching process (den Haan et al. (2000))

$$M(U_t, V_t) = \frac{U_t V_t}{(U_t^\varsigma + V_t^\varsigma)^{1/\varsigma}}$$

Prob. of filling a vacancy:

$$q(\theta_t) \equiv \frac{M(U_t, V_t)}{V_t} = \frac{1}{(1 + \theta_t^\varsigma)^{1/\varsigma}}$$

where $\theta_t \equiv V_t / U_t$ and $q'(\theta_t) < 0$

Model

Production by a representative firm

Managers maximize value of all current and future cash flows

$$J_t = \max_{\{I_{t+k}, V_{t+k}\}} \mathbb{E}\left[\sum_{k=0}^{\infty} \mathcal{M}_{t,t+k}\, D_{t+k} \,|\mathcal{F}_t\right]$$

where D_t are total dividends:

$$D_t = F(K_t, A_t N_t) - W_t N_t - \kappa \frac{\partial F}{\partial N_t} V_t - I_t$$

Model

Large Family - Preferences

- Family structure as in Merz (1995); Andolfatto (1996)
- Recursive Epstein and Zin (1989) preferences

$$\mathscr{V}_t(\cdot) = \left\{ (1 - e^{-\delta}) C_t^{1-\frac{1}{\psi}} + e^{-\delta} \mathcal{R}_t \left(\mathscr{V}_{t+1} \right)^{1-\frac{1}{\psi}} \right\}^{\frac{1}{1-\frac{1}{\psi}}},$$

where $\mathcal{R}_t = \mathbb{E}\left[\mathscr{V}_{t+1}^{1-\gamma} | \mathcal{F}_t \right]^{\frac{1}{1-\gamma}}$

Model

Asset Pricing

- Pricing Kernel:

$$\mathcal{M}_{t,t+1} \equiv e^{-\delta} \left(\frac{C_{t+1}}{C_t} \right)^{-1/\psi} \left(\frac{\mathcal{V}_{t+1}}{\mathbb{E}\left[\mathcal{V}_{t+1}^{1-\gamma} | \mathcal{F}_t \right]^{1/1-\gamma}} \right)^{\frac{1}{\psi}-\gamma}$$

- Lucas asset pricing:

$$1 = \mathbb{E}\left[\mathcal{M}_{t,t+1} R_{t,t+1} | \mathcal{F}_t \right]$$

- Risk-free rate:

$$R_t^F = 1/\mathbb{E}\left[\mathcal{M}_{t,t+1} | \mathcal{F}_t \right].$$

Model

Endogenous Wage Setting

Nash bargaining in a growing economy

$$W_t = \eta \left(\frac{\partial F}{\partial N_t} + \kappa \frac{\partial F}{\partial N_t} \theta_t \right) + (1 - \eta) \left[b \frac{\partial F}{\partial N_t} \right]$$

Model

Long-Run Risks

Productivity growth as in Croce (2014)

$$\begin{aligned}\Delta a_{t+1} &= \mu + x_t + \sigma_a \epsilon_{a,t+1} \\ x_t &= \rho_x x_{t-1} + \sigma_x \epsilon_{x,t} \\ \epsilon_{x,t}, \epsilon_{a,t+1} &\sim N\, i.i.d.(0,1)\end{aligned}$$

Small but persistent component (long-run productivity risk)

Calibration

Preliminary

- Standard in long-run risk literature:
  - Moderate risk aversion and intertemporal substitution > 1.
  - Productivity growth as in Croce (2014)
- Standard in labor market literature
  - Moderate $b = 0.7$ and $\eta = 0.5$
  - Others as in den Haan et al. (2000)
  - Investment adjustment costs mid-range $\xi_k = 8.5$

▸ Full calibration

Global Solution Methods

Challenges

1. Asset-pricing focus (approximation):

$$\mathbb{E}\left[\left(\frac{C_{t+1}}{C_t}\right)^{-1/\psi}\left(\frac{\mathcal{V}_{t+1}}{\mathbb{E}\left[\mathcal{V}_{t+1}^{1-\gamma}|\mathcal{F}_t\right]^{1/1-\gamma}}\right)^{\frac{1}{\psi}-\gamma}\right]$$

2. Decentralized search economy $\neq$ social planner solution
3. Large effects of small shocks + high persistence
4. High-order solution: study risk premia

Global Solution Methods

Projection Algorithm

- Policy: Chebyshev polynomial basis functions
- Global non-linear Galerkin projection algorithm
- Expectations: Gauss-Hermite quadrature + Markov-chain Tauchen (1986)
- Simulate data and take means across samples.

Results

Asset Market

Search economy is risky: Match array of finance facts

	Data	Model
$E[r_t - r_{f,t}]$	5.6%	4.5%
$E[r_{f,t}]$	0.3%	0.4%
$\sigma[r_{f,t}]$	0.3%	0.2%
$SR(r_t)^Q$	0.169	0.149
$ACF_1[d_t]$	0.016	0.005
$\sigma[d_t]$	0.074	0.021
$ACF_1[d_t - pt]$	0.963	0.942
$\sigma[d_t - pt]$	0.420	0.126
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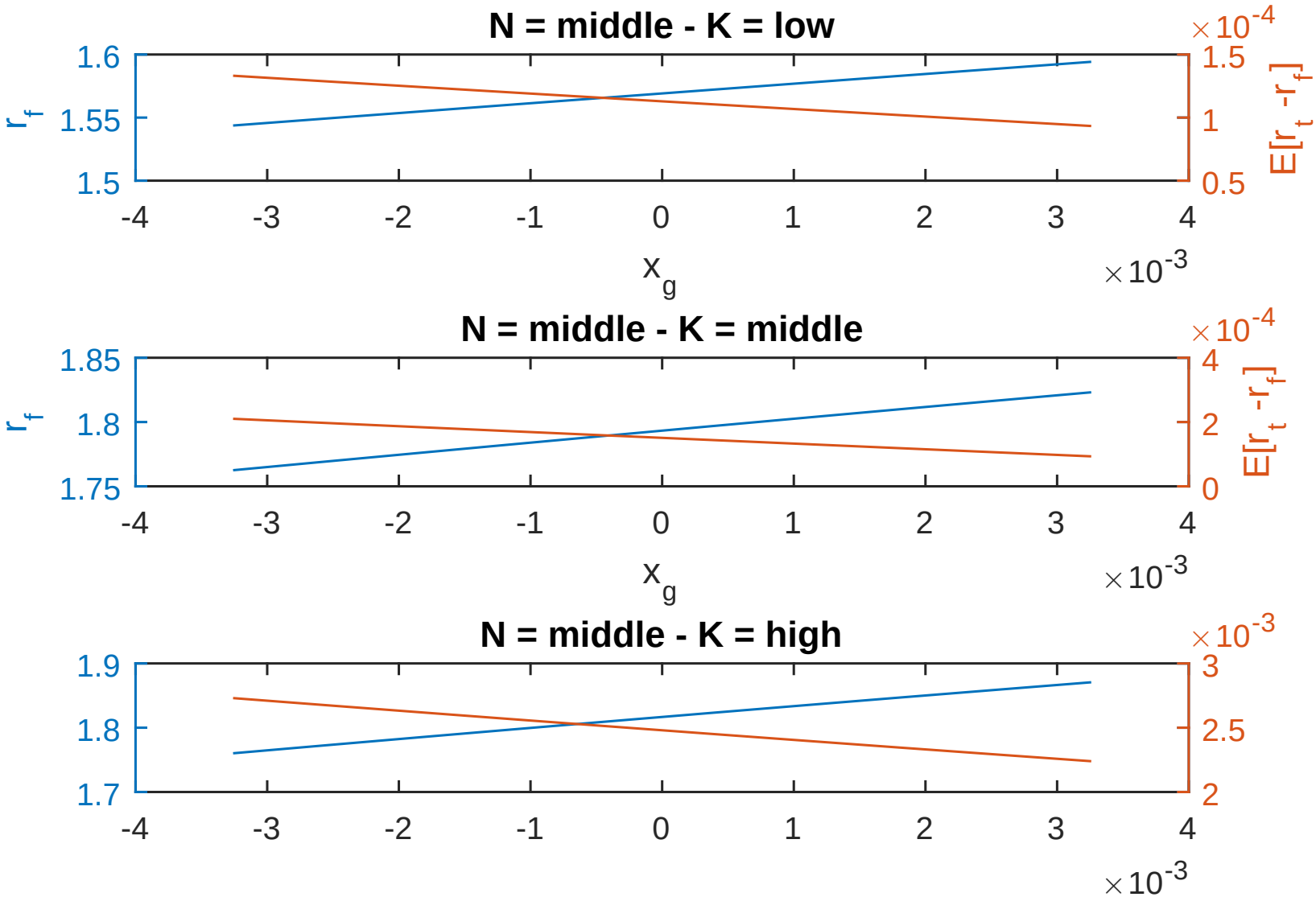
Asset Market

Novel in production-based asset pricing with LRR:

- Get the signs right:
  - Correlation of equity premium with output growth (-), labor market tightness (-) and dividend-price ratio (+)
- Introduce economic profit through search and matching (bargaining)

Results

Countercyclical Equity Premium



Results

Long-Run Risk and the Macroeconomy

Success in a production-economy

	Data	Model
$\sigma[\Delta c]$	1.72%	1.58%
$ACF_1[\Delta c]$	45.4%	53.3%
$\sigma[\Delta y]$	2.04%	2.66%
$\rho[\Delta c, \Delta y]$	0.892	0.723

Sign of labor market tightness

	Data	Model
$\rho[\theta, EP]$	-0.223	-0.787

Results

Long-run neutrality of employment to growth

Business Cycle Study

$$W_t = \eta \left(\frac{\partial F}{\partial N_t} + \kappa \theta_t \right) + (1 - \eta) b$$

Growing Economy

$$W_t = \eta \left(\frac{\partial F}{\partial N_t} + \kappa \frac{\partial F}{\partial N_t} \theta_t \right) + (1 - \eta) \left[b \frac{\partial F}{\partial N_t} \right]$$

Same force applies to employment and unemployment margin!

Results

Frictions matter I

Positive reaction of vacancies and investment

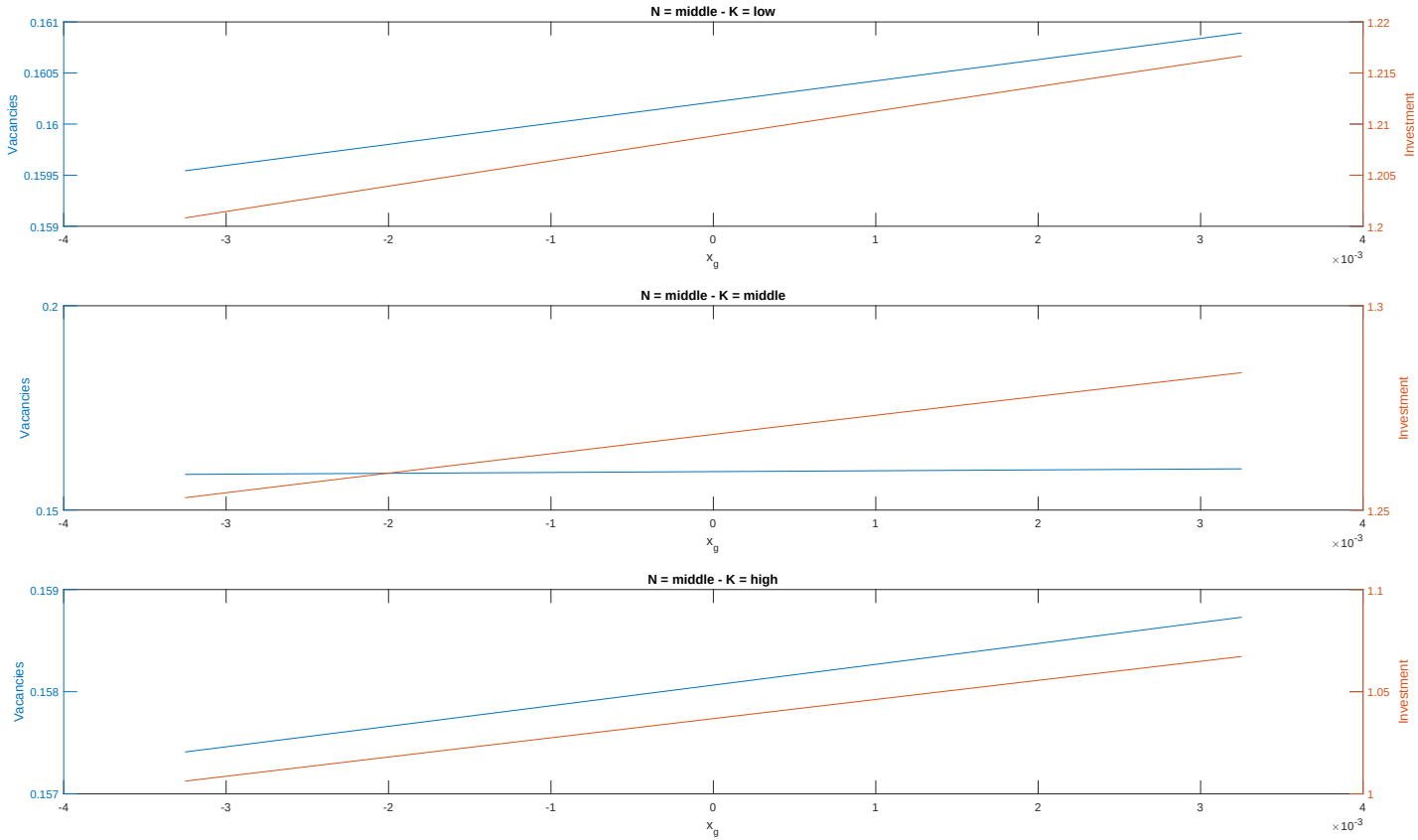


Figure: Vacancies and Investment: Productivity Space

Results

Frictions matter II

Positive reaction of vacancies and investment

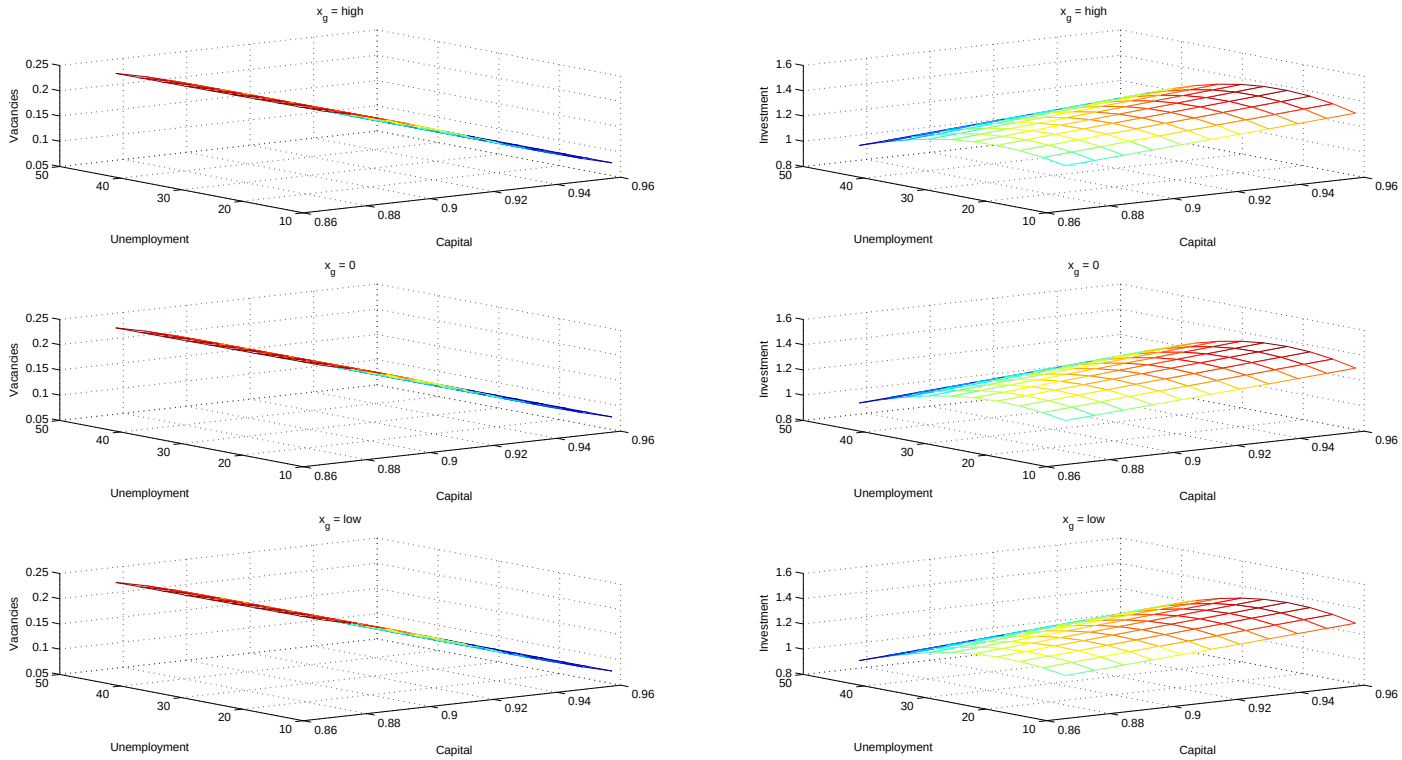


Figure: Vacancies and Investment: Productivity Space

Results

Frictions matter III

- Frictions needed to contain risk: Volatility through exogenous state variables in pricing kernel
- W.o. capital adjustment costs: Controls used as a hedge $\rightarrow$ through choices endogenous state variables
- Search and matching eliminates leisure (smoothing)

A potential solution

How to overcome?

- Long-run neutrality: (Blanchard, 2007, p.416) "*serious hole in our knowledge*", Mortensen and Pissarides (1998); Elsby and Shapiro (2012)
- Keep previous model & growth focus but use permanent shocks as in Kaltenbrunner and Lochstoer (2010)
- Ad-hoc solution by Favilukis and Lin (2013): Employment as a function of growth shocks

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- Keep previous model & growth focus but use permanent shocks as in Kaltenbrunner and Lochstoer (2010)
- Ad-hoc solution by Favilukis and Lin (2013): Employment as a function of growth shocks
- We want: Endogenous choices and (partially) keep mechanism from business cycle studies

A potential solution

Reservation wages

- Koenig et al. (2014) empirical evidence backward reference points in reservation wages
- Only data: BHPS and GSOEP with elicited reservation wage information (monthly)
- Present a search and matching that curbs the cyclicality of reservation wages
- *"Some degree of persistence in reservation wages - possibly driven by reference points - is needed"* [to match the data]
- See also reference-dependent search behavior (Della Vigna et al. 2014)

A potential solution

Model alternatives

- Study permanent shocks and assume sticky reservation wages

$$W_t = \eta \left(\frac{\partial F}{\partial N_t} + \kappa \frac{\partial F}{\partial N_t} \theta_t \right) + (1 - \eta) \left[B_t^* \right]$$

where

$$B_t^* = \rho^B B_{t-1}^* + (1 - \rho^B) b \frac{\partial F}{\partial N_t}$$

- Viable in a growing economy

A potential solution

First (very preliminary) results

	Data	Search and Matching	Fixed Labor
$\sigma[d_t]$	0.074	0.092	0.562
$ACF_1[d_t - pt]$	0.963	0.612	n/a
$E[r_{f,t}]$	0.3%	0.3%	0.1%
$\sigma[r_{f,t}]$	0.3%	0.2%	0.1%
$SR(r_t)^Q$	0.169	0.149	0.179
$\sigma[\mathcal{M}]/E[\mathcal{M}]$	n/a	0.153	0.185
$\sigma[\Delta c]$	1.72%	1.42%	2.68%
$\rho(\theta, EP)$	-0.22	-0.18	n/a

without (!) high-powered shocks to the highly persistent growth rate

Conclusion

Summary

Previous literature: Difficulty in replicating asset market facts in GE production economies

Conclusion

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Previous literature: Difficulty in replicating asset market facts in GE production economies

Long-run risk model with search and matching frictions and capital adjustment costs

- Match aggregate facts
  - Sizable and countercyclical equity premium; Sharpe-ratio
  - Endogenously match volatility of dividends and consumption
- Long-run neutrality of employment?
  - Shocks to the expected growth rate move macro variables only little

Conclusion

Take-away

- Frictions in capital and labor markets matter for asset prices & macro
- GE setup provides discipline for LRR models
- Can sticky reservation wages "activate" the labor market?

Future Work

Promising: Time-varying uncertainty

- Precautionary savings motive
- Time-varying bargaining?

Intensive vs. extensive labor margin

- Preference role vs. production input

Capital Market Frictions

Jermann (1998) - Adjustment Costs

The law of motion for capital is

$$K_{t+1} = (1 - \zeta^k)K_t + \phi\left(\frac{I_t}{K_t}\right)K_t. \tag{1}$$

where ζ^k is the capital depreciation rate and adjusting capital is costly

$$\phi\left(\frac{I_t}{K_t}\right) = a_0 + \frac{a_1}{1 - \frac{1}{\xi_k}}\left(\frac{I_t}{K_t}\right)^{1-\frac{1}{\xi_k}}. \tag{2}$$

▸ Back

Results

Frictions matter I

Positive reaction of vacancies and investment

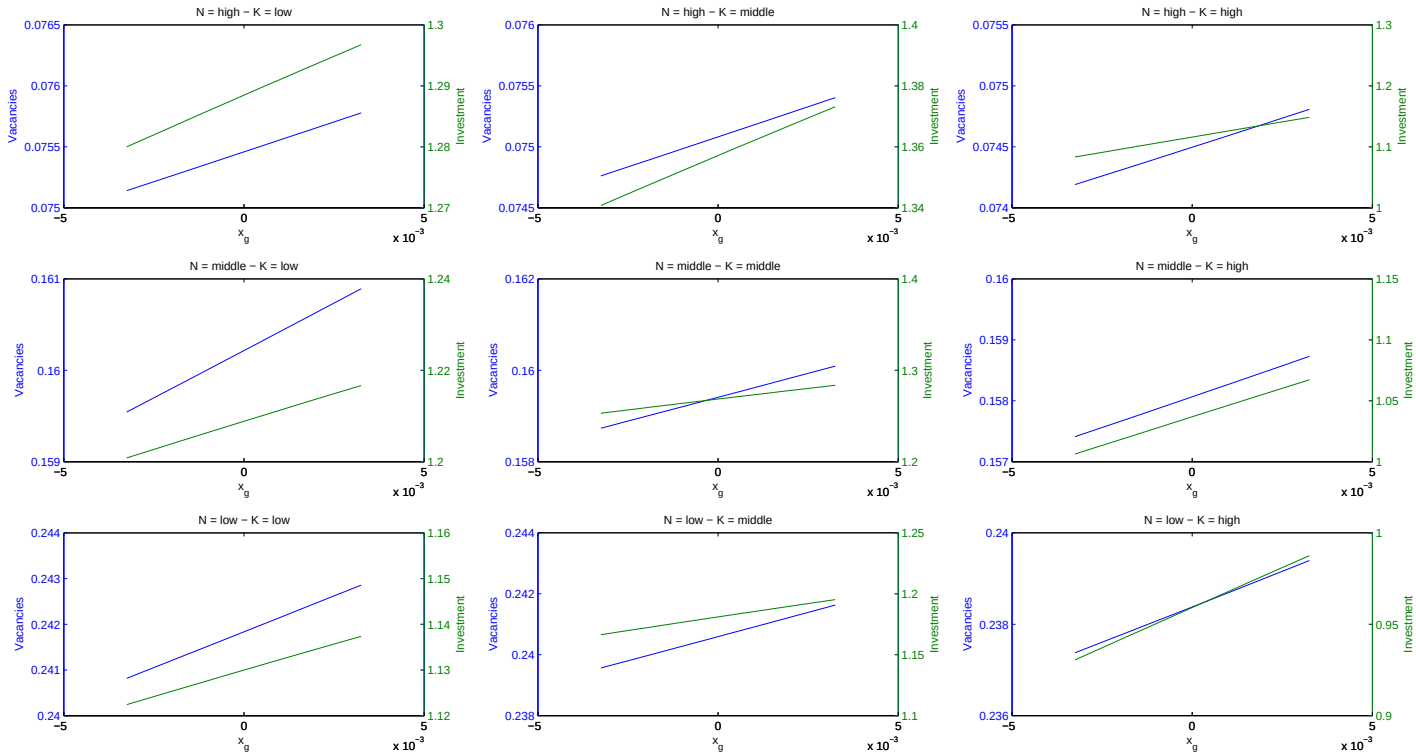

Figure: Vacancies and Investment: Productivity Space

Model

Large Family - Preferences & Asset Pricing

Recursive Epstein and Zin (1989) preferences

$$\mathscr{V}_t(\cdot) = \left\{ (1 - e^{-\delta}) C_t^{1-\frac{1}{\psi}} + e^{-\delta} \mathcal{R}_t \left(\mathscr{V}_{t+1} \right)^{1-\frac{1}{\psi}} \right\}^{\frac{1}{1-\frac{1}{\psi}}},$$

where $\mathcal{R}_t = \mathbb{E}\left[\mathscr{V}_{t+1}^{1-\gamma} | \mathcal{F}_t \right]^{\frac{1}{1-\gamma}}$ Back

Calibration

Very preliminary

Relative risk aversion coefficient, γ	10	Bansal and Yaron (2004)
Time discounting, δ	$\log(0.96^{1/4})$	
Elasticity of intertemporal substitution, ϕ	2	Bansal et al. (2007)
Growth Rate Parameter, μ	0.016	Croce (2014)
Growth volatility, σ_x	0.01	Croce (2014)
Long-run component, σ	$0.1 \cdot \sigma_x$	
Persistence, ρ_x	$0.8 \cdot \sigma_x$	

Table: Preferences and Technology

Calibration

Very preliminary

Worker's surplus share, η	0.5	Trigari (2009)
Worker's outside option, b	0.7	
Vacancy Posting Costs, κ	0.1	
Separation Rate, ζ^s	0.068	den Haan et al. (2000)
Matching elasticity, ς	1.27	den Haan et al. (2000)
Capital depreciation, ζ^k	0.016	
Capital share, α	0.36	

Table: Labor and Capital Markets

Back

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