The Demographics of Innovation and Asset Returns

Nicolae Garleanu¹  Leonid Kogan²  Stavros Panageas³

¹UC Berkeley, NBER and CEPR
²MIT and NBER
³LBS, Chicago Booth and NBER

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Contribution

- New description of aggregate fundamental risk
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- Systematic risk factor created by innovation: displacement risk
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- Empirical evidence for displacement risk
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- Systematic risk factor created by innovation: *displacement risk*
- Empirical evidence for displacement risk
- Value-growth factor and the value premium, equity premium
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- Systematic risk factor created by innovation: displacement risk
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- Value-growth factor and the value premium, equity premium
- Long-horizon asset allocation and risk faced by retail investors
Motivation

- Innovation generates systematic risks
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- Existing firms may lose market share to competition

Risk to financial capital
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- Displacement Risk
Motivation

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- Risk sharing is not perfect: no trading with future generations
- Older cohorts of agents cannot hedge displacement risk
- Displacement risk is a priced risk factor
Key Implications

- Standard Consumption-CAPM is misspecified: omits displacement risk
Consumption Risk

SDF = marginal rate of substitution for the same agent
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Future per-capita aggregate consumption is not the same as the future per-capita consumption of the current population of agents.

\[ \text{log consumption} \]

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$$\frac{\xi_{t+1}}{\xi_t} = \beta \left( \frac{Y_{t+1}}{Y_t} \right)^{-\gamma} \times \frac{1}{1 - \lambda} \left( 1 - \lambda \frac{C_{t+1,t+1}}{Y_{t+1}} \right)^{-\gamma}$$

Standard Term  Displacement correction
Key Implications

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- Value premium due to hedging demand for growth stocks
Hedging Demand and the Value Premium

Some firms more innovative than others, higher valuation ratios: growth firms
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- Growth and value firms have unequal exposure to innovation shocks ⇒ growth-value factor
- Growth-value factor tracks displacement shocks ⇒ priced risk factor
- Growth firms provide a valuable hedge against displacement risk ⇒ positive value premium
Key Implications

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- Value premium due to hedging demand for growth stocks
- Long-horizon investing: indexing ≠ keeping up
Long-Horizon Investing

- An average investor cannot beat the market
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- Popular advice: index, stay average
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Long-Horizon Investing

- An average investor cannot beat the market
- Popular advice: index, stay average
- Holding the market does not protect against displacement risk
- A typical investor will fall behind the “market” on average!
- A growth tilt in the portfolio could help mitigate displacement risk, but it is costly
Outline

1. Introduction
2. The Model
3. Empirical Results
4. Conclusion
Agents

- Arrive and die randomly each period
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- Supply labor to firms, trade in financial markets
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- Supply labor to firms, trade in financial markets
- Behave rationally and competitively
Technology

- Representative competitive firm produces the final consumption good using labor and intermediate goods
Technology

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- Many intermediate goods produced by monopolistically competitive firms
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- Innovation = Increased variety of intermediate goods
Representative competitive firm produces the final consumption good using labor and intermediate goods.

Many intermediate goods produced by monopolistically competitive firms.

Innovation = Increased variety of intermediate goods.

Innovation $\Rightarrow$ Higher output and more competition between intermediate-good producers.
Innovation

Inventions, firms, and inventors

- Inventions are patents for production of new intermediate goods
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Inventions, firms, and inventors

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- Intellectual property of inventions belongs to inventors (new firms) and old firms
- New firms can be of “value” and “growth” type
  - **Value** firms **produce** and do not invent, responsible for a fraction of production of new goods
  - **Growth** firms produce and **invent**, responsible for the rest of production and a fraction of invention
- Old generations capture a fraction of inventions through ownership of growth firms
A fraction of new generation are workers
Innovation

Workers

- A fraction of new generation are workers
- Workers are born with endowment of hours
Innovation

Workers

- A fraction of new generation are workers
- Workers are born with endowment of hours
- Assumption: older workers do not keep up with innovative technologies as well as the younger workers
Asset Markets

- Complete set of state-contingent claims
Asset Markets

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- Assets are priced by the standard DCF formula
Equilibrium

- Consumers (workers and inventors) chose their consumption optimally subject to their budget constraints
## Equilibrium

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- Firms maximize their profits.
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- Markets for labor and goods clear.
Summary

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  - Value (production, no innovation)
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- Innovation = Increased variety of intermediate goods
- Agents
  - Inventors (own patents/firms)
  - Workers (sell labor)
- Firms
  - Value (production, no innovation)
  - Growth (some innovation)
The Displacement Factor

- Theory: can estimate the displacement factor as a change in relative consumption of a group of households:

\[ \log \left( \frac{C_{t+1,s}^i}{C_{t+1}} \right) - \log \left( \frac{C_{t,s}^i}{C_t} \right) \]
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Use household-level consumption data (CEX, 1984-2003)
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$$\log \left( \frac{C_{t+1,s}^i}{C_{t+1}} \right) - \log \left( \frac{C_t^i}{C_t} \right)$$

Use household-level consumption data (CEX, 1984-2003)

Group all cohorts of households that entered the economy before date $s$
The Displacement Factor

![Graph showing the displacement factor over different cohorts and years](image-url)

Cohorts pre-1975  
Cohorts pre-1980  
Cohorts pre-1970  
Cohorts pre-1965

Garleanu, Kogan, Panageas (2009)
Introduction

The Model

Empirical Results

Conclusion

Garleanu, Kogan, Panageas (2009)
Consumption Cohort Effects

- Time-series dimension of CEX is limited
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- Use theory to exploit the cross-section of consumption
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\[ \log c_{t,s} = a_s + b_t \]

- \( t \) - calendar time
- \( s \) - cohort
Consumption Cohort Effects

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- \( t \) - calendar time
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- Displacement shocks are the permanent component of consumption cohort effects \( a_s \)
Consumption Cohorts

- Detrended cohorts (left axis)
- Detrended cumulative HML return (right axis)

Garleanu, Kogan, Panageas (2009)
Value Premium


Garleanu, Kogan, Panageas (2009)
Innovation Betas and Book-to-Market

Long-short B/M portfolios: Decile $i$ — Decile 10: 1927-1995

Garleanu, Kogan, Panageas (2009)
Alternative Measures of Innovation

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- Can one identify other, more direct proxies for innovation?
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- Can one identify other, more direct proxies for innovation?
- Motivated by the model: changes in the stock of trademarks
- Relate average returns on the book-to-market decile portfolios to innovation betas
Innovation Betas and Book-to-Market

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- Calibration (not shown) is quantitatively realistic
Displacement risk is a fundamental risk factor
Empirical evidence for displacement risk
Calibration (not shown) is quantitatively realistic
Better understanding of the value-growth factor, value premium, equity premium