Population Aging and the Macroeconomy

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Some research questions to discuss today...

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3. Does **relative** age affect the trade relationship between two countries?

Other questions I've been interested in...

1. Does population aging alter the transmission of fiscal and monetary policy?
   - Fiscal policy: Basso and Rachedi (2021), Monetary Policy: Eichenbaum et al. (2022), Money Growth: Kopecky (2023b), Austerity: Kopecky (2022),
2. How does population aging affect inflation?
   - Juselius and Takáts (2021), Mangiante (2022)

How does population age structure affect macroeconomic aggregates?

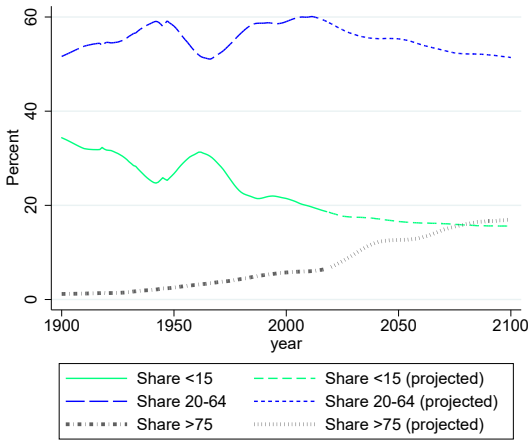
The secular stagnation hypothesis: right idea, wrong time?

In his 1938 address to the American Economic Association, Hansen (1939) predicted that population growth would lead to declines in investment and, as a result, output growth.

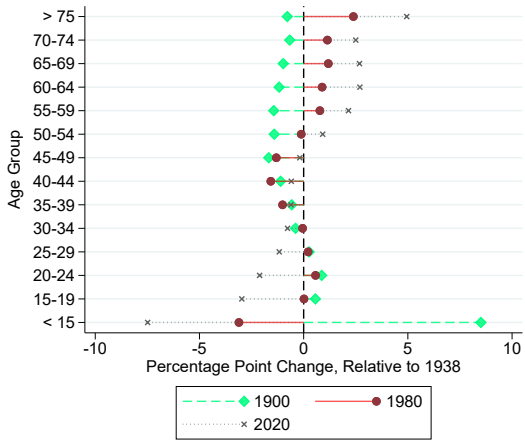
- This proved spectacularly incorrect... though a large part of what he missed was the *baby boom* from the late 1940s to early 1960s.
- Summers (2014a) and Summers (2014b) revitalized this idea. With many studying declines in safe rates (which we'll look at later).
- Looking back it's interesting to ask if Hansen (1939) had the right idea about the empirical relationship?

US demographics: past, present, and future

(a) Trends in Young, Old, and Working Populations



(b) Changes in Age Structure Relative to 1938



Data & Methodology

To investigate the relationship between age and asset prices we need three datasets:

1. Jordà et al. (2017) Macrohistory Database:
   - Macroeconomic data for 17 advanced economics from 1870. **Average panel length in my regressions is 102 years.**
   - Also (which I will show in a moment), information on: returns for T-Bills, long term government bonds, and equity:
     1.1 Safe Returns: Bills and Bonds
     1.2 Risky Returns: Equity and Housing
   - Other macroeconomic controls.
2. Human Mortality Database (2019)
   - Historic demographic data for a large number of countries.
   - In particular we use this to construct population age shares over time.
3. UN Population Projections

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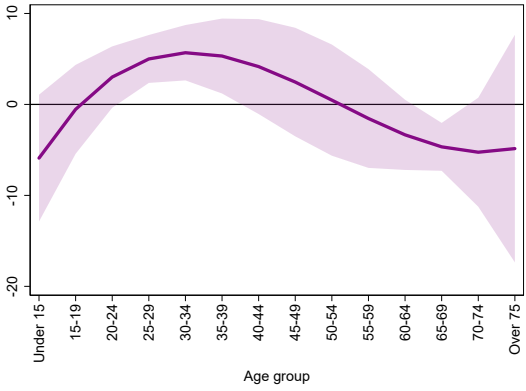
These are used in to conduct straightforward panel regression analysis of the form:

$$g_{i,t} = \theta D_{i,t} + \beta r_{i,t} + \omega D_{i,t} \times r_{i,t} + \phi g^{pop}_{i,t} + \rho X_{i,t} + \mu_i + \mu_t + \nu + \epsilon_{i,t} \quad (1)$$

...but let's not get technical.

Results from Long Run Panel Regression: Age Specific Effects

(a) Investment Growth



(b) Investment-to-GDP Growth

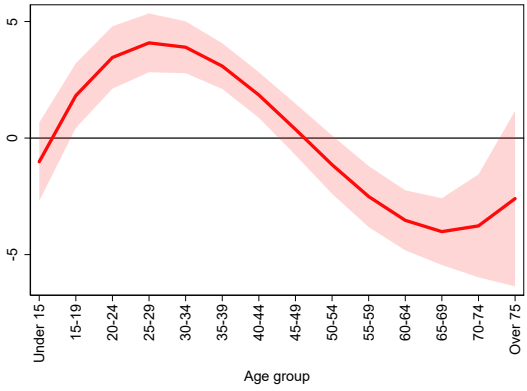


Figure: Implied Coefficients on Five-year Population Share Growth Rates: Investment

These are the marginal effects of increasing the share of a particular age group.

How Big Could the Effect Be?

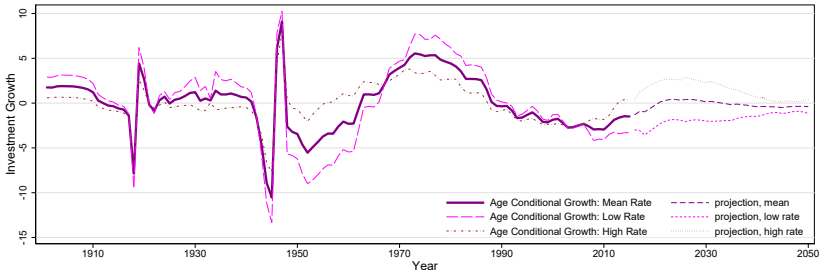
These pictures help us understand which ages seem to matter for asset returns. But it would be nice to have a sense of the potential magnitude. I conduct the following exercise (and will again throughout this talk)

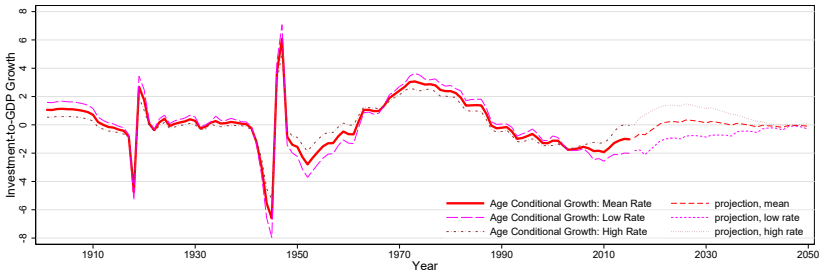
1. Take the point estimates from the age specific distributions above seriously.[1]
2. Use historical and projected movements in population age share to estimate the net demographic effect in a give year.
3. As I do in the paper I'll also present these movements under high and low interest rate environments.[2]

[1] So take these with a grain of salt, though we can (and in some papers I do) put error bars on them and they are usually at least statistically meaningful. Causal inference in this context is quite another story.

[2] This is tricky to interpret given that the interest rate is of course endogenous to investment supply/demand, but shows that even meaningful endogenous shifts are unlikely to wipe out the demographic effect fully.

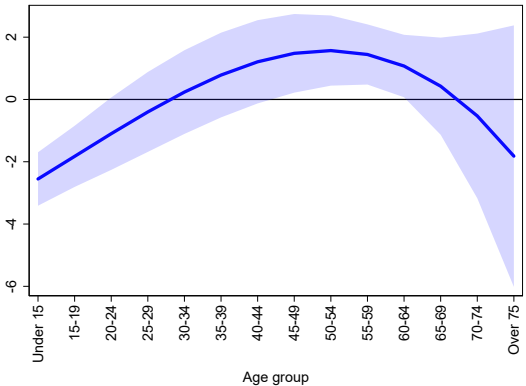
Predicted demographic effects: USA Investment





Estimating population age impacts: Results from Long Run Panel Regression

(a) Consumption Growth



(b) GDP Growth

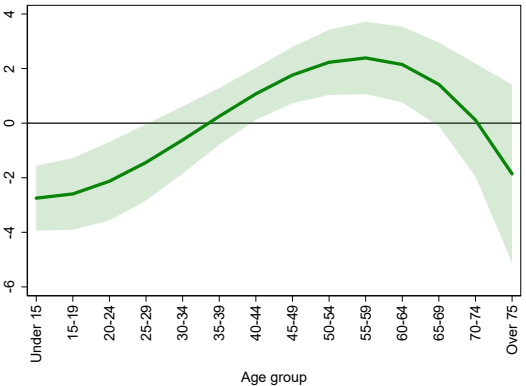
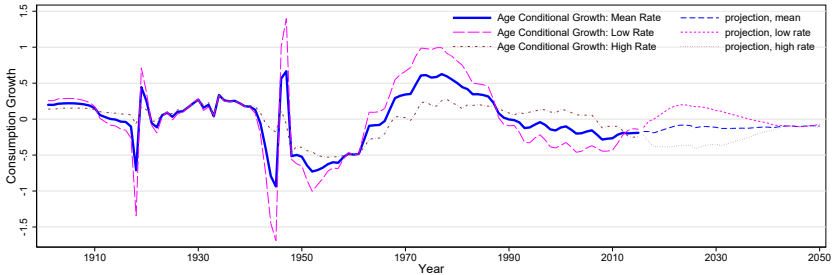
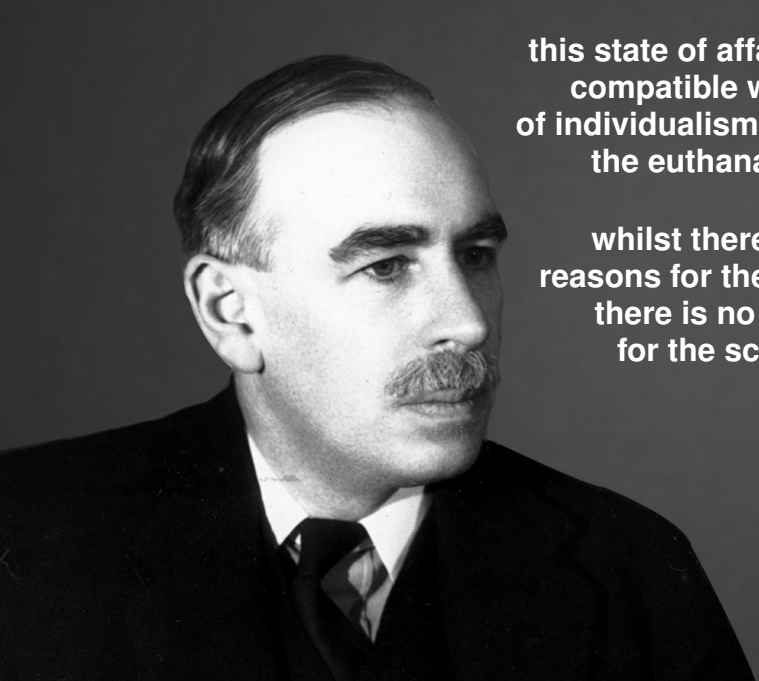


Figure: Implied Coefficients on Five-year Population Share Growth Rates: Consumption and Output

Predicted demographic effects. USA Consumption and GDP



How does population age structure affect the returns on safe and risky assets?



this state of affairs would be quite compatible with some measure of individualism, yet it would mean the euthanasia of the rentier...

whilst there may be intrinsic reasons for the scarcity of land, there is no intrinsic reasons for the scarcity of capital...

Why does household saving/investment behavior depend on age?

Many **potential** reasons.

- Credit constrained ages (younger)
- Ages with less flexible labor margins (retirees)
- High savers (40-65)
- Draw-down of saving (retirement)

Net result: a savings glut of the old... at least when concentrating population in the 50-70 range.

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Net result: a savings glut of the old... at least when concentrating population in the 50-70 range.

- Importantly: different households may be treated differently by these groups! Due to differences in:
  - Risk;
  - Liquidity properties;
  - Preferences/institutional reasons.

Motivation: Aging and the Equity Risk Premium

1. We've seen secular trends r^*

Figure: United States: R-Star

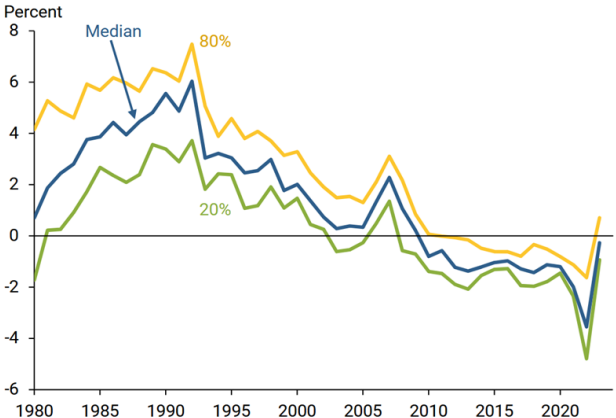
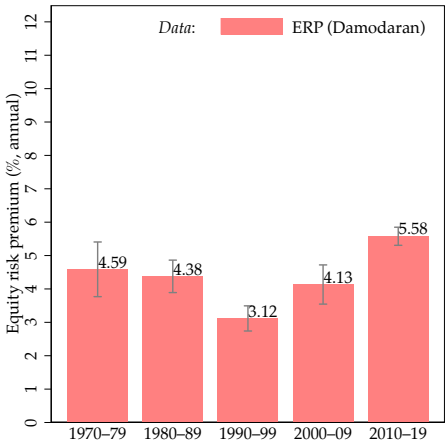


Figure: From Carvalho et al. (2025)

Motivation: Aging and the Equity Risk Premium

Figure: ERP: Free Cash Flow to Equity

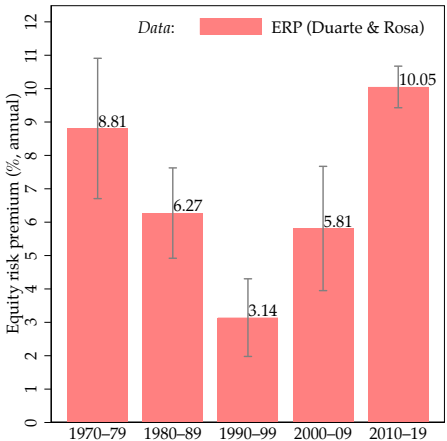


1. We've seen secular trends r^*
2. The equity risk premium has moved around a lot over the last 50 years.

$$RP_t(k) = E_t\left[R_{t+k}\right] - R^f_{t+k}\,.$$

Motivation: Aging and the Equity Risk Premium

Figure: ERP: Ensemble Principal Component



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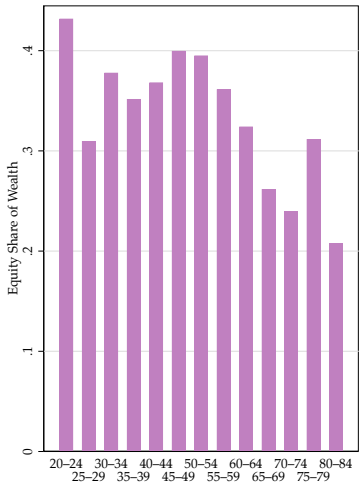
Motivation: Aging and the Equity Risk Premium

Figure: SCF: Equity Participants



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3. Portfolio allocations change over the life cycle.

Kopecky and Taylor (2022): Contribution

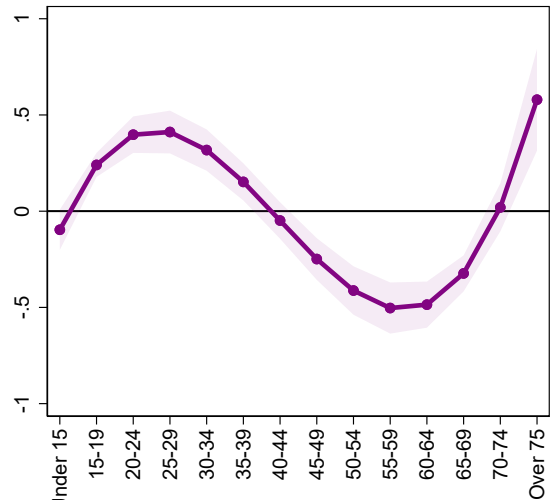
- **Empirical:** Investigate the long run relationship between population age structure and asset prices.
  1. Update Poterba (2001) with **much** longer and wider panel of data;
  2. Tease out which portions of the age distribution drive trends;
  3. Project potential quantitative impact in past and future.

- **Model :** Use a Life-cycle model to:
  1. Better understand the channel linking aging and asset prices;
  2. Estimate potential head/tailwinds to ERP from aging;
  3. Improve model ability to capture **negative** safe rates;
  4. Project future paths of asset pricing.

Age Specific Effects: On Asset Returns

- Marginal effect of population shares across the age distribution for:
  1. Bill Rates

Figure: Age Shares and Bill Rates

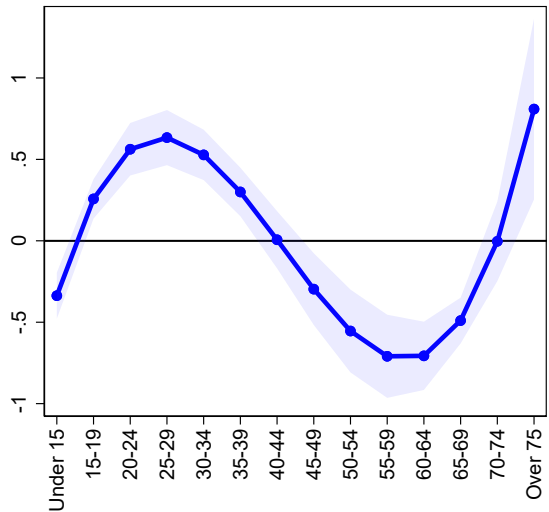


Age Specific Effects: On Asset Returns

- Marginal effect of population shares across the age distribution for:

  2. Long term government bond returns

Figure: Age Shares and Bonds

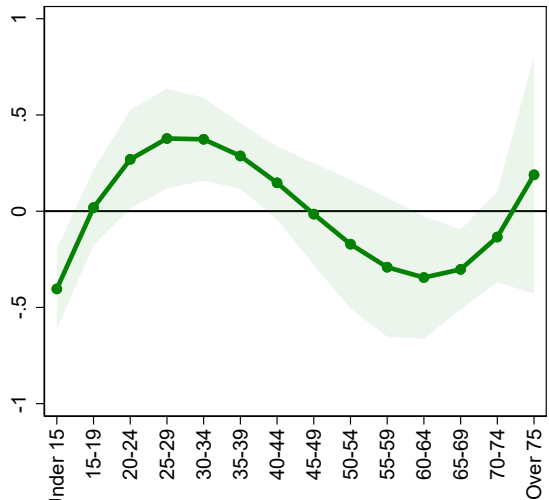


Age Specific Effects: On Asset Returns

- Marginal effect of population shares across the age distribution for:

3. Total returns on risky assets

Figure: Age Shares and Risky Assets

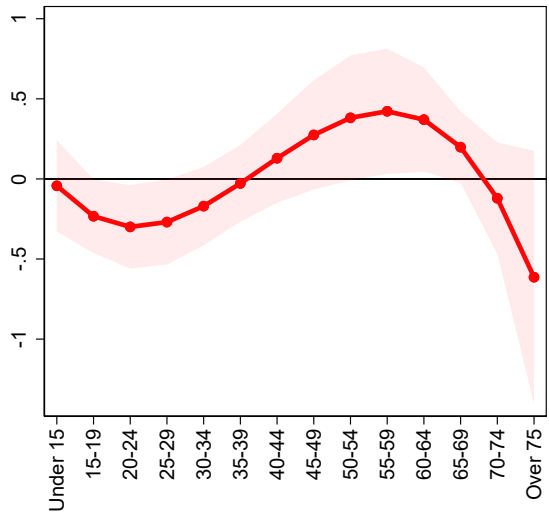


Age Specific Effects: On Asset Returns

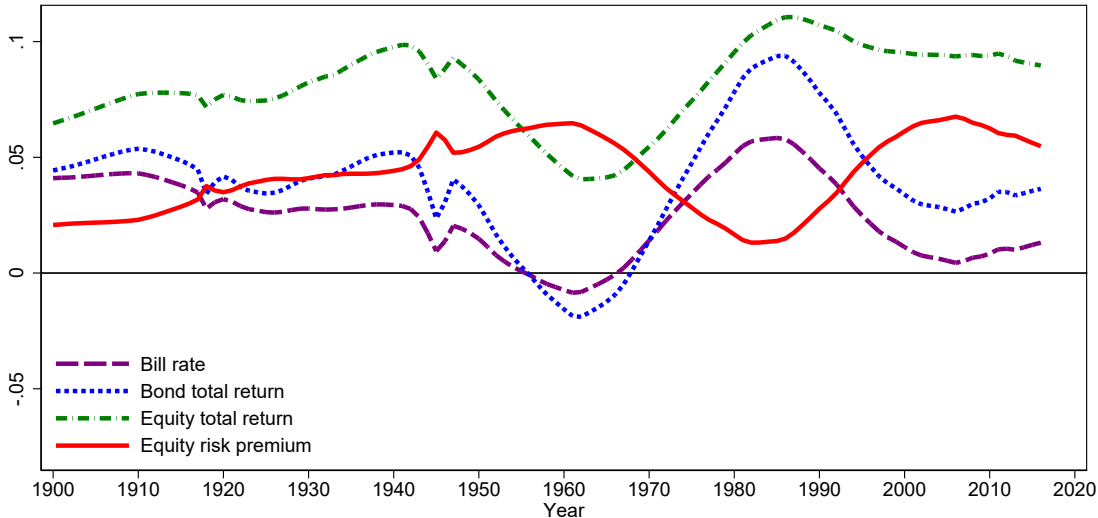
- Marginal effect of population shares across the age distribution for:

4. An implied risk premium

Figure: Age Share and ERP



Quantitative Estimate: Demographic Head/Tailwinds



Model Outline...

- **Production:** Aggregate firm produces with uncertain productivity and stochastic depreciation. ▸ Details
- **Goverment:** Runs fully funded social security each period. Trades bonds in positive net supply. ▸ Details
- **Financial Markets:** Two assets:
  - Risk free government bond P_t^B
  - Investment in capital with return: $R_t^k = \alpha Z_t \frac{L_t}{K_t}^{\alpha} - \delta_t$
  - One time cost of participation in equity markets.
  - ▸ Details
- **Households:**
  - Heterogeneous on individual wage productivity; ▸ Details
  - Maximize utility (EZ) over consumption, two preference types; ▸ Details
  - Finite lives, Exogenous retirement age, uncertain lifespan, and changing cohort size over time; ▸ Details

Model Results

Table: Returns and risk premiums in the model

		Model			
		1970	1990	2017	2050 (projected)
Equity return, mean	$\bar{r}_e$	7.05%	8.10%	2.57%	0.89 %
s.d.	σ_e	15.41%	15.44%	15.20%	15.19%
Safe return, mean	$\bar{r}_f$	4.93%	6.00%	-0.28%	-2.49%
s.d.	σ_f	4.19%	4.26%	4.11%	3.60%
ERP	$\overline{rp}$	2.12%	2.10%	2.85%	3.38%

NB: Each year represents a different steady state associated with a particular population age structure.

Model and Literature

Table: Falling safe real rates: model and literature versus data

	Period	Change in real safe rate
This model		
Baseline model: safe rate, $\bar{r}_f$	1990–2017	-6.28
Risk-free model: natural rate, $r^* = \bar{r}_e$	1990–2017	-2.43
Risk-free model: bond return, $\bar{r}_f$	1990–2017	-2.08
Other single-return models		
Gagnon, Johannsen, and López-Salido (2016)	1980–2016	-1.25
Carvalho, Ferrero, and Nechio (2016)	1990–2014	$\approx$ -2 *
Lisack, Sajedi, and Thwaites (2017)	1980–2015	-1.60
Eggertsson, Mehrotra, and Robbins (2019)†	1970–2015	-4.02
Summers and Rachel (2019)‡	1970–2019	-1.70
Data		
Rachel and Smith (2015)	1990–2015	-4.50

Notes: See text. *Measure that includes social security. †Their transition dynamics show much of this fall happening from the late 1980s/early 1990s. ‡They find a 700 basis point decline in the "private" neutral rate as counterbalancing public programs have offset much of the demographic declines.

Relative Age Structure and Trade

Why are trade and age linked?

- Work by Cai and Stoyanov (2016) construct industry-level measures of age-dependency of skills.
- Population aging leads to specialization in industries using *age-appreciating* skills;
- Aging erodes advantage in *age-depreciating skills.*

This has large potential implications when two countries demographics shift **relative** to one another.

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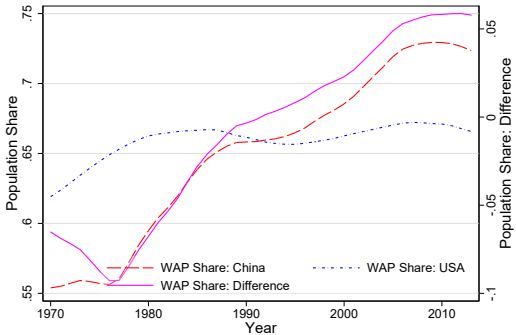
Somewhat surprisingly (to me) little work in gravity equation literature testing this. My paper Kopecky (2023a) is a very simple exercise doing just that!

Relative Demographics: USA and China

(a) Working Age Populations: China and USA



(b) Five-year Age Shares: Diff, China - USA

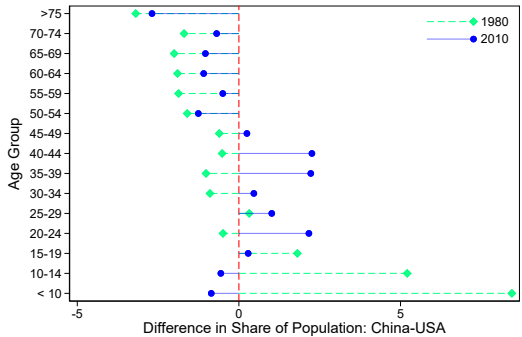


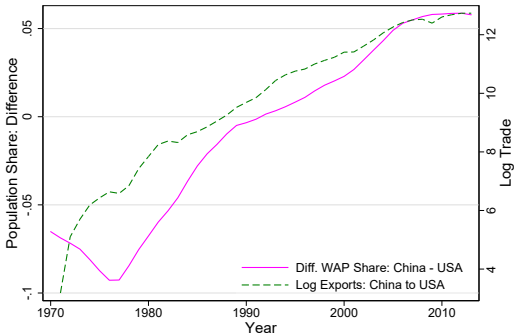
Figure: Relative Age Structure: China and the United States

WAP Share = Share of working age population in total population.

Was the United States importing Chinese Youth?

The **Eye-conometrics** look good...

(a) Chinese Exports to USA



(b) Balance of Trade: China and USA

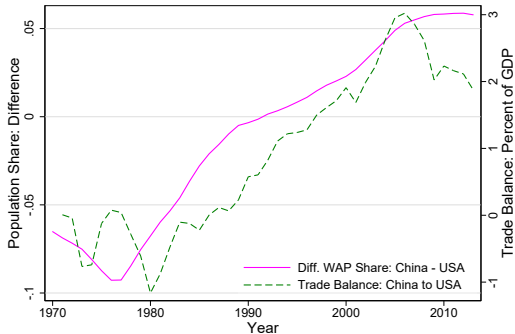


Figure: Working Age Population and China-US Trade

Punchlines from the Gravity Equation Estimations

But what about the econometrics?

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4. I also find similar results for trade balance.

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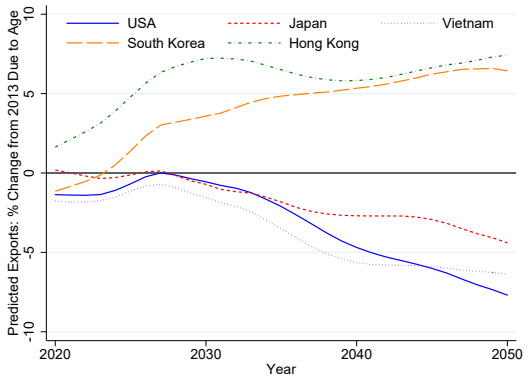
Quantitative Magnitudes

(a) Exports **FROM** China to...



(b) Exports **TO** USA from..

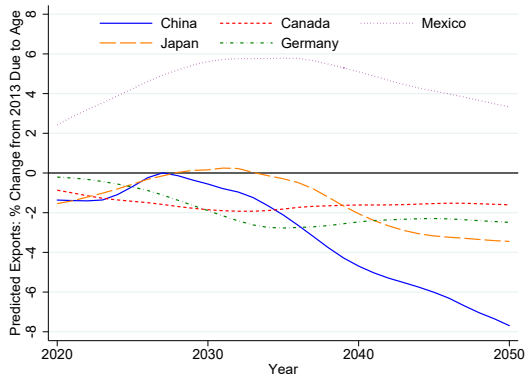
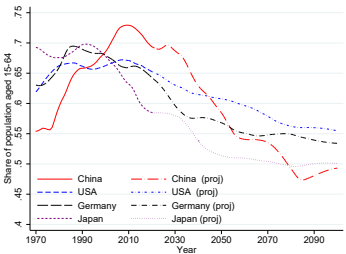


Figure: Predicted change in bilateral trade due to working age to old-age ratio

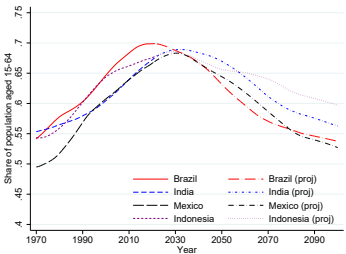
Last Thought...

If we think youth matters then the future is in Africa and Central Asia. China is investing in these relationships already (Belt and Road), perhaps the west should be doing more.

(a) Four Largest Exporters



(b) Current Global Youth



(c) Africa

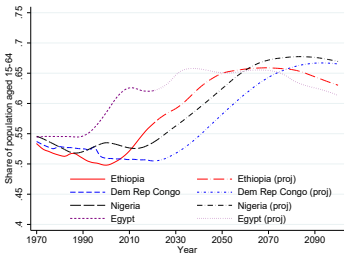


Figure: Trends in population aged 15-64

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