Population Ageing, Impact on Asset Values, Implications for Pension Plans

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Thank You To Our Partners

Social Sciences and Humanities Research Council

University of Kent and the University of Waterloo

We are still seeking partners, contributors and collaborators

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Project Overview

- Multi-year, multi-disciplinary, international project
- Three modelling stages
  - ➢Economic Demographic Model
  - ➢Asset Model
  - ➢Pension Model
- Preliminary results show aging population decreases asset values

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Overview of Research Team

- Lead researchers
  - Kent: Miguel Leon-Ledesma, Jaideep Oberoi, Pradip Tapadar
  - Waterloo: Doug Andrews, Steve Bonnar, Lori Curtis, Kate Rybczynski
- Other key team members
  - Kent: Aniketh Pittea
  - Waterloo: Soheyl Sadinejad, Mark Zhou

Background to this Research

- Initial project regarding whether retirement of the baby boomers would cause an asset meltdown
  - ➢ Funded by SOA
  - ➢ Joint work of Andrews – Oberoi – Rybczynski - Tapadar
- Reviewed 61 papers
  - ➢ 4 foresee significant meltdown
  - ➢ 33 suggest moderate decline in asset values
  - ➢ 14 reject idea
- Analyzed 2 papers supporting asset decline

Abel 2003 Paper

- The Effects of a Baby Boom on Stock Prices and Capital Accumulation in the Presence of Social Security
- ➢ Uses a 2 state OLG model: young and old
- ➢ Introduces rudimentary Social Security system that could be DB or DC
- ➢ Assumes fertility follows a random walk in order to introduce dynamics into the model

Abel 2003 Paper Argument

- Shows that a baby boom will increase the price of capital
  - ➢ When baby boomers are in the labour force earning wage income, national saving and investment are high
  - ➢ A high rate of investment can be achieved only by driving up the supply price of capital
- The price of capital displays mean reversion
  - ➢ This increase in the price of capital is followed by a fall in the price of capital in the following “year”
  - ➢ This supports the idea that the asset price will decline as the baby boomers retire

Liu and Spiegel 2011 Paper

- Boomer Retirement: Headwinds for U.S. Equity Markets?
  - ➢ Takes a statistical approach
  - ➢ With deterministic booms and busts in population growth
  - ➢ Focuses on strong historical co-relation between P/E ratios and the ratio of middle aged (40 – 49 *prime savers*) to old aged (60 – 69 *retired*)
  - ➢ Analysis examines period from 1954 to 2010
- They project the future P/E ratios to 2030, which shows a bearish pathway on the stock market

Comments on Liu and Spiegel 2011 Paper

- Dangers in empirical approach involve
  - Defining the cohorts
  - Selecting the data period
  - Deciding on whether to use lagged data
  - Autocorrelations
  - Difficulties in controlling for other explanatory variables

Further Background

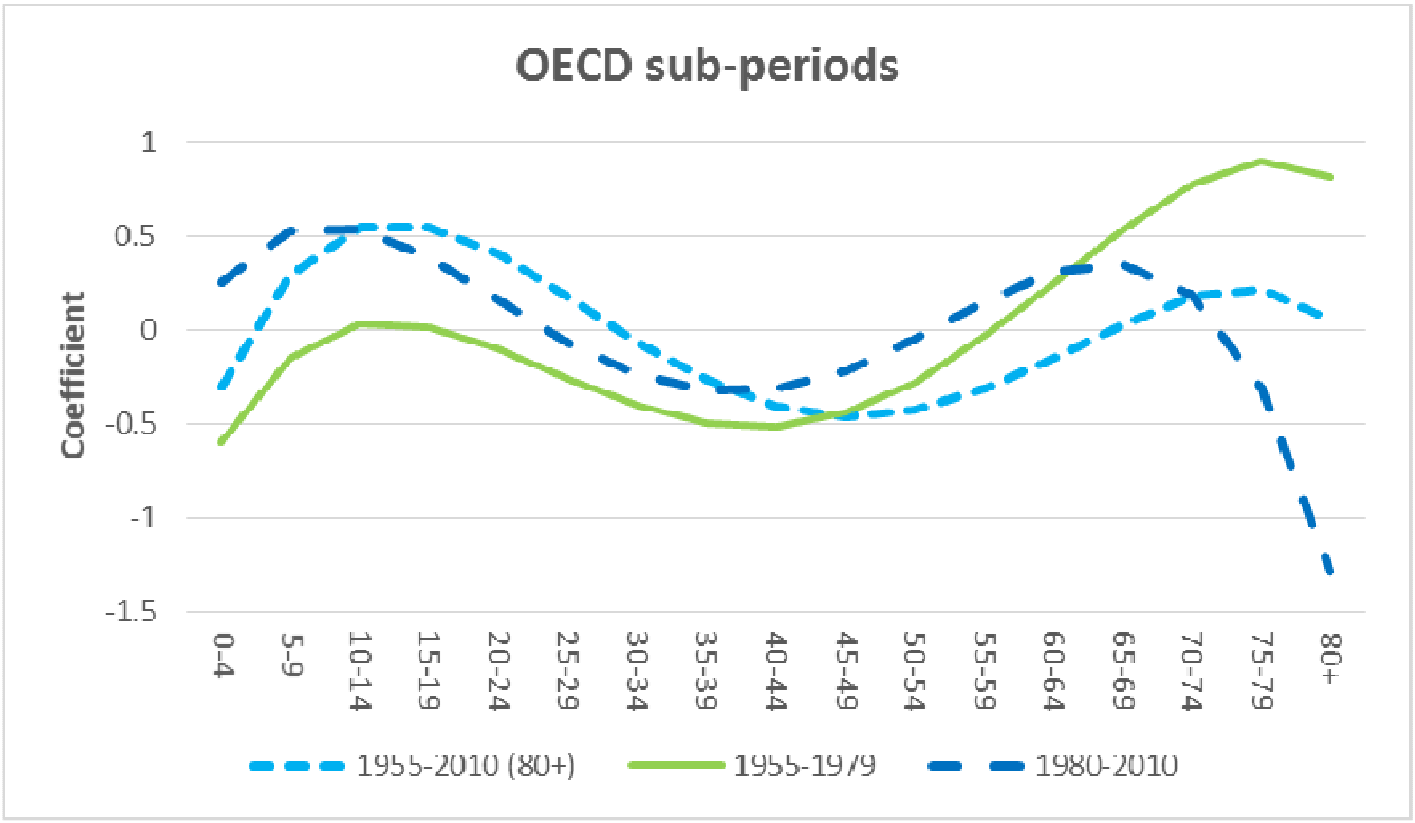
- Investigating the Link between Population Aging and Deflation
- ➢ Funded by SOA REX Pool
- ➢ Joint work of Andrews – Oberoi – Wirjanto - Zhou
- Uses empirical relationships to motivate study
- Uses a Vector Auto Regressive model
- ➢ Data from 1999 to 2010
- ➢ 20 countries
- ➢ 6 economic variables
- Reconciles differences between Juselius & Takats (2015) and Yoon, Kim & Lee (2014)

VAR Significant Influences

- Lagged growth → all including savings and interest rates
- Investment → growth, inflation, savings
- Hours worked → interest rates, inflation
- Interest rates → growth, investment, hours
- Inflation → interest rates
- Oil prices → all except investment
- Savings NO significant influence

Analysis may be affected by time period and sparsity of data

Age cohort impacts on Inflation – OECD data by sub-periods



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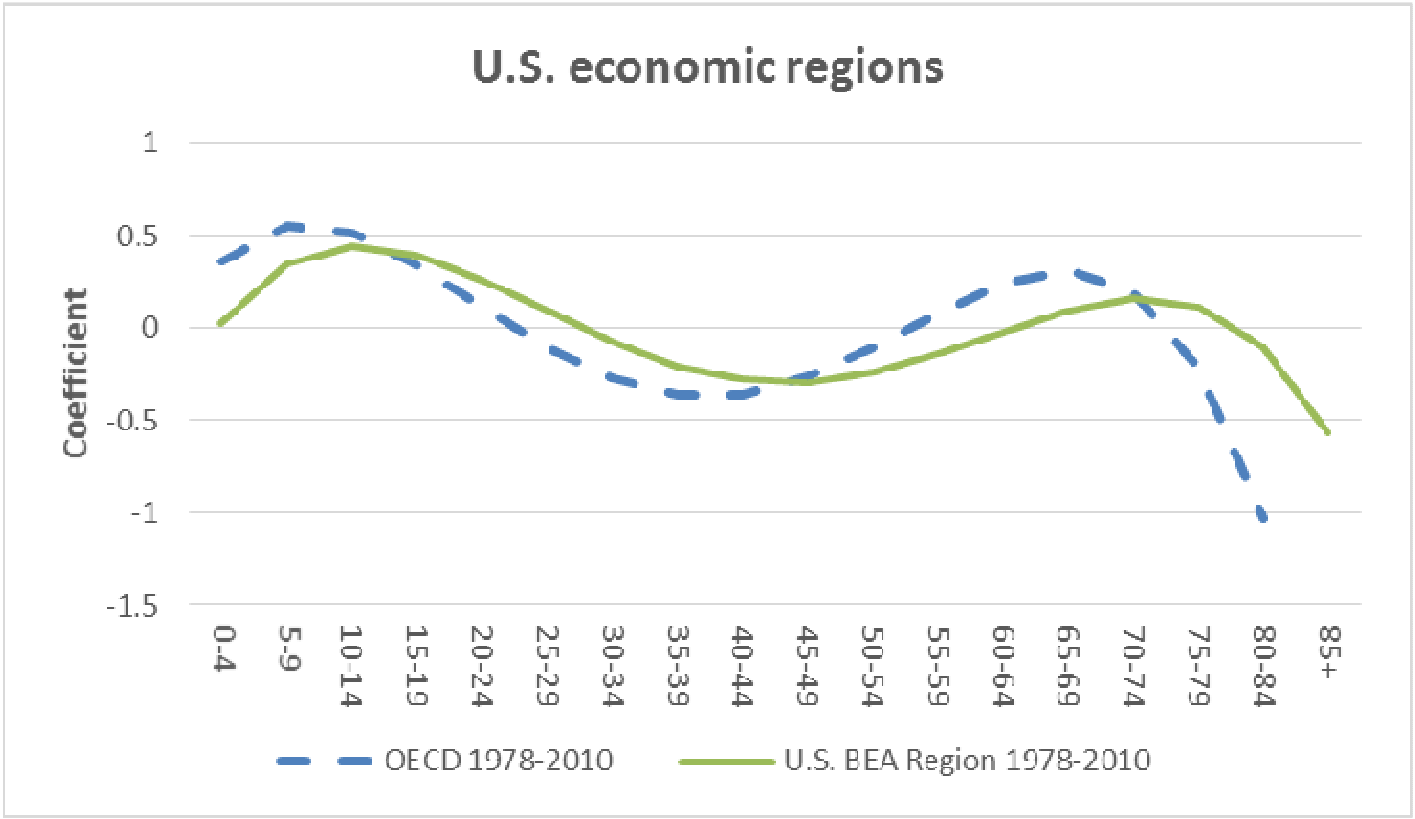
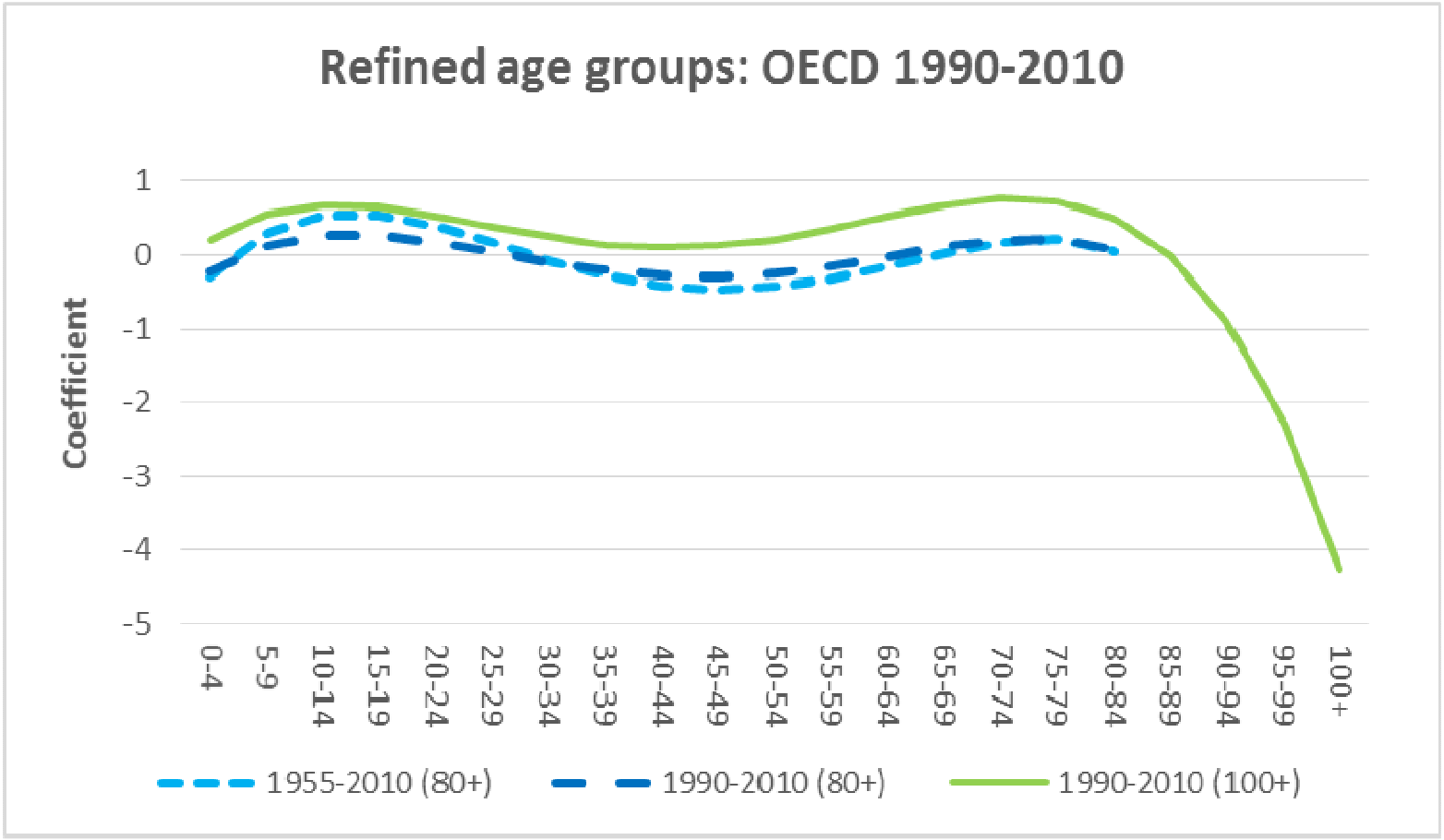
Plus U.S. economic regions



OECD with refined age groups



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Some Conclusions

- Sub-period rather than panel sample more important for determining pattern of impact of aging on inflation
- The older the age the more deflationary the cohort is
- Important to gather data with more refined older age groups
- Estimation of the coefficients of low frequency and highly collinear determinants is highly sensitive to the specification of the model and the estimation method used
- Demographic structure does affect economic factors such as growth and inflation

Next Speakers

- C. Mark Zhou – formerly post-doctoral fellow at uW
  - Now Canada Mortgage and Housing Corporation
  - Will present EDM and preliminary results
- Alex Maynard – Professor University of Guelph
  - Collaborator
  - Will present approach to connecting demographics to US equity returns

Part 2 - Asset Modelling

First Task – Literature Review

- Examined over 100 academic papers

- Selection criteria
  - Papers written in 2000 or later that link demographic factors to asset prices
  - Widely cited papers regardless of publication date or link to demography
  - Infrastructure papers written in 2000 or later

Literature Review – Influential Papers 1

- Two widely cited papers identified

- Fama & French (1993) and subsequent updates to 2016
  - Identify common risk factors in returns on stocks and bonds
    - Size
    - Book to Market ratio
    - Term premium
    - Default premium
    - Market return controlling for the preceding factors

Literature Review – Influential Papers 2

- Mankiw & Weil (1989)
  - Conclude that the number of births leads to large and predictable changes in demand for housing
  - This change in housing demand affects house prices significantly

Demographic Effect on Stocks/Bonds

- Davis & Li (2003)
  - Stock returns significantly affected by population structure
    - Share of population age 20 – 39 up 1 percentage point, stock returns up 2% - 3%
    - Share of population age 40 – 64 up 1 percentage point, stock returns up roughly 3%
  - Bond yields also affected by population structure
    - Share age 20 – 39 up 1 percentage point, real yields up by 15 to 25 basis points
    - Share age 40 – 64 up 1 percentage point, real yields down by 45 to 50 basis points

Demographic Effect on Housing

- Several papers document relationship between the Old Age Dependency (OAD) ratio and house prices
  - Many time periods
  - Many countries/regions
  - For a 1 percentage point increase in OAD, house prices reduce by 70 to 130 basis points

Demographic Effect on Infrastructure

- No literature connecting demographic variables to infrastructure returns

- Little literature on infrastructure at all
  - 7 papers since 2000
  - Academic work is very preliminary

Two Approaches to Modelling

- Detailed structural approach
  - Goyal (2004) for example
    - Full OLG framework
    - Creates theoretical approach to link demographic change to stock market returns and stock market inflows/outflows
- Risk factor approach (similar to Fama & French)
  - For example, a regression like the following

$$Return = \alpha + \beta\,[Economy] + \gamma[Demography] + \varepsilon$$

Current Thinking — Housing

- Structural model like Nishimura & Takats (2012)

  $U = \ln(cy_t) + \ln(h_t) + \ln(M_t / P_t) + \beta \ln(co_{t+1})$

  $cy_t \leq Y - h_t q_t - M_t / P_t$

  $co_t \leq h_t q_{t+1} + M_t / P_{t+1}$

- They assume housing is in fixed supply
- Our extension plans to have variable housing supply driven by demographic factors

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Variable Housing Supply

- May be more reasonable for large countries with smaller populations like Canada than for densely populated smaller countries like Japan
- In one formulation to ensure that the housing market clears the change in the rental price of housing is determined by its elasticity to the supply of housing
- In another formulation labour is fixed and housing supply is variable and housing demand is set equal to supply
- Just at stage of examining the data
- Different cultural preferences for renting vs owning and presence of rent controls may affect analysis

Current Thinking — Equities

- Risk factor approach like Gospodinov, Maynard & Pesavento (in progress)

$$dp_{t+1} = \alpha + \beta_1 dp_t + \beta_2 my_{t+1} + \beta_3 mo_{t+1}$$

- ➢ "my" is ratio of population 40 - 49 to population 20 - 29
- ➢ "mo" is ratio of population 40 - 49 to population 60 - 69

- Preliminary results promising for US
- Looking to collaborate for Canada and the UK
- Potentially will consider extending to bond yields

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Preliminary Thinking — Commercial Real Estate

- Approach such as used for equities applied to REITs
- Extend housing model for commercial real estate market
- Hybrid of these two approaches depending on results

Preliminary Thinking — Infrastructure

- Identify subclasses of infrastructure where demographics may affect returns (eg. toll roads versus timberland)
- With respect to identified subclasses, find a large pension plan with infrastructure investments to provide data for analysis
- In absence of this use combination of approaches to equities and bonds (eg. weighted average depending on whether income or capital considerations dominate)

Critical Step

- Developing co-variance matrix for different asset classes
- Historical data available
- Assumes that co-variances are unaffected by demographics
- May test sensitivity of modifying this assumption

Next Speakers

- Giovanna Apicella – doctoral candidate University of Rome La Sapienza
  - ➢ Will present approach analyzing the prospective dependence between mortality rates and interest rates
- Soheyl Sadinejad – post-doctoral fellow at uW
  - ➢ Will present a paper showing how fuzzy mathematics may be useful in analyzing demographic factors
- Aniketh Pittea – doctoral candidate University of Kent
  - ➢ Will describe how PM will tie together the work of the project

Questions