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Human-Capital Risk and Pension Portfolio Choice

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Portfolio selection

- How people should invest their wealth
  - Process of trading off between risk and expected return, to find the best portfolio of assets and liabilities.
  - *Narrow definition*: decisions about how much to invest in stocks, bonds, and other securities
  - *Broader definition*: whether to buy or rent one's house, what types and amounts of insurance to purchase, and how to manage one's liabilities
  - *Even broader definition*: how much to invest in one's human capital
- The **common element** → trade-off between risk and expected returns

Life cycle finance

- Dynamic process in which investment portfolios change according to investors' particular consumption and savings preferences at any time in their life.
- How to spread labor income over our whole life.
- Complements traditional portfolio theory
  - Asset allocation based only on investors' risk-return preferences

Background

- Samuelson (1969) and Merton (1969)
  - Labor market is frictionless and uncorrelated with stock markets.
  - Optimal fraction α of wealth invested in risky asset is constant, and independent of wealth and age.
  - α depends only on risk aversion γ and the moments of asset's excess return (μ, σ^2).

$$\alpha = \frac{\mu}{\gamma \sigma_\eta^2}$$

Background

- Samuelson (1969) denied the validity of the concept of "businessman's risk" (holding risky assets is only advisable for young businessmen and not for widows)
  - Optimal portfolio decision is independent of wealth at each state and independent of all consumption-savings decisions.
  - Assumes independent and identical distributed returns, with frictionless markets and no labor income
- Merton (1971)
  - Consumption-portfolio problem. Introduces stochastic wage income, risk of default, uncertainty about life expectancy and alternative types of price dynamics.

Background

- Bodie, Merton and Samuelson (1992)
  - Examine the effect of the labor-leisure choice on portfolio and consumption decisions over an individual's life cycle.
  - Individuals may have flexibility in varying their work effort (including their choice of when to retire).
  - Given flexibility, the individual simultaneously determines optimal levels of current consumption, labor effort, and an optimal financial investment strategy at each point in his life cycle.
  - Objective: to maximize individual´s discounted lifetime expected utility.

Background

- Bodie, Merton and Samuelson (1992) cont.
  - First to endogenize the labor/leisure decision in an intertemporal consumption–portfolio choice model (Samuelson , 1969 and Merton 1969, 1971 type models).
  - Human capital has a critical impact on optimal policies
  - Investment behavior typically becomes more conservative as retirement approaches, and
  - Labor flexibility smooth consumption behavior and promotes greater risk-taking in financial investments
  - At any given age in the life cycle, the riskier is an individual's human capital, the lower will be his financial investment in risky assets

Life-cycle models

- Cocco, Gomes and Maenhout (2005)
  - The level and risk of the labor income stream change over the life cycle; portfolio choice should also depend on these factors
  - The presence of labor income provides a rationale for age-varying investment strategies
- Labor markets are not complete
  - Moral hazard issues,
  - Investors face borrowing constraints that prevent them from capitalizing future labor income
  - No well developed explicit insurance markets for labor income risk

Life-cycle models

- Cocco, Gomes and Maenhout (2005) cont.
  - Quantitative model to solve for the optimal consumption and portfolio decisions of a finitely lived individual, with labor income uncertainty, investing in a risky or a riskless asset
  - Labor income is risky, but if it is uncorrelated with equity returns is perceived as a closer substitute for risk-free asset holdings
  - The presence of labor income increases the demand for stocks, especially early in life
  - A (small) probability of a disastrous labor income draw substantially decreases the average allocation to equities

Life-cycle models

- Gomes, Kotlikoff, and Viceira (2008)
  - Life-cycle model with wage rate uncertainly, variable labor supply, and portfolio choice over safe bonds and risky equities
  - Support prior findings that equities are the preferred asset for young households. Optimal share of equities declines prior to retirement.
  - Variable labor supply alters preretirement portfolio choice by significantly raising optimal equity holdings.
  - Post retirement, optimal equity share increases as households spend down their financial assets
  - It is highly costly for moderately risk-averse investors to invest their savings only in stable value funds

Individual's Total wealth

Total Wealth =

Financial wealth+ Human capital Wealth (HC)

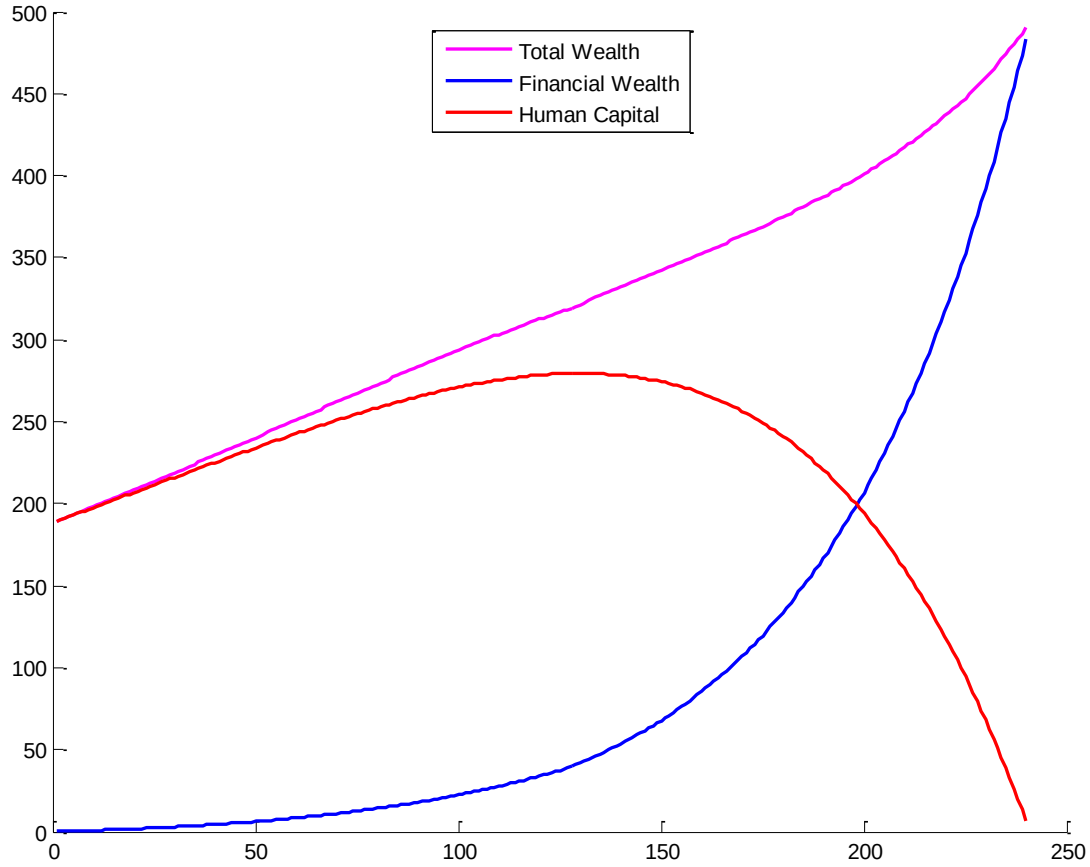
- HC = Present value of future labor income

$$HC(x) = \sum_{t=x+1}^{n} \frac{E[h_t]}{(1+r+v)^{t-x}}$$

x = individual´s age , h_t= labor income, n = life expectancy, r = real risk free rate, v = discount rate

- Perks are also part of human capital
- Human capital starts at a maximum level and progressively decreases over time.

Human capital and retirement assets over the Life Cycle



Total wealth and portfolio/consumption decision

- The individual's optimal investment and consumption decisions are influenced by human capital
- Investments in risky assets are best understood if viewed in terms of total wealth
- To limit attention to the individual's financial wealth alone leads to a systematic underestimate of the investment resources at the individual's disposal.

Defined Contribution Pension systems

- Introduced in Chile in 1981
  - Improve the actuarial characteristics and to increase intergenerational fairness
  - Introduced the *second pillar:* individual accounts, administered by private funds managers
- As of today 32 have the fully funded second pillar (100 million participants in 2010)
- Key feature of DC systems
  - Workers bear the total investment risk
  - Uncertainty on whether pension savings is enough to substitute labor income at retirement (substitution rate)

Investment regime and Life-cycle DC systems

- Common feature
  - Setting quantitative limits on investment in equities to control for excessive risk taking
- Investment regime
  - Used to be much more restricted
  - Today there are more portfolio choices to boost returns on pension savings. Participants can select among the different pension funds.
  - Normally fund choice restrictions are based on hazardous jobs or on the age of the participant
  - DC systems with pension choices based on the age of the participant are known as **life-cycle DC pension systems**

Life-cycle DC systems

- Three broad phases in a person's life

1) growing up and getting education
2) working life or accumulation phase, and
3) the retirement stage when lifetime savings substitute labor income.

- Life-cycle DC systems
  - depart from the premise that during early stages of the accumulation phase people can tolerate higher risk
  - risk tolerance progressively decreases as the worker approaches to retirement.

Fallacy of time diversification

- Widespread belief that stocks are less risky in the long run than in the short run.
  - Invest more in stocks the longer the holding period.
  - The longer the holding period, the smaller the standard deviation of returns
  - The longer the holding period, the lower the probability that stocks will earn less than the risk-free rate (*shortfall*)
- However
  - People care about final wealth. St. deviation of total wealth increases over time.
  - Shortfall risk depends on the probability of occurrence and the *severity.* <u>There is no decline in risk as the holding period lengthens.</u>

Time diversification

- Ibbotson et all (2007)
  - "no investment is riskless if the run is long enough".
- The probability of a catastrophic event increases as the holding period increases.
- Long term investment horizons provide enough time for younger people to build up retirement savings, or to replace losses in the investment portfolio using their labor income.

Mexican pension system

- Current architecture result of structural reforms in 1992 and 1997
- Moved from a pay-as-you go mechanism, administered by the Social Security Institute, to a defined contribution scheme
- Final reform fully adopted in June 1997.
  - Publicly managed first pillar with a redistributive objective (guaranteed minimum pension for low income workers)
  - Fully-funded second pillar with mandatory individual accounts and exclusive and specialized mutual fund management
  - Third pillar consisting of voluntary savings

Mexican pension system (life-cycle investment regime)

- (2004), a second investment fund created to allocate resources from workers with 56 years old or less.
  - Investment fund for younger workers enabled higher risk taking (equity investments through indices and structured notes)
- (2007), 3 additional funds dividing workers according to their age
  - A worker can choose a fund with lower risk, but not with higher risk
- 2012, the two riskier funds were merged

Mexican pension system

- Retirement funds (SIEFOREs) defined by worker's age
- Each fund has its own investment regime, with permitted assets and investment limits
- Step-wise linear approach. The proportion allocated to riskier assets decreases only when the worker is transferred to the next SIEFORE

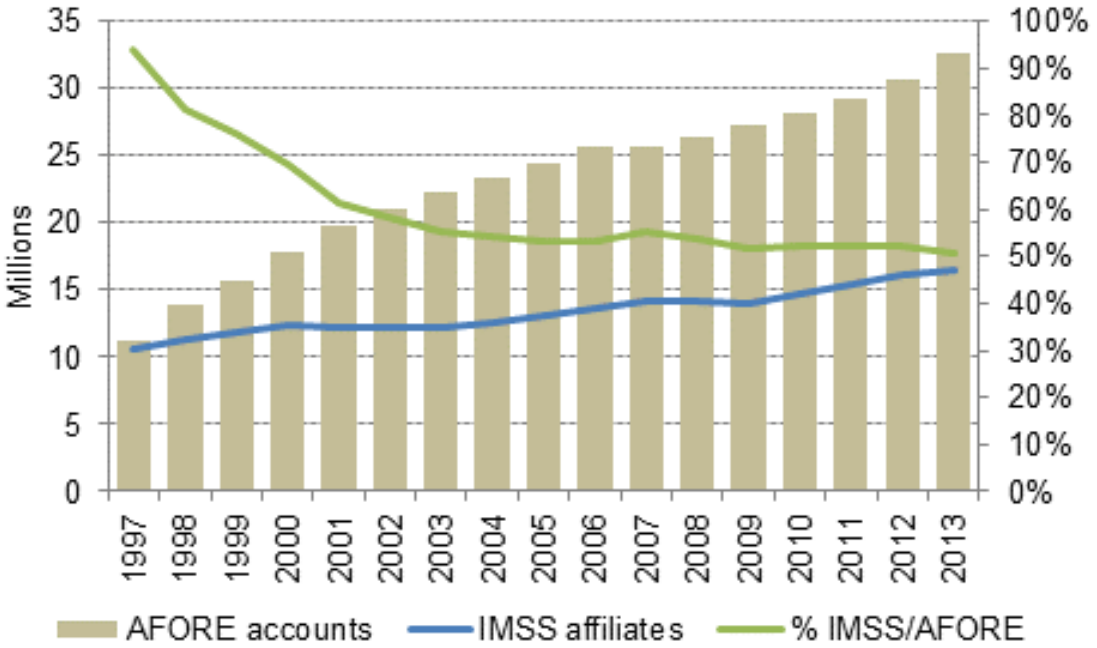
	SIEFORE			
	1	2	3	4
Age range	60 years old and older	46 to 59 years old	37 to 45 years old	36 years old and younger
Maximum equity allocation	5%	25%	30%	40%

Mexican pension system

- The risks associated to workers' earning power is not considered in the design of the system
  - Based on naïve assumptions (uninterrupted labor, uninterrupted contribution, constant salary growth rates)
- Current structure is suboptimal
  - Fails to adequately diversify the risks inherent to labor income and pension contribution
  - Does not capture the complexities of people's circumstances (Bodie, Detemple and Rindisbacher, 2009).

Contribution rates

- To contribute to the system workers need to be registered at the Social Security Institute (IMSS)
- As of 33 million registered pension accounts, only 16.7 million workers are currently affiliated with IMSS



What do we do?

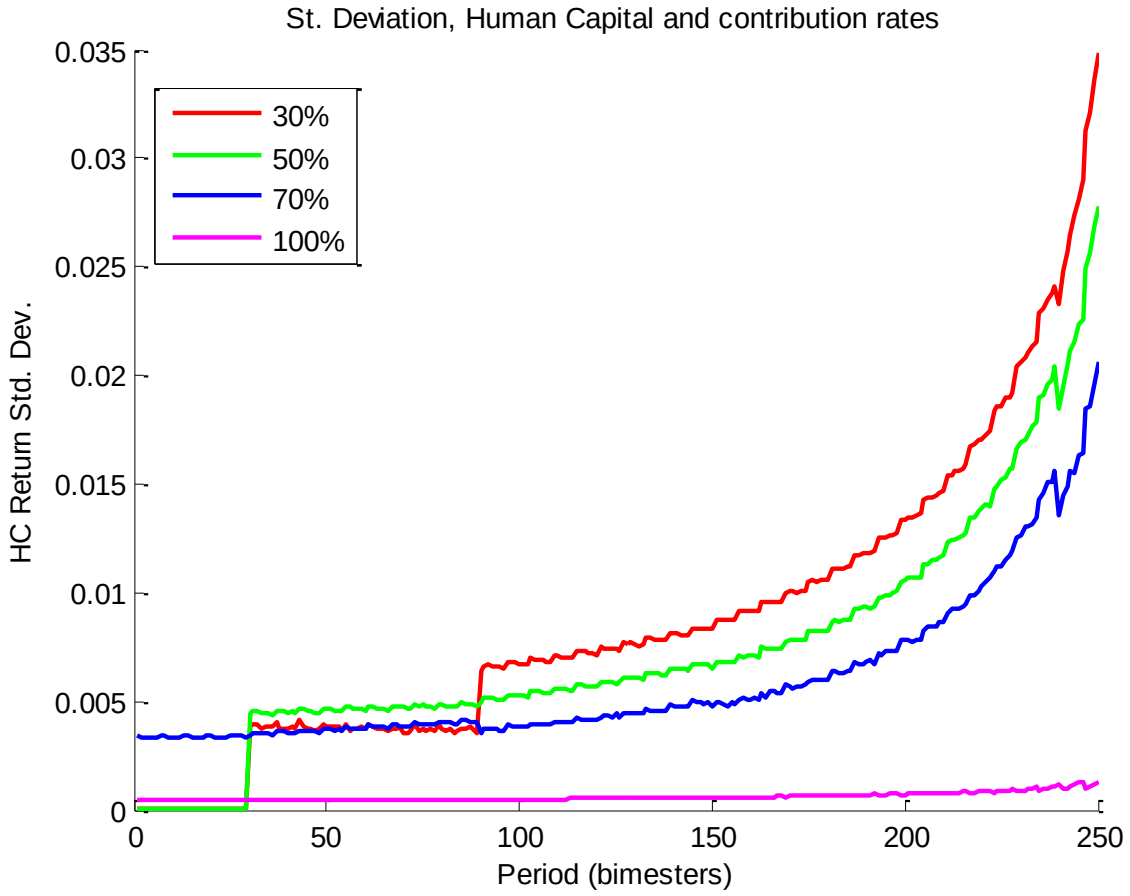
- We relax assumptions of 100% contribution rates and constant salary growth
- We use data on
  - AFOREs' risk and return
  - AFOREs current investment regime
  - Actual system affiliation
  - Actual contribution rates
  - Salaries growth rates
- To estimate actual risk, i.e. total wealth risk and evaluate the impact on final wealth
- To find key factors to serve as proxies for human capital risks

What do we do?

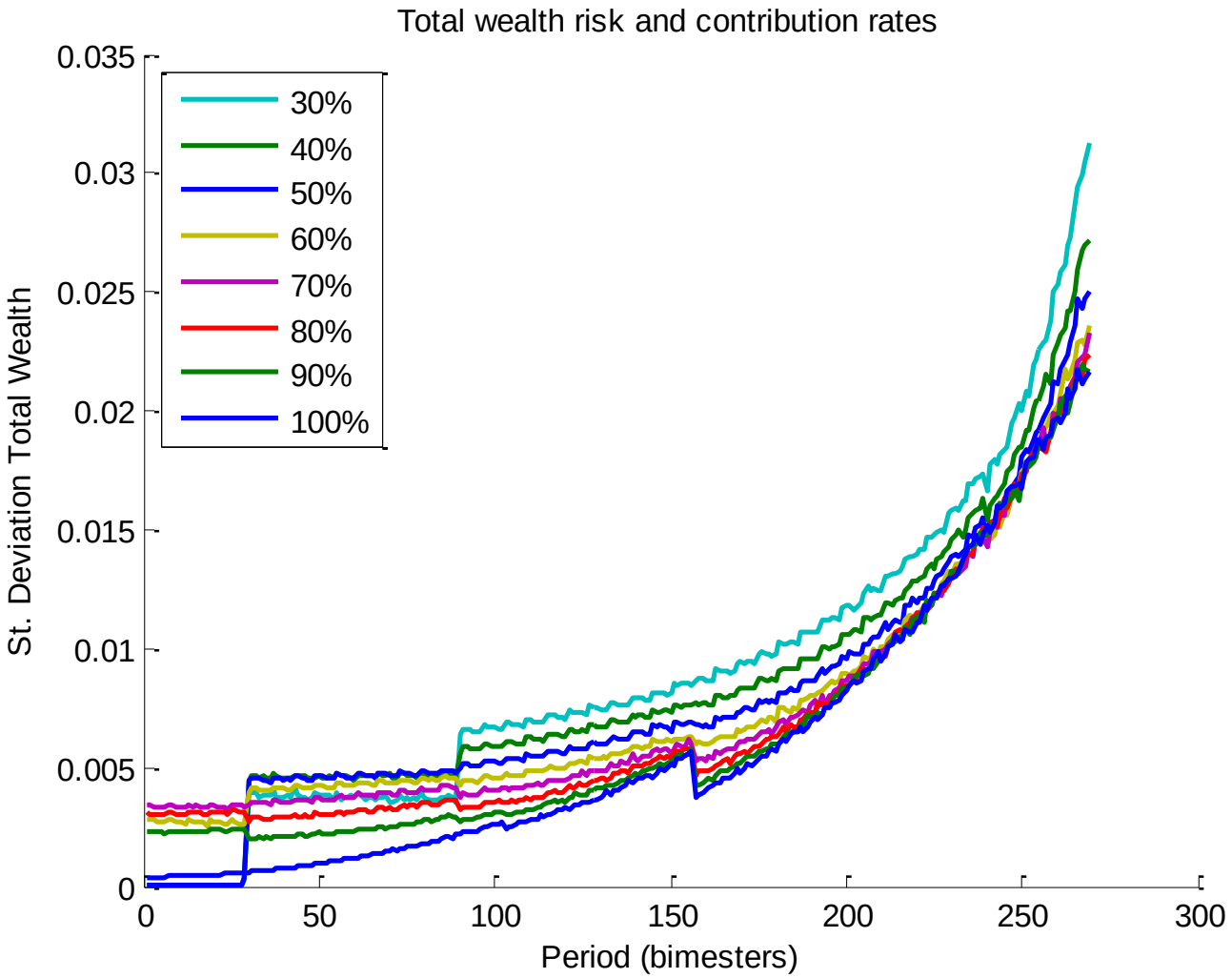
- Through data simulation, and based on real parameters, we measure differences in the amount, return and risk of wealth over the life cycle
  - Total, financial and human capital wealth
  - With and without human capital risk
- Using risk and return measures,
  - Propose alternative portfolio choices, given human capital risk and risk tolerance defined by the current investment regime

Results – Human capital risk

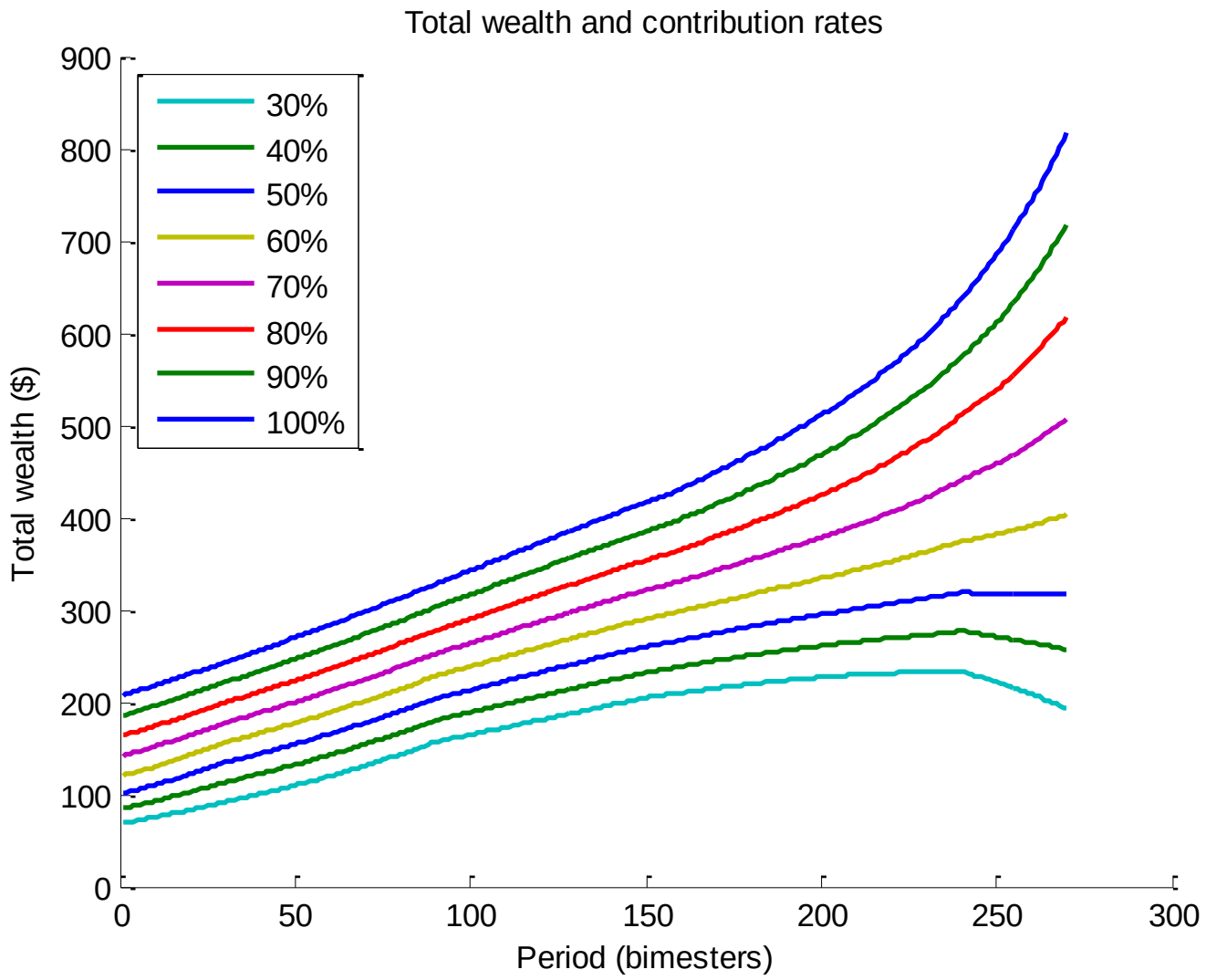
Human capital and pension contribution rates
Standard deviation of returns



Results: Total wealth risk and contribution rates



Results: total wealth and contribution rates



Results: total wealth and contribution rates

Contribution Rate	Total Wealth	St. Dev.	T-Test (Diff. between means)	Wealth % change
30%	192.7	50.7		-25.2%
40%	257.6	71.8	998.0	-19.2%
50%	318.3	90.3	998.7	-21.4%
60%	405.2	119.8	1,130.5	-19.8%
70%	505.2	158.3	1,139.2	-17.6%
80%	613.0	199.3	1,191.8	-14.8%
90%	719.5	231.9	1,318.1	-13.2%
100%	829.1	278.8	1,131.6	

Public policy recommendations

- To consider variables other than age to assign workers pension portfolios (SIEFOREs)
- Reallocate workers to lower risk SIEFOREs during unemployment periods
- At some point, retirement portfolios could bear higher risk when human capital is taken into account
- Taguas and Vidal-Aragón (2005)
  - Optimum portfolio depends on the characteristics of the market, regulation and the characteristics of the people (risk aversion, age, wealth, productivity).

Next steps

- Model calibration with actual asset allocation data and not with permitted asset allocation
  - Actual equity allocation lower than permitted

Asset type	Siefore 1	Siefore 2	Siefore 3	Siefore 4	Siefore Aditional	Total
Domestic Equities (%)	1.3	6.4	8.0	11.2	3.8	8.0
International Equities (%)	2.8	14.2	16.7	20.8	8.9	16.2

- Discount rate to estimate the present value of future labor income
  - should be the same for everybody? or
  - defined by individual's labor income risk?

Next steps

- Human capital risk profiles
  - Age dependent
  - Industry
  - Gender
  - Geographic region
  - Others?
- Labor income profiles
  - Income growth rate varies with age

Conclusions

- Naïve assumptions to estimate contribution rates, salary growth rates, and replacement rates
- The current structure of DC pension funds is suboptimal
  - Not adequate risk diversification
- No HC risk provisions: all workers treated equally
- Systems with different funds can easily consider HC to assign workers to a more suitable pension funds.