Inflation, Money Demand and Portfolio Choice

Kosuke Aoki
University of Tokyo

Alex Michaelides
Imperial, University of Cyprus, CEPR and NETSPAR

Kalin Nikolov
European Central Bank

January 2015

Motivation

- How does/should inflation affect asset allocation and stock market participation decisions?

Motivation

- How does/should inflation affect asset allocation and stock market participation decisions?
- How does/should inflation affect wealth accumulation?

Motivation

- How does/should inflation affect asset allocation and stock market participation decisions?
- How does/should inflation affect wealth accumulation?
- Focus on role of inflation on money demand and asset allocation decisions from household side (in a life-cycle partial equilibrium model).

Motivation

- How does/should inflation affect asset allocation and stock market participation decisions?
- How does/should inflation affect wealth accumulation?
- Focus on role of inflation on money demand and asset allocation decisions from household side (in a life-cycle partial equilibrium model).
- How costly is inflation for different groups of households? ((Doepke and Schneider, JPE, 2006)

Motivation (Continued)

- Literature on this topic is "split"

Motivation (Continued)

- Literature on this topic is "split"
- Recent household portfolio choice literature assumes households invest in real stocks and real bonds and/or housing (Cocco, Gomes and Maenhout (2005), Gomes and Michaelides (2005), Polkovnichenko (2007) and Wachter and Yogo (2010))

Motivation (Continued)

- Literature on this topic is "split"
- Recent household portfolio choice literature assumes households invest in real stocks and real bonds and/or housing (Cocco, Gomes and Maenhout (2005), Gomes and Michaelides (2005), Polkovnichenko (2007) and Wachter and Yogo (2010))
- Money demand literature focusses on the choice between money and nominal bonds but ignores higher-yielding assets (Mulligan and Sala-i-Martin (2000) and Alvarez and Lippi (2009))

Motivation (Continued)

- Literature on this topic is "split"
- Recent household portfolio choice literature assumes households invest in real stocks and real bonds and/or housing (Cocco, Gomes and Maenhout (2005), Gomes and Michaelides (2005), Polkovnichenko (2007) and Wachter and Yogo (2010))
- Money demand literature focusses on the choice between money and nominal bonds but ignores higher-yielding assets (Mulligan and Sala-i-Martin (2000) and Alvarez and Lippi (2009))
- We aim to fill the gap by analyzing the effects of inflation on money demand and portfolio choice across different assets in a nominal model

Motivation (Continued)

- Literature on this topic is "split"
- Recent household portfolio choice literature assumes households invest in real stocks and real bonds and/or housing (Cocco, Gomes and Maenhout (2005), Gomes and Michaelides (2005), Polkovnichenko (2007) and Wachter and Yogo (2010))
- Money demand literature focusses on the choice between money and nominal bonds but ignores higher-yielding assets (Mulligan and Sala-i-Martin (2000) and Alvarez and Lippi (2009))
- We aim to fill the gap by analyzing the effects of inflation on money demand and portfolio choice across different assets in a nominal model
- Rational Model: Ignore Money Illusion effects for now

Findings

- Shopping time model that can be readily estimated through Method of Simulated Moments

Findings

- Shopping time model that can be readily estimated through Method of Simulated Moments
- Moments: mean W/Y for stockholders and non-stockholders and mean portfolio shares (bonds, stocks, money)

Findings

- Shopping time model that can be readily estimated through Method of Simulated Moments
- Moments: mean W/Y for stockholders and non-stockholders and mean portfolio shares (bonds, stocks, money)
- Fixed cost of participation to separate wealthier stockholders from poorer non-stockholders

Findings

- Shopping time model that can be readily estimated through Method of Simulated Moments
- Moments: mean W/Y for stockholders and non-stockholders and mean portfolio shares (bonds, stocks, money)
- Fixed cost of participation to separate wealthier stockholders from poorer non-stockholders
- Ex ante preference heterogeneity used to achieve this, reasonable shopping costs

Findings

- Model can generate fact that the share of wealth in stocks increases as financial wealth rises, providing an alternative explanation to Wachter and Yogo (2010). The young economize on shopping costs by holding money to cover liquidity needs. As saving for retirement begins, they diversify into stocks and bonds

Findings

- Model can generate fact that the share of wealth in stocks increases as financial wealth rises, providing an alternative explanation to Wachter and Yogo (2010). The young economize on shopping costs by holding money to cover liquidity needs. As saving for retirement begins, they diversify into stocks and bonds
- Higher mean inflation causes reallocation away from money into stocks, effect stronger for younger agents

Findings

- Model can generate fact that the share of wealth in stocks increases as financial wealth rises, providing an alternative explanation to Wachter and Yogo (2010). The young economize on shopping costs by holding money to cover liquidity needs. As saving for retirement begins, they diversify into stocks and bonds
- Higher mean inflation causes reallocation away from money into stocks, effect stronger for younger agents
- Deflation increases money demand with bonds sometimes completely crowded out from household portfolios

Findings

- Model can generate fact that the share of wealth in stocks increases as financial wealth rises, providing an alternative explanation to Wachter and Yogo (2010). The young economize on shopping costs by holding money to cover liquidity needs. As saving for retirement begins, they diversify into stocks and bonds
- Higher mean inflation causes reallocation away from money into stocks, effect stronger for younger agents
- Deflation increases money demand with bonds sometimes completely crowded out from household portfolios
- Higher inflation decreases aggregate wealth accumulation and aggregate consumption

Findings

- Model can generate fact that the share of wealth in stocks increases as financial wealth rises, providing an alternative explanation to Wachter and Yogo (2010). The young economize on shopping costs by holding money to cover liquidity needs. As saving for retirement begins, they diversify into stocks and bonds
- Higher mean inflation causes reallocation away from money into stocks, effect stronger for younger agents
- Deflation increases money demand with bonds sometimes completely crowded out from household portfolios
- Higher inflation decreases aggregate wealth accumulation and aggregate consumption
- Magnitude of hedging demands

Empirical Evidence

- US SCF triennial surveys 1989-2007 but focus on 2007 only

Empirical Evidence

- US SCF triennial surveys 1989-2007 but focus on 2007 only
- Why? Earlier surveys (eg 1989) feature lower stock market participation and higher shares of money in portfolios. Secular rise of equity culture in 1990s probably responsible.

Empirical Evidence

- US SCF triennial surveys 1989-2007 but focus on 2007 only
- Why? Earlier surveys (eg 1989) feature lower stock market participation and higher shares of money in portfolios. Secular rise of equity culture in 1990s probably responsible.
- Time-age-cohort identification problem

Empirical Evidence

- US SCF triennial surveys 1989-2007 but focus on 2007 only
- Why? Earlier surveys (eg 1989) feature lower stock market participation and higher shares of money in portfolios. Secular rise of equity culture in 1990s probably responsible.
- Time-age-cohort identification problem
- But between 1998 and 2007 surveys we get similar stylized facts and interpret the cross sectional results from 2007 as life cycle implications to explain

Empirical Evidence (cont'd)

Life Cycle Financial Wealth Accumulation

Age Group	Mean (Median) Non-Stockholders	Mean (Median) Stockholders
20-34	6034 (1100)	56966 (20750)
35-45	10688 (1200)	158989 (62550)
46-55	21334 (1800)	275634 (106580)
56-65	31433 (3540)	434306 (155600)
66+	47852 (6900)	516218 (177200)

- Fixed cost interpretation of limited stock market participation because stockholders are an order of magnitude richer

Empirical Evidence (cont'd)

Life Cycle Financial Wealth Accumulation

Age Group	Mean (Median) Non-Stockholders	Mean (Median) Stockholders
20-34	6034 (1100)	56966 (20750)
35-45	10688 (1200)	158989 (62550)
46-55	21334 (1800)	275634 (106580)
56-65	31433 (3540)	434306 (155600)
66+	47852 (6900)	516218 (177200)

- Fixed cost interpretation of limited stock market participation because stockholders are an order of magnitude richer
- Table also illustrates skewed distribution of wealth in data

Empirical Evidence (cont'd)

Life Cycle Financial Wealth Accumulation Relative to Mean Labor Income

Age Group	Mean (Wealth/Income) NonStockholders	Mean (Wealth/Income) Stockholders
20-34	0.31	0.85
35-45	0.26	1.53
46-55	0.56	2.65
56-65	0.77	7.02
66-75	2.48	15.7

- These are moments to be matched

Empirical Evidence (cont'd)

Life Cycle Financial Wealth Accumulation Relative to Mean Labor Income

Age Group	Mean (Wealth/Income) NonStockholders	Mean (Wealth/Income) Stockholders
20-34	0.31	0.85
35-45	0.26	1.53
46-55	0.56	2.65
56-65	0.77	7.02
66-75	2.48	15.7

- These are moments to be matched
- Treatment of housing wealth

Empirical Evidence (cont'd)

Money: LIQ in SCF public extract is defined as the sum of all checking, saving, money market, deposit and call accounts. We use the same definition for money.

Life Cycle Portfolio Choice

	Non-Stockholders			Stockholders		
Age Group	α_m	α_b	α_s	α_m	α_b	α_s
20-34	75.8	24.2	0.0	28.6	29.8	41.5
35-45	67.9	32.1	0.0	16.7	35.3	48.0
46-55	62.5	37.5	0.0	14.4	37.6	48.0
56-65	59.2	40.8	0.0	13.5	38.7	47.8
66-75	63.3	36.7	0.0	16.2	42.0	41.8

- Money is a key feature of the household portfolio, despite rate of return dominance

Empirical Evidence (cont'd)

Money: LIQ in SCF public extract is defined as the sum of all checking, saving, money market, deposit and call accounts. We use the same definition for money.

Life Cycle Portfolio Choice

	Non-Stockholders			Stockholders		
Age Group	α_m	α_b	α_s	α_m	α_b	α_s
20-34	75.8	24.2	0.0	28.6	29.8	41.5
35-45	67.9	32.1	0.0	16.7	35.3	48.0
46-55	62.5	37.5	0.0	14.4	37.6	48.0
56-65	59.2	40.8	0.0	13.5	38.7	47.8
66-75	63.3	36.7	0.0	16.2	42.0	41.8

- Money is a key feature of the household portfolio, despite rate of return dominance
- Money a more prominent feature of the portfolio of non-stockholders (as a percentage of total financial wealth)

Role of Money

- How do we generate any money demand?

Role of Money

- How do we generate any money demand?
- Kiyotaki and Wright (1989) search models

Role of Money

- How do we generate any money demand?
- Kiyotaki and Wright (1989) search models
- Lucas and Stokey (1987) cash-in-advance models

Role of Money

- How do we generate any money demand?
- Kiyotaki and Wright (1989) search models
- Lucas and Stokey (1987) cash-in-advance models
- Sidrauski (1967) money-in-utility models

Role of Money

- How do we generate any money demand?
- Kiyotaki and Wright (1989) search models
- Lucas and Stokey (1987) cash-in-advance models
- Sidrauski (1967) money-in-utility models
- McCallum and Goodfriend (1987) shopping time models.

Shopping time model

- Tractable model to confront data, therefore use reduced form approach as in shopping time models

Shopping time model

- Tractable model to confront data, therefore use reduced form approach as in shopping time models
- Money provides liquidity services and therefore reduces transaction costs for consumption purposes

Shopping time model

- Tractable model to confront data, therefore use reduced form approach as in shopping time models
- Money provides liquidity services and therefore reduces transaction costs for consumption purposes
- Everything else similar to life cycle models with uninsurable labor income risk (Deaton (1991) and Carroll (1997)) as extended in portfolio choice literature by Cocco, Gomes and Maenhout (2005)

Shopping time model

- Tractable model to confront data, therefore use reduced form approach as in shopping time models
- Money provides liquidity services and therefore reduces transaction costs for consumption purposes
- Everything else similar to life cycle models with uninsurable labor income risk (Deaton (1991) and Carroll (1997)) as extended in portfolio choice literature by Cocco, Gomes and Maenhout (2005)
- Our setting nests life cycle portfolio choice models when the transaction cost is zero and money does not circulate in the economy

Model

- Nominal version of life cycle portfolio choice models

Model

- Nominal version of life cycle portfolio choice models
- Households earn labor income subject to uninsurable shocks

Model

- Nominal version of life cycle portfolio choice models
- Households earn labor income subject to uninsurable shocks
- Borrowing and no short sale constraints exist

Model

- Nominal version of life cycle portfolio choice models
- Households earn labor income subject to uninsurable shocks
- Borrowing and no short sale constraints exist
- Can save through money holdings, nominal bonds and nominal stocks

Model

- Nominal version of life cycle portfolio choice models
- Households earn labor income subject to uninsurable shocks
- Borrowing and no short sale constraints exist
- Can save through money holdings, nominal bonds and nominal stocks
- Households can save in money and bonds but need to pay a one-time fixed cost to participate in the stock market

Households: Preferences

- Epstein-Zin-Weil Preferences

$$V_{it}^{j} = \left\{ \begin{array}{c} (1-\beta) C_{it}^{1-1/\psi_j} + \\ \beta \left(E_t \left[\begin{array}{c} \xi_t V_{it+1}^{1-\rho_j} \\ +(1-\xi_t) \varphi_j \left(\frac{X_{it+1}}{P_{t+1}} \right)^{1-\rho_j} \end{array} \right] \right)^{\frac{1-1/\psi_j}{1-\rho}} \end{array} \right\}^{\frac{1}{1-1/\psi_j}}$$

Households: Preferences

- Epstein-Zin-Weil Preferences

$$V_{it}^{j} = \left\{ \begin{array}{c} (1-\beta) C_{it}^{1-1/\psi_j} + \\ \beta \left(E_t \left[\begin{array}{c} \xi_t V_{it+1}^{1-\rho_j} \\ +(1-\xi_t)\varphi_j \left(\frac{X_{it+1}}{P_{t+1}} \right)^{1-\rho_j} \end{array} \right] \right)^{\frac{1-1/\psi_j}{1-\rho}} \end{array} \right\}^{\frac{1}{1-1/\psi_j}}$$

- Following Vissing-Jorgensen (2002) households are heterogeneous in their EIS (two equal-sized groups: high and low), also risk aversion and bequest heterogeneity

Households: Preferences

- Epstein-Zin-Weil Preferences

$$V_{it}^{j} = \left\{ \begin{array}{c} (1-\beta) C_{it}^{1-1/\psi_j} + \\ \beta \left(E_t \left[\begin{array}{c} \xi_t V_{it+1}^{1-\rho_j} \\ +(1-\xi_t) \varphi_j \left(\frac{X_{it+1}}{P_{t+1}} \right)^{1-\rho_j} \end{array} \right] \right)^{\frac{1-1/\psi_j}{1-\rho}} \end{array} \right\}^{\frac{1}{1-1/\psi_j}}$$

- Following Vissing-Jorgensen (2002) households are heterogeneous in their EIS (two equal-sized groups: high and low), also risk aversion and bequest heterogeneity
- Stockholders can invest in fiat money (M_{it}), nominal bonds (B_{it}) and nominal stocks (S_{it}) after they have incurred a one-time fixed cost.

Households: Preferences

- Epstein-Zin-Weil Preferences

$$V_{it}^{j} = \left\{ \begin{array}{c} (1-\beta) C_{it}^{1-1/\psi_j} + \\ \beta \left(E_t \left[\begin{array}{c} \xi_t V_{it+1}^{1-\rho_j} \\ +(1-\xi_t) \varphi_j \left(\frac{X_{it+1}}{P_{t+1}} \right)^{1-\rho_j} \end{array} \right] \right)^{\frac{1-1/\psi_j}{1-\rho}} \end{array} \right\}^{\frac{1}{1-1/\psi_j}}$$

- Following Vissing-Jorgensen (2002) households are heterogeneous in their EIS (two equal-sized groups: high and low), also risk aversion and bequest heterogeneity
- Stockholders can invest in fiat money (M_{it}), nominal bonds (B_{it}) and nominal stocks (S_{it}) after they have incurred a one-time fixed cost.
- Non-stockholders can invest in money and bonds without incurring any cost.

Households: Labor Income

- Identical labor income processes ex ante

Households: Labor Income

- Identical labor income processes ex ante
- Idiosyncratic component has both permanent and transitory components

$$Y_{it} = Y_{it}^{p} U_{it}$$

and

$$Y_{it}^{p} = \exp(f(t, Z_{it})) Y_{it-1}^{p} N_{it}$$

Households: Labor Income

- Identical labor income processes ex ante
- Idiosyncratic component has both permanent and transitory components

$$Y_{it} = Y_{it}^{p} U_{it}$$

and

$$Y_{it}^{p} = \exp(f(t, Z_{it})) Y_{it-1}^{p} N_{it}$$

- Earnings in retirement are $Y_{it} = \lambda Y_{iK}^{p}$ where K is the exogenous retirement age (65).

Households: Labor Income

- Identical labor income processes ex ante
- Idiosyncratic component has both permanent and transitory components

$$Y_{it} = Y_{it}^{p} U_{it}$$

and

$$Y_{it}^{p} = \exp(f(t, Z_{it})) Y_{it-1}^{p} N_{it}$$

- Earnings in retirement are $Y_{it} = \lambda Y_{iK}^{p}$ where K is the exogenous retirement age (65).
- Treatment of housing expenditures.

Households: Budget Constraint

- Household budget constraint is given by

$$X_{it} = P_t C_{it} + S_{it} + B_{it} + M_{it} + 1_t(.) P_t FY_{it}^p$$

Households: Budget Constraint

- Household budget constraint is given by

$$X_{it} = P_t C_{it} + S_{it} + B_{it} + M_{it} + 1_t(.) P_t F Y_{it}^p$$

- Total financial wealth evolves as

$$\begin{aligned} X_{it+1} &= R_{t+1}^s S_{it} + R_{t+1}^b B_{it} + M_{it} \\ &\quad + P_{t+1} Y_{it+1} - P_{t+1} \Omega_{it} Y_{it}^p \end{aligned}$$

Households: Budget Constraint

- Household budget constraint is given by

$$X_{it} = P_t C_{it} + S_{it} + B_{it} + M_{it} + 1_t(.) P_t F Y_{it}^p$$

- Total financial wealth evolves as

$$\begin{aligned} X_{it+1} &= R_{t+1}^s S_{it} + R_{t+1}^b B_{it} + M_{it} \\ &\quad + P_{t+1} Y_{it+1} - P_{t+1} \Omega_{it} Y_{it}^p \end{aligned}$$

- F is the one-time fixed cost of stock market participation and is only paid when the indicator for first time access is one.

Households: Shopping Cost

- To generate money holdings, we assume a shopping cost transaction friction: a direct physical cost in consumption goods:

$$\Omega_{it} Y_{it}^{p} = \Omega(C_{it}, M_{it}/P_t; \varepsilon), \quad \Omega_C > 0, \quad \Omega_M < 0$$

Households: Shopping Cost

- To generate money holdings, we assume a shopping cost transaction friction: a direct physical cost in consumption goods:

$$\Omega_{it} Y_{it}^p = \Omega(C_{it}, M_{it}/P_t; \varepsilon), \quad \Omega_C > 0, \quad \Omega_M < 0$$

- In the benchmark case we assume

$$\Omega_{it} Y_{it}^p = \varepsilon \frac{C_{it}}{M_{it}/P_t} Y_{it}^p, \quad \varepsilon \geqq 0$$

which means

$$\Omega_{it} = \varepsilon \frac{c_{it}}{m_{it}}, \quad \varepsilon \geqq 0$$

Households: Shopping Cost

- To generate money holdings, we assume a shopping cost transaction friction: a direct physical cost in consumption goods:

$$\Omega_{it} Y_{it}^p = \Omega(C_{it}, M_{it}/P_t; \varepsilon), \quad \Omega_C > 0, \quad \Omega_M < 0$$

- In the benchmark case we assume

$$\Omega_{it} Y_{it}^p = \varepsilon \frac{C_{it}}{M_{it}/P_t} Y_{it}^p, \quad \varepsilon \geqq 0$$

  which means

$$\Omega_{it} = \varepsilon \frac{c_{it}}{m_{it}}, \quad \varepsilon \geqq 0$$

- Interpretation: transaction cost is opportunity cost of time

Households: Shopping Cost

- To generate money holdings, we assume a shopping cost transaction friction: a direct physical cost in consumption goods:

$$\Omega_{it} Y_{it}^p = \Omega(C_{it}, M_{it}/P_t; \varepsilon), \quad \Omega_C > 0, \quad \Omega_M < 0$$

- In the benchmark case we assume

$$\Omega_{it} Y_{it}^p = \varepsilon \frac{C_{it}}{M_{it}/P_t} Y_{it}^p, \quad \varepsilon \geqq 0$$

  which means

$$\Omega_{it} = \varepsilon \frac{c_{it}}{m_{it}}, \quad \varepsilon \geqq 0$$

- Interpretation: transaction cost is opportunity cost of time
- Functional form is consistent with Lucas (2000), who shows that the implied money demand function is consistent with Baumol-Tobin type models.

Normalizations

- Need to normalize by growth rate in prices and in permanent component of labor income

$$x_{it+1} = \frac{r^s_{t+1}}{g_{it+1}} s_{it} + \frac{r^b_{t+1}}{g_{it+1}} b_{it} + \frac{r^m_{t+1}}{g_{it+1}} m_{it} + U_{it+1} - \frac{\Omega_{it}}{g_{it+1}}$$

where

$$x_{it} = X_{it} / (Y^p_{it} P_t)$$

and the real rates of return are

$$r^s_{t+1} \equiv R^s_{t+1} \pi^{-1}_{t+1}, \quad r^b_{t+1} \equiv R^b_{t+1} \pi^{-1}_{t+1}, \quad r^m_{t+1} \equiv \pi^{-1}_{t+1}$$

and $\pi_{t+1} \equiv P_{t+1} / P_t$ denotes gross inflation, and $g_{it+1} \equiv Y^p_{it+1} / Y^p_{it}$ is the gross growth rate of permanent income.

Estimation

- Estimate preference parameters that can generate model moments

Estimation

- Estimate preference parameters that can generate model moments
- Given large number of parameters, we calibrate some and estimate preference ones

Estimation

- Estimate preference parameters that can generate model moments
- Given large number of parameters, we calibrate some and estimate preference ones
- The calibration for labor income uses the estimates in Cocco et al (2005) for educated households and $\sigma_u = 0.1$, $\sigma_n = 0.08$, and $\lambda = 0.68$

Estimation (cont'd)

- Annual CRSP data for US but use shorter period given our cross sectional calibration (from 1995 to 2008)

Means and Standard Deviations

Variable	Mean	S. D.
Inflation	2.5	1.0
Bond Returns	2.4	2.6
Stock Returns	6.4	18.0
Wage growth	2.7	2.0

Estimation (cont'd)

- Annual CRSP data for US but use shorter period given our cross sectional calibration (from 1995 to 2008)

Means and Standard Deviations

Variable	Mean	S. D.
Inflation	2.5	1.0
Bond Returns	2.4	2.6
Stock Returns	6.4	18.0
Wage growth	2.7	2.0

- Correlations from 1995-2008 period: bond and stock returns correlation is zero, as is correlation between inflation and real wage growth

Estimation (cont'd)

- Annual CRSP data for US but use shorter period given our cross sectional calibration (from 1995 to 2008)

Means and Standard Deviations

Variable	Mean	S. D.
Inflation	2.5	1.0
Bond Returns	2.4	2.6
Stock Returns	6.4	18.0
Wage growth	2.7	2.0

- Correlations from 1995-2008 period: bond and stock returns correlation is zero, as is correlation between inflation and real wage growth
- Correlation between inflation and bond returns is -0.5, inflation and stock returns is 0.25 and wage growth and bond and stock returns at 0.4.

Estimation (cont'd)

- Which moments to match?

Estimation (cont'd)

- Which moments to match?
- 5 age-related financial wealth to labor income ratios for stockholders and non-stockholders and the mean participation rate

Estimation (cont'd)

- Which moments to match?
- 5 age-related financial wealth to labor income ratios for stockholders and non-stockholders and the mean participation rate
- Match the two shares (money and stocks say with bonds determined as a residual) for stockholders and money for non-stockholders.

Estimation (cont'd)

- Which moments to match?
- 5 age-related financial wealth to labor income ratios for stockholders and non-stockholders and the mean participation rate
- Match the two shares (money and stocks say with bonds determined as a residual) for stockholders and money for non-stockholders.
- Total of 26 moment conditions.

Estimation (cont'd)

- Which moments to match?
- 5 age-related financial wealth to labor income ratios for stockholders and non-stockholders and the mean participation rate
- Match the two shares (money and stocks say with bonds determined as a residual) for stockholders and money for non-stockholders.
- Total of 26 moment conditions.
- Calibrated parameters are
  $\{\varphi_L = 0.0, \psi_H = 0.5, \psi_L = 0.3, \rho_H = 5.0, \rho_L = 1.3\}$

Estimation (cont'd)

- Which moments to match?
- 5 age-related financial wealth to labor income ratios for stockholders and non-stockholders and the mean participation rate
- Match the two shares (money and stocks say with bonds determined as a residual) for stockholders and money for non-stockholders.
- Total of 26 moment conditions.
- Calibrated parameters are $\{\varphi_L = 0.0, \psi_H = 0.5, \psi_L = 0.3, \rho_H = 5.0, \rho_L = 1.3\}$
- Estimation: $\beta, \varepsilon_w, \varepsilon_r, F$ where ε_w denotes the shopping cost for workers and ε_r the one for retirees and F is fixed cost.

Results

- Estimated structural parameters

Structural Parameters	
Parameter	Value
F	$0.0385(0.01)$
b	$0.93(0.01)$
φ_H	$4.2(0.02)$
ε_H	$0.012(0.003)$
ε_L	$0.00006(0.00001)$

- Fixed cost consistent with previous studies (eg Alan (2006), Gomes and Michaelides (2005))

Results

- Estimated structural parameters

Structural Parameters	
Parameter	Value
F	$0.0385(0.01)$
b	$0.93(0.01)$
φ_H	$4.2(0.02)$
ε_H	$0.012(0.003)$
ε_L	$0.00006(0.00001)$

- Fixed cost consistent with previous studies (eg Alan (2006), Gomes and Michaelides (2005))
- Bequest consistent with De Nardi (2004)

Results

- Estimated structural parameters

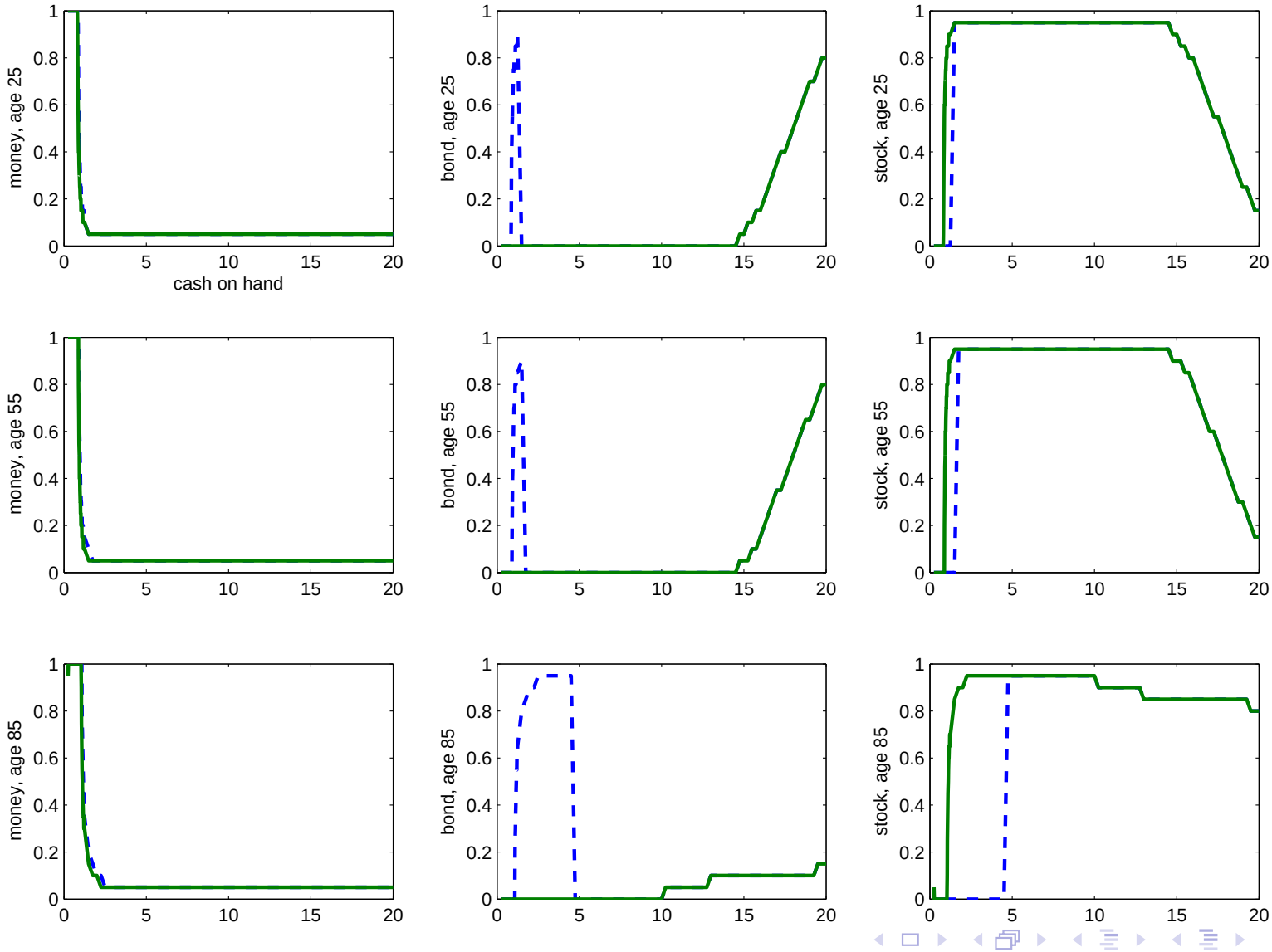
Structural Parameters

Parameter	Value
F	$0.0385(0.01)$
b	$0.93(0.01)$
φ_H	$4.2(0.02)$
ε_H	$0.012(0.003)$
ε_L	$0.00006(0.00001)$

- Fixed cost consistent with previous studies (eg Alan (2006), Gomes and Michaelides (2005))
- Bequest consistent with De Nardi (2004)
- Shopping cost between 0.5-2.0% of mean annual labor income: consistent with Lucas (2000) calibration, except during retirement

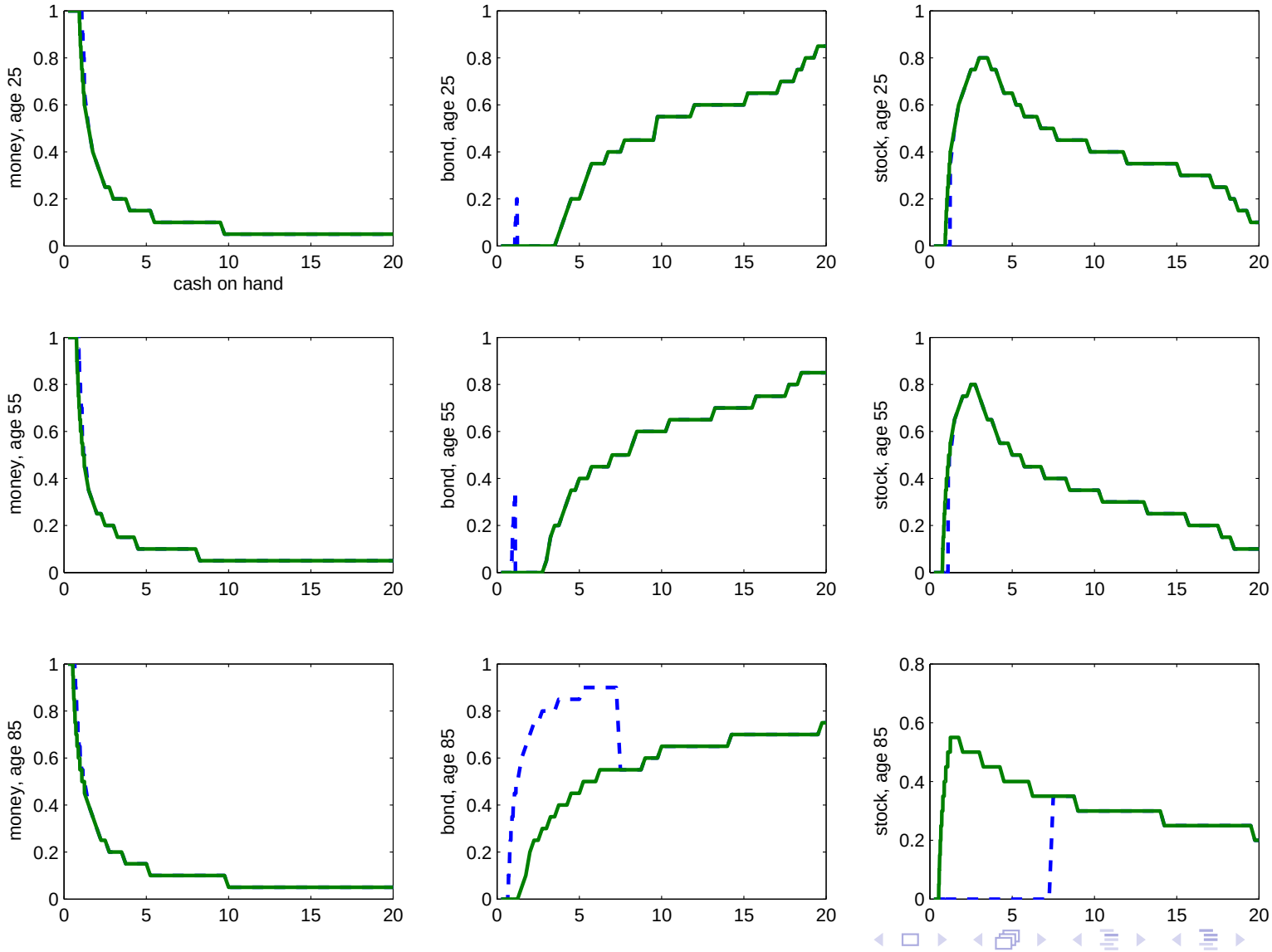
Policy Functions: Low EIS, low RRA

Figure 1: Policy functions: low IES, low RRA



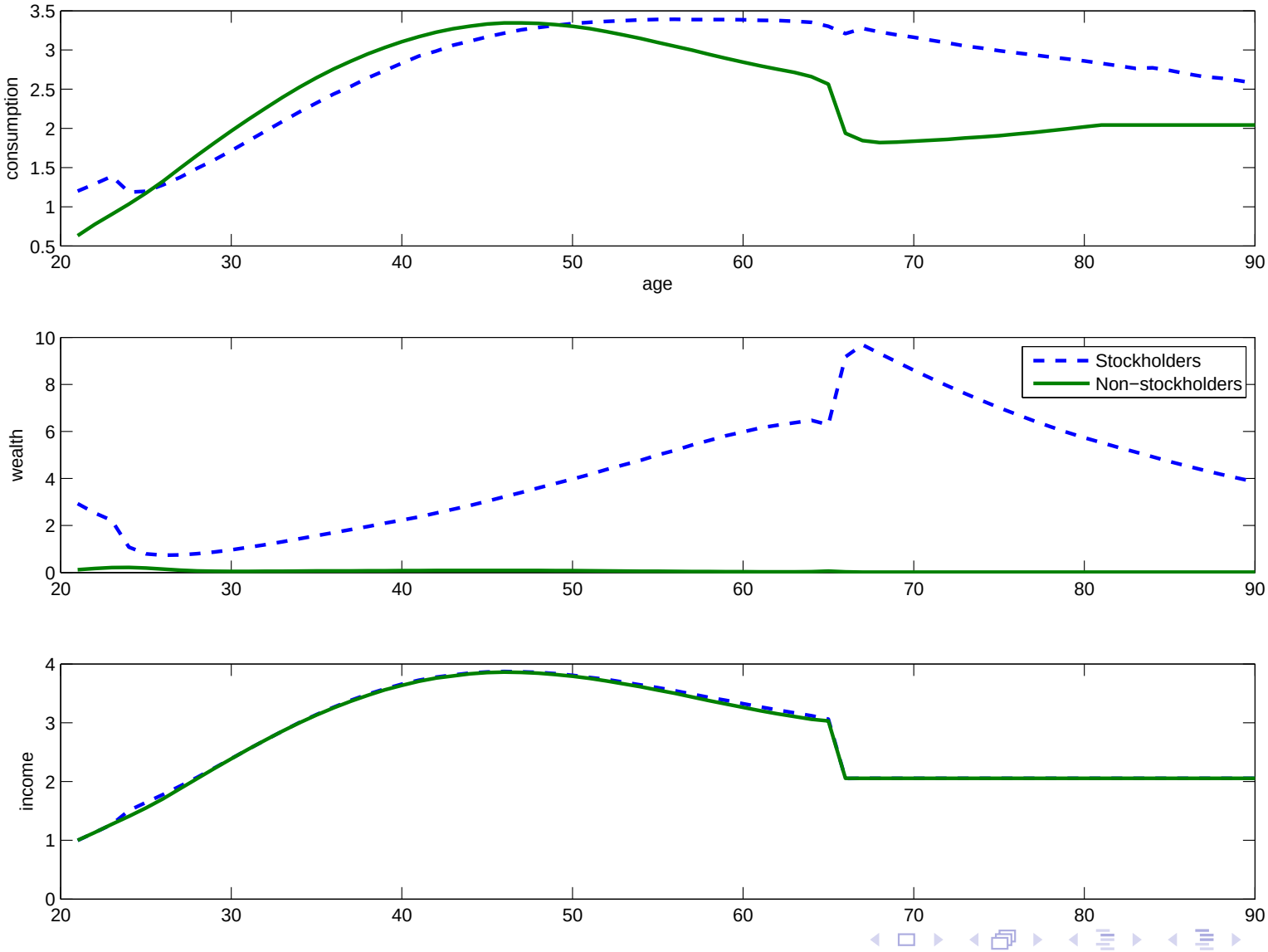
Policy Functions: High EIS, high RRA

Figure 2: Policy functions: high IES, high RRA



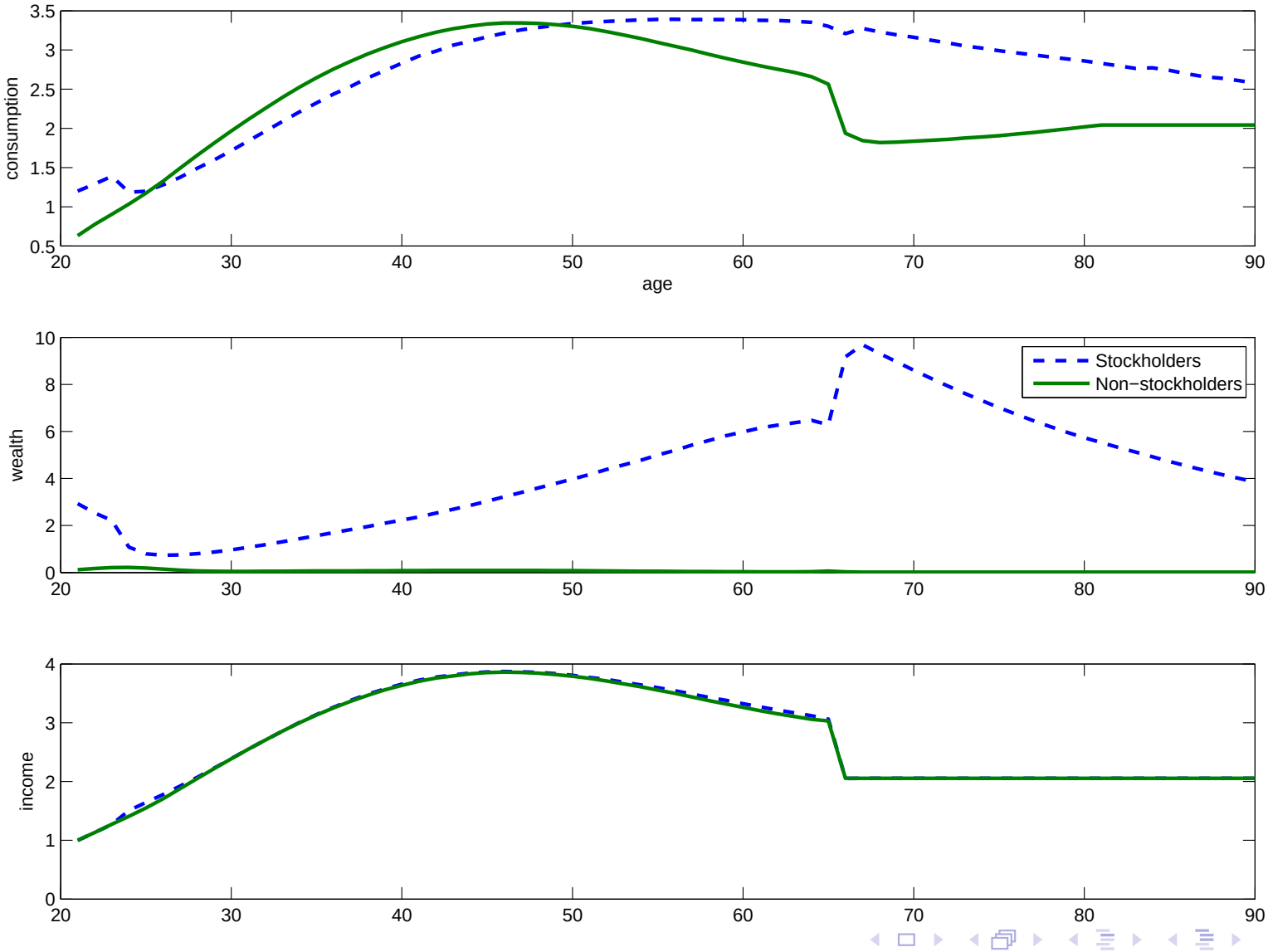
Simulations

Figure 3: Consumption, financial wealth and income over the life cycle: Baseline model



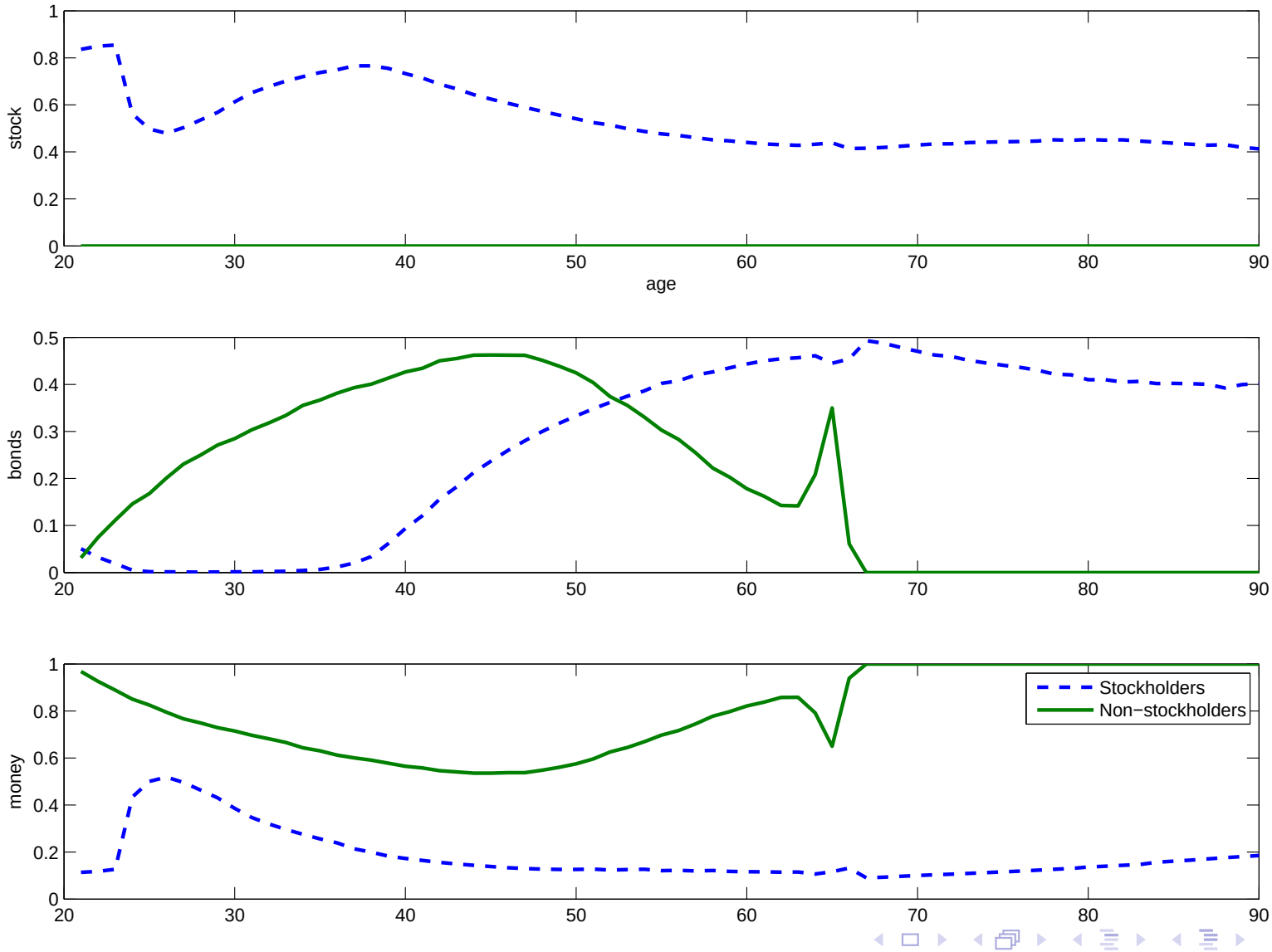
Simulations

Figure 3: Consumption, financial wealth and income over the life cycle: Baseline model



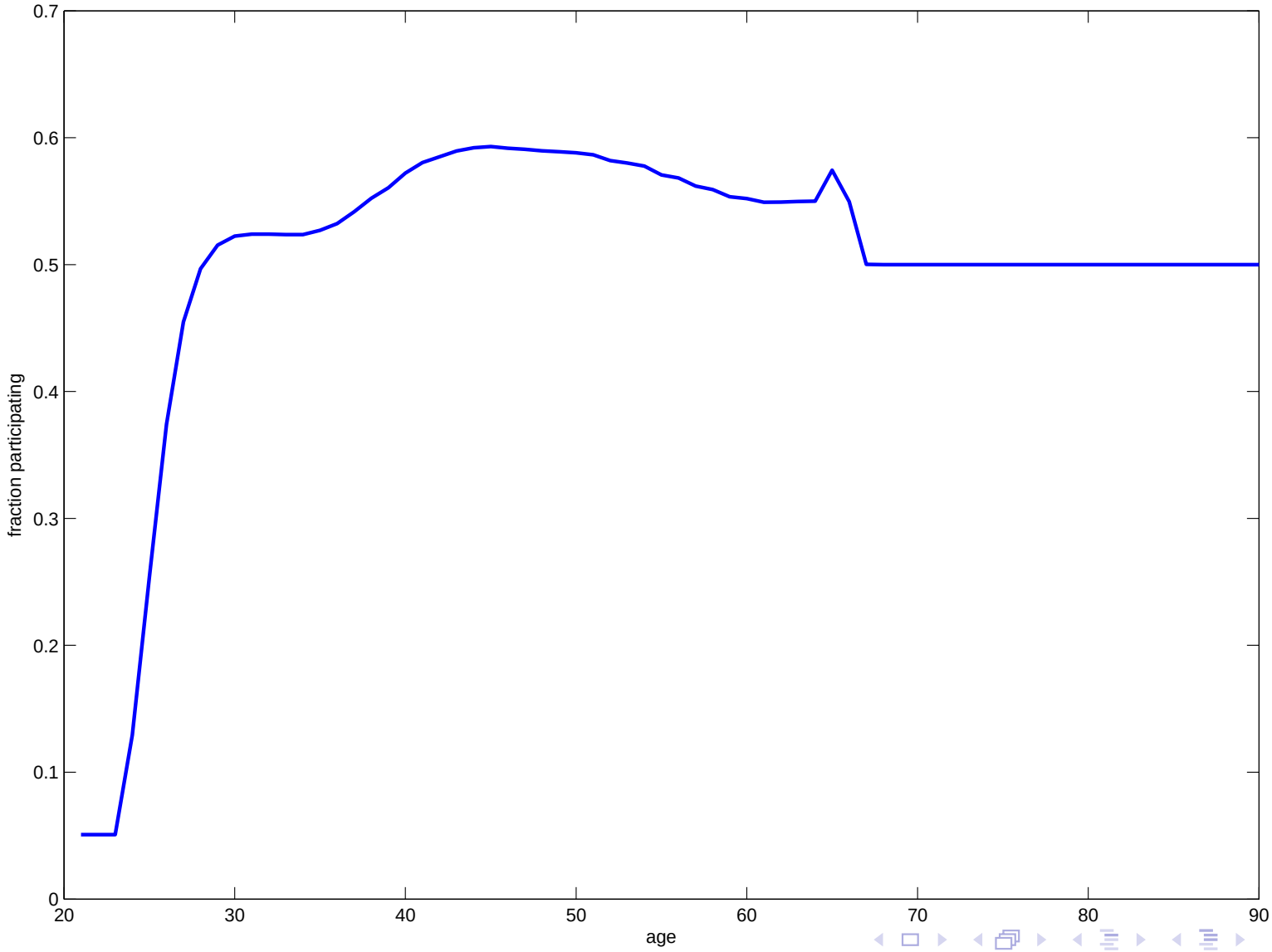
Simulations

Figure 4: Portfolio choice over the life cycle: Baseline model



Stock Market Participation

Figure 5: Stock market participation over the life cycle: Baseline model



Model vs Data

The Wealth Moments
Mean Financial Wealth/Income: Data vs Model

Age Group	NonStockholders		Stockholders	
	Data	Model	Data	Model
20-34	0.31	0.11	0.85	1.34
35-45	0.26	0.08	1.53	2.18
46-55	0.56	0.08	2.65	3.88
56-65	0.77	0.04	7.02	5.80
66-75	2.48	0.03	15.7	8.34

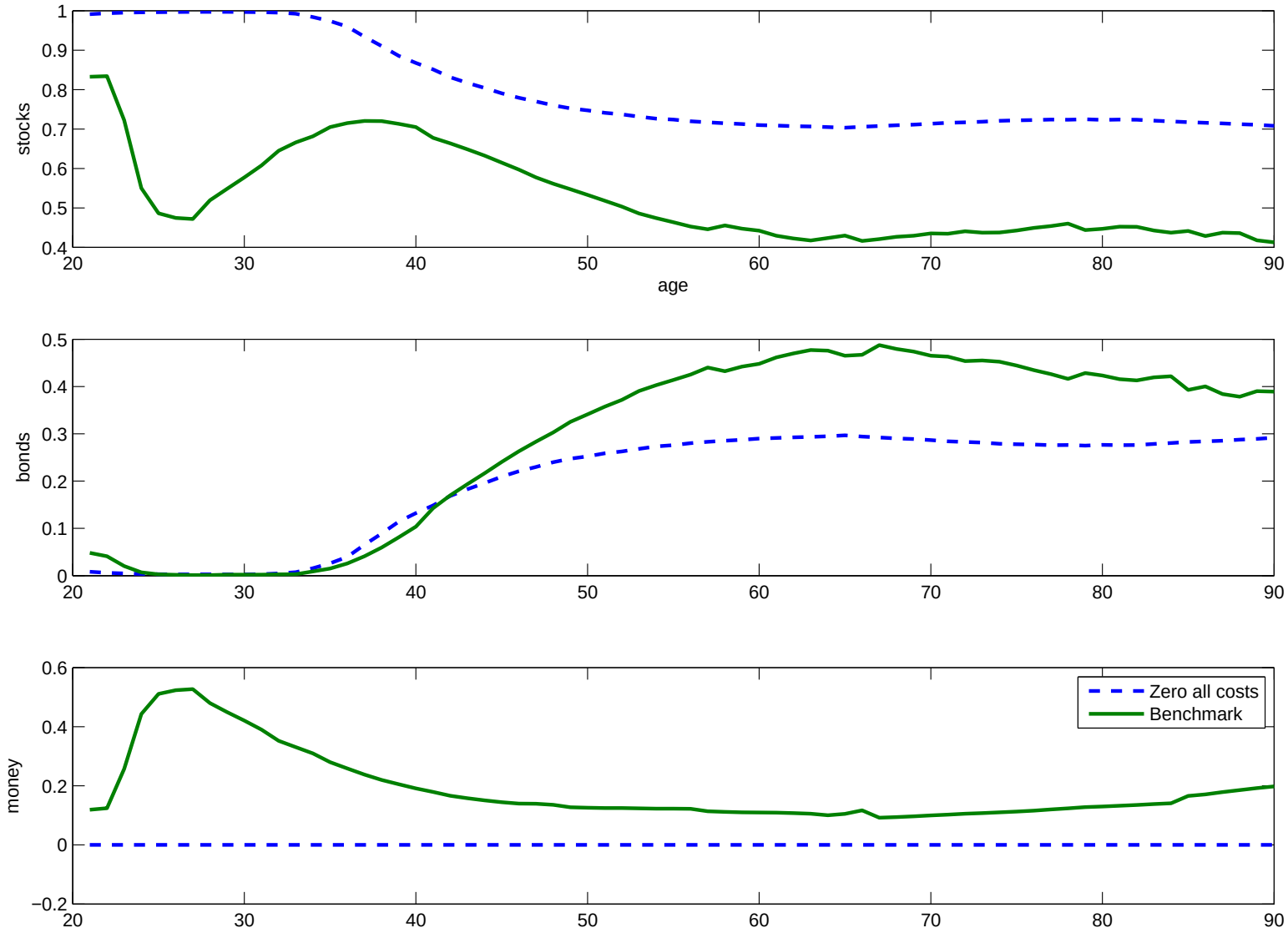
Model vs Data (cont'd)

Life Cycle Portfolio Choice by Age

	Non-Stockholders		Stockholders			
Age	Data	Model	Data	Model	Data	Model
Group	α_m	α_m	α_m	α_m	α_s	α_s
20-34	75.8	77.9	28.6	34.4	41.5	64.6
35-44	67.9	57.6	16.7	18.8	48.0	72.3
45-54	62.5	58.3	14.4	12.9	48.0	55.3
55-64	59.1	78.9	13.5	11.8	47.8	44.8
65+	63.3	98.4	16.2	10.6	41.8	42.9

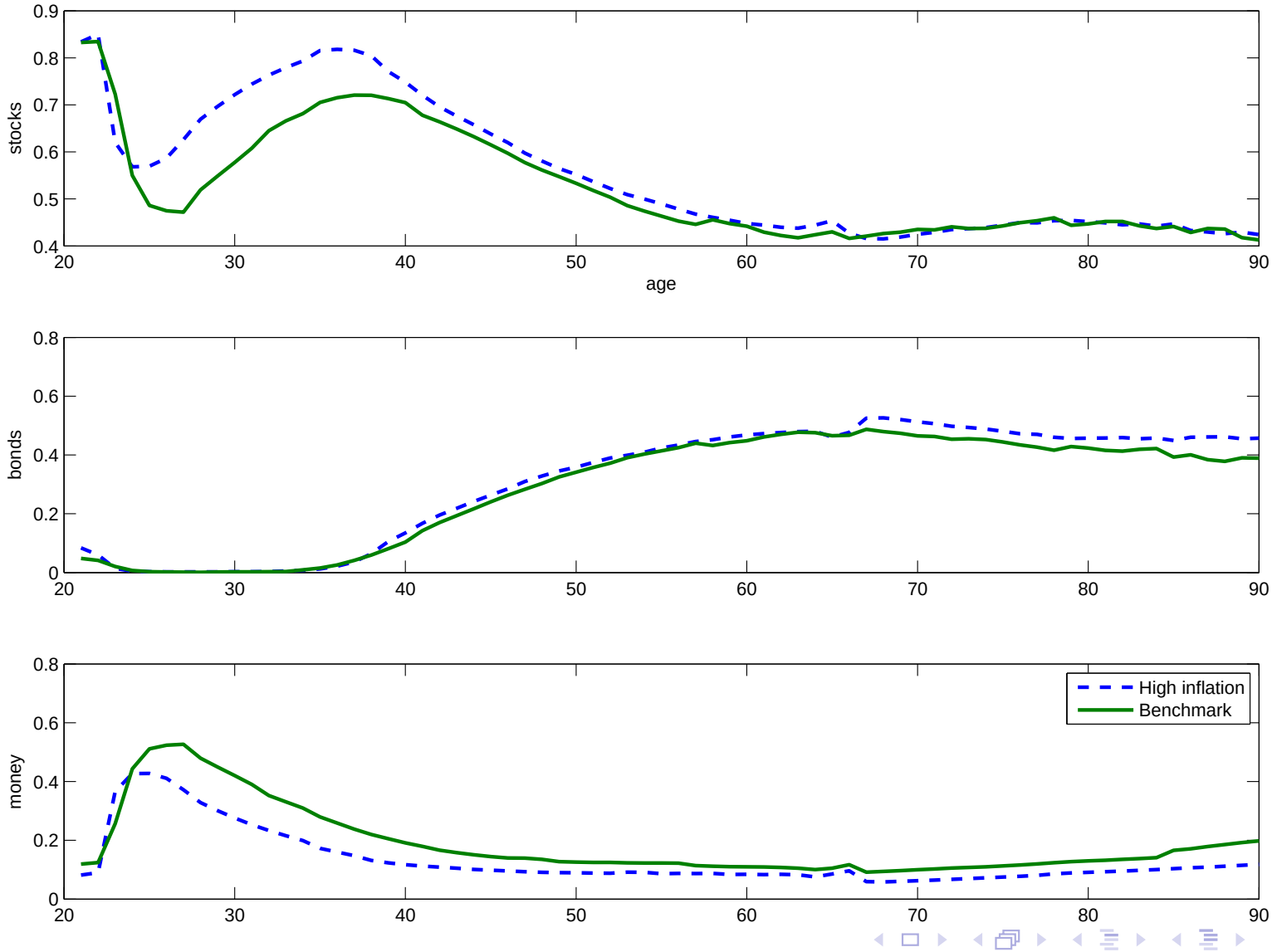
Comparative Statics: No money case for stockholders

Figure 6: Stockholder portfolios over the life−cycle: No shopping and participation costs versus Baseline Model



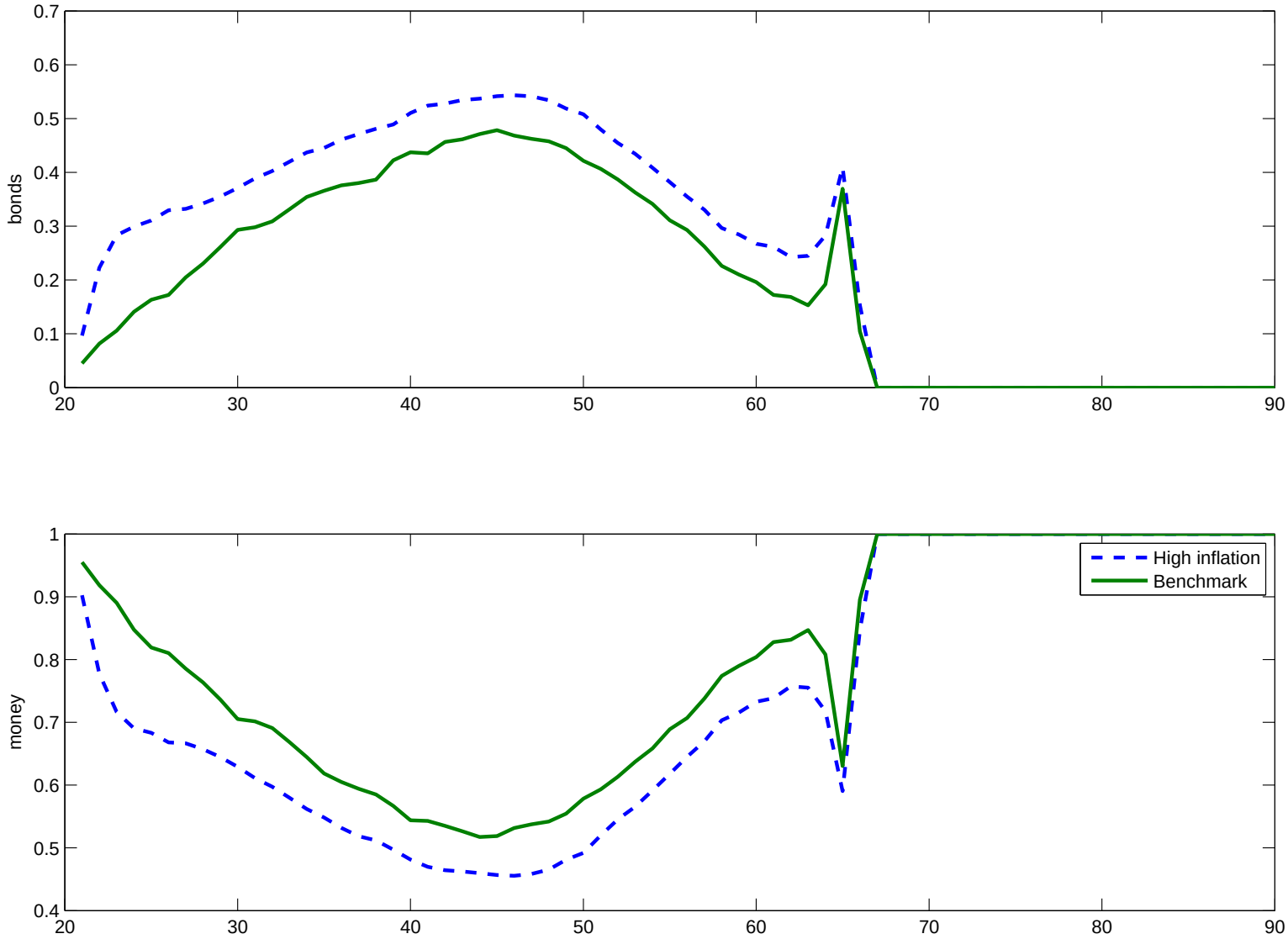
Comparative Statics: High inflation for stockholders

Figure 7: Stockholder portfolios over the life cycle: High Mean Inflation (10% per annum) versus Baseline Model (2.5% per annum)



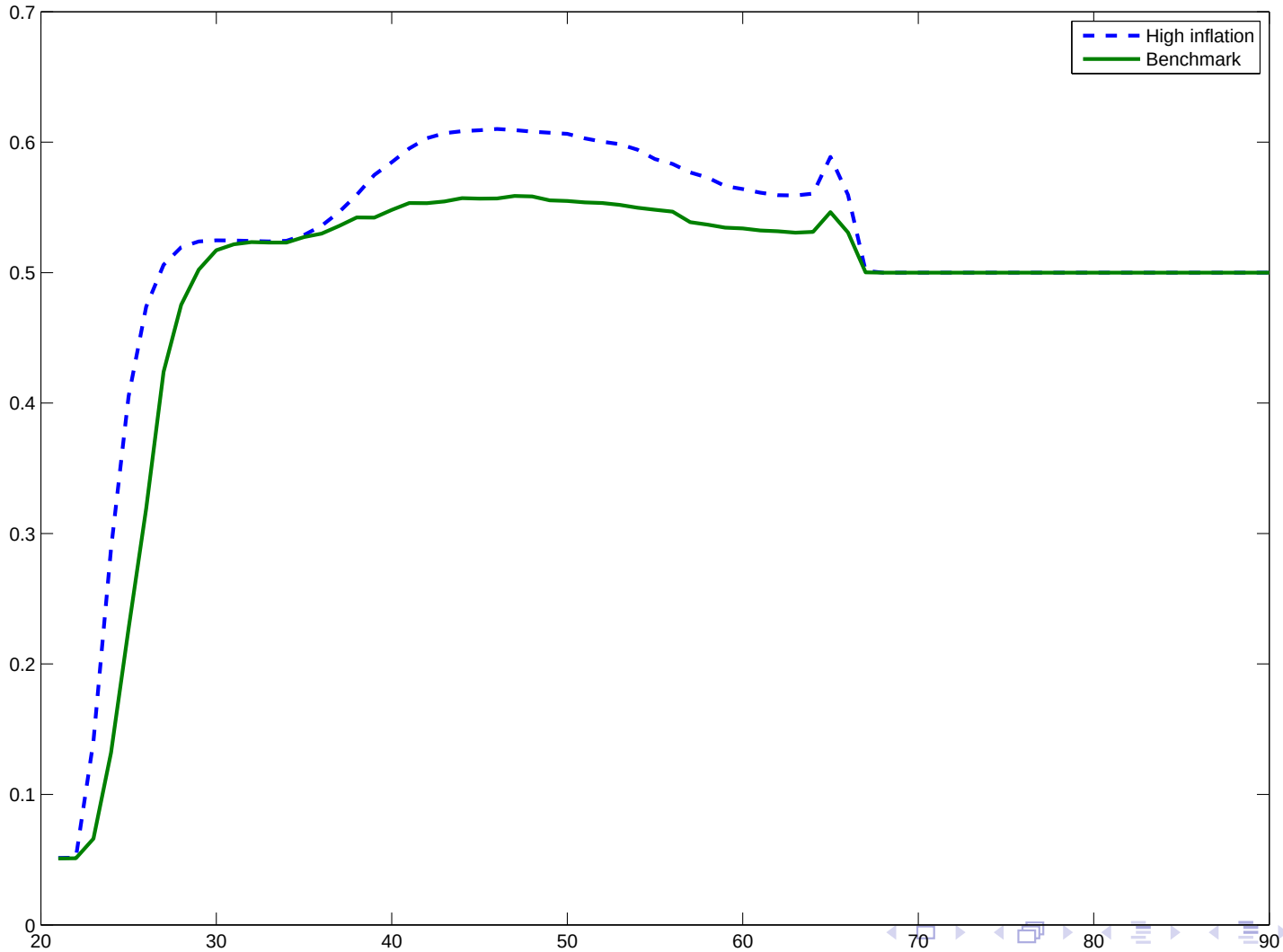
Comparative Statics: High inflation for non-stockholders

Figure 8: Non−stockholder portfolios over the life cycle: High Mean Inflation (10% per annum) versus Baseline Model (2.5% per annum)



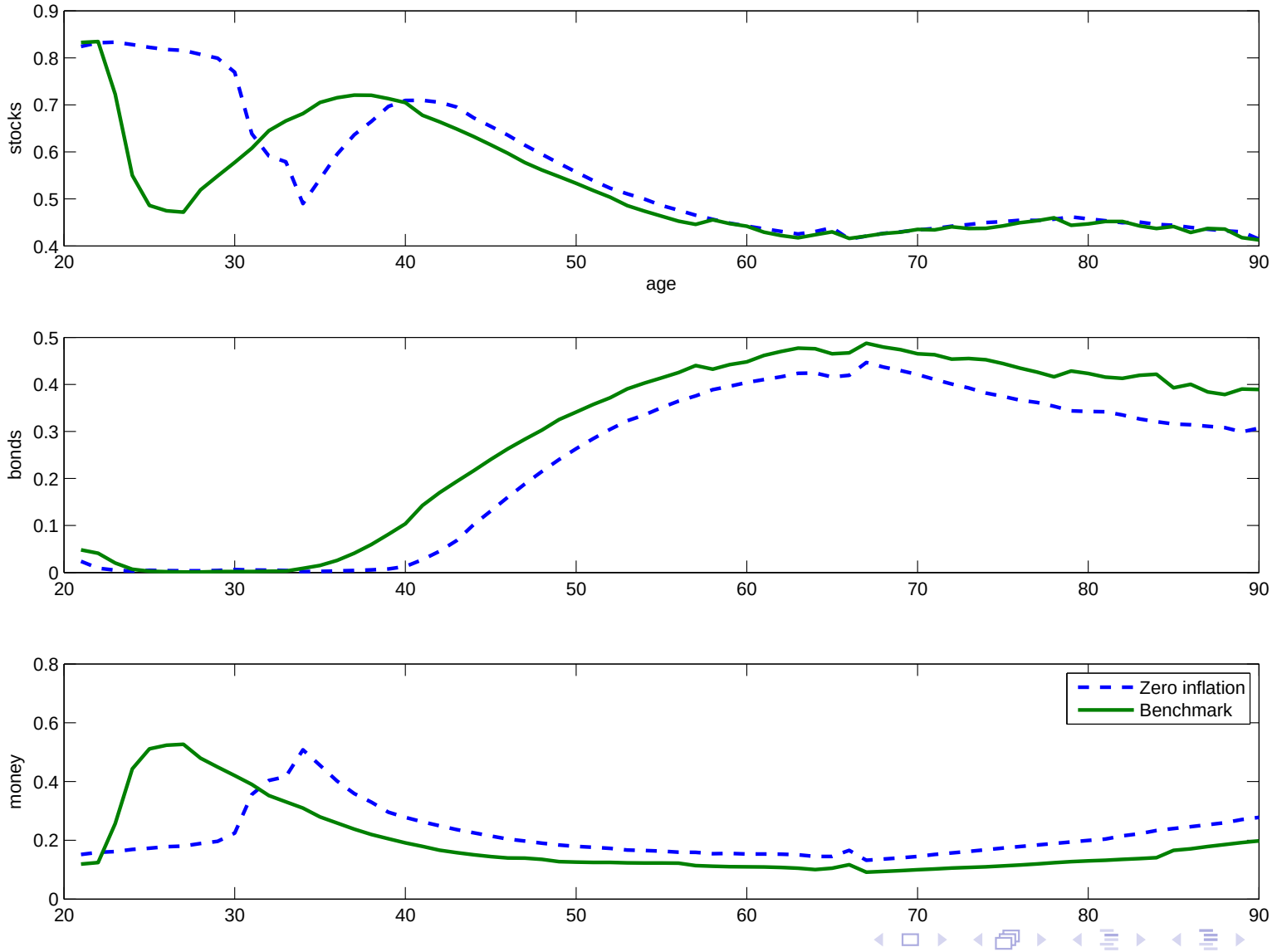
Comparative Statics: High inflation and stock market participation

Figure 10: Stock market participation: High Mean Inflation (10% per annum) versus Baseline Model (2.5% per annum)



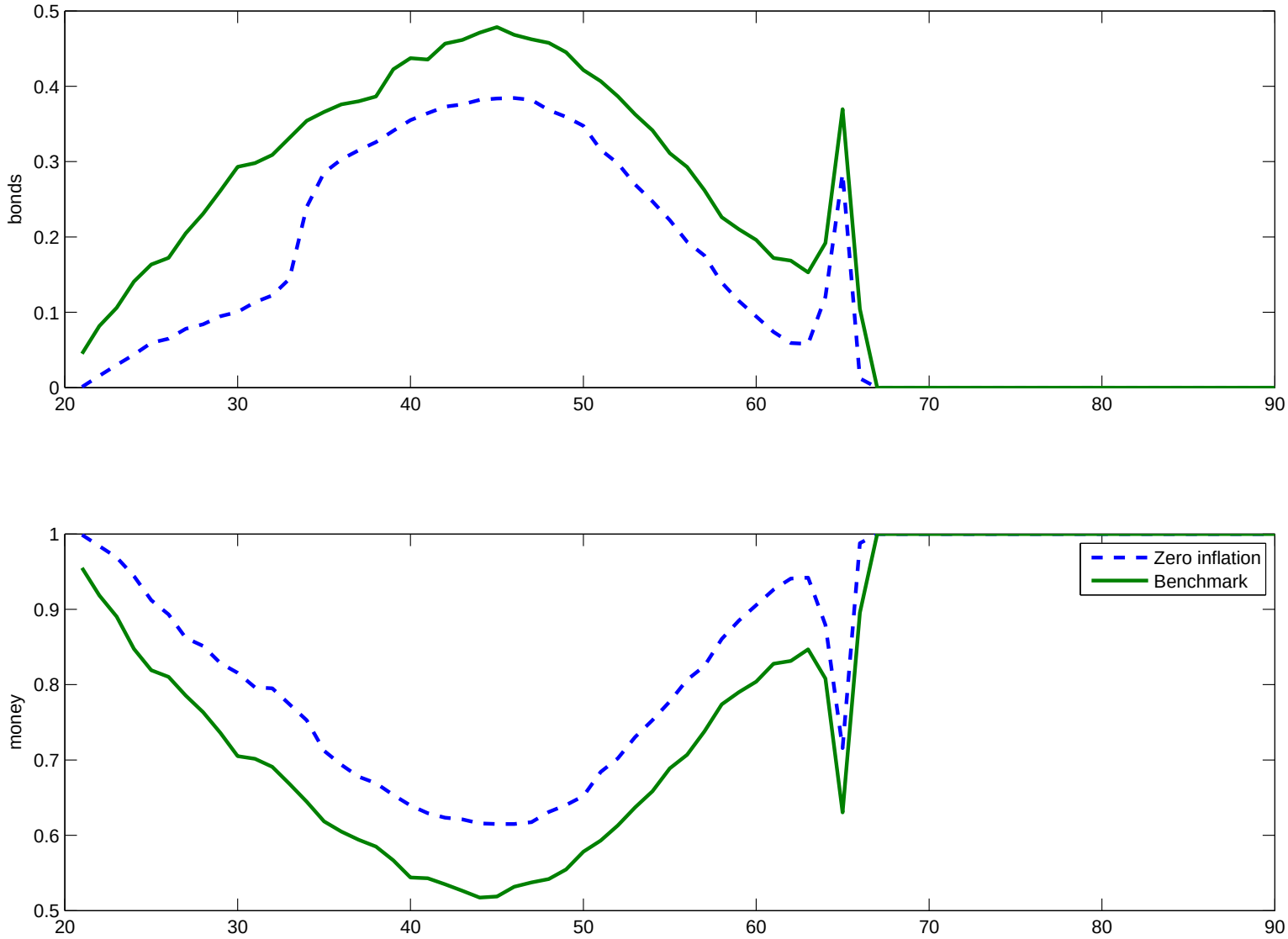
Comparative Statics: Zero Inflation for Stockholders

Figure 11: Stockholder Portfolios over the life cycle: Zero Mean Inflation versus Baseline Model (2.5% per annum)



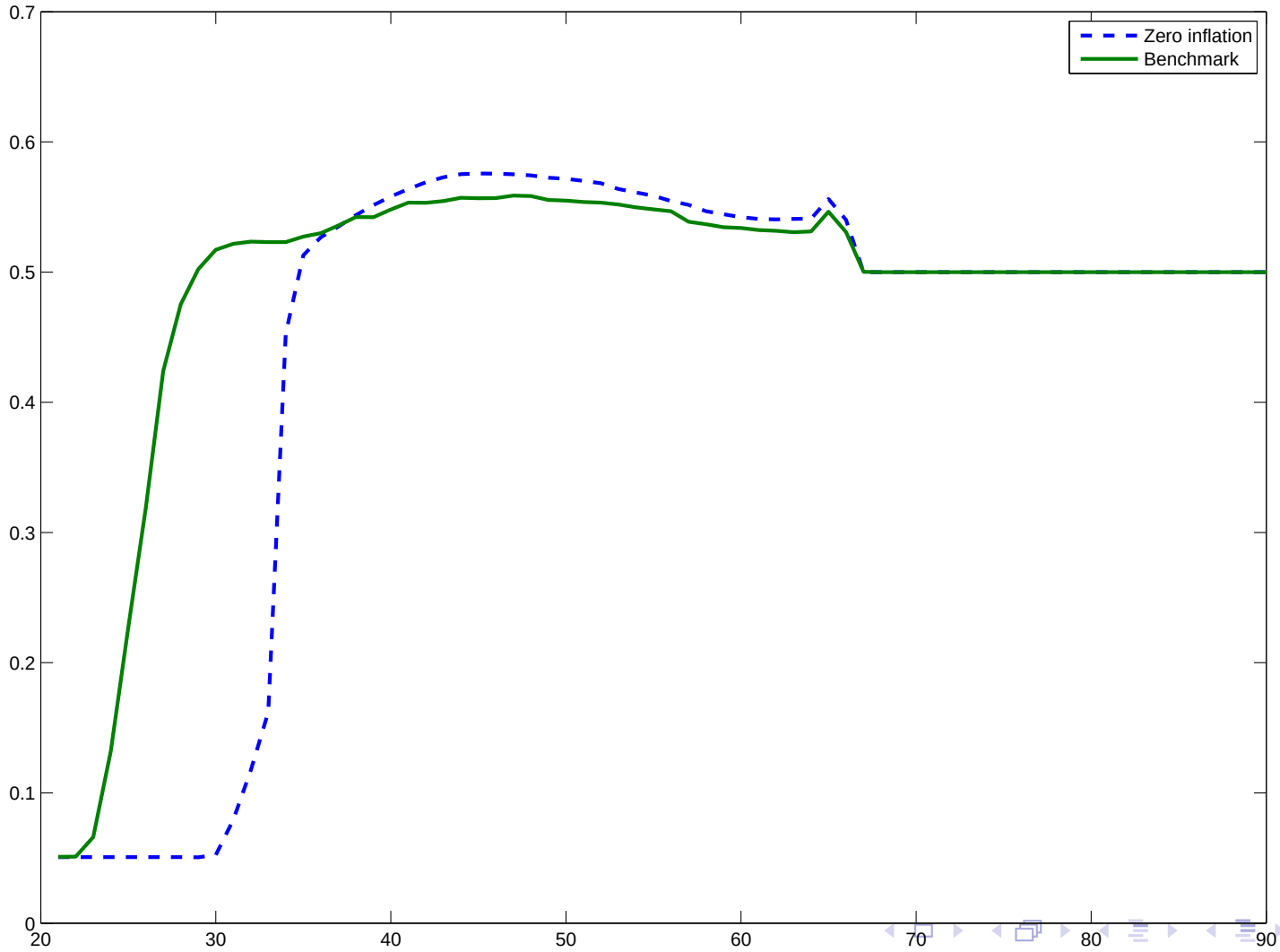
Comparative Statics: Zero Inflation for Non-Stockholders

Figure 12: Non−stockholder portfolios over the life cycle: Zero Mean Inflation versus Baseline Model (2.5% per annum)



Comparative Statics: Zero inflation and stock market participation

Figure 14: Stock Market Participation: Zero Mean Inflation versus Baseline Model (2.5% per annum)



Hedging demands

- Higher inflation volatility

Hedging demands

- Higher inflation volatility
- Correlation of inflation with stock returns set to zero

Hedging demands

- Higher inflation volatility
- Correlation of inflation with stock returns set to zero
- Correlation of inflation with bond returns set to zero

Hedging demands

- Higher inflation volatility
- Correlation of inflation with stock returns set to zero
- Correlation of inflation with bond returns set to zero
- Hedging demands very low. Presumably idiosyncratic uncertainty key.

Hedging demands

- Higher inflation volatility
- Correlation of inflation with stock returns set to zero
- Correlation of inflation with bond returns set to zero
- Hedging demands very low. Presumably idiosyncratic uncertainty key.
- Further work needed to understand interaction between aggregate and idiosyncratic uncertainty, what agents know and how they form expectations (for instance, separating aggregate from idiosyncratic shocks and learning)

Summary/Conclusions

- Structural model of stock market participation, money demand and portfolio choice over the life cycle

Summary/Conclusions

- Structural model of stock market participation, money demand and portfolio choice over the life cycle
- Model can be used to examine how inflation/deflation affects money demand, saving and portfolio choice.

Summary/Conclusions

- Structural model of stock market participation, money demand and portfolio choice over the life cycle
- Model can be used to examine how inflation/deflation affects money demand, saving and portfolio choice.
- Work in progress: Estimation and persistent processes to investigate hedging demand results