Learning From Stock Prices

And Economic Growth

Joel Peress
INSEAD

Motivation

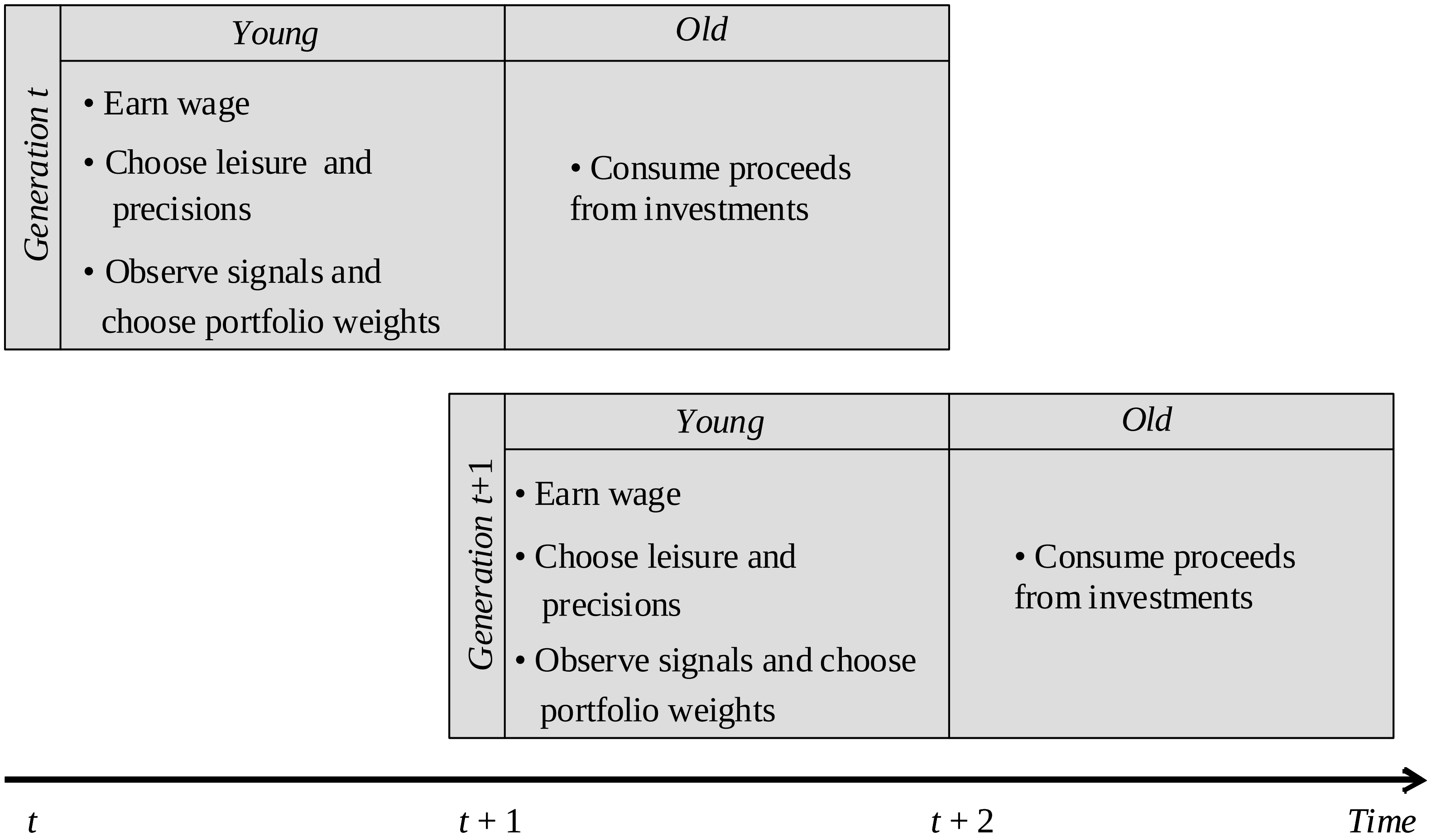
- What is the role of the stock market for economic growth?
  - Focus on informational frictions
  - Levine (1997): "Existing theories have not yet assembled the links in the chain from the functioning of stock markets, to information acquisition, and finally to aggregate long-run economic growth"
- Embed a stock market with informative stock prices into a neoclassical growth economy
  - Study the production of information and its dissemination through stock prices
  - Characterize various aspects of growth path: level and growth rate of income, precision of information, efficiency of investments, TFP, degree of economic specialization, wealth inequality, trading volume, liquidity, volatility

Sketch of the Model

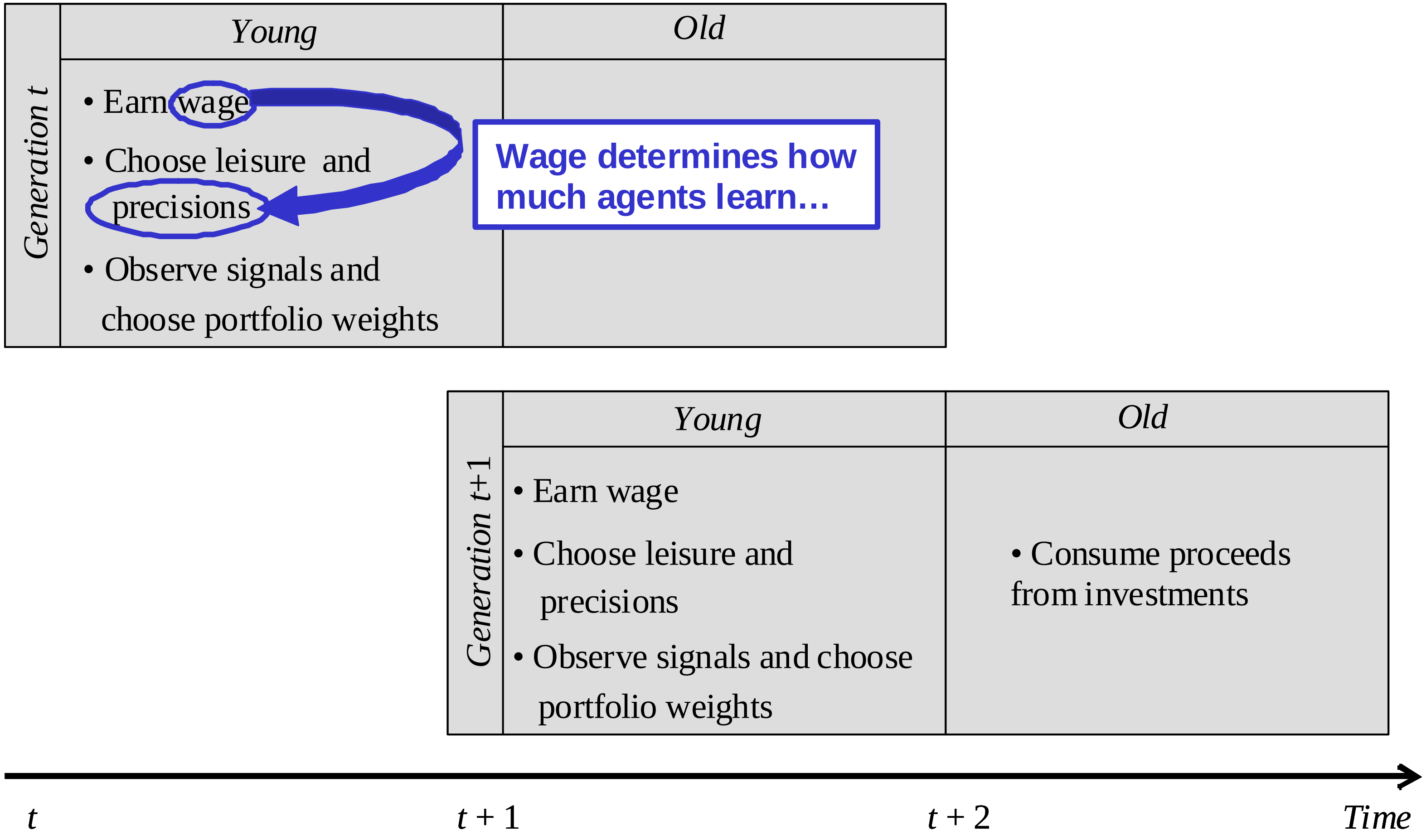
- Backbone of the model is a neoclassical OLG model
  - Each generation = a continuum of agents
  - Endowed with 1 unit of labor time, and 1 unit of free time (for leisure or learning)
  - Two sectors:
    - 1 final good (invest at $t \longrightarrow$ yields at t)
    - M intermediate goods (invest at $t \longrightarrow$ yields at $t+1$)
  - Young work in final good sector, invest wage in intermediate firms through SM
  - Agents derive utility from consumption of final goods and leisure
  - No technological progress, no population growth

- Embed a competitive stock market in the spirit of Grossman and Stiglitz (1980)
  - Intermediate firms (= stocks) are subject to random productivity shocks
  - Investors can acquire private signals about them at the expense of leisure time
  - Signals are revealed through stock prices, but only partially because of noise trading
  - No riskless asset

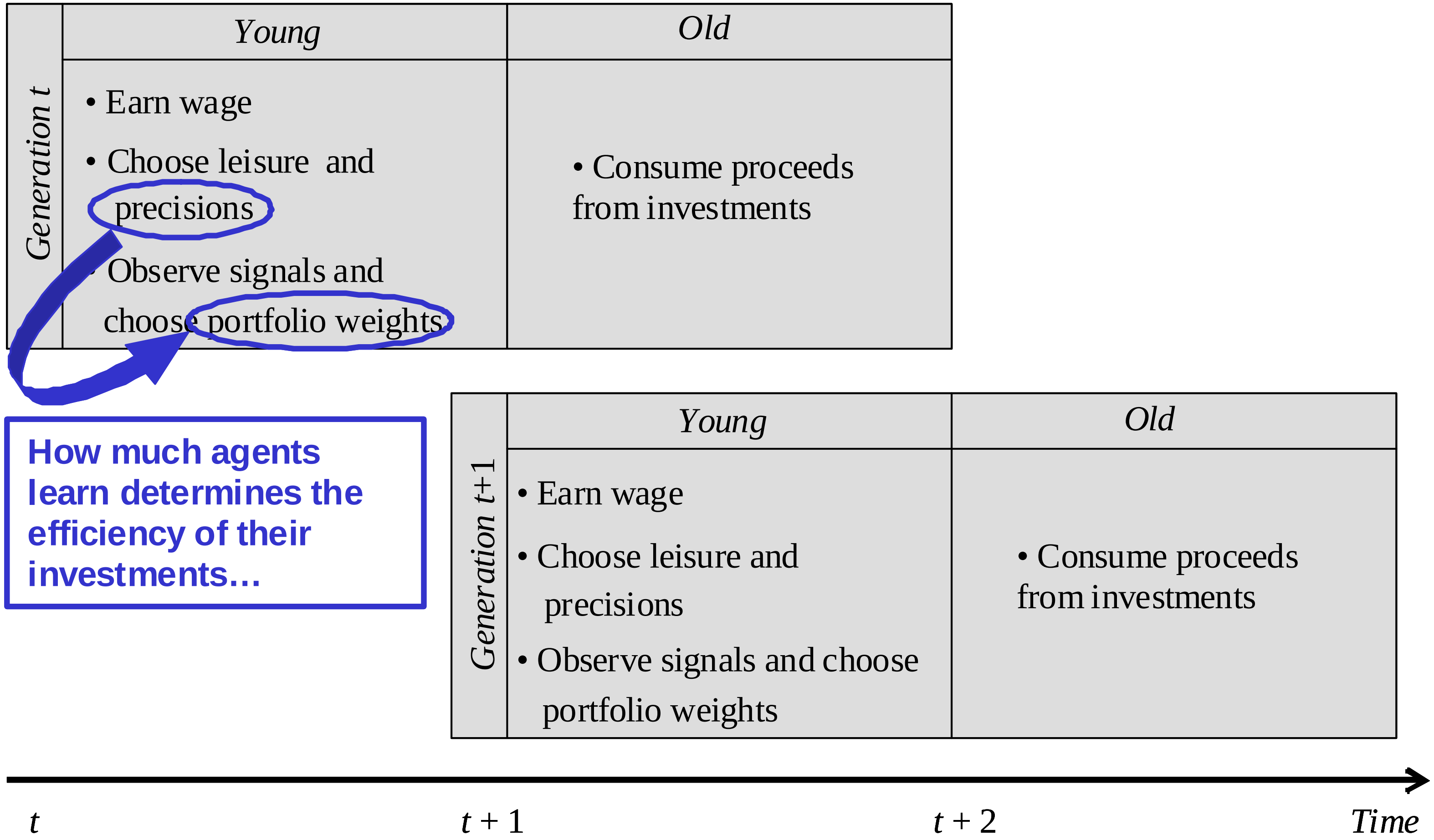
Timing


Generation t
Young
Old
• Earn wage
• Choose leisure and precisions
• Observe signals and choose portfolio weights
• Consume proceeds from investments
Generation t+1
Young
Old
• Earn wage
• Choose leisure and precisions
• Observe signals and choose portfolio weights
• Consume proceeds from investments
t
t + 1
t + 2
Time

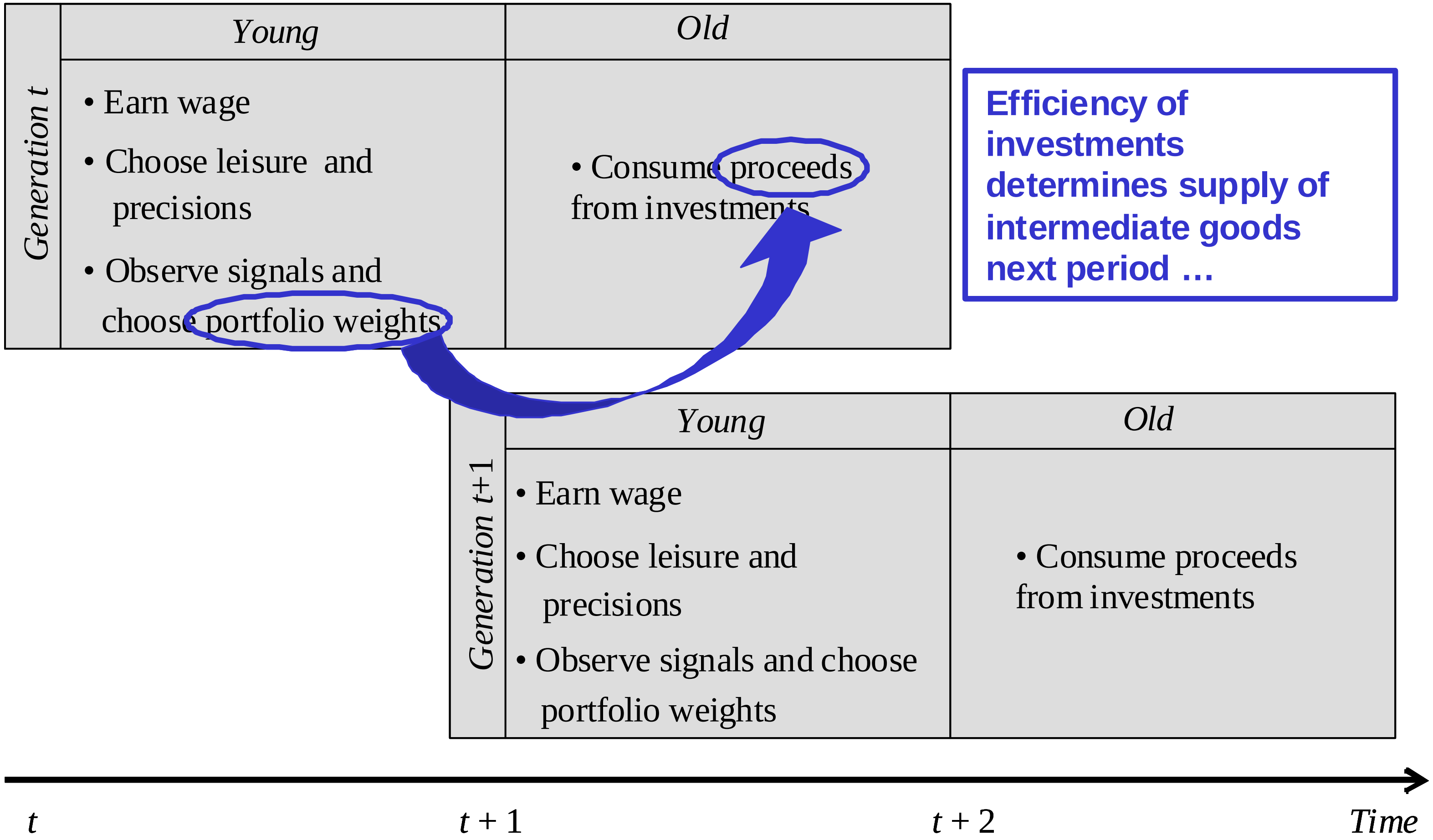
Timing


Generation t
Young
Old
• Earn wage
• Choose leisure and precisions
• Observe signals and choose portfolio weights
Wage determines how much agents learn…
Generation t+1
Young
Old
• Earn wage
• Choose leisure and precisions
• Observe signals and choose portfolio weights
• Consume proceeds from investments
t
t + 1
t + 2
Time

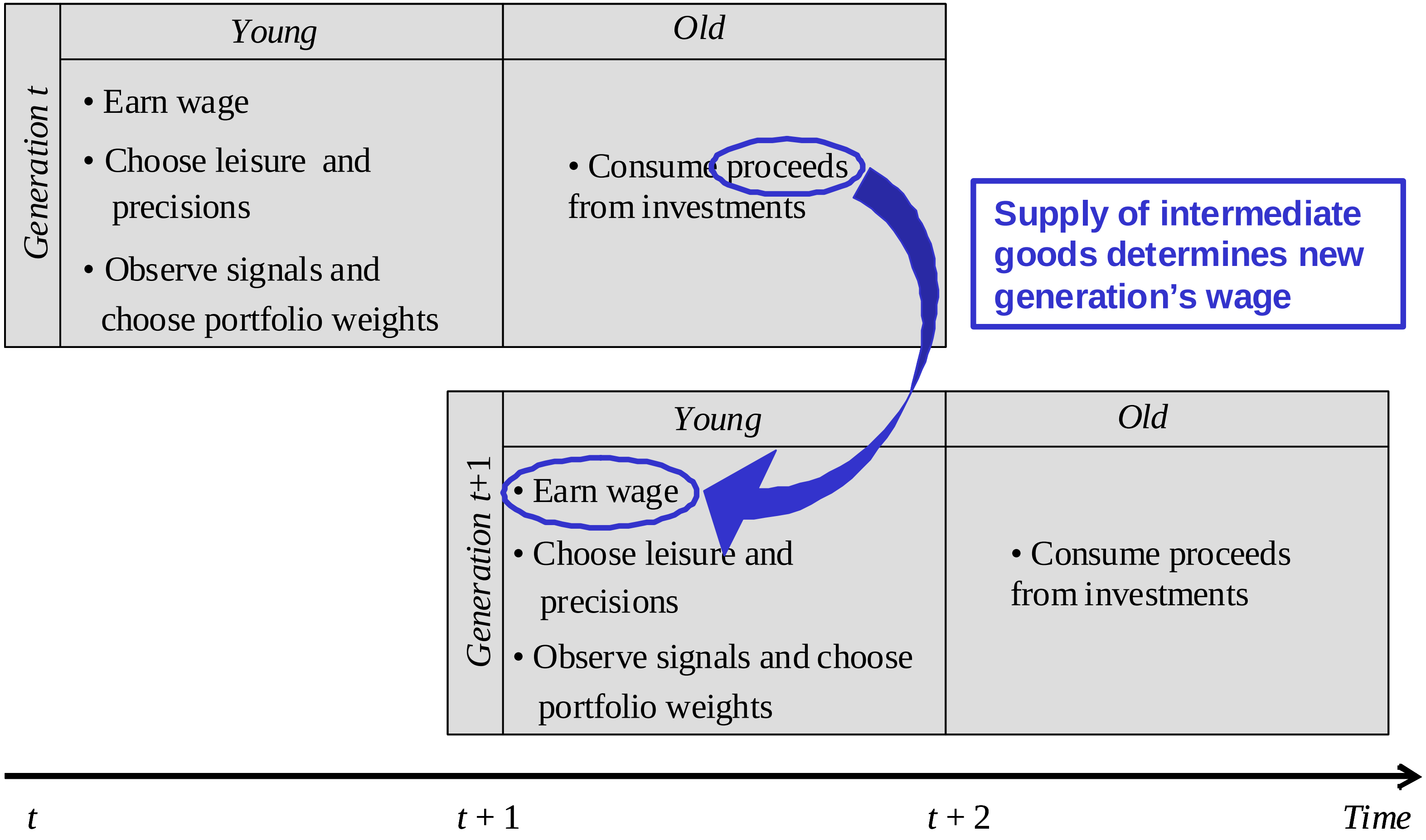
Timing


Generation t
Young
Old
• Earn wage
• Choose leisure and precisions
• Observe signals and choose portfolio weights
• Consume proceeds from investments
How much agents learn determines the efficiency of their investments…
Generation t+1
Young
Old
• Earn wage
• Choose leisure and precisions
• Observe signals and choose portfolio weights
• Consume proceeds from investments
t
t + 1
t + 2
Time

Timing


Generation t
Young
Old
• Earn wage
• Choose leisure and precisions
• Observe signals and choose portfolio weights
• Consume proceeds from investments
Efficiency of investments determines supply of intermediate goods next period …
Generation t+1
Young
Old
• Earn wage
• Choose leisure and precisions
• Observe signals and choose portfolio weights
• Consume proceeds from investments
t
t + 1
t + 2
Time

Timing


Generation t
Young
Old
• Earn wage
• Choose leisure and precisions
• Observe signals and choose portfolio weights
• Consume proceeds from investments
Supply of intermediate goods determines new generation's wage
Generation t+1
Young
Old
• Earn wage
• Choose leisure and precisions
• Observe signals and choose portfolio weights
• Consume proceeds from investments
t
t + 1
t + 2
Time

Main Results

- Dynamics of learning
  - Better information at $t \Rightarrow$ More efficient investments at $t \Rightarrow$ Supply of interm. goods$\nearrow$ at $t+1 \Rightarrow$ M.P. of labor$\nearrow$ at $t+1$
  - Income$\nearrow$ at $t \Rightarrow$ Info. production at t $\begin{cases} \nearrow \text{ through scale effect of info.} \\ \text{But } \searrow \text{ through substitution effect} \end{cases}$
  - Impact of learning is only transitory

- Role of the stock market
  - First best achieved if signals' precision is contractible, not achieved otherwise
  - SM allows to share costly private signals in incentive-compatible way (noise trading)
  - *Ex post* information sharing vs. ($>$) *ex ante* disincentive
  - In the limit, when noise trading ≈ 0, first best is reached

- Along the average growth path, when scale effect $>$ substitution effect:
  - Capital efficiency$\nearrow$, TFP$\nearrow$, industrial specialization$\nearrow$, inequality, stock trading intensity and liquidity$\nearrow$ then $\searrow$, stock price volatility$\nearrow$ and return volatility $\searrow$

Related Literature

- Theoretical literature on finance and growth
  - Banks as selectors of the best entrepreneurs (e.g. King and Levine (1993), Acemoglu, Aghion and Zilibotti (2003) and Morales (2003))
  - Stock markets and their information processing role (Greenwood and Jovanovic (1990))

- Endogenous growth literature (e.g. Romer (1986, 1990), Aghion and Howitt (1992), Grossman and Helpman (1991))
  - Here, selection of technologies rather than their discovery

- Literature on trading under endogenous and asymmetric information
  - Real benefits of informational efficiency

Summary

- A growth model with information acquisition and dissemination through stock prices, and capital allocation
- The stock market allows investors to share their costly private signals in an incentive-compatible way when the signals' precision is not contractible
- Its impact is only transitory
- Tradeoffs
  - Learning: Substitution effect vs. scale effect of information
  - Stock market: *Ex post* information sharing vs. ($>$) *ex ante* disincentive
- Several predictions on the evolution of real and financial variables are derived
  - Capital efficiency, TFP, industrial specialization, inequality, stock trading intensity, liquidity, volatility

An Overlapping Generations Model...

- Two sectors
  - M intermediate goods

$$\widetilde{Y}_{t+1}^m \equiv \widetilde{A}_t^m K_t^m \qquad \text{for } m = 1, ..., M$$

    Firms raise capital by issuing 1 share at price P_t^m, liquidated after production

  - One final good

$$G_t \equiv L^{1-\beta} \sum_{m=1}^{M} (Y_t^m)^\beta \quad \text{where} \quad 0 < \beta < 1$$

- A continuum of agents, indexed by $l \in [0, L]$
  - Endowed with 1 unit of labor time and 1 unit of free time (for leisure or learning)
  - Young work in final good sector. Invest wage w_t in intermediate good sector

An Overlapping Generations Model...

- $U(g, j) =$ Utility from consumption of final goods g and leisure j

$$\tau(g) \equiv -\frac{\frac{\partial U}{\partial g}(g,1)}{\frac{\partial^2 U}{\partial g^2}(g,1)}$$

Absolute risk tolerance

$\nearrow$ in g

$$\rho(g) \equiv \frac{\frac{\partial U}{\partial j}(g,1)}{\frac{\partial U}{\partial g}(g,1)}$$

Marginal rate of substitution between g and j

$\nearrow$ in g

- For example, Constant Elasticity of Substitution (CES):

$$U(g, j) \equiv (\varpi g^\sigma + (1-\varpi) j^\sigma)^{1/\sigma}$$

where $0 < \varpi < 1$, $\sigma < 1$, $1/(1-\sigma)$= Elast. of subst. between goods and leisure

$$\tau(g) = \frac{g(\varpi g^\sigma + 1 - \varpi)}{(1-\sigma)(1-\varpi)} \qquad \rho(g) = \frac{(1-\varpi)}{\varpi} g^{1-\sigma}$$

...With a Competitive Stock Market

- Productivity shocks $\widetilde{A}_t^m$ are log-normally distributed
  - $\ln \widetilde{A}_t^m \equiv \widetilde{a}_t^m z$ where $\widetilde{a}_t^m z$ i.i.d. $\sim N(\widetilde{\alpha}_t^m z, \sigma_a^2 z)$
  - Mean shock, $\widetilde{\alpha}_t^m$, i.i.d. $\sim N(0, \sigma_\alpha^2)$
  - z is small scaling factor (model solved in closed form for $z \approx 0$)
- Agents can acquire private information about average shock $\widetilde{\alpha}_t^m$ at a cost

$$s_{l,t}^m = \beta \widetilde{\alpha}_t^m + \widetilde{\varepsilon}_{l,t}^m$$

  - $\widetilde{\varepsilon}_{l,t}^m$ i.i.d. $\sim N(0, 1/x_{l,t}^m)$: $x =$ Precision of private information; X in equilibrium
  - Cost $C(x_{l,t}^m)z$ units of free time
  - C continuous, increasing, convex and $C(0) = C'(0) = 0$
- Noise trading
  - Fraction q of agents believes expected return on stock m equals $\widetilde{\theta}_t^m$, exogenous
  - $\widetilde{\theta}_t^m$ i.i.d. $\sim N(0, \sigma_\theta^2)$
  - No riskless asset

Equilibrium Concept

1. Market clearing in the intermediate goods sector

$$\widetilde{w}_{t+1} = (1-\beta)\sum_{m=1}^{M}(\widetilde{Y}_{t+1}^{m}/L)^{\beta} \quad \text{and} \quad \widetilde{\rho}_{t+1}^{m} = \beta(L/\widetilde{Y}_{t+1}^{m})^{1-\beta}$$

$\widetilde{\rho}_{t+1}^{m}$ = price of intermediate good m; $\widetilde{\Pi}_{t+1}^{m} = \widetilde{\rho}_{t+1}^{m}\widetilde{Y}_{t+1}^{m}$ = firm m's profit

2. Capital allocation

$$\max_{\left\{f_{l,t}^{m}\right\}} E\left[U(\widetilde{g}_{l,t+1}, j_t) \mid \mathcal{F}_{l,t}\right] \text{ subject to } \begin{cases} \widetilde{g}_{l,t+1} = w_t \widetilde{R}_{l,t+1} \\ \widetilde{R}_{l,t+1} = \sum_{m=1}^{M} f_{l,t}^{m}\widetilde{R}_{t+1}^{m} \\ \sum_{m=1}^{M} f_{l,t+1}^{m} = 1 \end{cases}$$

$f_{l,t}^{m}$ = Agent $l's$ portfolio weights; $\mathcal{F}_{l,t} \equiv \{s_{l,t}^{m}, P_t^m$ for $m = 1$ to $M\}$, $\widetilde{R}_{l,t+1}$ = Portfolio return; $\widetilde{R}_{t+1}^{m} = \widetilde{\Pi}_{t+1}^{m}/P_t^m$ = Return on stock m; X_t^m = Average precision of private information about firm $m \Longrightarrow U_0(\{x_t^m, X_t^m\}, j_t, w_t)$ = Value function for this problem

Equilibrium in the stock market:

$$\int_l w_t f_{l,t}^m = K_t^m = P_t^m \quad \text{for } m = 1, ..., M$$

3. <u>Precision choice</u>

Optimal precision $x_t^m = x(w_t, \{X_t^m\})$ solves:

$$\max_{\{j_t \geq 0,\ x_t^m \geq 0\}} E[U_0(\{x_t^m, X_t^m\}, j_t, w_t)] \text{ subject to } \sum_{m=1}^{M} C(x_t^m)z + j_t = 1$$

taking average precisions $\{X_t^m\}$ as given

In equilibrium, the average and optimal precisions must be consistent:

$$X_t^m = x(w_t, \{X_t^m\}) \quad \text{for } m = 1, ..., M$$

<u>Notation</u>

For any firm-specific variable ψ_t^m, $\overline{\psi}_t \equiv \frac{1}{M} \sum_{m=1}^{M} \psi_t^m$ and $\Delta\psi_t^m \equiv \psi_t^m - \overline{\psi}_t$

First Best

- Agents collect signals of infinitesimal precisions (≈ 0 but > 0) and announce them
  - Law of Large Numbers $\Rightarrow$ Productivity shocks are revealed
  - Capital allocation: Firm m's capital stock equals $K_t^{mFB} \approx \frac{Lw_t}{M} \exp(\Delta k_t^{mFB} z)$

$$\text{where} \quad \Delta k_t^{mFB} = \frac{1}{1-\beta} \Delta\beta \widetilde{\alpha}_t^m$$

- Standard neoclassical economy: Income $\nearrow$ at a decreasing rate until it reaches a steady-state:

$$E(\widetilde{w}_{t+1}) \approx \underbrace{\Lambda \exp\left(\lambda^{FB} z^2\right)}_{\text{a cons}\tan\text{t}} w_t^{\beta}$$

- First Best is what G&J (1990) consider (endowed signals)
  - First Best is not a Nash equilibrium when <u>precisions are not contractible</u>
  - Agents' best response is to set their precisions to zero and report noise $\Rightarrow$ <u>No learning</u>

Agents' Portfolio Weights

Guess that firm $m's$ capital stock takes the form $K_t^m \approx \frac{Lw_t}{M}\exp(\Delta k_t^m z)$ where $\Delta k_t^m \equiv k_{\alpha t}^m(\beta\Delta\widetilde{\alpha}_t^m + \mu_t^m \Delta\widetilde{\theta}_t^m)$ and μ_t^m is a deterministic scalar ('noisiness')

- Portfolio weights (the fraction of agent l's income invested in stock m) :

$$\frac{1}{M} + \frac{\tau(\varphi(w_t))}{\varphi(w_t)} \frac{E(\Delta r_{t+1}^m \mid \text{Info.}_{l,t})}{Var(\Delta r_{t+1}^m \mid \text{Info.}_{l,t})} \quad \text{where } \varphi(w) \equiv \beta M^{1-\beta} w^\beta$$

  - For rational traders $\approx \dfrac{1}{M} + \dfrac{\tau(\varphi(w_t))}{\varphi(w_t)\beta^2\sigma_a^2}\left\{Weight\_s * \Delta s_{l,t}^m + Weight\_k * \Delta k_t^m\right\}$
  - For noise traders $\approx \dfrac{1}{M} + \dfrac{\tau(\varphi(w_t))}{\varphi(w_t)\beta^2\sigma_a^2}\Delta\widetilde{\theta}_t^m$

- Under CES:
  - $\dfrac{\tau(\varphi(w))}{\varphi(w)}$(= Relative risk tolerance)↗ with w if $\sigma > 0$, ↘ with w if $\sigma < 0$
  - independent of w if $\sigma = 0$ (Cobb-Douglas = CRRA: $U(g,j) \equiv g^\varpi j^{1-\varpi}$)

Capital Allocation

Noisiness μ_t^m is given. There exists a log-linear rational expectations equilibrium.

Capital equals $K_t^m \approx \frac{Lw_t}{M}\exp(\Delta k_t^m z)$

$$\text{where} \quad \Delta k_t^m \equiv k_\alpha(\mu_t^m)(\beta\Delta\widetilde{\alpha}_t^m + \mu_t^m \Delta\widetilde{\theta}_t^m)$$

- X_t^m (Average precision of information about stock m) and μ_t^m (its <u>noisiness</u>) are related through:

$$X(\mu) \equiv \frac{H(\mu)}{\frac{1-q}{q}\mu - 1} \quad \text{where} \quad H(\mu) \equiv \frac{1}{\beta^2\sigma_\alpha^2} + \frac{1}{\mu^2\sigma_\theta^2}$$

- Total precision of investor's information: $H(\mu) + X(\mu)$

- Elasticity of stock price to prod. shock : $k_\alpha(\mu) \equiv \frac{1}{1-\beta}\left(1 - \frac{1}{\beta^2\sigma_\alpha^2\left(H(\mu)+X(\mu)\right)}\right)$

Information Acquisition: First-Order Condition

- μ_t^m (noisiness of stock m's price) is given. An investor sets the precision of her private signal about stock m, x_t^m, such that

$$\rho(\varphi(w_t))C'\left(x_t^m\right) \qquad = \qquad \tau(\varphi(w_t))\frac{M-1}{2M\beta^2\sigma_a^2}\left(\frac{1}{H(\mu_t^m)+x_t^m}\right)^2$$

Marginal cost of information	Marginal benefit of information
$\nearrow$ in income w_t	$\nearrow$ in income w_t
(substitution effect)	(scale effect of information)

Information Acquisition: Properties of Individual Precisions $\mathbf{x}_t^m$

- Agents collect more precise signals ($x_t \nearrow$) when:
  - priors are less informative ($\sigma_\alpha^2 \nearrow$)
  - noise trading intensifies (μ_t^m or $\sigma_\theta^2 \nearrow$)
  - conditional variance of productivity shocks falls ($\sigma_a^2 \searrow$)
  - marginal cost of information falls ($C' \searrow$)
- x_t is non-monotonic in β (factor share of intermediate goods)
  - Lower $\beta \Rightarrow$ Investors' share of GDP $\searrow$ ($\varphi(w_t)$ term) $\Rightarrow \dfrac{\partial U}{\partial g} \nearrow \Rightarrow \rho$ and $\tau \nearrow$
  - Lower $\beta \Rightarrow$ Stocks are less sensitive to productivity shocks
    - $\Rightarrow \widetilde{\alpha}_t^m$ (component of shock that can be learnt) has smaller impact on profit $\Rightarrow$ Info less valuable
    - $\Rightarrow$ Stock less risky (component of shock that cannot be learnt) $\Rightarrow$ Larger positions $\Rightarrow$ Info more valuable

Information Acquisition: Equilibrium

- In equilibrium, the noisiness of stock prices, μ_t, is the unique solution to:

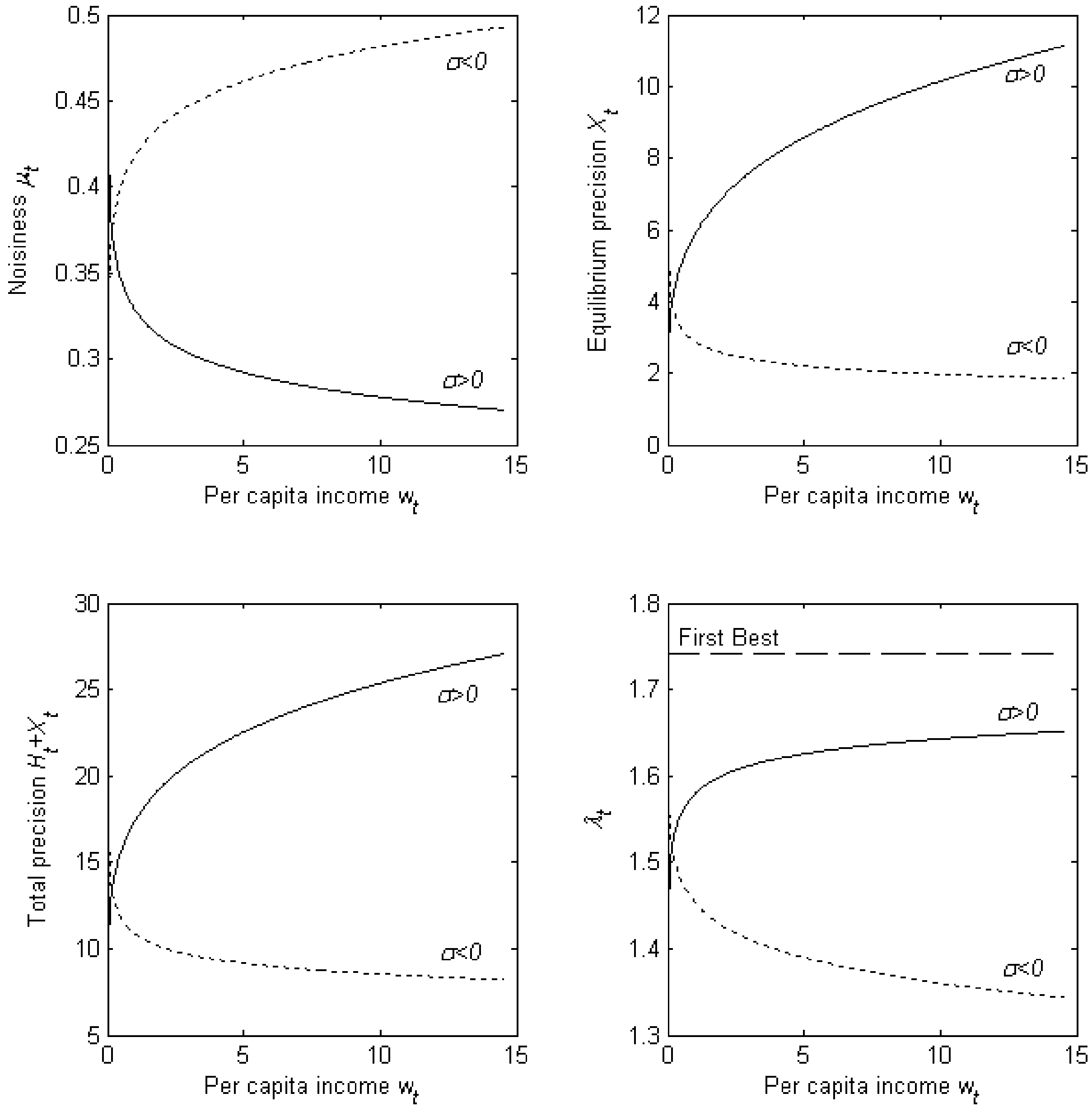
$$\rho(\varphi(w_t))C'\left(\frac{H(\mu_t)}{\frac{1-q}{q}\mu_t - 1}\right) = \tau(\varphi(w_t))\frac{M-1}{2M\beta^2\sigma_a^2}\left(\frac{1-\frac{q}{(1-q)\mu_t}}{H(\mu_t)}\right)^2$$

- Properties of μ_t : $\mu_t \searrow$ (i.e. stock prices are <u>more informative</u>) when:
  - priors are more accurate ($\sigma_\alpha^2 \searrow$)
  - variance of noise trades increases ($\sigma_\theta^2 \nearrow$)
  - conditional variance of productivity shocks falls ($\sigma_a^2 \searrow$)
  - marginal cost of information falls ($C' \searrow$)
  - fraction of noise traders falls ($q \searrow$, direct effect of q on μ_t dominates its indirect effect through X_t)

Information Acquisition: Impact of Income

- Current income w_t $\Rrightarrow$Current noisiness μ_t
  - If $\tau/\rho \nearrow$ in consumption (e.g. $\sigma > 0$ under CES utility), then noisiness declines with income (precision of info. rises)
  - If $\tau/\rho \searrow$ (e.g. $\sigma < 0$), then noisiness rises with income
  - Two competing forces: Substitution effect vs. Scale effect of information

- Current noisiness μ_t $\Rrightarrow$ Future expected income $E(\widetilde{w}_{t+1})$
  - Income is larger on average when agents are better informed (noisiness lower)
  - Indeed: Noisiness$\searrow$ $\Rightarrow$ More efficient investments $\Rightarrow$ Supply of intermediate goods$\nearrow$ on average $\Rightarrow$ Marginal product of labor$\nearrow$ on average



0.5
0.45
0.4
0.35
0.3
0.25
Noisiness μ_t
σ<0
σ>0
0
5
10
15
Per capita income w_t
12
10
8
6
4
2
0
Equilibrium precision X_t
σ>0
σ<0
Per capita income w_t
30
25
20
15
10
5
Total precision H_t+X_t
σ>0
σ<0
Per capita income w_t
1.8
1.7
1.6
1.5
1.4
1.3
λ_t
First Best
σ>0
σ<0
Per capita income w_t

Dynamics of Income (Along the Average Growth Path)

Income converges to a steady-state in which it no longer grows:

$$E(\widetilde{w}_{t+1}) \approx \Lambda w_t^{\beta} \exp\left(\boxed{\lambda(w_t)} z^2\right)$$

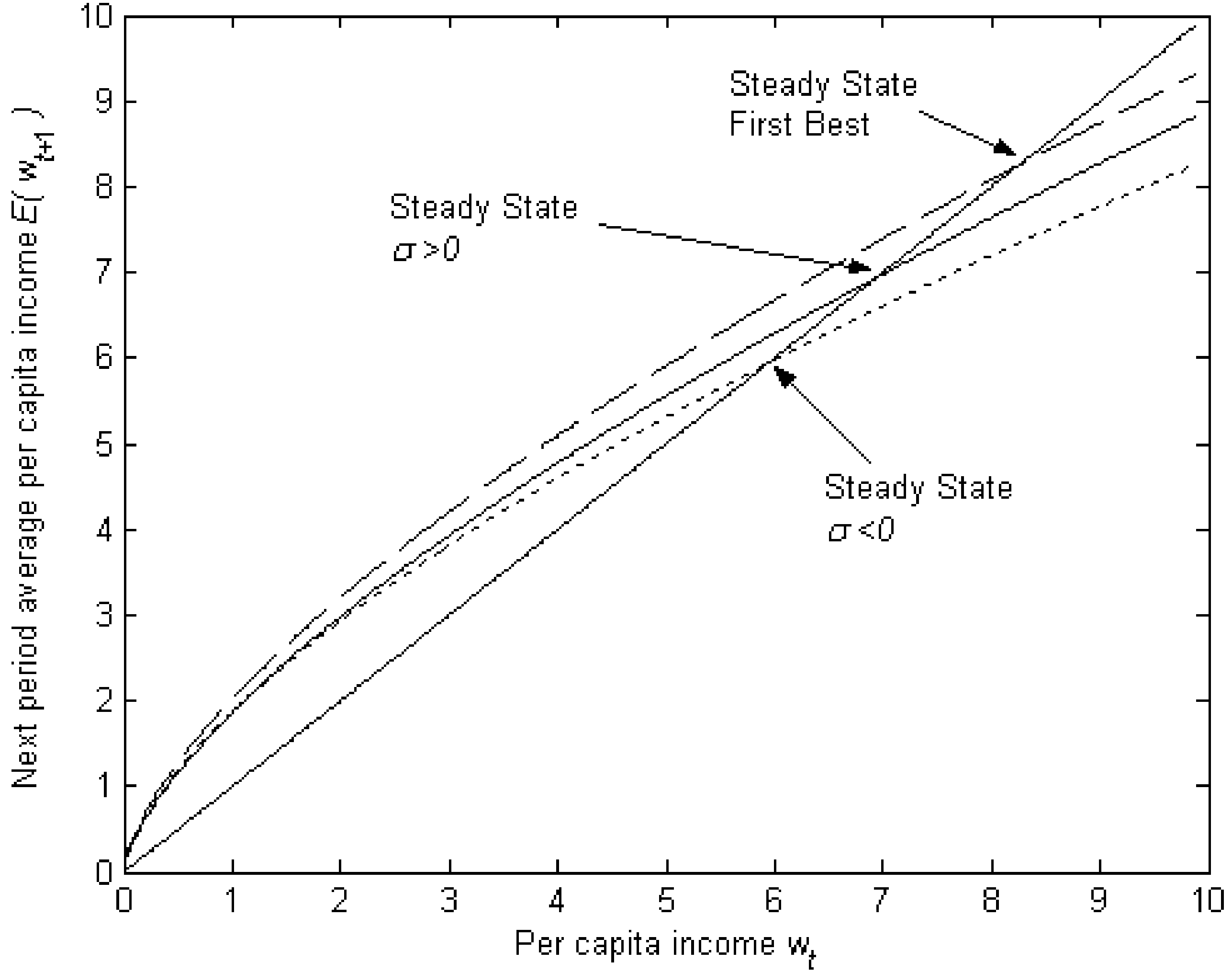
where $\quad \lambda(w_t) \equiv \frac{M-1}{M}\beta^2 \left(k_\alpha(\mu_t)\beta\sigma_\alpha^2 + \frac{k_\alpha(\mu_t)^2}{2}(\beta^2\sigma_\alpha^2 + \mu_t^2\sigma_\theta^2) \right) > 0$

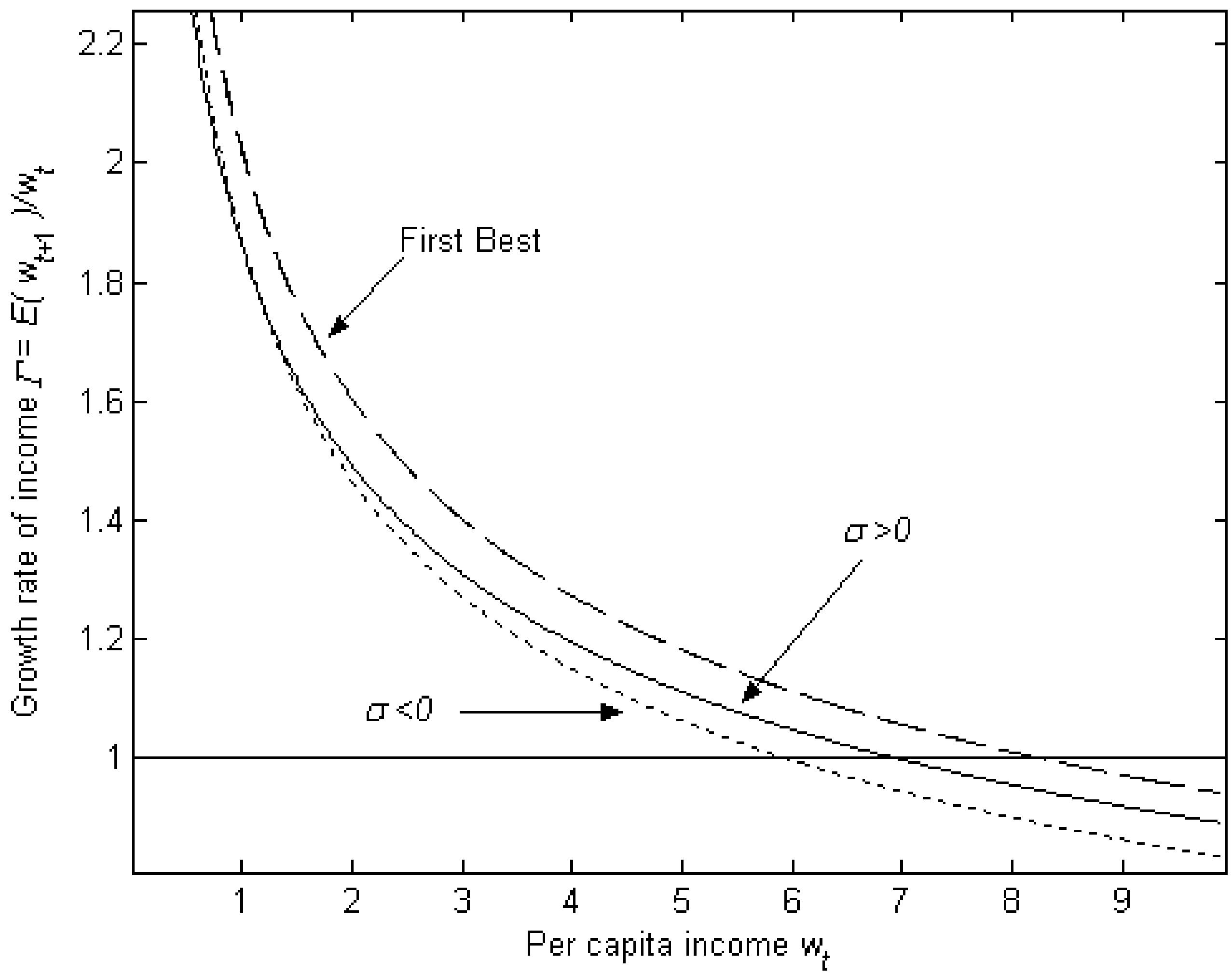
- If $\tau/\rho \nearrow$ (e.g. $\sigma > 0$), then $\lambda \nearrow$ with w (to λ^{FB}) so $E(\widetilde{w}_{t+1})/w_t$ (growth rate of income) $\searrow$ less fast than in FB:

$$\frac{d\ln\left(E(\widetilde{w}_{t+1})/w_t\right)}{d\ln w_t} = -(1-\beta) + \frac{d\lambda(w_t)}{d\ln w_t} z^2 > -(1-\beta)$$

- If $\tau/\rho \searrow$ (e.g. $\sigma < 0$), then $\lambda \searrow$ and $E(\widetilde{w}_{t+1})/w_t \searrow$ at a faster rate than in FB:

$$\frac{d\ln\left(E(\widetilde{w}_{t+1})/w_t\right)}{d\ln w_t} = -(1-\beta) + \frac{d\lambda(w_t)}{d\ln w_t} z^2 < -(1-\beta).$$


Steady State
First Best
Steady State
$\sigma > 0$
Steady State
$\sigma < 0$
Next period average per capita income $E(w_{t+1})$
Per capita income w_t
0
1
2
3
4
5
6
7
8
9
10



2.2
2
1.8
1.6
1.4
1.2
1
1
2
3
4
5
6
7
8
9
Per capita income w_t
Growth rate of income $\Gamma = E(w_{t+1})/w_t$
First Best
$\sigma>0$
$\sigma<0$

The Role of the Stock Market

- When the fraction of noise traders $q \searrow$:
  - Less information is produced but more is shared through stock prices
  - Net effect = improvement in total info. and in efficiency of investments ($k_{\alpha t} \nearrow$)

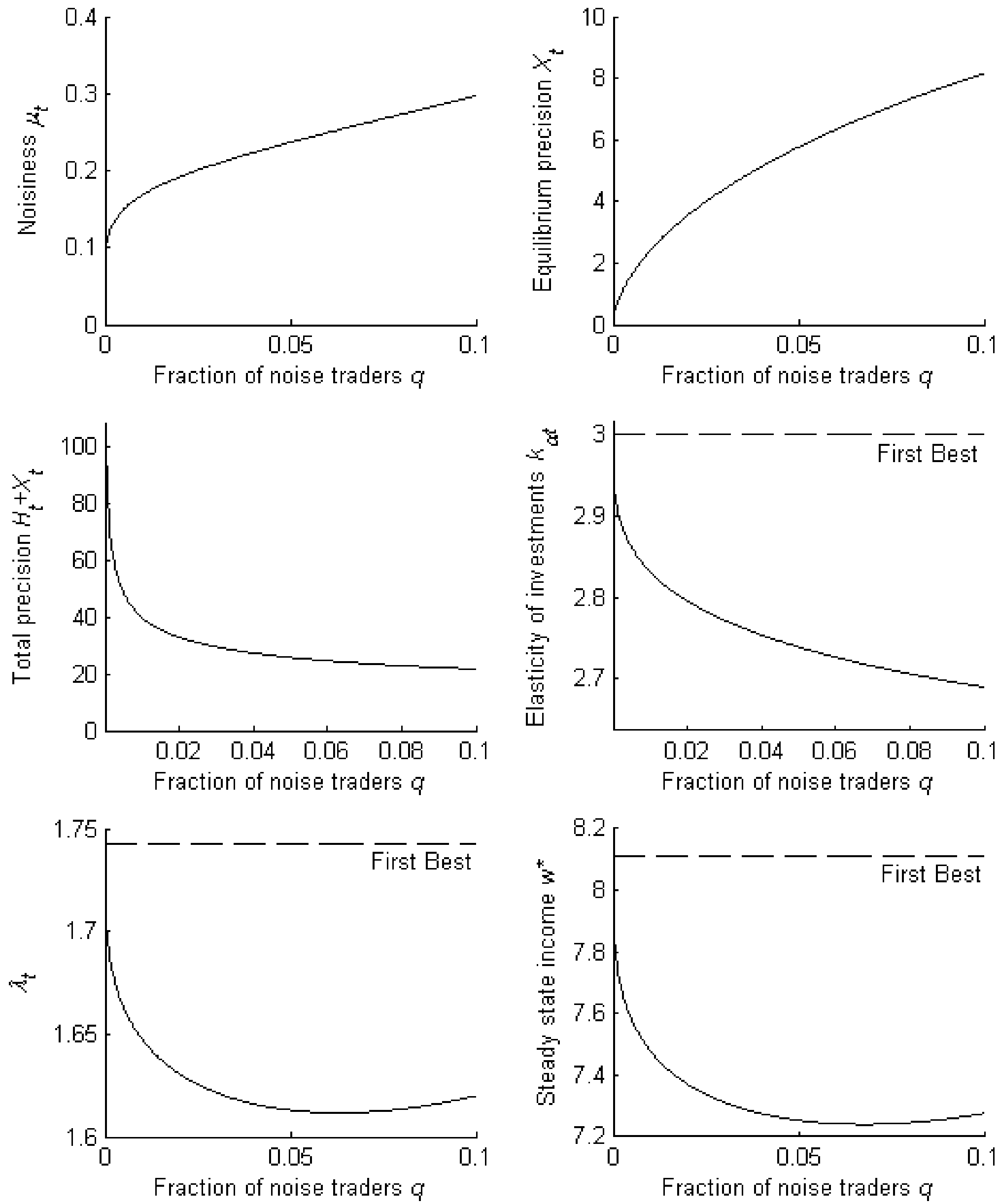
$$\underset{<0}{\frac{d\left(H(\mu_t)+X(\mu_t)\right)}{dq}} = \underbrace{\underset{<0}{\frac{\partial H_t}{\partial \mu_t}_{(X_t)}} * \underset{>0}{\frac{\partial \mu_t}{\partial q}_{(X_t)}}}_{<0} + \underbrace{\underset{<0}{\frac{\partial H_t}{\partial \mu_t}_{(X_t)}} * \underset{<0}{\frac{\partial \mu_t}{\partial X_t}_{(q)}} * \underset{>0}{\frac{dX_t}{dq}} + \underset{>0}{\frac{dX_t}{dq}}}_{>0}$$

Ex post information sharing   *Ex ante* disincentive

- As the fraction of noise traders q approaches zero:
  - The allocation of capital converges to the FB allocation

$$\lim_{q \to 0\ (q>0)} k_t^m = k_t^{mFB} \quad \text{for } m = 1, ..., M$$

  - SS level of income and transitory growth rate converge to those of FB



Noisiness μ_t
Fraction of noise traders q
Equilibrium precision X_t
Fraction of noise traders q
Total precision H_t+X_t
Fraction of noise traders q
Elasticity of investments $k_{\alpha t}$
First Best
Fraction of noise traders q
λ_t
First Best
Fraction of noise traders q
Steady state income w^*
First Best
Fraction of noise traders q

Real Variables Along the Average Growth Path

Assume scale effect > substitution effect (e.g. $\sigma > 0$) $\Longrightarrow$ Noisiness $\mu_t \searrow$ with w_t

- Elasticity of investments to productivity shocks and TFP increase as the eco. grows
  - TFP defined from economy-wide production function
  - Empirically: Elasticity of investments to value added $\nearrow$ with informativeness of a country's stock market (Wurgler (2000)). Stock markets promote growth in TFP (Levine and Zervos (1998))

- Capital and profits are more concentrated across firms as the economy grows
  - Herfindahl index: $Her(K_t^m) \equiv E(K_t^{m2})/[E(K_t^m)]^2$
  - Empirically: Sectoral concentration $\searrow$ at first, then $\nearrow$ with GDP (Imbs and Wacziarg (2003)). Industrial specialization is positively related to share of financial sector in GDP (Kalemli-Ozcan, Sørensen and Yosha (2003))

Real Variables Along the Average Growth Path

- Wealth inequality follows a "Kuznets curve", $\nearrow$ at first, then $\searrow$ as eco. grows
  - Inequality driven by disagreement between investors about stocks
    - At early stage, private signals are imprecise $\Longrightarrow$ Follow mostly price signals $\Longrightarrow$ Low disagreement
    - Precision $\nearrow$ $\Longrightarrow$ Private signals recieve more weight $\Longrightarrow$ Disagreement $\nearrow$
    - More precise private signals are also more similar $\Longrightarrow$ Disagreement $\searrow$ beyond a point
  - Empirically: Mixed evidence in favor of Kuznets curve

Financial Variables Along the Average Growth Path (e.g. $\sigma > 0$)

- As the economy grows, trading on the equity market and liquidity $\nearrow$ at first, then $\searrow$
  - As with inequality, driven by disagreement
  - Empirically: Share turnover on the stock market is positively related to output growth (Levine and Zervos (1998), Rousseau and Wachtel (2000))

- Impact on stocks' volatility as the economy grows:
  - In current setup (1 trading round), stock price volatility $\nearrow$, idiosyncratic and total return volatility $\searrow$, market volatility constant
  - Conjecture: With 2 trading rounds, return volatility $\nearrow$
  - Empirically: Stock prices are less synchronous in richer economies (Morck, Yeung and Yu (2000)). Idiosyncratic return volatility $\nearrow$ in the U.S. from 1962 to 1997, while the volatility of the market remained stable (Campbell, Lettau, Malkiel and Xu (2001))