# Retirement in the Shadow (Banking)

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# This is What We Do

- Life expectancy **conditional** on retirement has increased in the US from 77 to 83 years (this is, 50%!) since 1980.

- Does the "domestic savings glut" change financial intermediation?
  - $\uparrow$ savings demand $\Longrightarrow$ $\downarrow$ savings returns $\Longrightarrow$ reach for yields.
  - Securitization $\Longrightarrow$ easier liquidation of productive assets.
    - $\downarrow$ intermediation costs (interest spreads from 4% to 3%).
    - $\uparrow$ credit (household debt from 1GDP to 1.66GDP).
    - $\uparrow$ shadow banking (from 10% to 50% of household debt).

- What are the quantitative implications for macro outcomes?
  - The gains from shadow banking net of the cost of the crisis (even though this paper is NOT about the crisis) - **around half a GDP**

# This is How We Do It

- Theoretical
  - OLG model with retirement, credit and intermediation.
- Empirical
  - Measure of how much securitization reduced intermediation costs.
- Quantitative
  - Calibration and decomposition of the importance of retirement and securitization in credit and other macroeconomic variables.
- Counterfactual
  - Hypothetical economy without shadow banks (nor crisis).

# Agents

- OLG of agents (population grows at rate $\eta$).
  - Working age $j \leq T$: Live with certainty and work.
  - Retirement $j > T$: Do not work and die each period with prob. $\delta$.
  - When they die, they may leave bequests $b_j$.
    (equally distributed to younger agents of age $j = T_I < T$)

$$U(\alpha, \underline{c}, \underline{b}) = \sum_{j=0}^{T} \beta^j \log c_j + \sum_{j=T+1}^{\infty} \beta^j (1-\delta)^{j-T-1} [(1-\delta) \log c_j + \delta \alpha \log b_j]$$

$\alpha \geq 0$: heterogeneous strength of bequest motive

# Firms

- Perfectly competitive firms that produce

$$Y_t = K_t^{\theta}(\Gamma_t L_t)^{1-\theta}.$$

- Productivity $\Gamma_t$ grows at rate $\gamma$.
- Wages and stock returns

$$\begin{aligned} y &= F_L(K_t, \Gamma_t L_t) \\ r_e &= F_K(K_t, \Gamma_t L_t) - \delta_k \end{aligned}$$

# Agents' Saving Choices

- Agents choose at birth how to save for retirement.
- **Capital Markets (C):** Buy equity. (or become entrepreneurs!)
  - Invest in firms such that
    - Working age: Accumulate stocks (with own funds and borrowing).
    - Retirement: Sell stocks to consume and leave bequest at death.

# Agents' Saving Choices

- Agents choose at birth how to save for retirement.
- **Banks (B):** Buy debt. (or become depositors!)
  - Contract with a financial intermediary that specifies
    - Working age: Agent pays $d_j$ to intermediary (who lends).
    - Retirement: Intermediary pays $c_j$ to agent while alive, and $b_j$ at death.
  - Choose whether to sign the contract with
    - Traditional Bank (TB): Return $r$ at no cost.
    - Shadow Bank (SB): Securitization $\implies$ higher return $r$ at utility cost $\kappa$
  - Benefits: A bank is a pool $\implies$ Insurance against living long.
  - Costs: A bank charges a fee $\implies$ Lower returns on savings.

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- B-agents demand **safe assets** (smooth consumption after retirement)
- Securitization improves liquidity and raises safe asset returns!

# Agents' Wealth

- Consolidated wealth at birth (for $i \in \{B, S\}$).
  - All agents earn $y_j$ when working. Labor taxes are $\tau$.
  - All agents of age $T_I$ obtain an inheritance of $\bar{b}$.
  - Agents $i$ receive social security transfers $Tr_i$ after retirement.
  - Savings of agents $i$ pay a return $r_i \in \{r, r_e\}$.

$$v_0^i = \sum_{j=0}^{T-1} \frac{(1-\tau)y_j}{(1+r_i)^j} + \frac{\bar{b}}{(1+r_i)^{T_I}} + \frac{(1+r_i)}{r_i+\delta}\frac{Tr_i}{(1+r_i)^T}$$

When calibrating we will assume $Tr_i = ss_i y_T$.

Only source of uncertainty in the model is death!

# Banks

- Balance sheet of perfectly competitive banks.
  - Liabilities: $D(1+r)$.
  - Assets:
    - Government bonds: $(1-f)A(1+r_L)$.
    - Loans: $fA(1+r_e)$.
  - Management cost: $A\widehat{\phi}$

- Banks choose $A^*$, $f^*$ and $r^*$ such that
  - Feasibility: $A^* \leq D$.
  - Zero-profit condition:

$$[f^*(1+r_e) + (1-f^*)(1+r_L) - \widehat{\phi}]A^* = (1+r^*)D$$

  - Liquidity: Use bonds and a fraction $z$ of risky loans to face a run,

$$[z(1+q) + (1-f^*)(1+r_L)]A^* \geq (1+r^*)D \qquad \texttt{where } z \leq f^*$$

# Banks

- Assumptions:
  - No arbitrage (agents can buy bonds): Implies $r_L = r$.
  - Relatively low operation costs ($r_e > \widehat{\phi}$): Implies $A^* = D$.
- Market for liquidated assets (fire sales):
  - Demand: Buyers can rematch the asset and obtain $r_e$.

$$\max_z \left[ \underbrace{Pr(rematch)}_{(1+\Psi)\ln\zeta(1+z)\frac{1+r}{1+r_e}} (1+r_e) - (1+q)z \right] \implies 1+q_D = \frac{(1+\Psi)(1+r)}{1+z}$$

  - Supply: From liquidity constraint: $1 + q_S = \frac{f(1+r)}{z}$.
  - Market clearing: $z^* = \frac{f}{1+\Psi-f}$ `s.t.` $z^* \leq f \implies f \leq \Psi$

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  - Market clearing: $z^* = \frac{f}{1+\Psi-f}$ `s.t.` $z^* \leq f \implies f \leq \Psi$
- Banks choose $f^* = \min\{1, \Psi\}$. From ZPC, $r^* = r_e - \frac{\widehat{\phi}}{f^*}$.

$$SPREAD : \phi \equiv r_e - r^* = \underbrace{\widehat{\phi}}_{VA} \underbrace{\max\{1, \Psi^{-1}\}}_{Liq\ cost}$$

# Government

- Commitment to fiscal expenses, transfers and a debt policy.
- Set $\tau$ to balance the budget

$$\tau y_t L_t + (D_{t+1}^G - D_t^G) = gY_t + \overline{Tr}_t + r_L D_t^G.$$

# Aggregates

- Let $\mu_j^i(\alpha)$ be the mass of age $j$ agents with bequest motive $\alpha$ who choose savings $i \in \{C, B\}$. Aggregates, as functions of $(r_e, \bar{b})$, are

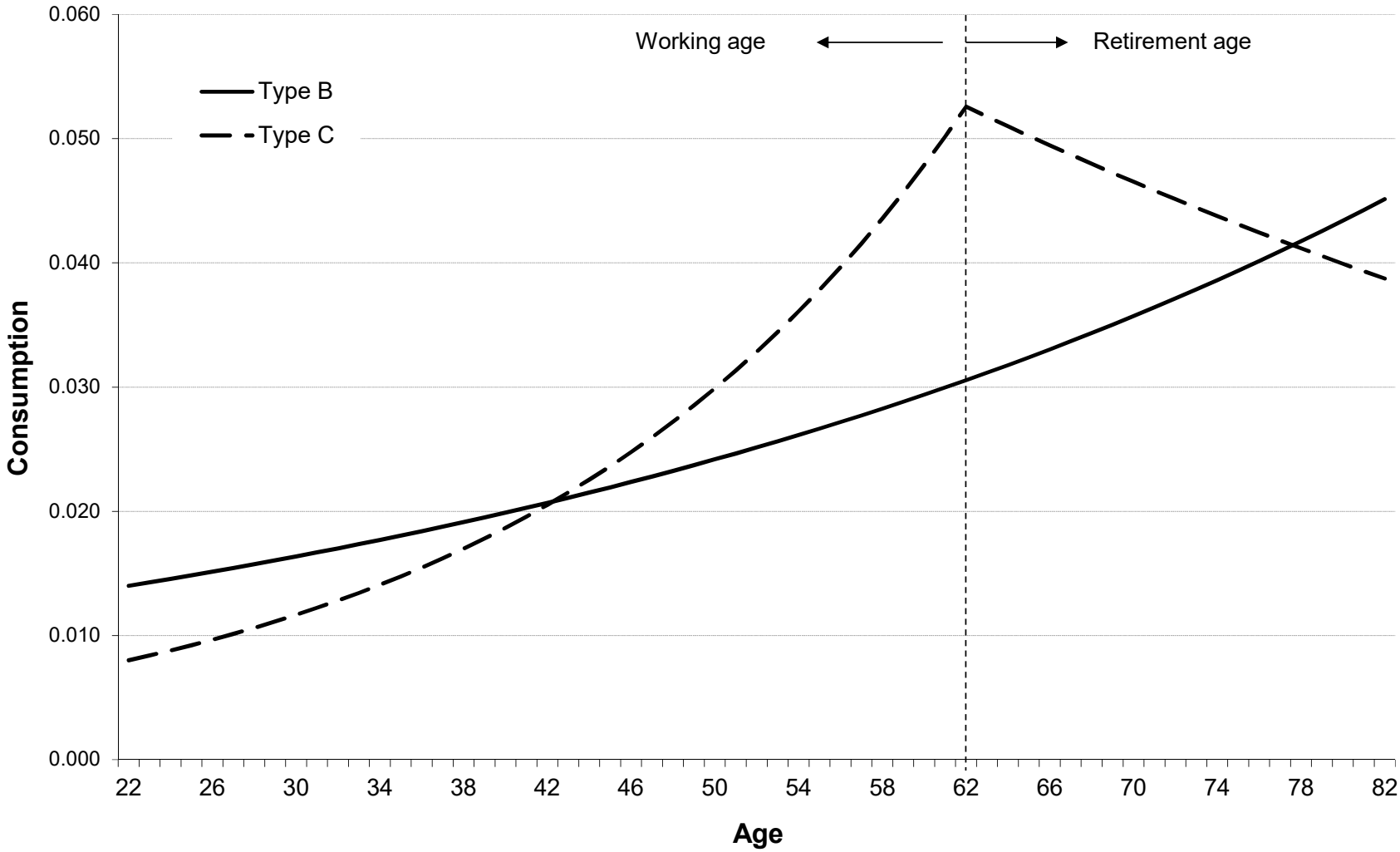
$$\begin{aligned}
\mathbb{C}(r_e, \bar{b}) &= \sum_{i=S,B} \sum_{j=1}^{\infty} \int c_j^i(r_e, \bar{b}; \alpha) \mu_j^i(\alpha) d\alpha \\
\mathbb{W}^i(r_e, \bar{b}) &= \sum_{j=1}^{\infty} \int w_j^i(r_e, \bar{b}; \alpha) \mu_j^i(\alpha) d\alpha \\
\mathbb{B}(r_e, \bar{b}) &= \sum_{i=S,B} \sum_{j=T+1}^{\infty} \delta \int b_j(r_e, \bar{b}; \alpha) \mu_{j-1}^i(\alpha) d\alpha \\
L_t &= \sum_{j=0}^{T-1} (1+\eta)^{t-j}
\end{aligned}$$

# Stationary Equilibrium

Given fiscal policies $\{g, Tr_i, D^G\}$, a stationary equilibrium is characterized by individual allocations $\{\underline{c}(\alpha), \underline{w}(\alpha), \underline{b}(\alpha)\}_{\forall \alpha \geq 0}$ together with saving decisions $\{\{B_{TB}, B_{SB}\}, C\}$, aggregate allocations $\{Y, X, K, \mathbb{B}, \mathbb{C}\}$ and prices $\{y, r_e, r\}$ such that,

- Given prices and fiscal policies, agents maximize utility
- Given prices and fiscal policies, firms and banks maximize profits.
- The government budget constraint holds.
- Markets clear,
  - Feasibility: $Y = gY + \mathbb{C}(r_e, \bar{b}) + X + \phi \left[ \frac{\mathbb{W}^B(r, \bar{b})}{1+r} - D^G \right]$
  - Assets market: $\frac{\mathbb{W}^B(r, \bar{b})}{1+r} + \frac{\mathbb{W}^S(r_e, \bar{b})}{1+r^e} = D^G + K$
  - Bequest=Inheritance: $\bar{b} = (1+\gamma)^{T_I} \mathbb{B}(r_e, \bar{b})$

# Comparison of Consumption Patterns



# Saving Decisions

**Proposition 1:** *Agents with high bequest motives save in capital markets*

If $\underline{\phi} \leq \widehat{\phi} \leq \bar{\phi}$, there exists a unique $\alpha^* > 0$ such that,

- if $\alpha \geq \alpha^*$ the agent saves in capital markets.
- if $\alpha < \alpha^*$ the agent saves in banks.

**Proposition 2:** *Longer-living agents will use shadow banking*

Among agents with low enough $\alpha$, saving in banks, there is a unique $\delta^*(\alpha, \kappa) > 0$ (increasing in $\alpha$ and decreasing in $\kappa$) such that,

- if $\delta \geq \delta^*(\alpha, \kappa)$ uses traditional banking.
- if $\delta < \delta^*(\alpha, \kappa)$ uses shadow banking.

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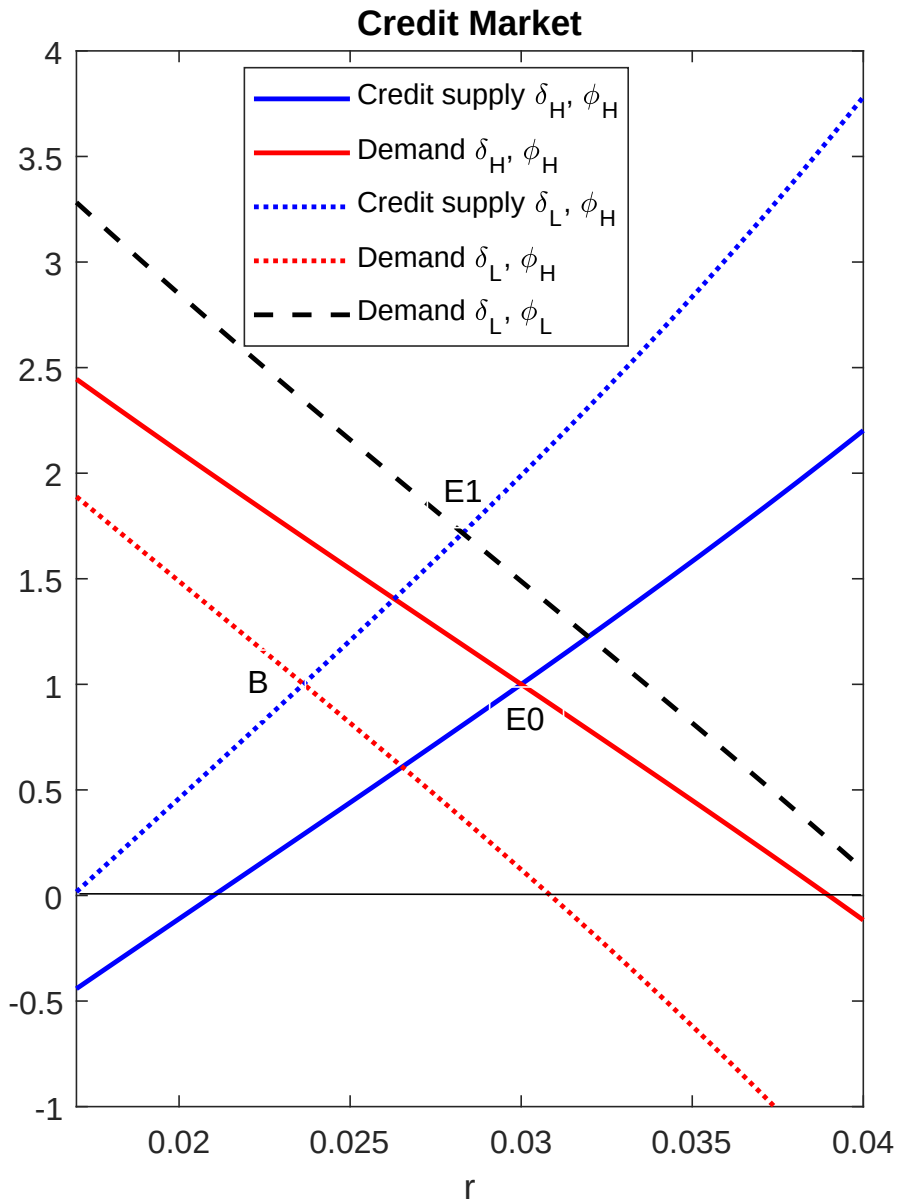
From now on we assume that $\mu$ agents have $\alpha = 0$ and the rest $\alpha = \widehat{\alpha} > \alpha^*$

# Intuition of the Main Forces

Demand: $K(r_e) - \frac{\mathbb{W}^S(r_e,\bar{b})}{1+r^e}$

Supply: $\frac{\mathbb{W}^B(r,\bar{b})}{1+r} - D^G$

Spread: $r_e - r = \frac{\hat{\phi}}{f}$



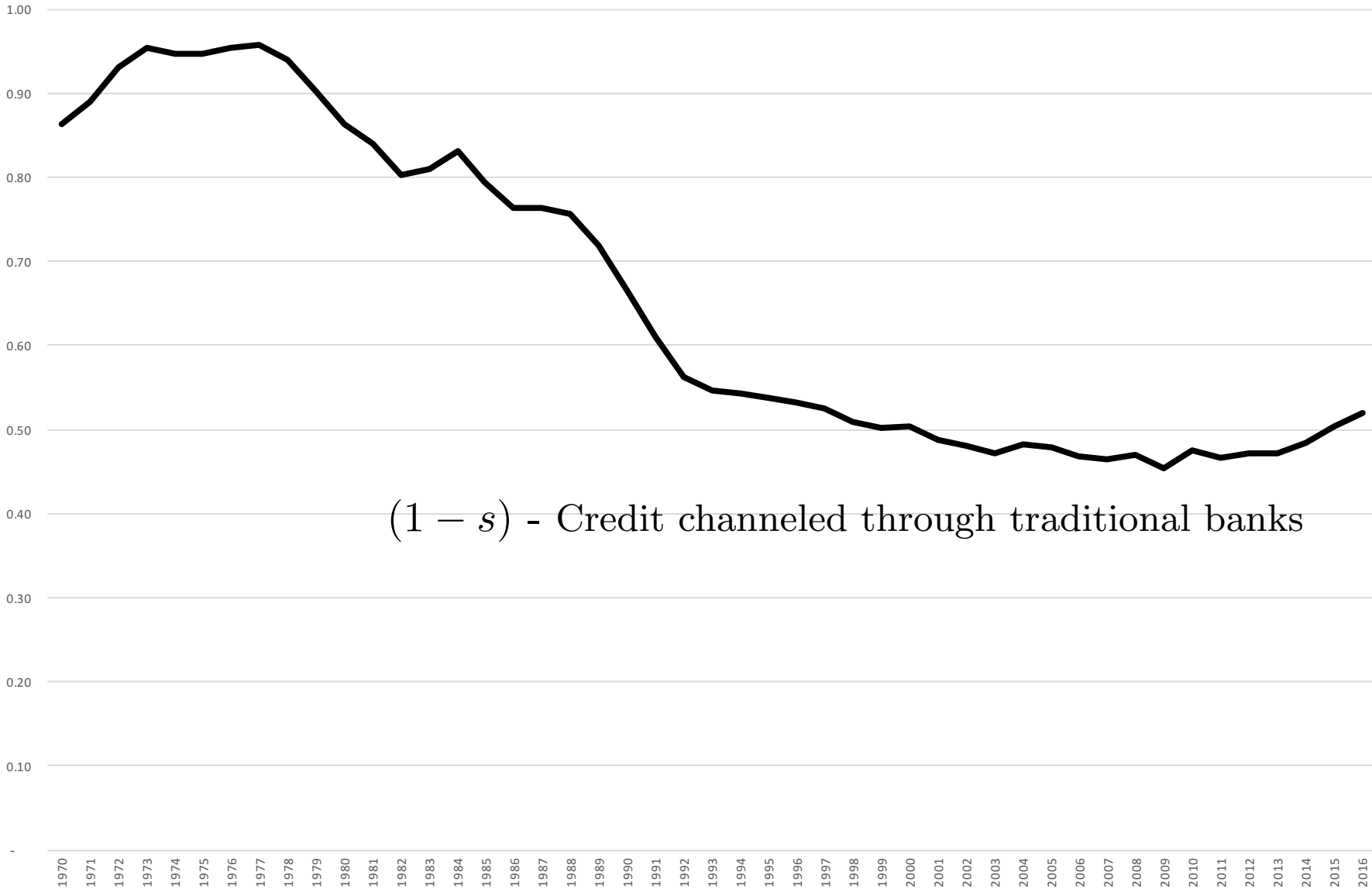
# Spreads from NIPA Tables

- We want the spread $\phi \equiv r_e - r$

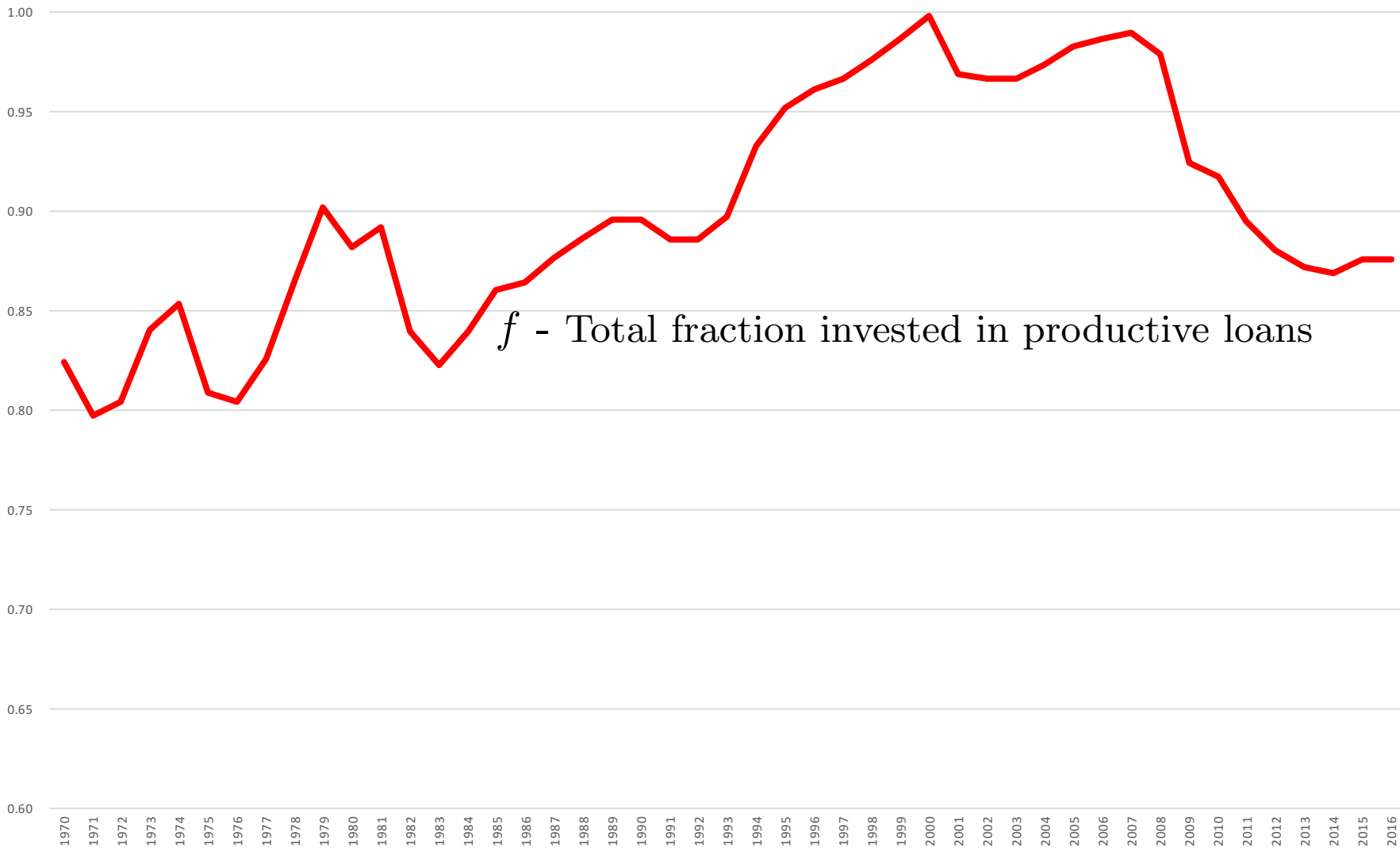
$$r_e - (\overbrace{r_L + r_s}^{r}) = \frac{\overbrace{r_T - (1-f)r_L}^{r_e}}{f} - (\overbrace{r_L + r_s}^{r}) = \frac{r_T - r_L}{f} - r_s$$

  - $r_T$ =(Total private interest received - bad debt expenses)/hh's debt.
    (Table 7.11 line 28 - Table 7.1.6 line 12)/Table D.3.
  - $r_L$=(Total private interest paid)/hh's debt.
    (Table 7.11 line 4)/Table D.3.
  - $r_s$=(Services furnished without payment)/hh's debt.
    (Table 2.4.5 line 88)/Table D.3.
  - $f = s + (1-s)\widehat{f}$
    $(1-s)$ = Consumer credit and mortgages to hh's channeled by TB
    = (Table 110 lines 14 and 15)/(Table D.3 columns 3 and 4)
    $\widehat{f}$ = (Total TB loans)/ (total TB deposits).
    = (Table 110 lines 12, 14 and 15)/(Table 110 lines 23 and 24)

# Size of Traditional Banking



# Investment in Productive Loans



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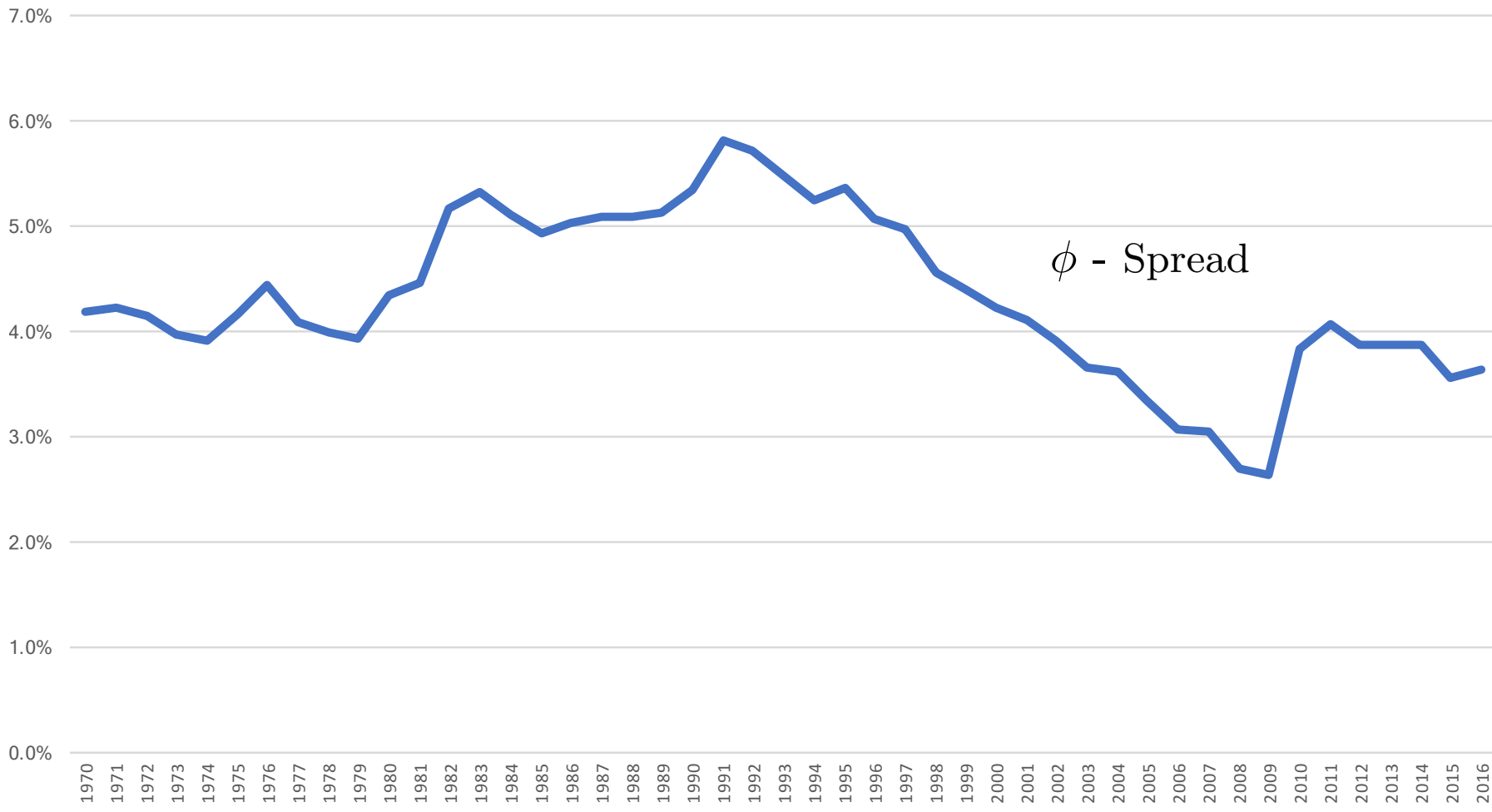
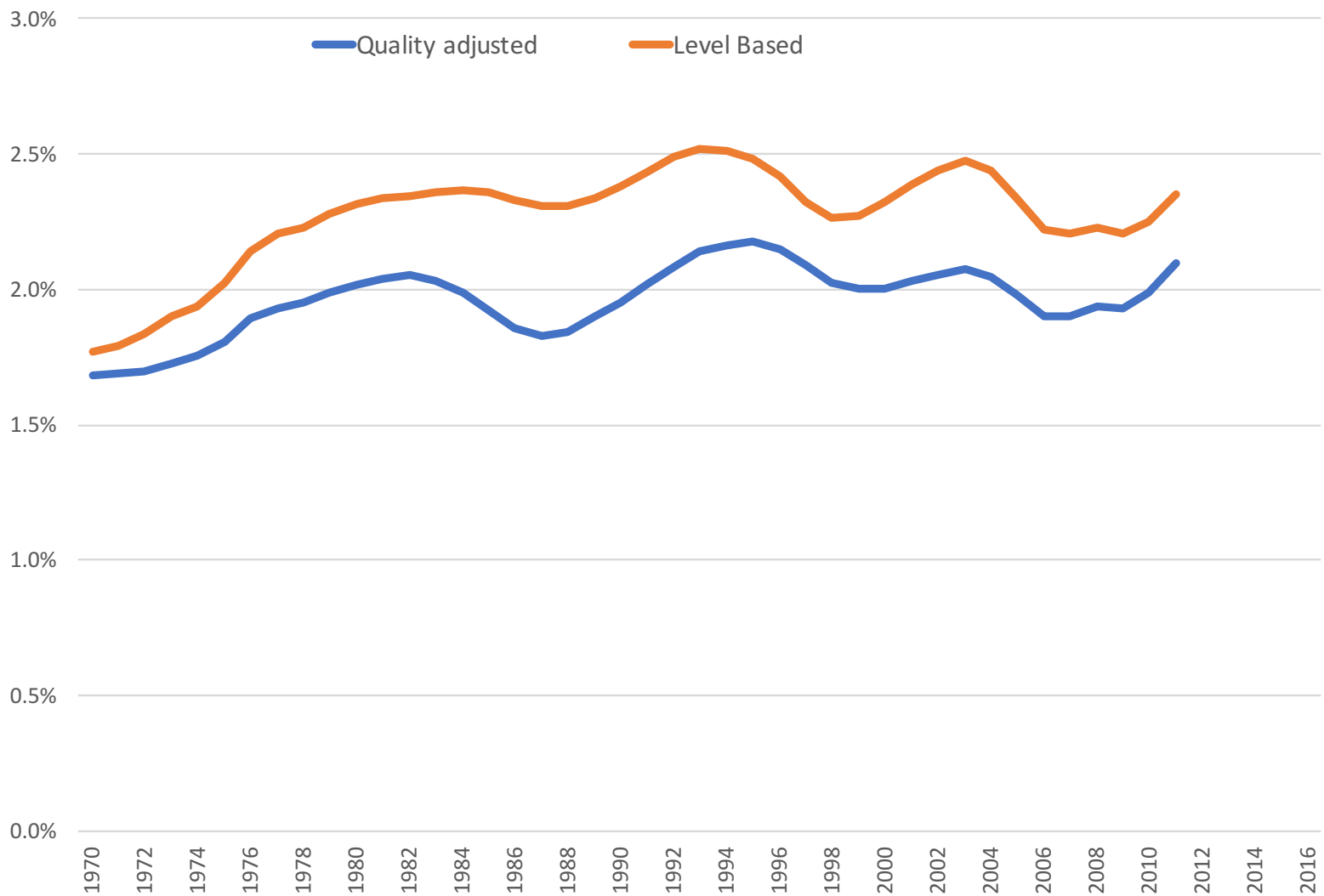


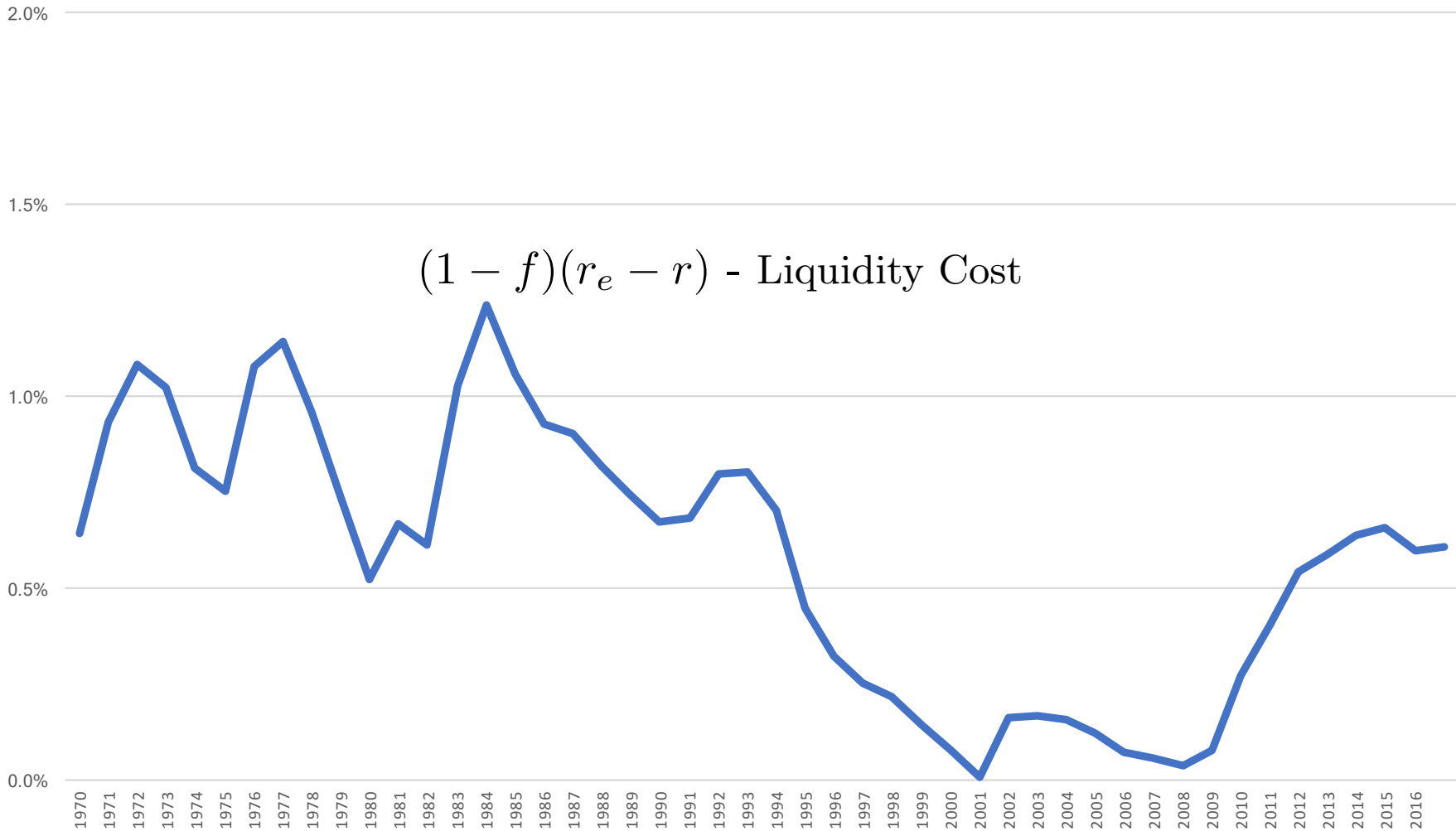

▸ Corbae and D'Erasmo Spreads

# Value Added: Philippon (AER, 2015)

The drop in spreads is not because an improvement in efficiency!



# Liquidity Costs



# Taking the Model to the Data

- Calibrate the model economy to 1980.
- Counterfactual in 2007.
  - Do life expectancy and shadow banking account for the aggregate changes we observed? What was their individual contribution?
- Counterfactual without shadow banking (and without crisis).

# Calibration to 1980

| **Parameter** | **Notation** | **Value** | **Source** |
|---|---|---|---|
| Discount Rate | $\beta$ | 0.99 | Standard |
| Productivity Growth | $\gamma$ | 0.02 | Standard |
| Population Growth | $\eta$ | 0.01 | Standard |
| Capital Share | $\theta$ | 0.33 | Standard |
| Inheritance Age | $T_I$ | 29 | Age 52 |
| Retirement Age | $T$ | 40 | Age 63 |
| Fraction of agents with $\alpha = 0$ | $\mu$ | 0.75 | Flow of Funds |
| Government Spending/GDP | $g$ | 0.20 | NIPA Tables |
| Government Debt/GDP | $D^G/Y$ | 0.33 | NIPA Tables |
| Depreciation Capital | $\delta_k$ | 0.027 | Match $K/Y = 3.4$ |
| Bequest Motive | $\widehat{\alpha}$ | 4.64 | Match $\frac{Hh\ Debt}{Y} = 1$ |
| SS Transfers (fix $ss_S = 0$) | $ss_B$ | 0.55 | Match $\frac{G\ Debt}{Y} = 0.33$ |

# Counterfactual in 2007

- Life expectancy and spreads in 1980
  - $\delta = 0.072 \Rightarrow$ Post-retirement life expectancy of 14 years
  - $\phi = 0.04.$ As discussed above.

- Counterfactuals in 2007
  - $\delta = 0.052 \Rightarrow$ Post-retirement life expectancy of 20 years
  - $\phi = 0.03.$ As discussed above.

▸ We maintain debt/GDP constant at 33%

# Counterfactual Decomposition

| Economy | 1980 Benchmark | Lower $\delta$ $TB$ | Same $\delta$ $SB$ | Lower $\delta$ $SB$ |
|---|---|---|---|---|
| Interm. Cost ($\phi$) | 4% | 4% | 3% | 3% |
| Survival prob. ($\delta$) | 0.072 | 0.052 | 0.072 | 0.052 |
| **Interest Rates** | | | | |
| Borrowing Rate ($r$) | 0.030 | 0.023 | 0.034 | 0.028 |
| Lending Rate ($r_e$) | 0.070 | 0.063 | 0.064 | 0.058 |
| **National Accounts** | | | | |
| Output | 1.000 | 1.035 | 1.031 | 1.070 |
| Capital output ratio | 3.40 | 3.65 | 3.62 | 3.90 |
| **Net Worth** | | | | |
| Total | 3.73 | 3.98 | 3.95 | 4.23 |
| Equity (Plan C) | 2.40 | 2.68 | 2.08 | 2.28 |
| Debt (Plan B) | 1.33 | 1.30 | 1.86 | 1.94 |
| *Data (FF: Table L100)* | *1.36* | | | *2.33* |
| Bequest/GDP | 0.049 | 0.049 | 0.040 | 0.039 |
| Government Debt/GDP | 0.33 | 0.33 | 0.33 | 0.33 |
| Households Debt/GDP | 1.00 | 0.96 | 1.53 | 1.62 |
| *Data (FF: Table D3)* | *1.00* | | | *1.66* |

# Welfare Effects

| Economy | 1980 Benchmark | Lower $\delta$ $TB$ | Same $\delta$ $SB$ | Lower $\delta$ $SB$ |
|---|---|---|---|---|
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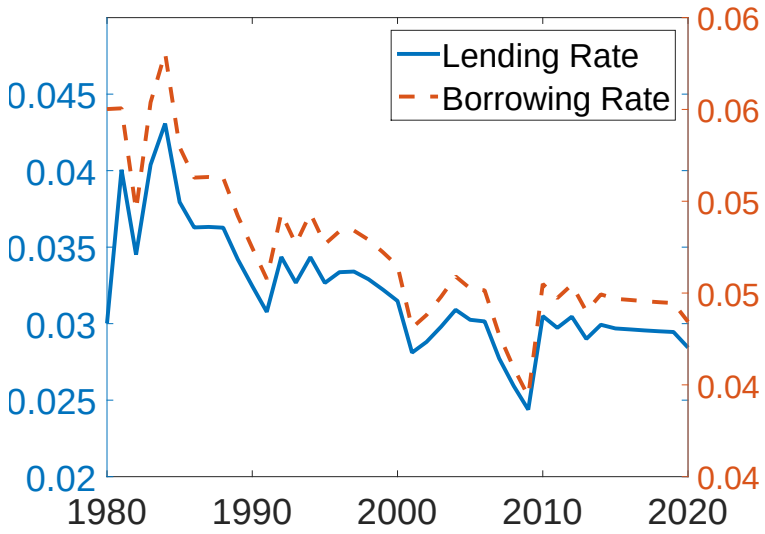
| *Data (FF: Table L100)* | *1.36* | | | *2.33* |
| Change on welfare at birth | - | - | 0.3% | 0.4% |
| Plan C | - | - | -4.3% | -4.8% |
| Plan B | - | - | 2.5% | 2.8% |

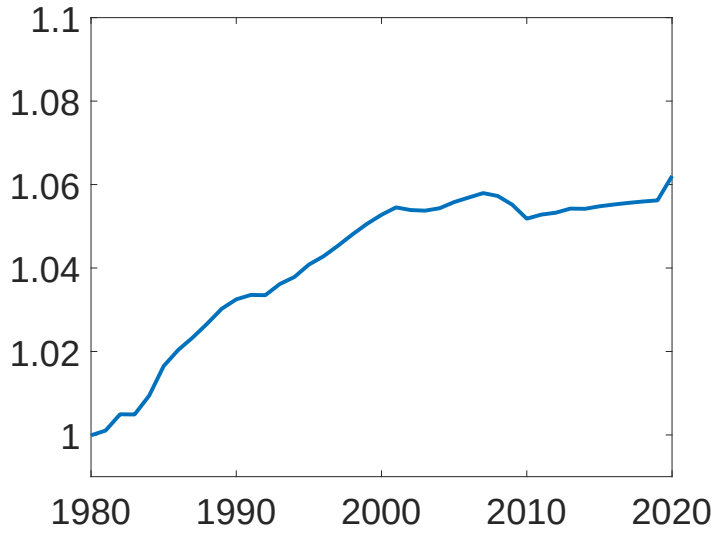
# Alternative Gov. Debt/GDP

| Economy | 1980 Benchmark | 2007 Calibration | Free $D^G$ | All $D^G$ Domestic |
|---|---|---|---|---|
| Interm. Cost ($\phi$) | 4% | 3% | 3% | 3% |
| Survival prob. ($\delta$) | 0.072 | 0.052 | 0.052 | 0.052 |
| **Interest Rates** | | | | |
| Borrowing Rate ($r$) | 0.030 | 0.028 | 0.027 | 0.029 |
| Lending Rate ($r_e$) | 0.070 | 0.058 | 0.057 | 0.059 |
| **National Accounts** | | | | |
| Output | 1.000 | 1.070 | 1.071 | 1.060 |
| Capital output ratio | 3.40 | 3.90 | 3.91 | 3.85 |
| **Net Worth** | | | | |
| Total | 3.73 | 4.23 | 4.21 | 4.47 |
| Equity (Plan C) | 2.40 | 2.28 | 2.28 | 2.36 |
| Debt (Plan B) | 1.33 | 1.94 | 1.93 | 2.11 |
| *Data (FF: Table L100)* | *1.36* | *2.33* | | |
| Bequest/GDP | 0.049 | 0.039 | 0.039 | 0.041 |
| **Government Debt/GDP** | 0.33 | **0.33** | 0.30 | **0.62** |
| Households Debt/GDP | 1.00 | 1.62 | 1.63 | 1.49 |
| *Data (FF: Table D3)* | *1.00* | *1.66* | | |

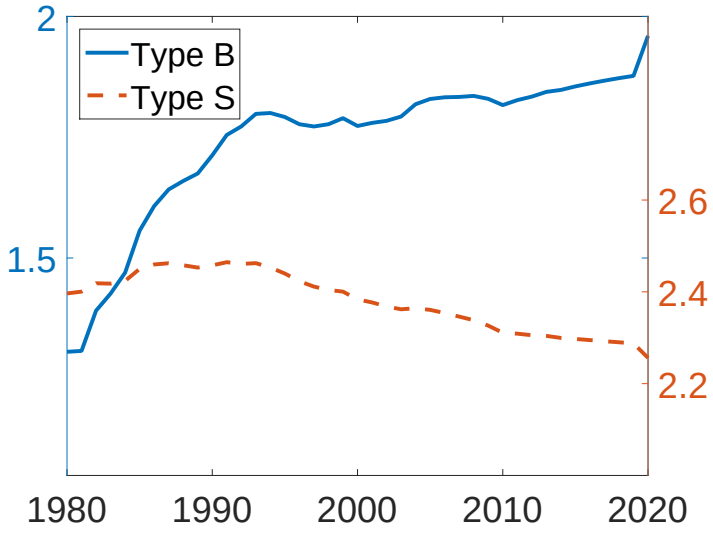
# Transitions: Realized TFP



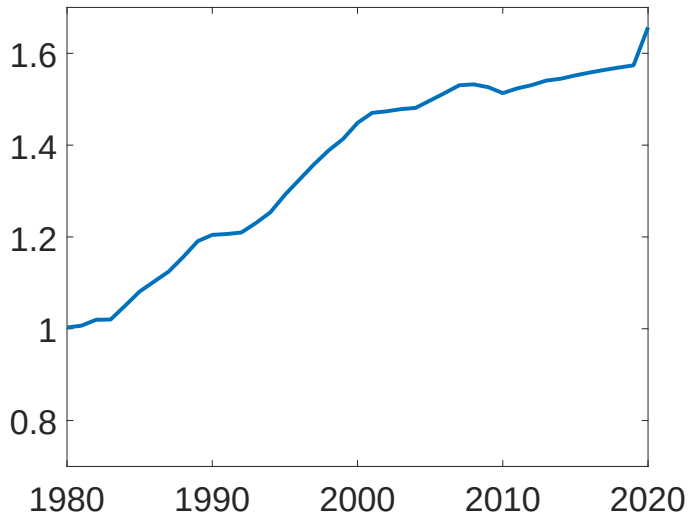

(a) Interest Rates




(b) Output

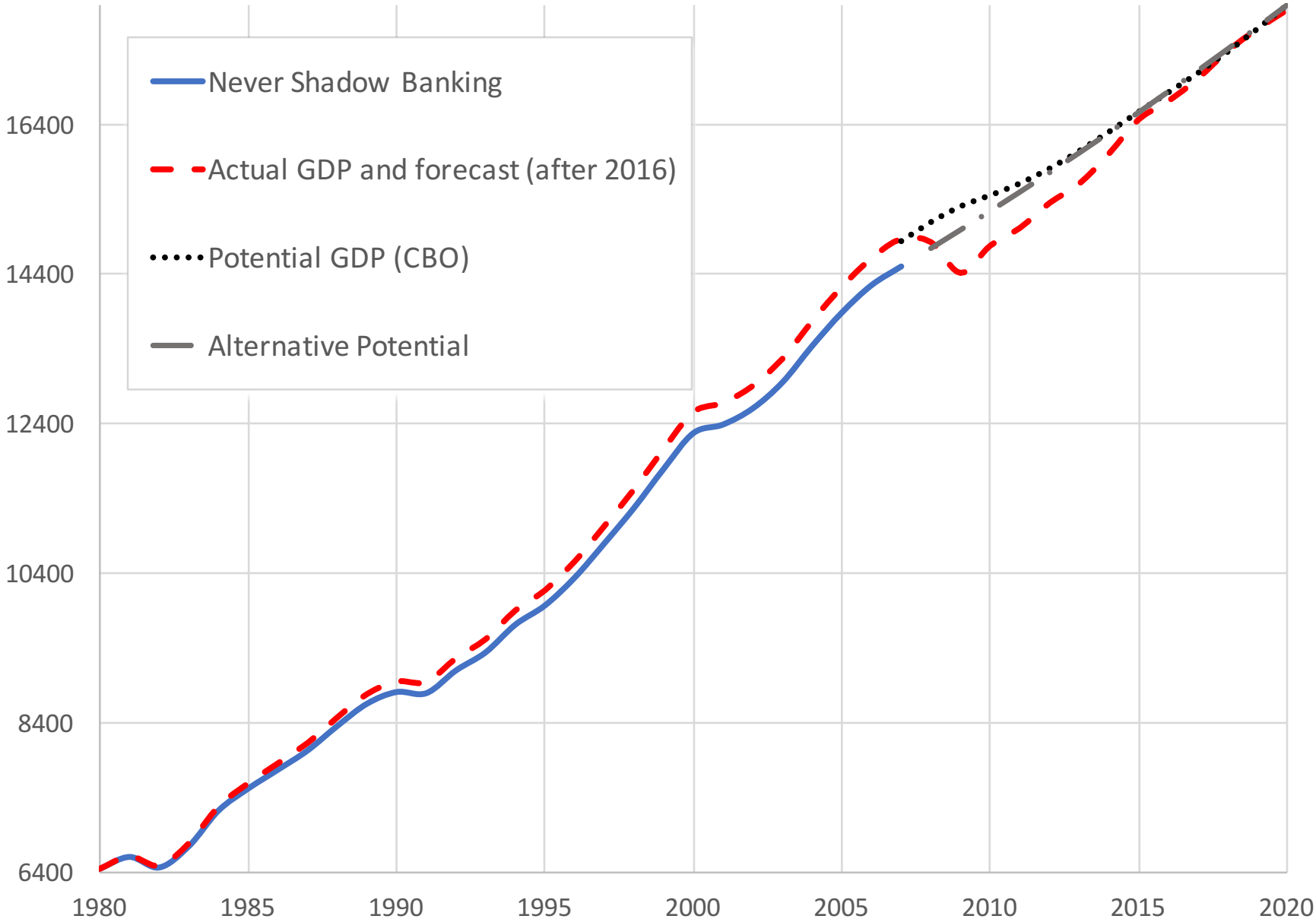



(c) Aggregate Assets/Output




(d) Household Debt/Output

# Costs and Benefits of Shadow Banking



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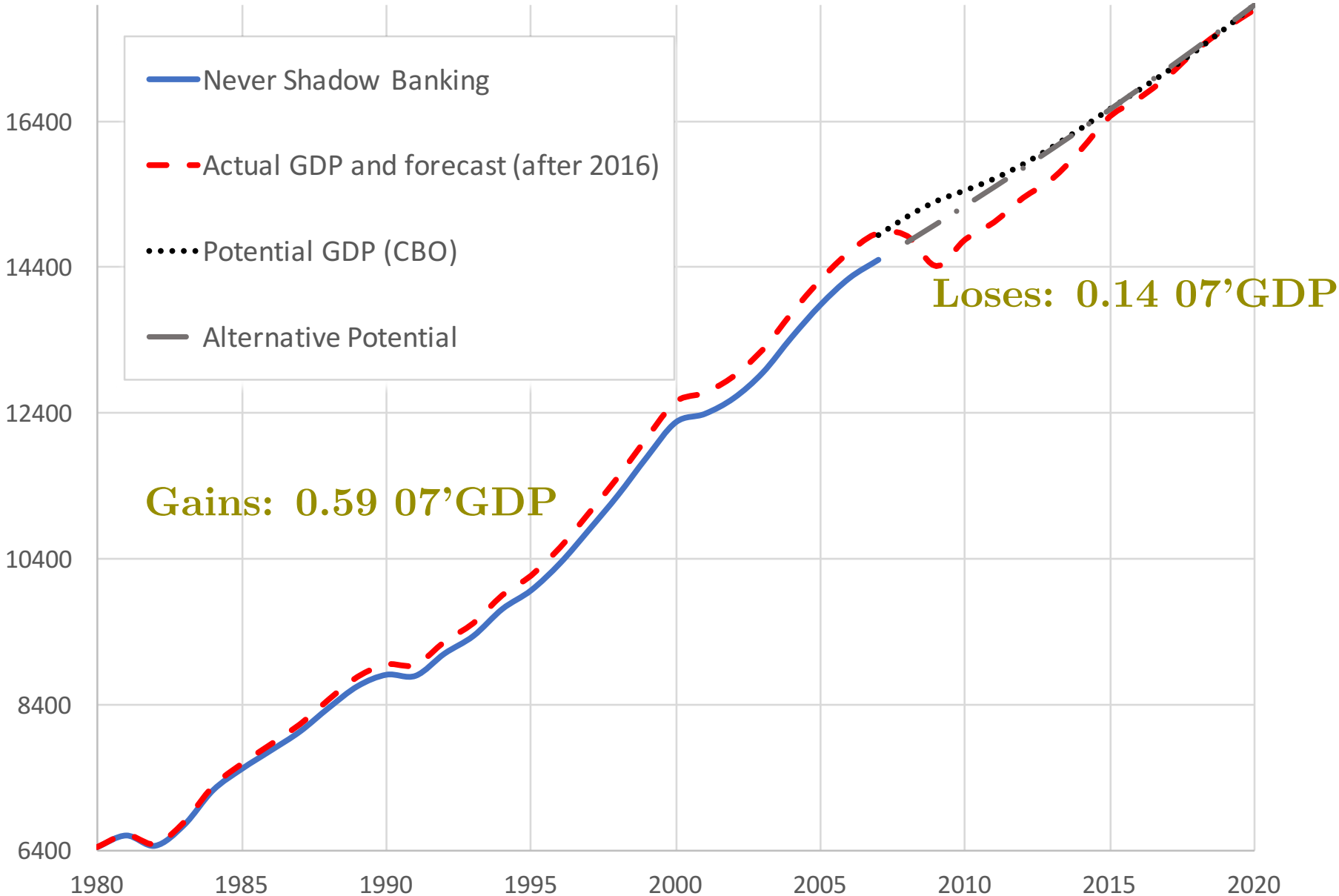


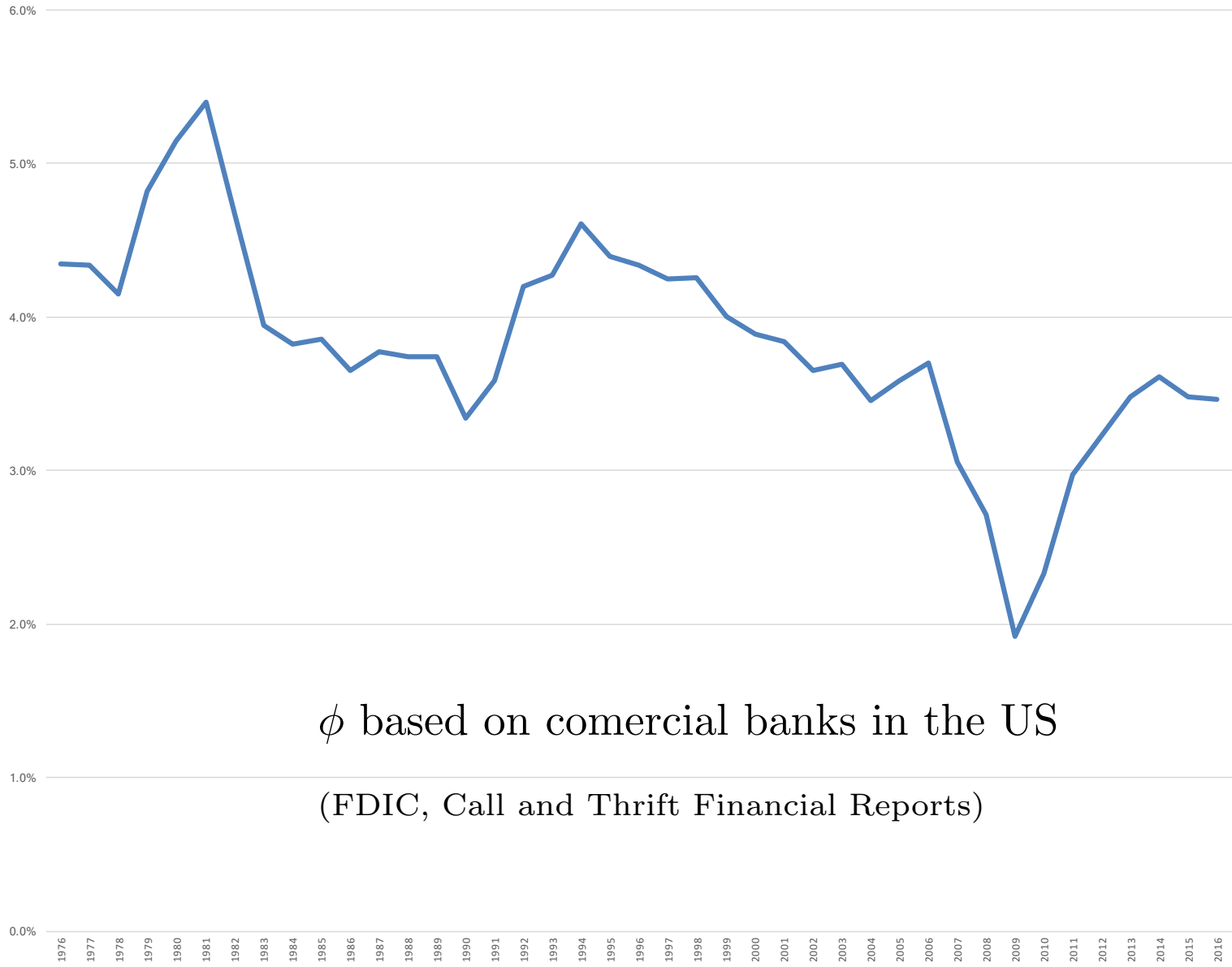
# Final Remarks

- People lives longer $\Rightarrow$ "Domestic Saving Glut" $\Rightarrow \downarrow$ saving returns.
- Pressure for a new technology $\Rightarrow$ Shadow Banking$\Rightarrow \uparrow$ saving returns.
- This is why we need to go quantitative. In net
  - Large increase in credit.
  - Small reduction in returns.
  - Sizeable increase in output.

- Careful with asphyxiating shadow banking!

# Corbae and D'Erasmo Spreads

back



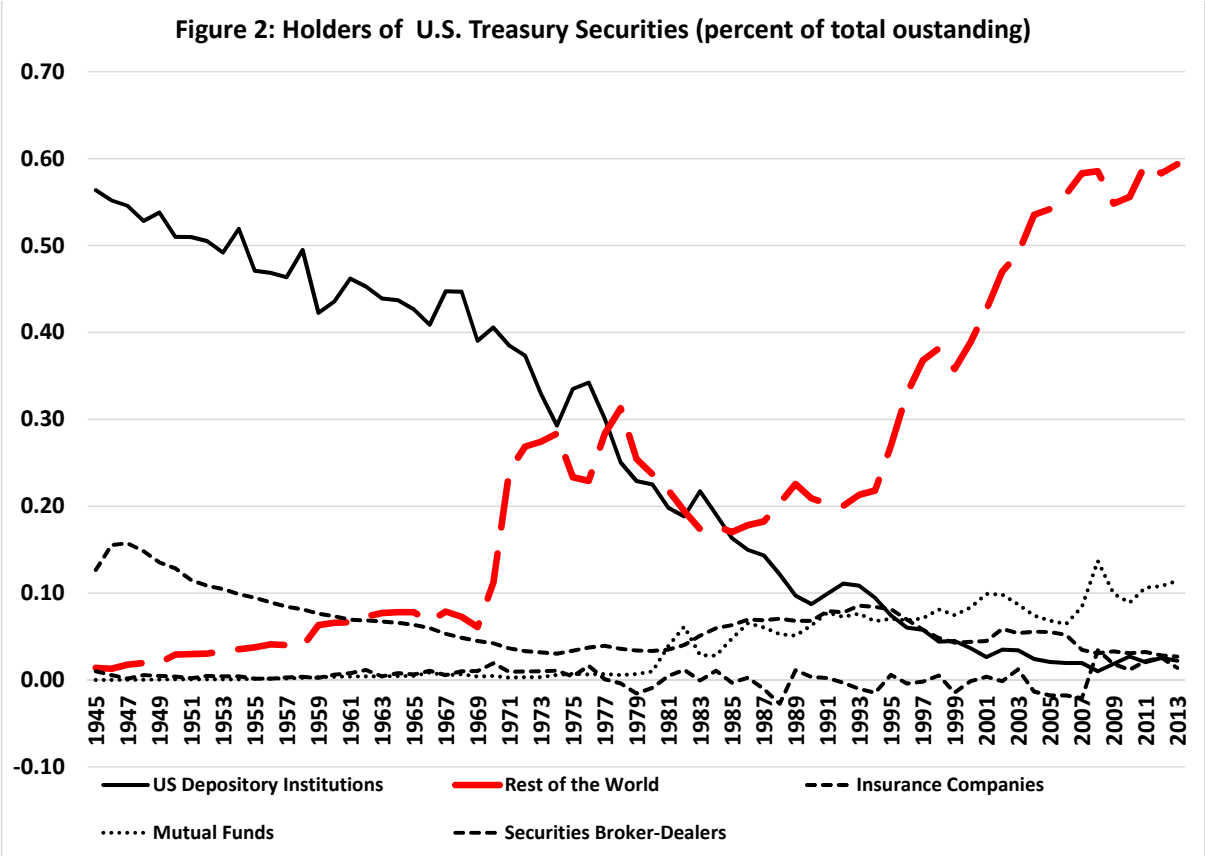

$\phi$ based on comercial banks in the US

(FDIC, Call and Thrift Financial Reports)

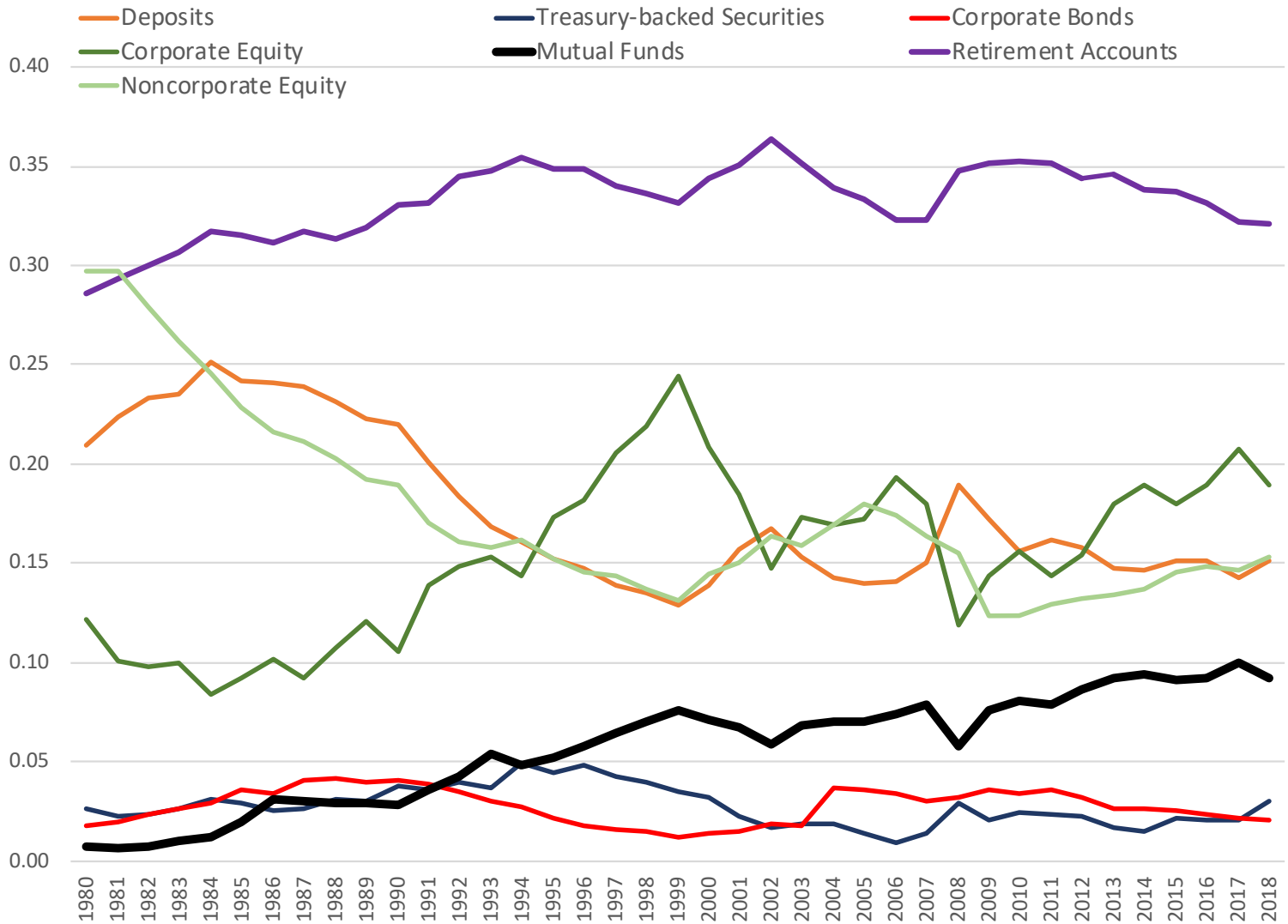
# Maintaining Debt/GDP constant

back

- In 1980 $\frac{GDebt}{Y} = 0.37$, but 80% held domestically, then $\frac{D^G}{Y} \approx 0.3$.
- In 2007 $\frac{GDebt}{Y} = 0.62$, but 40% held domestically, then $\frac{D^G}{Y} \approx 0.3$.



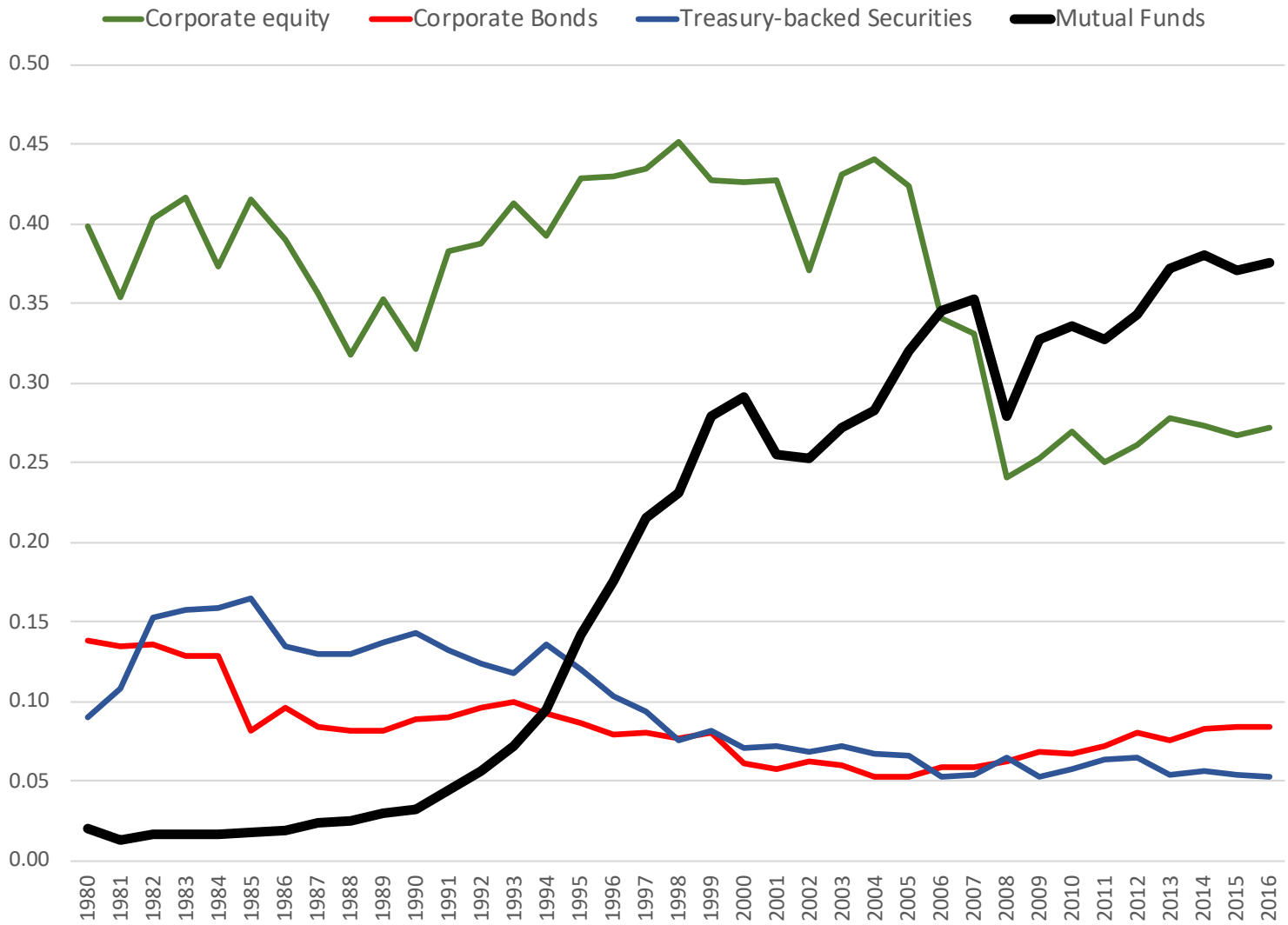
# Composition of Financial Assets (B101-FF)




Large fraction of savings are channeled through intermediaries.

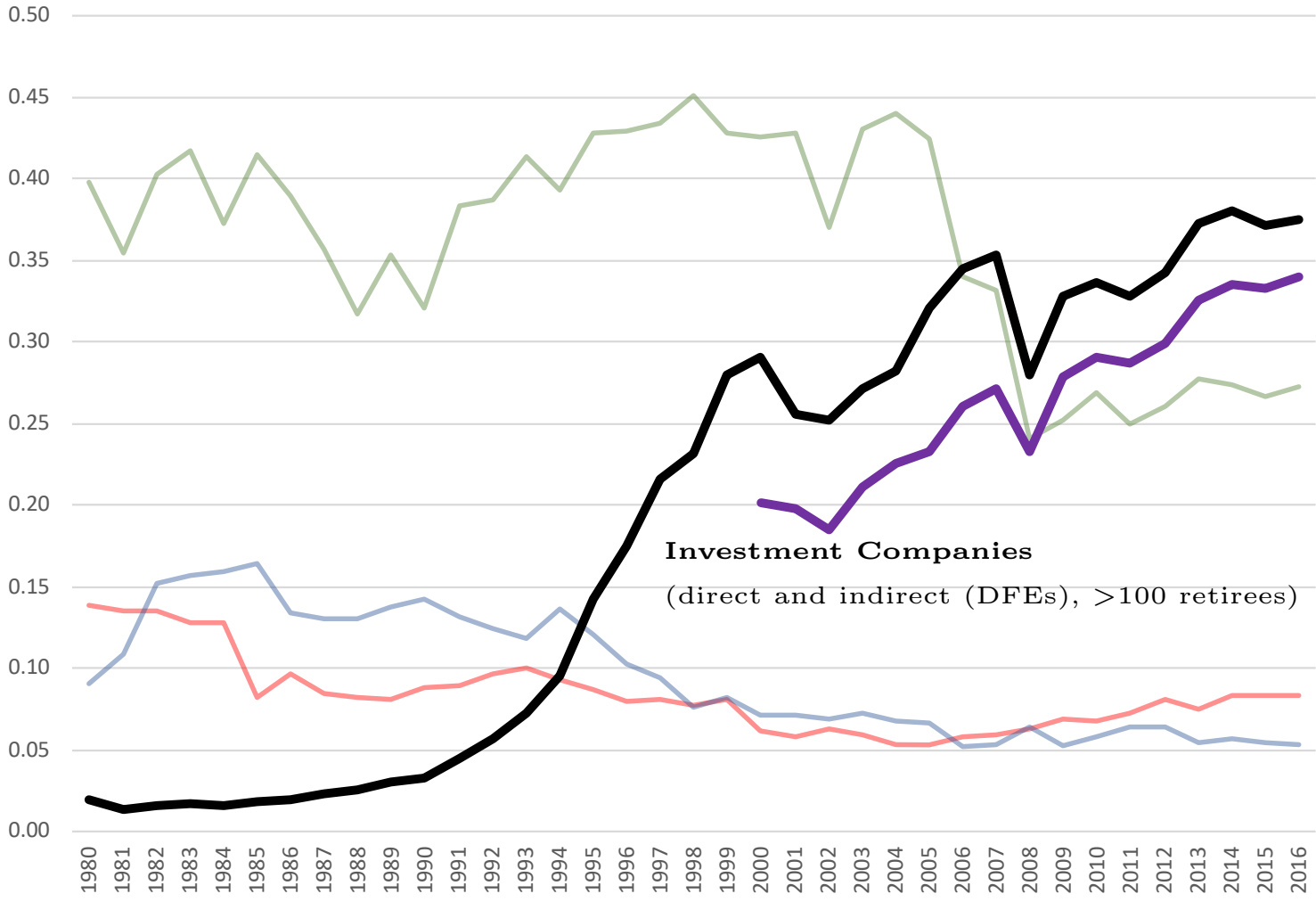
Shadow intermediaries replaced traditional ones

# Composition of Pensions (L118-FF)



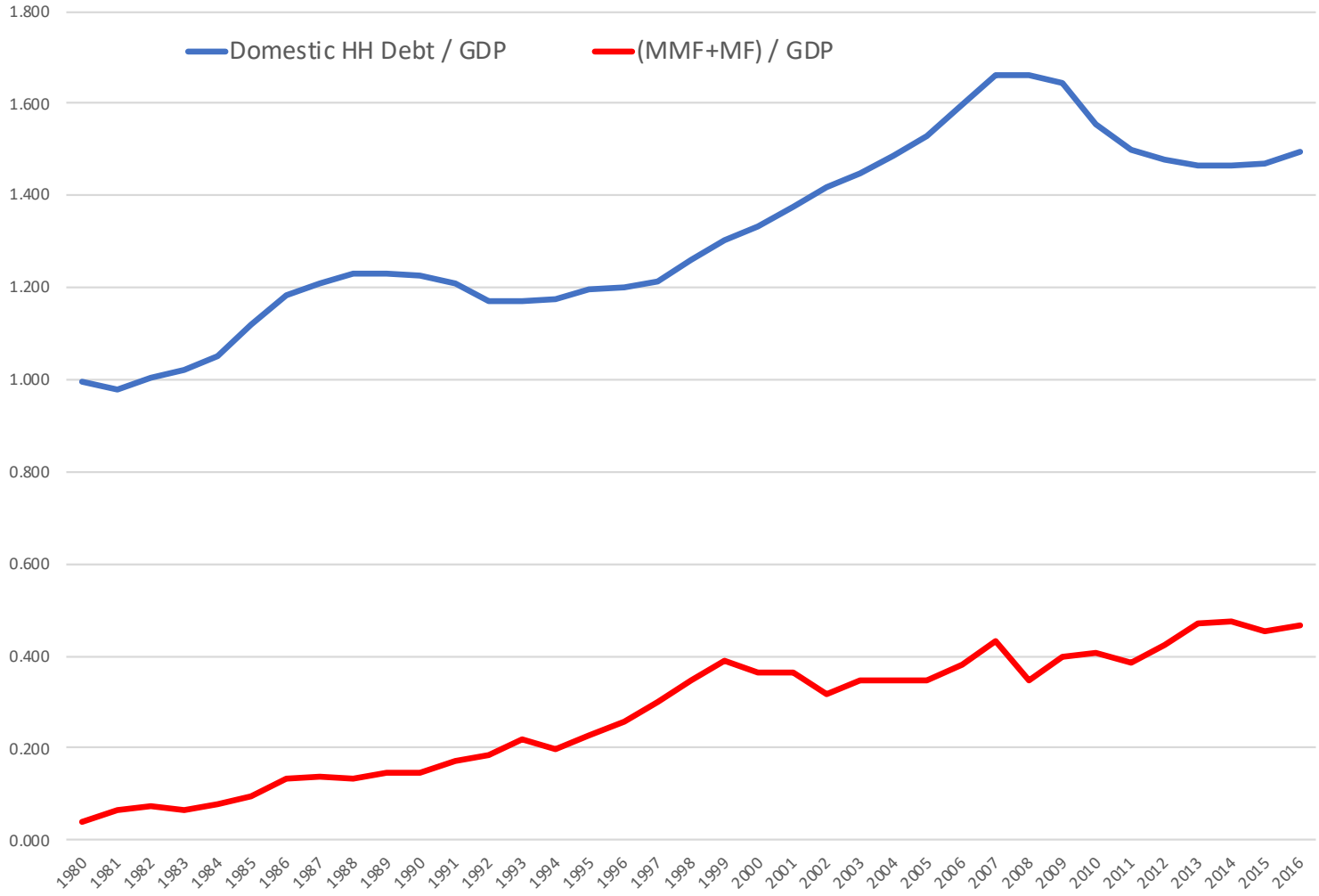

Securitization was also used by traditional intermediaries.....

# Investment Companies in Pensions (5500-EBSA)




....and may have allowed expanding their productive investments

# Shadow Banks and Credit (D3-NIPA and B101-FF)




....and expanding credit more generally in the economy.

# Related Work

- Financial Effects of Savings for Retirement Needs
  - Scharfstein (2018), Shourideh and Troshkin (2019).
- Macroeconomics Effects of Shadow Banking
  - Moreira and Savov (2015), Begenau and Landvoigt (2017).
- Demand of Safe Assets
  - Caballero (2010), Caballero, Farhi and Gourinchas (2016).
- Supply of Safe Assets (via securitization and shadow banking).
  - Gorton and Ordonez (2014), Ordonez (2018a, 2018b)

    Farhi and Tirole (2017).