Uncertainty, Investment and Cash Holding: Theory and Firm-level Evidence

Aubhik Khan[1] Tatsuro Senga[2] Julia K. Thomas[3]

[1]The Ohio State University

[2]Queen Mary University of London, ESCoE, and RIETI

[3]The Ohio State University

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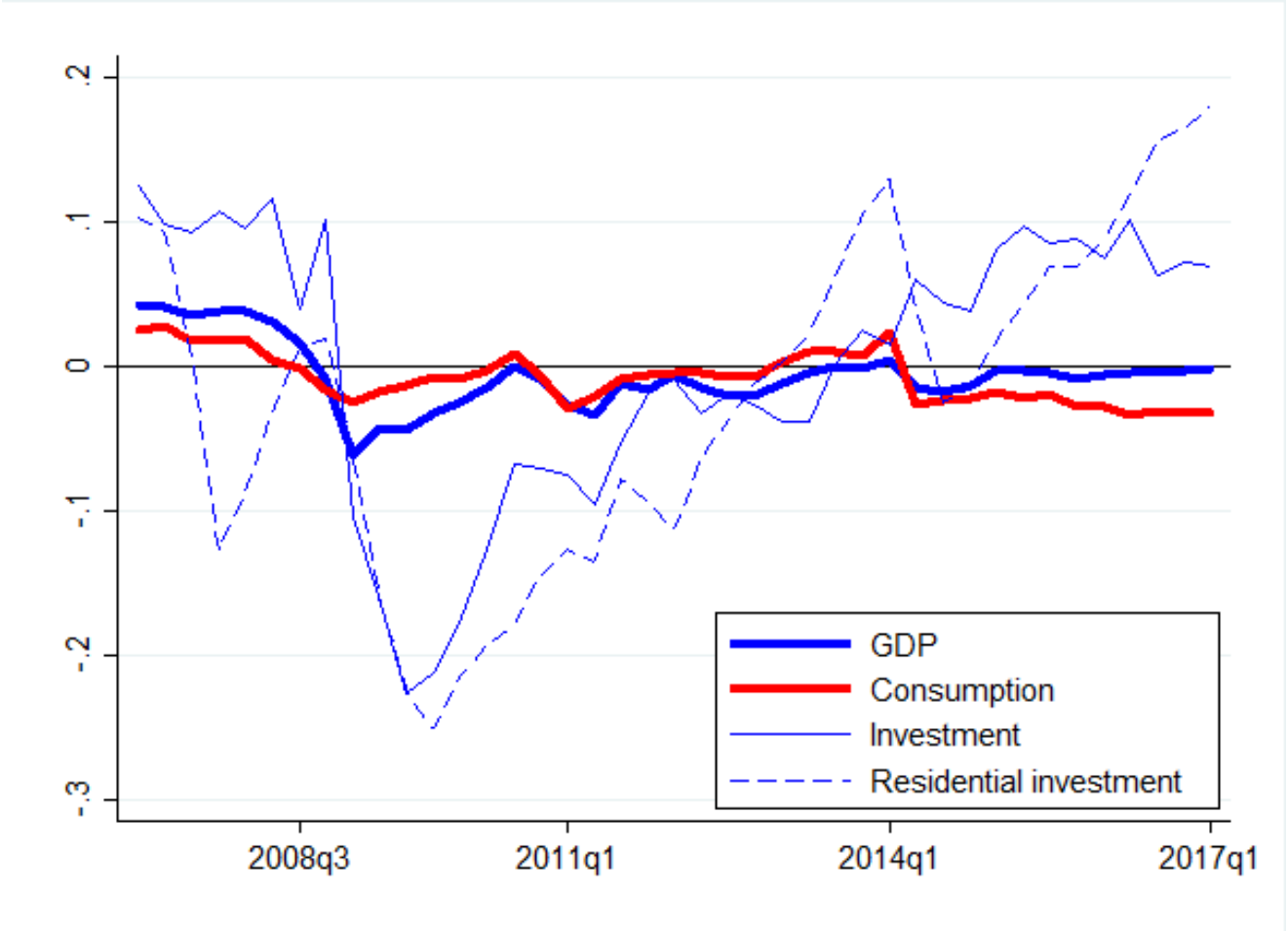
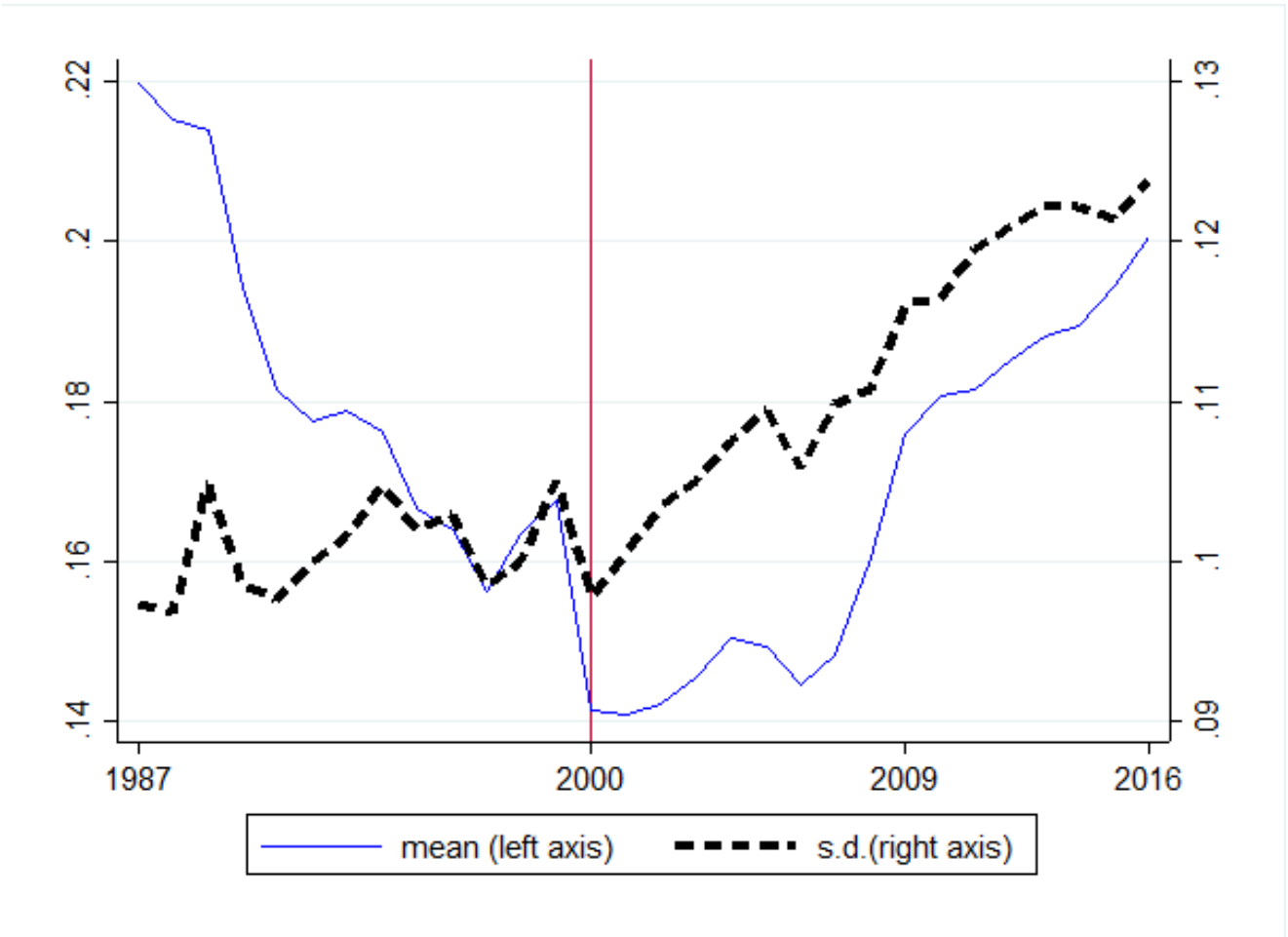
Recent business cycles in Japan



- 2008 Q3: Lehman Brothers filed for bankruptcy (15 September, 2008)
- 2011 Q1: The Tohoku earthquake (11 March, 2011)
- 2014 Q1: Consumption Tax increased to 8% from 5%

Japanese listed firms are increasing their cash holdings

- (Cash + Short-term investment) / Total assets
- Compustat: 2,960 Japanese companies averaging 17 year observations



The trickle down of Abenomics?

"The situation went much too far, we must think of ways for that money to be spent on capital spending and wages"

— Finance Minister Taro Aso, October 2017

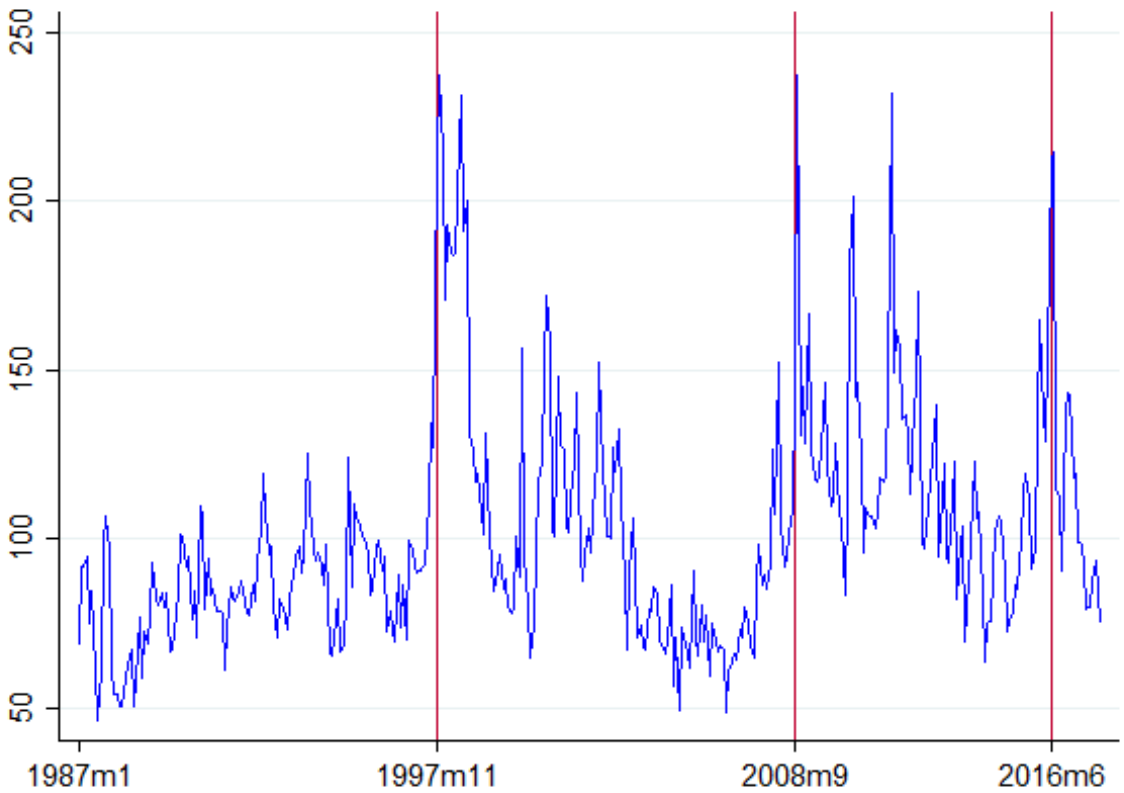
This paper

Uncertainty?

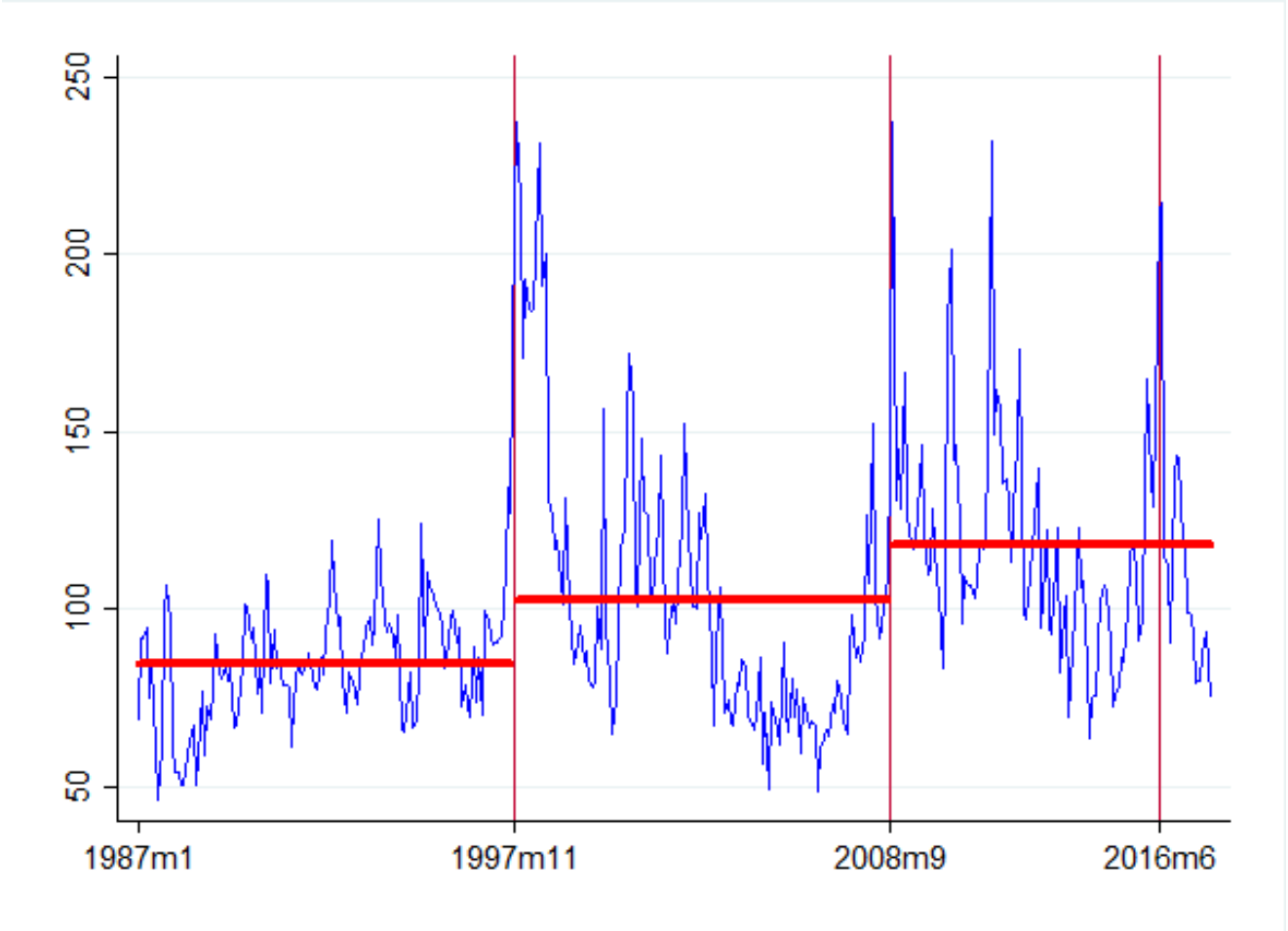
- Investment is negatively associated with uncertainty
  (e.g. Ogawa and Suzuki, 2000; Tanaka, 2004; Miyao, 2009)
- Is uncertainty holding back investment, which is leading to cash-hoarding?

Uncertainty varies across time

- Economic policy uncertainty (EPU) indices for Japan (Arbatli et al., 2017)
- The frequency of newspaper articles that contain certain terms (uncertainty, uncertain, etc).



Uncertainty appears to be rising in Japan



- Nov 1997: The closure of Yamaichi Securities and Hokkaido Takushoku Bank
- Sep 2008: Lehman Brothers filed for bankruptcy
- Jun 2016: UK voted to leave EU (Brexit)

This paper

Approach:

- Build a heterogeneous firm model with default risk

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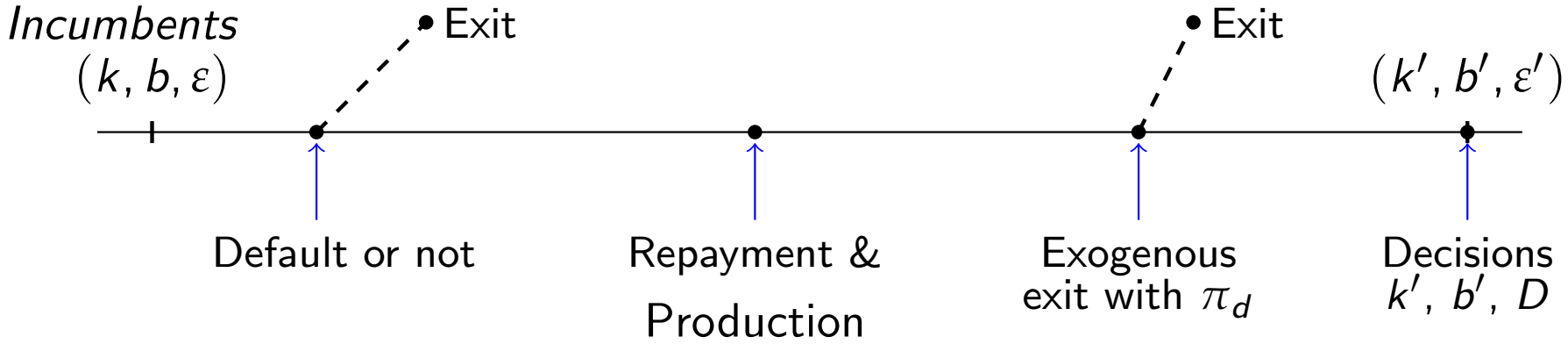
Key model ingredients:

- $y = \varepsilon k^{\alpha} n^{\nu}$
  - heterogeneity of ε (firm-level productivity)
  - a conditional volatility of ε (risk-uncertainty)
  - an optimal scale of capital $k^{*}(\varepsilon)$
- firms can borrow $b > 0$, alternatively have financial savings $b < 0$

(Timing within a Period)



(Key model ingredients)

$$\pi(k, \varepsilon) = \varepsilon k^{\alpha} n^{*}(k, \varepsilon)^{\nu} - \omega n^{*}(k, \varepsilon)$$

$$x = \pi(k, \varepsilon) + (1 - \delta)k - b - \xi$$

Values of firms

x (cash-on-hand) and ε (firm-level productivity) identify a firm.

$$
\begin{aligned}
V^0(x,\varepsilon_i) &= \max\{V^1(x,\varepsilon_i),0\} \\
V^1(x,\varepsilon_i) &= \pi_d x + (1-\pi_d)V^2(x,\varepsilon_i) \\
V^2(x,\varepsilon_i) &= \max_{k',b'\in\Phi(x,\varepsilon_i)}\left[D+\beta\sum_{j=1}^{N_\varepsilon}\pi_{ij}^{\varepsilon}V^0\left(x_j',\varepsilon_j\right)\right], \\
\text{subject to} &: \\
D &= x-k'+q\left(k',b',\varepsilon_i\right)b' \\
\Phi(x,\varepsilon_i) &= \left\{\left(k',b'\right)\in R_+\times R \mid D\left(x,\varepsilon,k',b'\right)\geq 0\right\} \\
x_j' &= \pi\left(k',\varepsilon_j\right)+(1-\delta)k'-b'-\xi
\end{aligned}
$$

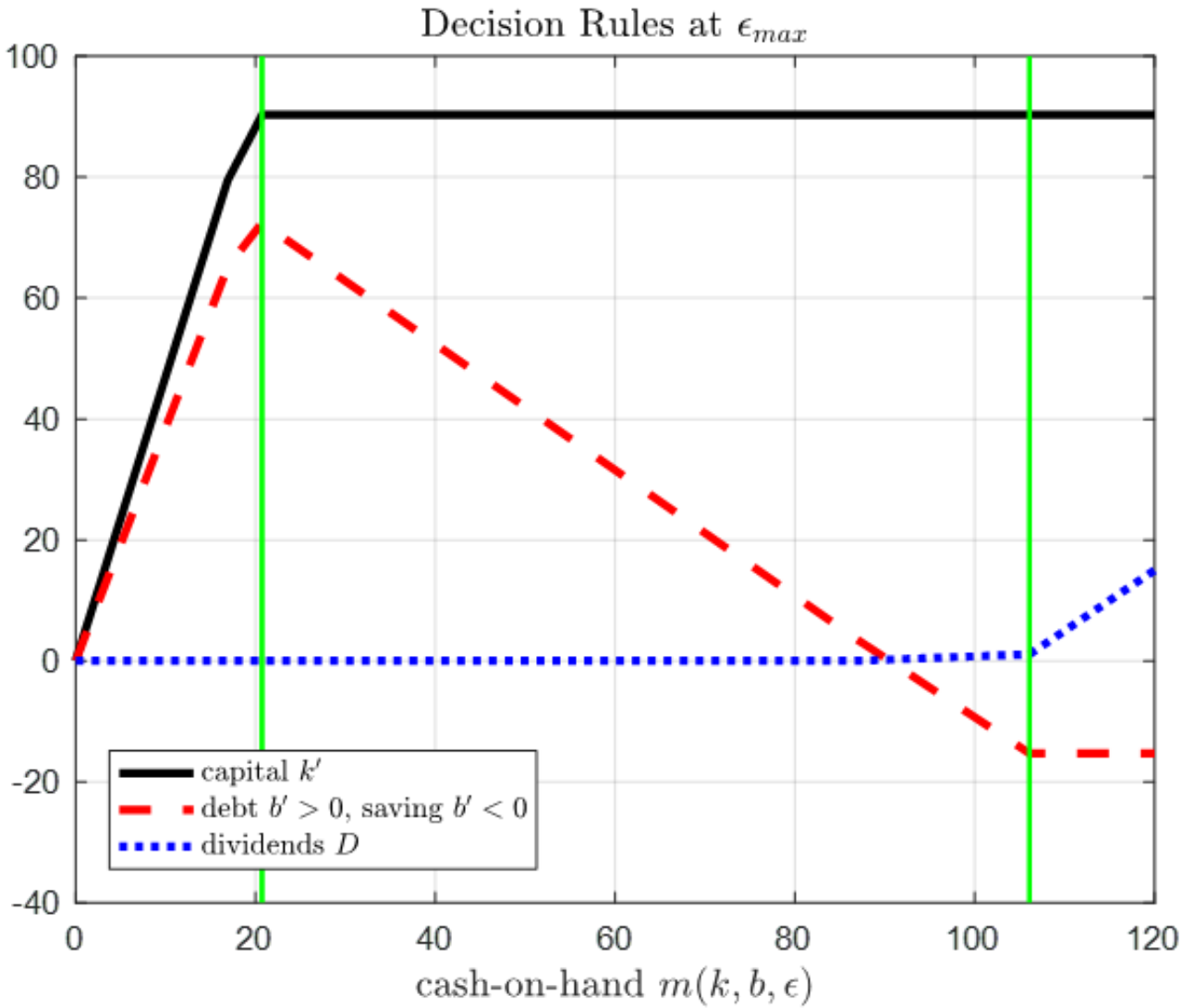
Default risk and loan rates

$q\left(k', b', \varepsilon_i\right)$: loan rates, which depend on the probability of default

$$
\begin{aligned}
q\left(k', b', \varepsilon_i\right) b' &= \beta \sum_{j=1}^{N_\varepsilon} \pi_{ij}^{\varepsilon} \Big[\underbrace{\chi\left(x_j', \varepsilon_j\right) b'}_{repayment} \\
&+ \underbrace{\left[1 - \chi\left(x_j', \varepsilon_j\right)\right] \min\left\{b', \rho\left(1-\delta\right) k'\right\}}_{default} \Big].
\end{aligned}
$$

- $\chi\left(x_j', \varepsilon_j\right)$: default probability

Life-cycle pattern of firms



Minimum savings policy

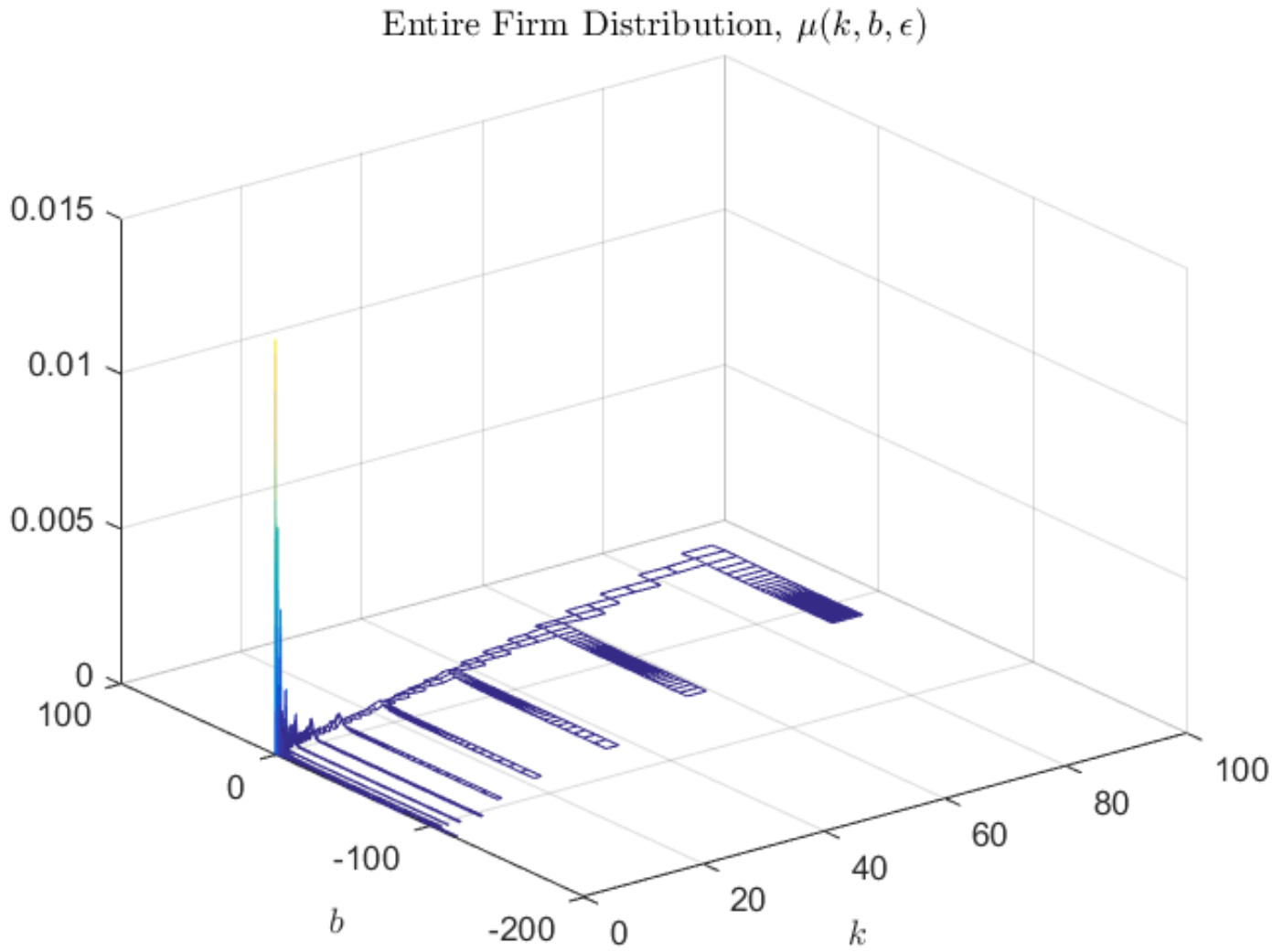
$B^w(\varepsilon)$ is the minimum savings policy ensuring unconstrained firm of type ε adopting $k^*(\varepsilon)$ will remain unconstrained and never default.

$$B^w(\varepsilon) = \min_{\{\varepsilon_j | \pi_{ij}^{\varepsilon} > 0\}} \widetilde{B}\left(k^*(\varepsilon), \varepsilon_j\right)$$

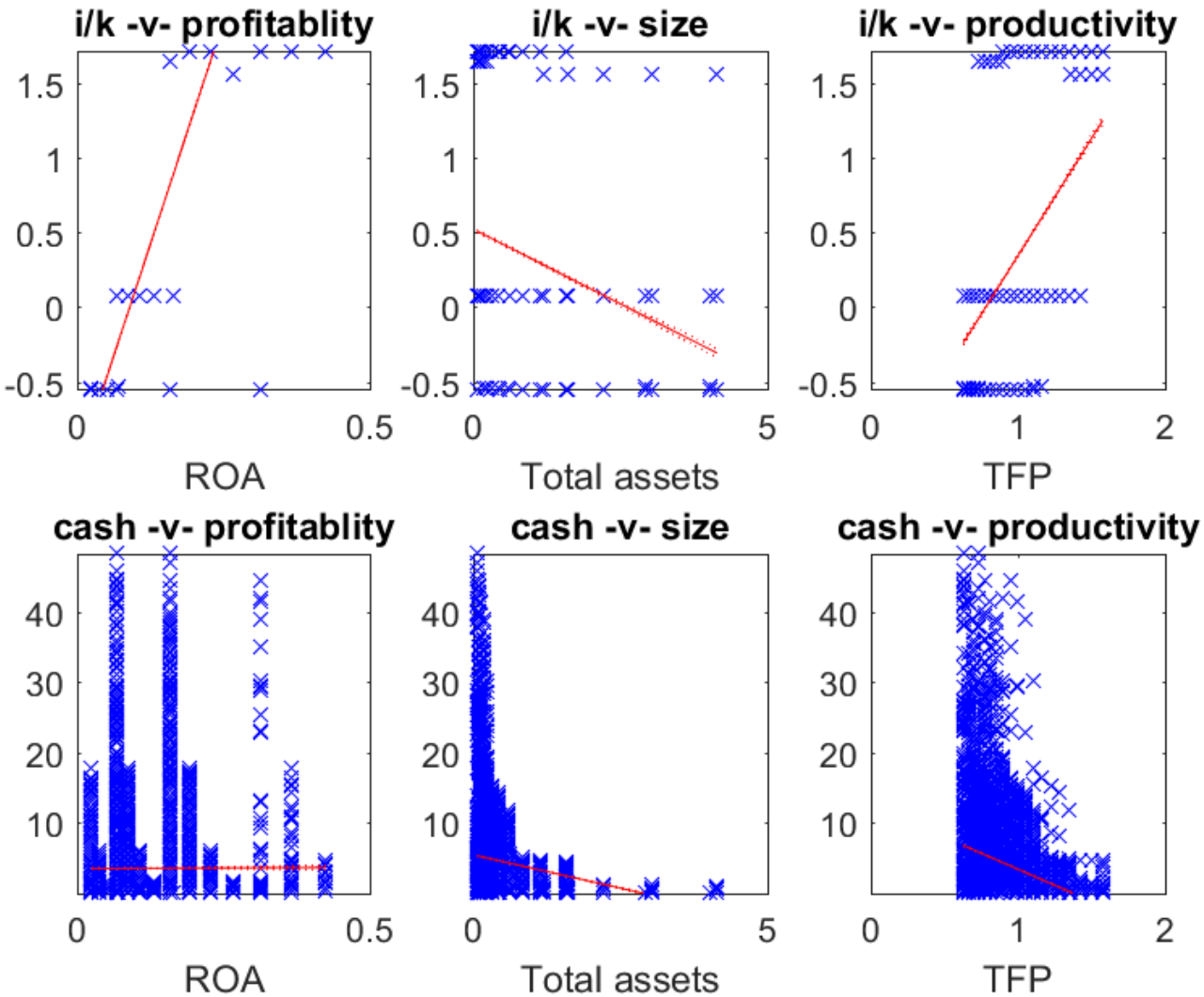
$$\begin{aligned} \widetilde{B}(k,\varepsilon) &\equiv \pi(k,\varepsilon) - \xi + (1-\delta)k - \\ &+ \min\left\{-k^*(\varepsilon) + q_0 B^w(\varepsilon), 0\right\} \end{aligned}$$

$\widetilde{B}(k,\varepsilon)$ is the largest b a type (k,ε_i) firm can owe this period and implement $k^*(\varepsilon_i)$ and $b' = B^w(\varepsilon_i)$ while satisfying $D \geq 0$.

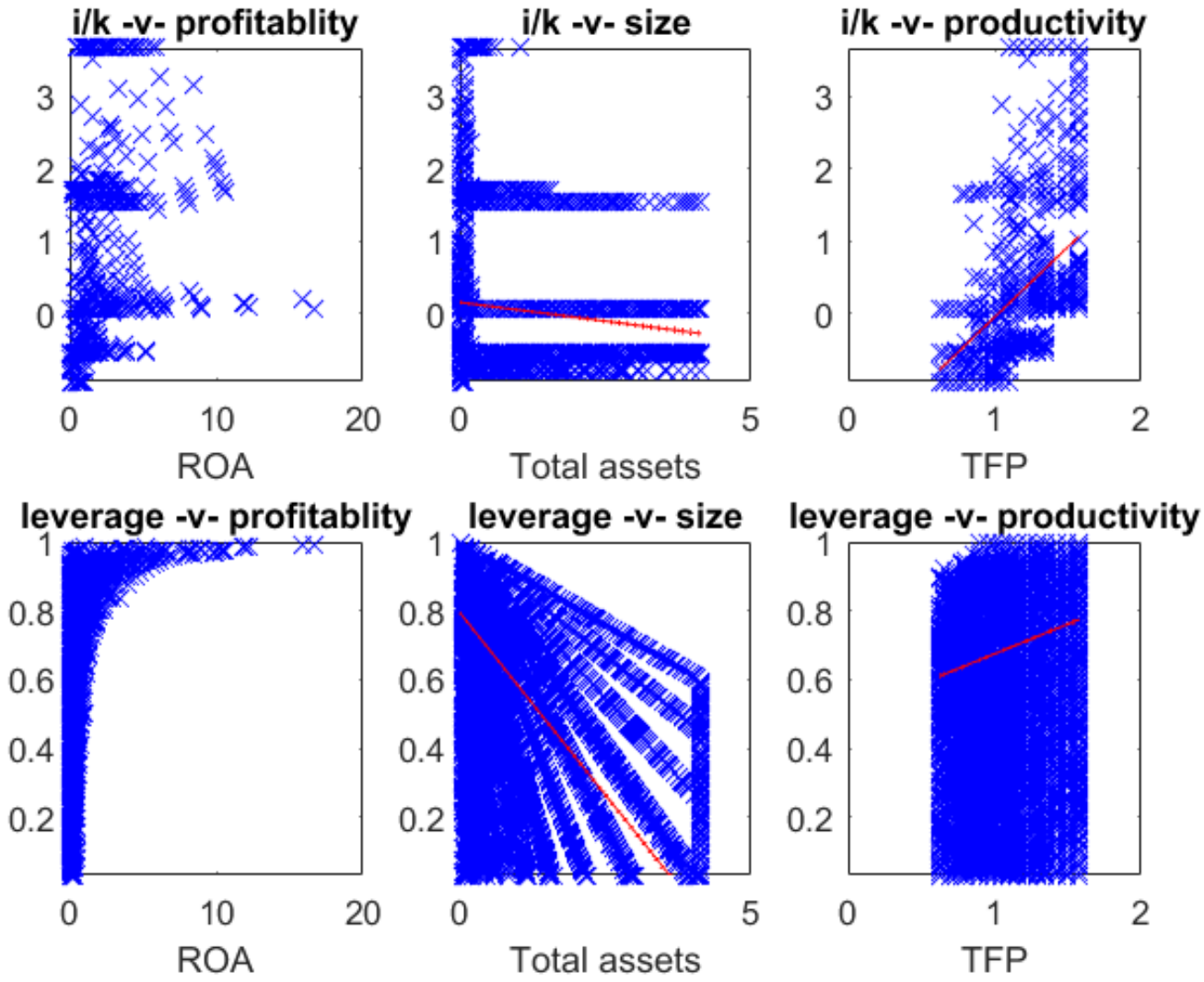
Distribution firms



Cash-holding firms



Levered firms



Summary

- Proposed a model of corporate cash-holdings, arising from uncertainty about productivity and default risk.
- Investment is positively correlated with productivity and negatively related with cash-holdings.
- Low investment spending and high cash-hoarding observed in the aggregate data may be due to the productivity slowdown, which is an acute problem not only in Japan but also across major developed countries.

Future plans

- Estimate the model using micro-level data of Japanese firms, if possible
- Study quantitative implications of the mechanism proposed in the paper
- Counterfactuals in exploring policy implications