Banks, credit supply, and the life cycle of firms: evidence from late nineteenth century Japan

John Tang - University of Melbourne
Sergi Basco - University of Barcelona

8th Banco de España Economic History Seminar
20 October 2022

Motivation and contributions

- what is the impact of capital availability on firm life cycles?
  - credit expansion corresponds with increased economic volatility (Schularick and Taylor, 2012)
  - mixed micro-level evidence (Gopinath et al., 2017)
    - credit rationing limits entrepreneurial activity
    - credit abundance increases adverse selection
- historical firm data drawn from corporate genealogies
- use of financial system shock across regions to identify causal impact on firm dynamics
  - lifespan, creation, destruction
  - sectoral disaggregation

Motivation and contributions

- what is the impact of capital availability on firm life cycles?
  - credit expansion corresponds with increased economic volatility (Schularick and Taylor, 2012)
  - mixed micro-level evidence (Gopinath et al., 2017)
    - credit rationing limits entrepreneurial activity
    - credit abundance increases adverse selection
- historical firm data drawn from corporate genealogies
- use of financial system shock across regions to identify causal impact on firm dynamics
  - lifespan, creation, destruction
  - sectoral disaggregation

Motivation and contributions

- what is the impact of capital availability on firm life cycles?
  - credit expansion corresponds with increased economic volatility (Schularick and Taylor, 2012)
  - mixed micro-level evidence (Gopinath et al., 2017)
    - credit rationing limits entrepreneurial activity
    - credit abundance increases adverse selection
- historical firm data drawn from corporate genealogies
- use of financial system shock across regions to identify causal impact on firm dynamics
  - lifespan, creation, destruction
  - sectoral disaggregation

Historical setting and research design

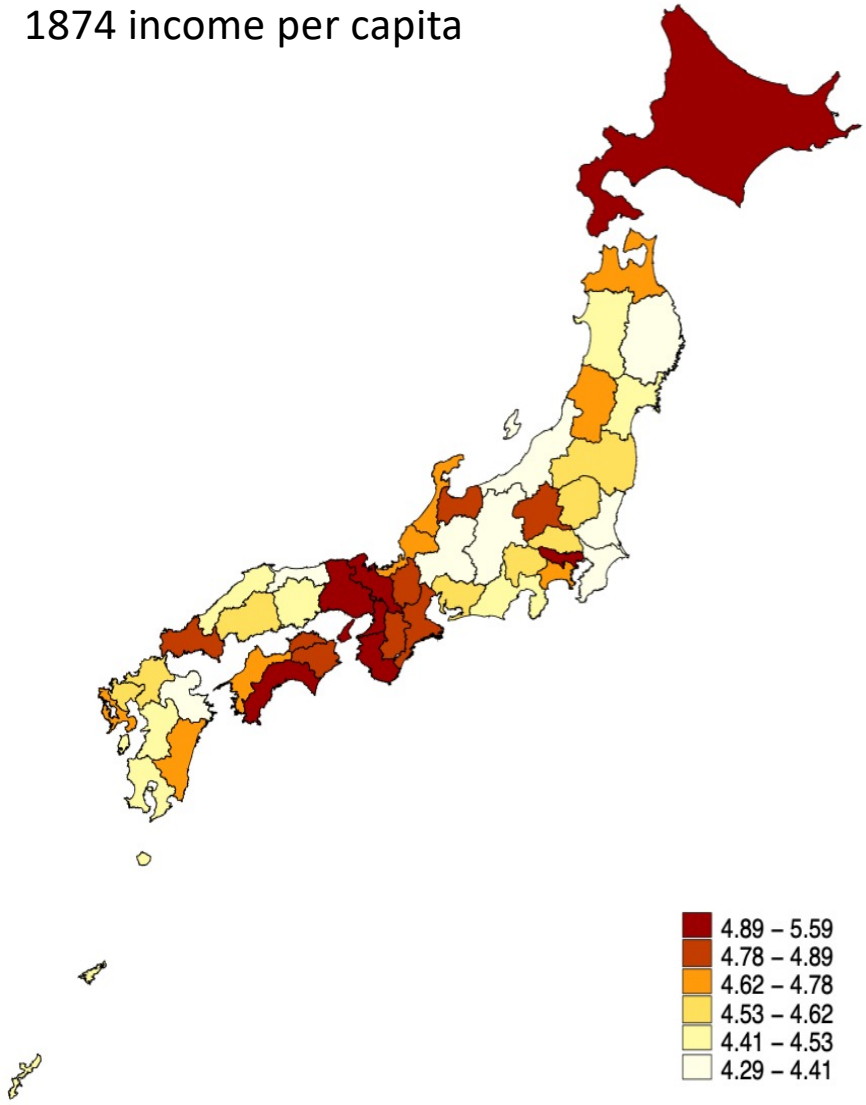
- 1876 samurai annuity conversion
  - ¥174 million in short-term government bonds
  - transmission via banking and direct investment
  - regional variation in bond distribution
    - on average ¥4.6 million (between ¥54K and ¥13.1M)
- Instrumental variable analysis
  - historical distribution of samurai (exclusion restriction)
  - bond availability corresponding with banking capital (relevance restriction)

Historical setting and research design

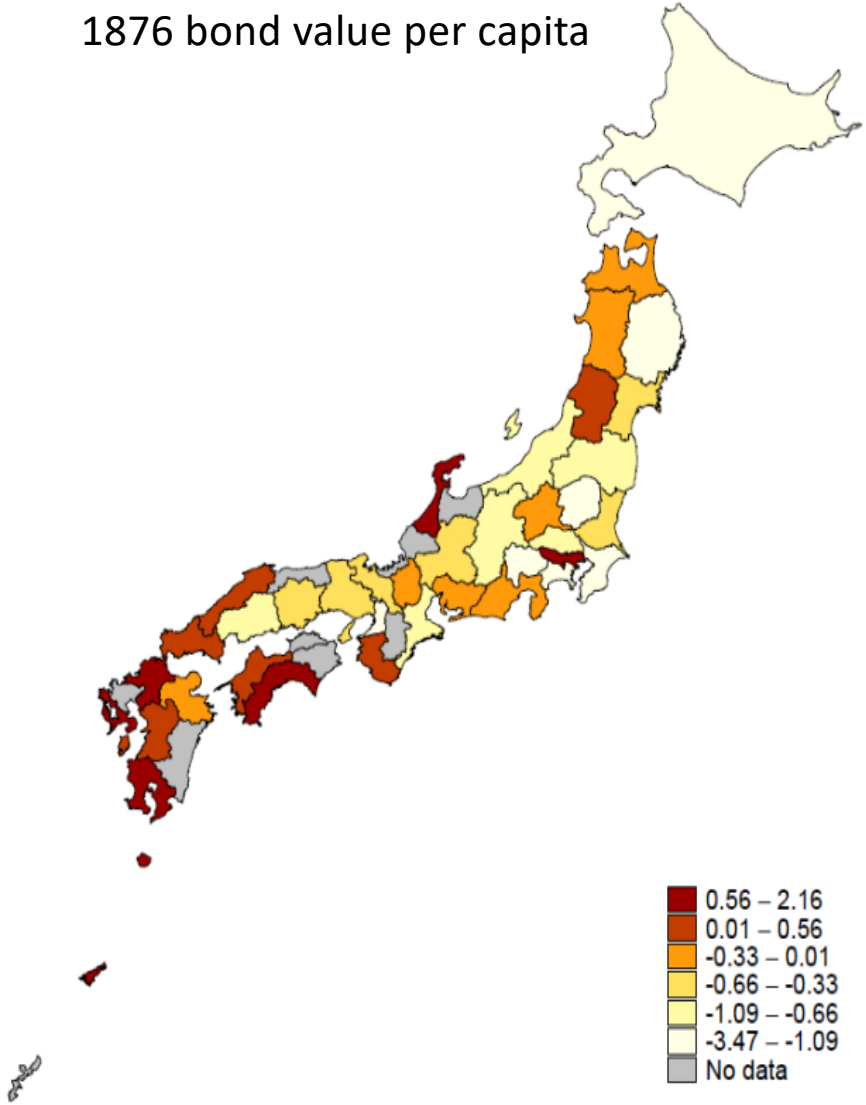
- 1876 samurai annuity conversion
  - ¥174 million in short-term government bonds
  - transmission via banking and direct investment
  - regional variation in bond distribution
    - on average ¥4.6 million (between ¥54K and ¥13.1M)
- Instrumental variable analysis
  - historical distribution of samurai (exclusion restriction)
  - bond availability corresponding with banking capital (relevance restriction)

Prefectural income and bond value

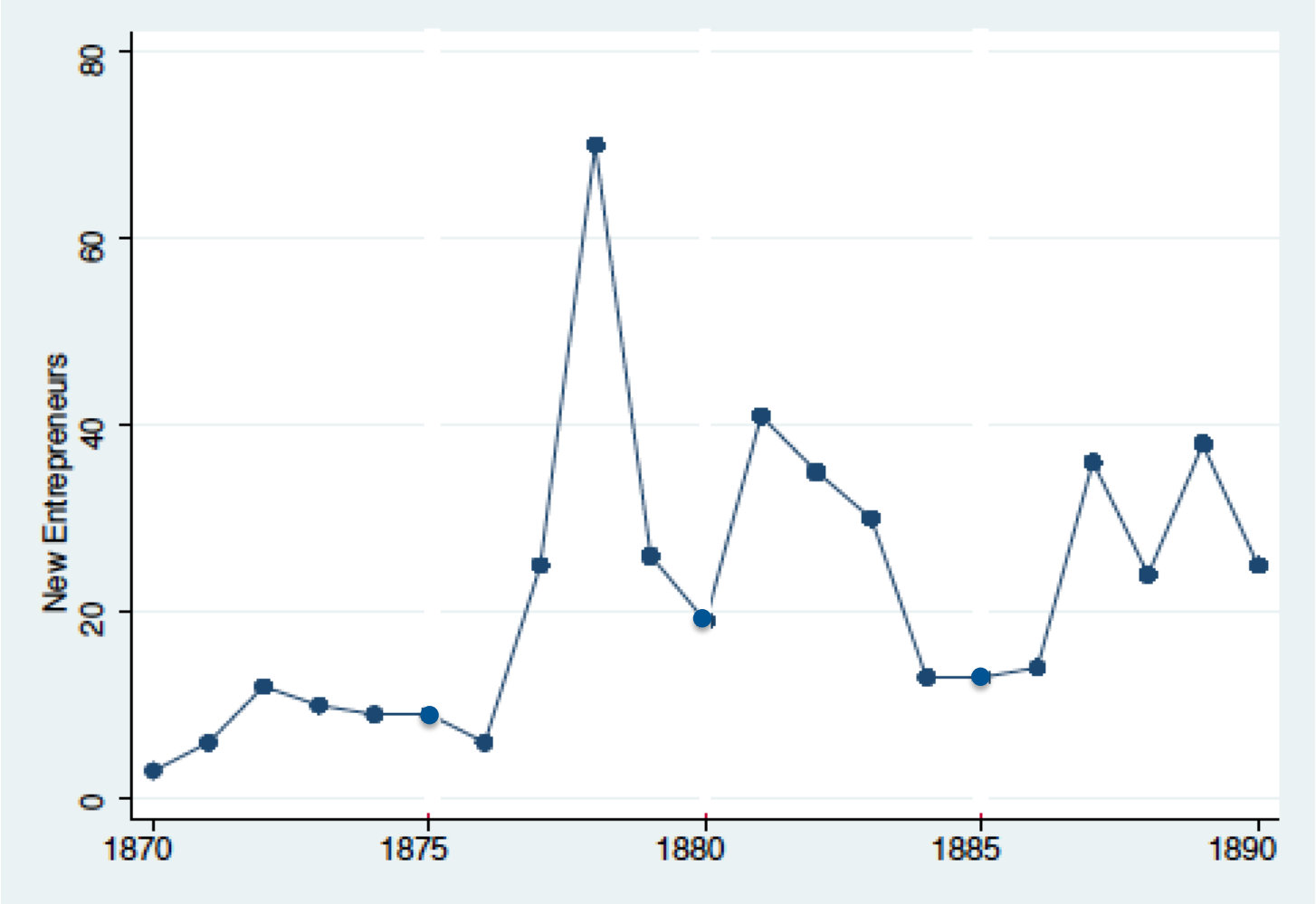
1874 income per capita



1876 bond value per capita

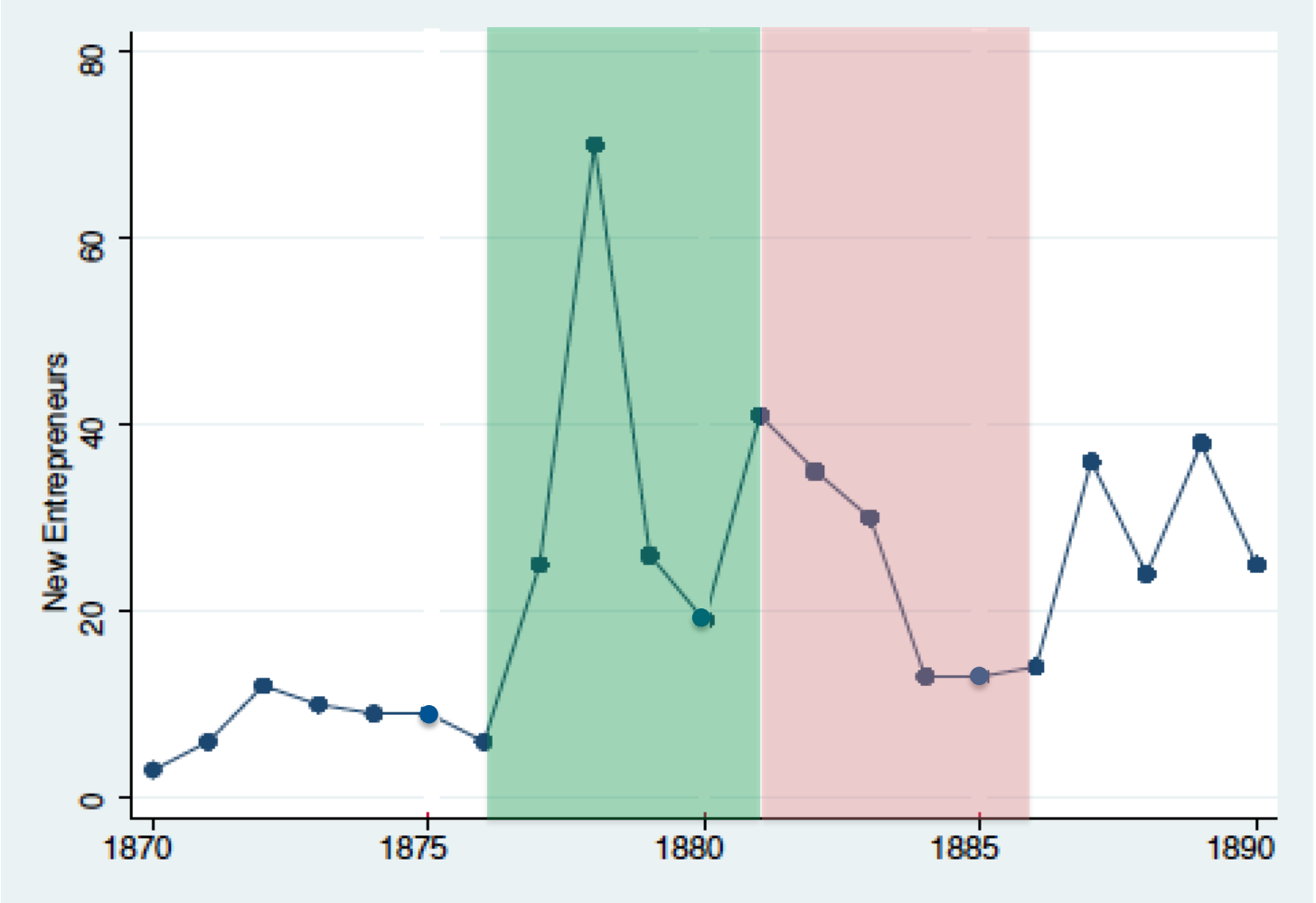


Firm entry, 1870-1890



Source: authors' calculations.

Firm entry, 1870-1890



Source: authors' calculations.

Testable hypotheses and findings

*H1: firm longevity is **lower** in areas with more banking capital*

- 10% increase in per capita bank capital → 32% decrease in firm lifespan measured in years
  - 7% decrease in mfg firm lifespan

*H2: firm creation is **higher** in areas with more banking capital*

- no statistically significant relationship in aggregate
  - 2% increase in mfg firm entry

*H3: firm destruction is **higher** in areas with more banking capital*

- 10% increase → 7% increase in firm exit
  - 6% increase in mfg firm exit

Testable hypotheses and findings

*H1: firm longevity is **lower** in areas with more banking capital*

- 10% increase in per capita bank capital → 32% decrease in firm lifespan measured in years
  - 7% decrease in mfg firm lifespan

*H2: firm creation is **higher** in areas with more banking capital*

- no statistically significant relationship in aggregate
  - 2% increase in mfg firm entry

*H3: firm destruction is **higher** in areas with more banking capital*

- 10% increase → 7% increase in firm exit
  - 6% increase in mfg firm exit

Testable hypotheses and findings

*H1: firm longevity is **lower** in areas with more banking capital*

- 10% increase in per capita bank capital → 32% decrease in firm lifespan measured in years
  - 7% decrease in mfg firm lifespan

*H2: firm creation is **higher** in areas with more banking capital*

- no statistically significant relationship in aggregate
  - 2% increase in mfg firm entry

*H3: firm destruction is **higher** in areas with more banking capital*

- 10% increase → 7% increase in firm exit
  - 6% increase in mfg firm exit

Related literature

- Financial impact on economic activity
  - Acemoglu and Zillibotti (1997): increased financial intermediation and securities reduce investment uncertainty and vice versa
  - Rajan and Zingales (1998): credit access affects firms differentially by sectoral capital dependence
  - Tang (2013): financial sector growth predicts extensive growth in modern industrial firms
- Firm dynamics
  - Dunne et al (1998): firm entry and exit correlated by industry and inversely related to scale

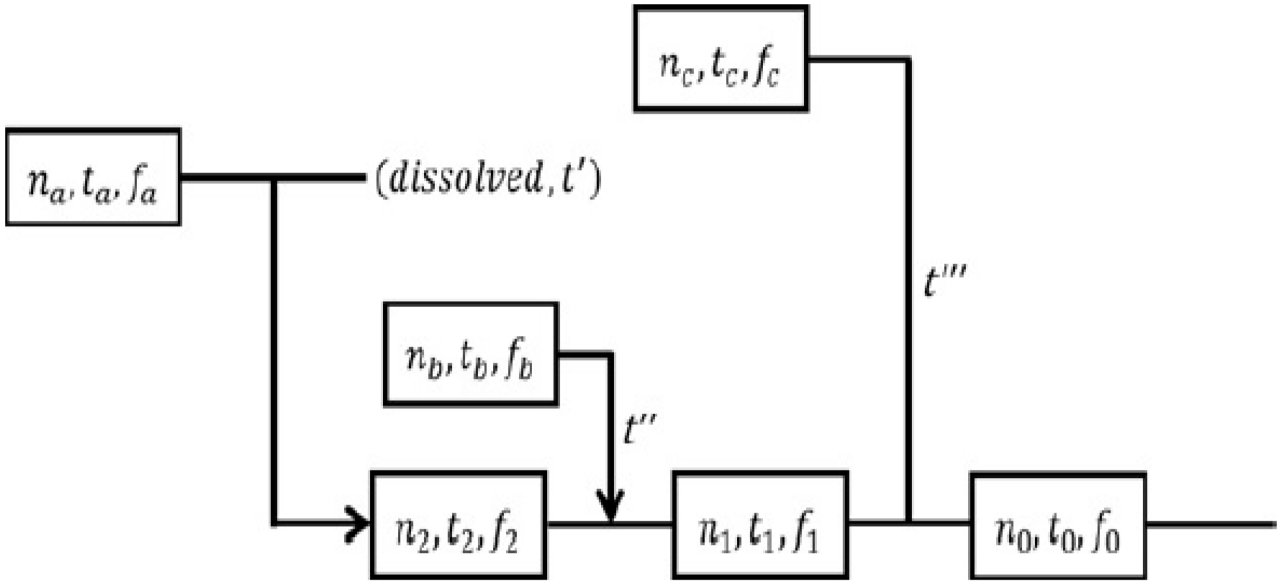
Related literature (cont.)

- Historical evidence
  - Gregg (2018): limited credit access impeded industrial development but mitigated by incorporation
  - Gregg and Nafziger (2018): firm entry associated with size (+), financial access (-); exit is negatively associated with size, age, and financial access; survivorship associated with convergence to incumbents
  - Tang (2011): internal financing offset financial system immaturity and promoted technology adoption
  - Onji and Tang (2017): firm incorporation response to fiscal policy changes
  - Basco and Tang (2020): credit availability associated with structural transformation

Data sources

- Main sources
  - Prefectural bond values (Ministry of Finance, 1904)
  - Corporate genealogies (Yagura and Ikushima, 1986)
    - firm establishment, ownership change, exit, industry, location
    - cf. Tang (2011, 2013), Onji and Tang (2017)
- Secondary sources
  - demographic variables (Japan Statistical Association, 1962)
  - income data (Fukao et al., 2015)
  - railway station construction (Chuo Shoin, 1995)

Corporate genealogy example (Figure 3)



Source: Onji and Tang (2016). Firms indexed by *n*, changes in life cycle by *t*, and organizational type by *f.*

Regression models

- OLS functional form

$$Lifespan_{it} = \beta \cdot BankCap_{it} + \gamma \cdot PrefCont_i + FE_t + e_{it}$$

- Poisson MLE functional form

$$Entry_{ip} = \beta \cdot BankCap_{ip} + \gamma \cdot PrefCont_i + FE_p + e_{ip}$$

$$Exit_{ip} = \beta \cdot BankCap_{ip} + \gamma \cdot PrefCont_i + FE_p + e_{ip}$$

- IV model substitutes samurai bond value for banking capital
- all specifications also have separate sectoral disaggregation
- bank and bond values are transformed using inverse hyperbolic sine

Firm data summary statistics (Table 2)

	All years	1870-75	1876-80	1881-85	1886-90
Firm lifespan (yr)	**20.6**	**18.9**	**19.3**	**23.1**	**20.4**
Manufacturing	17.1	17.2	20.5	17.2	16.0
Finance	21.7	13.3	18.2	25.0	29.3
Firm entry (ct)	**440**	**43**	**142**	**122**	**133**
Manufacturing	145	20	20	38	67
Finance	224	10	114	64	36
Firm exit (ct)	**84**	**6**	**12**	**25**	**41**
Manufacturing	46	2	6	9	29
Finance	31	2	4	13	12

Source: authors' calculations. Lifespan calculated as difference between entry and exit years.

Lifespan regression results, total banking capital

DV: firm lifespan	OLS		IV	
Bank capital p.c.	-1.306**	-1.748*	-2.472**	-3.367***
Pref. income p.c.		28.972*		45.627***
Population		9.741**		8.496*
Urbanization		2.049		1.472
Samurai bond value p.c.			0.927***	0.724***
First-stage F-statistic			20.13	53.41

Significance: *10%, **5%, ***1%. Robust standard errors clustered by prefecture. Bank capital and samurai bond value in nominal yen. Bond value per capita is transformed using an inverse hyperbolic sine to account for zero value before 1876. Year and sector fixed effects included.

Lifespan regression results, total banking capital

DV: firm lifespan	OLS		IV	
Bank capital p.c.	-1.306**	-1.748*	-2.472**	-3.367***
Pref. income p.c.		28.972*		45.627***
Population		9.741**		8.496*
Urbanization		2.049		1.472
Samurai bond value p.c.			0.927***	0.724***
First-stage F-statistic			20.13	53.41

Significance: *10%, **5%, ***1%. Robust standard errors clustered by prefecture. Bank capital and samurai bond value in nominal yen. Bond value per capita is transformed using an inverse hyperbolic sine to account for zero value before 1876. Year and sector fixed effects included.

Lifespan regression results, national banking capital

DV: firm lifespan	OLS		IV	
Bank capital p.c.	-0.993*	-1.633**	-2.223**	-2.988***
Pref. income p.c.		29.826**		45.482***
Population		10.035**		9.163*
Urbanization		2.142		1.699
Samurai bond value p.c.			1.031***	0.815***
First-stage F-statistic			21.50	59.47

Significance: *10%, **5%, ***1%. Robust standard errors clustered by prefecture. Bank capital and samurai bond value in nominal yen. Bond value per capita is transformed using an inverse hyperbolic sine to account for zero value before 1876. Year and sector fixed effects included.

Lifespan regression results, national banking capital

DV: firm lifespan	OLS		IV	
Bank capital p.c.	-0.993*	-1.633**	-2.223**	-2.988***
Pref. income p.c.		29.826**		45.482***
Population		10.035**		9.163*
Urbanization		2.142		1.699
Samurai bond value p.c.			1.031***	0.815***
First-stage F-statistic			21.50	59.47

Significance: *10%, **5%, ***1%. Robust standard errors clustered by prefecture. Bank capital and samurai bond value in nominal yen. Bond value per capita is transformed using an inverse hyperbolic sine to account for zero value before 1876. Year and sector fixed effects included.

Lifespan regression results, total banking capital

DV: mfg firm lifespan	OLS	IV
Bank capital p.c.	-1.751*	-1.798**
Pref. income p.c.	43.842***	44.313***
Population	4.144	4.089
Urbanization	2.369*	2.350*
Samurai bond value p.c.		0.741***
First-stage F-statistic		175.85

Significance: *10%, **5%, ***1%. Robust standard errors clustered by prefecture. Bank capital and samurai bond value in nominal yen. Bond value per capita is transformed using an inverse hyperbolic sine to account for zero value before 1876. Year and sector fixed effects included.

Lifespan regression results, total banking capital

DV: mfg firm lifespan	OLS	IV
Bank capital p.c.	-1.751*	-1.798**
Pref. income p.c.	43.842***	44.313***
Population	4.144	4.089
Urbanization	2.369*	2.350*
Samurai bond value p.c.		0.741***
First-stage F-statistic		175.85

Significance: *10%, **5%, ***1%. Robust standard errors clustered by prefecture. Bank capital and samurai bond value in nominal yen. Bond value per capita is transformed using an inverse hyperbolic sine to account for zero value before 1876. Year and sector fixed effects included.

Entry regression results, total banking capital

DV: firm entry	Poisson		IV Poisson	
Bank capital p.c.	0.502***	0.278**	0.353**	0.062
Pref. income p.c.		5.411**		7.948***
Population		-0.017		-0.043
Urbanization		-0.096*		-0.145***
Samurai bond value p.c.			0.472***	0.273***
First-stage F-statistic			270.32	588.89

Significance: *10%, **5%, ***1%. Robust standard errors clustered by prefecture. Bank capital and samurai bond value in nominal yen. Bond value per capita is transformed using an inverse hyperbolic sine to account for zero value before 1876. Year and sector fixed effects included.

Entry regression results, total banking capital

DV: firm entry	Poisson		IV Poisson	
Bank capital p.c.	0.502***	0.278**	0.353**	0.062
Pref. income p.c.		5.411**		7.948***
Population		-0.017		-0.043
Urbanization		-0.096*		-0.145***
Samurai bond value p.c.			0.472***	0.273***
First-stage F-statistic			270.32	588.89

Significance: *10%, **5%, ***1%. Robust standard errors clustered by prefecture. Bank capital and samurai bond value in nominal yen. Bond value per capita is transformed using an inverse hyperbolic sine to account for zero value before 1876. Year and sector fixed effects included.

Entry regression results, national banking capital

DV: firm entry	Poisson		IV Poisson	
Bank capital p.c.	0.472***	0.219**	0.319*	0.057
Pref. income p.c.		5.932***		7.969***
Population		-0.039		-0.047
Urbanization		-0.117**		-0.148***
Samurai bond value p.c.			0.641***	0.358***
First-stage F-statistic			535.57	776.87

Significance: *10%, **5%, ***1%. Robust standard errors clustered by prefecture. Bank capital and samurai bond value in nominal yen. Bond value per capita is transformed using an inverse hyperbolic sine to account for zero value before 1876. Year and sector fixed effects included.

Entry regression results, national banking capital

DV: firm entry	Poisson		IV Poisson	
Bank capital p.c.	0.472***	0.219**	0.319*	0.057
Pref. income p.c.		5.932***		7.969***
Population		-0.039		-0.047
Urbanization		-0.117**		-0.148***
Samurai bond value p.c.			0.641***	0.358***
First-stage F-statistic			535.57	776.87

Significance: *10%, **5%, ***1%. Robust standard errors clustered by prefecture. Bank capital and samurai bond value in nominal yen. Bond value per capita is transformed using an inverse hyperbolic sine to account for zero value before 1876. Year and sector fixed effects included.

Entry regression results, total banking capital

DV: mfg firm entry	Poisson	IV Poisson
Bank capital p.c.	0.212***	0.155***
Pref. income p.c.	11.907***	12.513***
Population	0.266	0.246
Urbanization	-0.158**	-0.179***
Samurai bond value p.c.		0.283***
First-stage F-statistic		278.88

Significance: *10%, **5%, ***1%. Robust standard errors clustered by prefecture. Bank capital and samurai bond value in nominal yen. Bond value per capita is transformed using an inverse hyperbolic sine to account for zero value before 1876. Year and sector fixed effects included.

Entry regression results, total banking capital

DV: mfg firm entry	Poisson	IV Poisson
Bank capital p.c.	0.212***	0.155***
Pref. income p.c.	11.907***	12.513***
Population	0.266	0.246
Urbanization	-0.158**	-0.179***
Samurai bond value p.c.		0.283***
First-stage F-statistic		278.88

Significance: *10%, **5%, ***1%. Robust standard errors clustered by prefecture. Bank capital and samurai bond value in nominal yen. Bond value per capita is transformed using an inverse hyperbolic sine to account for zero value before 1876. Year and sector fixed effects included.

Exit regression results, total banking capital

DV: firm exit	Poisson		IV Poisson	
Bank capital p.c.	0.841***	0.621***	0.897***	0.697***
Pref. income p.c.		4.932		3.911
Population		-0.012		0.004
Urbanization		-0.096		-0.074
Samurai bond value p.c.			0.472***	0.273***
First-stage Wald statistic			270.32	588.89

Significance: *10%, **5%, ***1%. Robust standard errors clustered by prefecture. Bank capital and samurai bond value in nominal yen. Bond value per capita is transformed using an inverse hyperbolic sine to account for zero value before 1876. Year and sector fixed effects included.

Exit regression results, total banking capital

DV: firm exit	Poisson		IV Poisson	
Bank capital p.c.	0.841***	0.621***	0.897***	0.697***
Pref. income p.c.		4.932		3.911
Population		-0.012		0.004
Urbanization		-0.096		-0.074
Samurai bond value p.c.			0.472***	0.273***
First-stage Wald statistic			270.32	588.89

Significance: *10%, **5%, ***1%. Robust standard errors clustered by prefecture. Bank capital and samurai bond value in nominal yen. Bond value per capita is transformed using an inverse hyperbolic sine to account for zero value before 1876. Year and sector fixed effects included.

Exit regression results, national banking capital

DV: firm exit	Poisson		IV Poisson	
Bank capital p.c.	0.741***	0.484***	0.783***	0.620***
Pref. income p.c.		5.866*		3.706
Population		-0.068		-0.058
Urbanization		-0.067		-0.131
Samurai bond value p.c.			0.641***	0.358***
First-stage F-statistic			535.57	776.87

Significance: *10%, **5%, ***1%. Robust standard errors clustered by prefecture. Bank capital and samurai bond value in nominal yen. Bond value per capita is transformed using an inverse hyperbolic sine to account for zero value before 1876. Year and sector fixed effects included.

Exit regression results, national banking capital

DV: firm exit	Poisson		IV Poisson	
Bank capital p.c.	0.741***	0.484***	0.783***	0.620***
Pref. income p.c.		5.866*		3.706
Population		-0.068		-0.058
Urbanization		-0.067		-0.131
Samurai bond value p.c.			0.641***	0.358***
First-stage F-statistic			535.57	776.87

Significance: *10%, **5%, ***1%. Robust standard errors clustered by prefecture. Bank capital and samurai bond value in nominal yen. Bond value per capita is transformed using an inverse hyperbolic sine to account for zero value before 1876. Year and sector fixed effects included.

Exit regression results, total banking capital

DV: mfg firm exit	Poisson	IV Poisson
Bank capital p.c.	0.500***	0.546***
Pref. income p.c.	10.087***	9.544***
Population	0.473	0.493
Urbanization	-0.046	-0.026
Samurai bond value p.c.		0.283***
First-stage F-statistic		278.88

Significance: *10%, **5%, ***1%. Robust standard errors clustered by prefecture. Bank capital and samurai bond value in nominal yen. Bond value per capita is transformed using an inverse hyperbolic sine to account for zero value before 1876. Year and sector fixed effects included.

Exit regression results, total banking capital

DV: mfg firm exit	Poisson	IV Poisson
Bank capital p.c.	0.500***	0.546***
Pref. income p.c.	10.087***	9.544***
Population	0.473	0.493
Urbanization	-0.046	-0.026
Samurai bond value p.c.		0.283***
First-stage F-statistic		278.88

Significance: *10%, **5%, ***1%. Robust standard errors clustered by prefecture. Bank capital and samurai bond value in nominal yen. Bond value per capita is transformed using an inverse hyperbolic sine to account for zero value before 1876. Year and sector fixed effects included.

Conclusion and discussion

- banking capital negatively associated with firm longevity and positively with destruction
  - manufacturing firms disproportionately affected
- no significant relationship with overall firm creation, but positively associated with manufacturing
- findings robust to different banking series
- suggestive evidence that samurai bond issuance facilitated Japanese financial and industrial development
  - relatively strong state capacity needed to implement fiscal and monetary reforms (vis-à-vis China)
  - concurrent with institutional development and international market integration

Conclusion and discussion

- banking capital negatively associated with firm longevity and positively with destruction
  - manufacturing firms disproportionately affected
- no significant relationship with overall firm creation, but positively associated with manufacturing
- findings robust to different banking series
- suggestive evidence that samurai bond issuance facilitated Japanese financial and industrial development
  - relatively strong state capacity needed to implement fiscal and monetary reforms (vis-à-vis China)
  - concurrent with institutional development and international market integration

Conclusion and discussion

- banking capital negatively associated with firm longevity and positively with destruction
  - manufacturing firms disproportionately affected
- no significant relationship with overall firm creation, but positively associated with manufacturing
- findings robust to different banking series
- suggestive evidence that samurai bond issuance facilitated Japanese financial and industrial development
  - relatively strong state capacity needed to implement fiscal and monetary reforms (vis-à-vis China)
  - concurrent with institutional development and international market integration

Conclusion and discussion

- banking capital negatively associated with firm longevity and positively with destruction
  - manufacturing firms disproportionately affected
- no significant relationship with overall firm creation, but positively associated with manufacturing
- findings robust to different banking series
- suggestive evidence that samurai bond issuance facilitated Japanese financial and industrial development
  - relatively strong state capacity needed to implement fiscal and monetary reforms (vis-à-vis China)
  - concurrent with institutional development and international market integration