

Firm Exit during the Covid-19 Pandemic: Evidence from Japan

(コロナ禍における企業退出)

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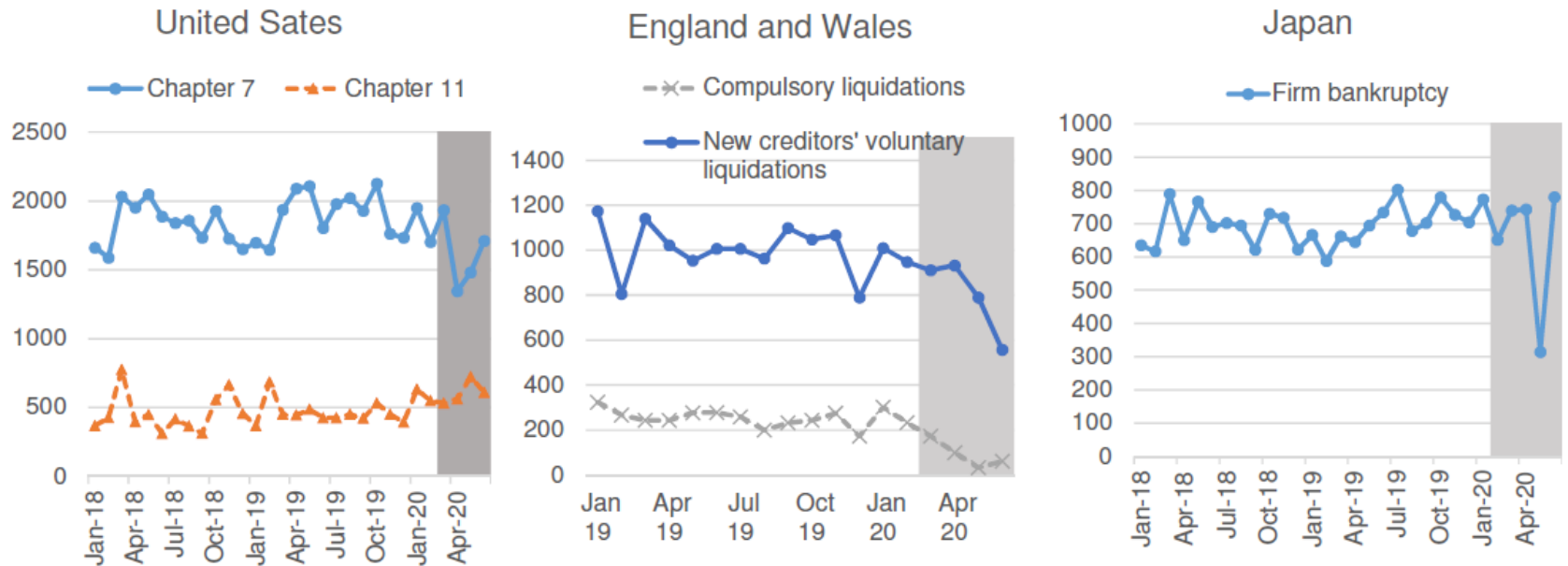
問題意識

- コロナショック ⇒ 企業業績の悪化 ⇒ 退出？

- 本研究の目的と内容
 - 退出社数・退出率のベンチマーク
 - 政策規模のガイドライン
 - ⇒ 退出に関する理論モデル + 構造推定
 - ⇒ 足元のデータを用いたシミュレーション
(本来生じたであろう退出 vs. 実際の退出)

- 分析上の課題
 - 退出：倒産(政策・金融・手続き遅延の影響)
休廃業(リアルタイム観測の難しさ)
 - 業績：リアルタイム観測の難しさ

Figure 1: Firm Bankruptcies



Note: Data sources are the Epiq AACER for the United States, Insolvency Service for England and Wales, and Tokyo Shoko Research for Japan. The shaded areas indicate the period in which the COVID-19 affected the economy (from February 2020 for Japan and from March 2020 for the rest).

関連文献

- 企業の退出
 - Griliches and Regev (J. Econom '95), Olley and Pakes (Ecmt '96)

- 日本
 - Caballero et al. (AER '08), Tsuruta (RIETI '19), Xu (RIETI '19)

- コロナ後
 - Elenev et al. (NBER '20)
 - Miyakawa et al. (RIETI '20)

理論的枠組み

- “F” の下での最適停止時間問題
 - Outside option、固定費
 - $F = \text{固定 or 確率変数}$

$$\ln s_t = \ln s_0 + \left(\mu - \frac{\sigma_s^2}{2} \right) t + \sigma_s W_t.$$

$$u(s_t) = \ln s_t, \quad x_t \equiv \ln s_t$$



$$V(x) = \sup_b E_x \left[\int_0^{T(b)} x_t e^{-\rho t} dt \right]$$

$$V(b) = F. \quad V'(b) = 0.$$

理論的枠組み

□ 解の特徴付け

$$V(x) = \begin{cases} \underbrace{\frac{1}{\rho} \left[x + \frac{1}{\rho} \left(\mu - \frac{\sigma_s^2}{2} \right) \right]}_{\text{Value without exit}} \underbrace{- \frac{1}{\rho\lambda} e^{\lambda(x-b)}}_{\text{Return from exit}} & \text{for } x > b, \\ F & \text{for } x \leq b, \end{cases}$$

where

$$\lambda = -\frac{1}{\sigma_s^2} \left[\left(\mu - \frac{\sigma_s^2}{2} \right) + \sqrt{\left(\mu - \frac{\sigma_s^2}{2} \right)^2 + 2\rho\sigma_s^2} \right]$$

$$b = \rho F + \frac{\sigma_s^2}{\mu - \frac{\sigma_s^2}{2} - \sqrt{\left(\mu - \frac{\sigma_s^2}{2} \right)^2 + 2\rho\sigma_s^2}}$$

退出ルール with b :

b は

① μ の減少関数

② σ_s については
 μ の水準に依存

実証戦略

- $F \sim N(F_0, \sigma_F^2)$ と仮定
 - 業種レベル μ と σ_s^2
 - 企業レベル x と退出
- } \Rightarrow コロナ前データから計算
- 業種レベル (F_0, σ_F^2) を最尤法推定

$$L(F_0, \sigma_F^2 | \mu, \sigma_s^2) = \sum_{i \in \Omega_{t-1} \cap \text{Exit}} \log(1 - \eta(x_{it-1} | \mu, \sigma_s^2, F_0, \sigma_F^2)) \\ + \sum_{i \in \Omega_{t-1} \cap \text{No Exit}} \log(\eta(x_{it-1} | \mu, \sigma_s^2, F_0, \sigma_F^2))$$

$$\eta(x_{it-1} | \mu, \sigma_s^2, F_0, \sigma_F^2) = \Phi\left(\frac{x_{it-1} + \mu - \sigma_s^2/2 - \bar{b}(\mu, \sigma_s^2) - \rho F_0}{\sqrt{\rho^2 \sigma_F^2 + \sigma_s^2}}\right)$$

シミュレーション方法

- 推定された業種レベルの(F_0, σ_F^2)
- 業種×地域レベルのコロナ禍における μ' と $\sigma'_s{}^2$
- 倒産件数・倒産確率のシミュレーション

- μ'_κ と $\sigma'_{s\kappa}{}^2$ ：パラメータ $\kappa \Leftrightarrow$ 影響期間の長さ
(e.g., $\kappa=0.02 \Leftrightarrow$ 2年間)
$$\mu'_\kappa = \mu + (\mu' - \mu)\kappa$$
$$\sigma'_{s\kappa}{}^2 = \sigma_s^2 + (\sigma'_s{}^2 - \sigma_s^2)\kappa$$

- 倒産確率のdecomposition

$$d\delta = d\delta^\mu + d\delta^{\sigma_s^2} + d\delta^{\text{residual}},$$

データ：TSR

□ 企業レベルデータセット

- 2018年～2019年の企業属性
- 2019年の退出データ（複数の退出態様）
- 2020年2月以降の「倒産」データ

□ 企業向けアンケートデータ（要約値のみ利用）

- 2020年2月以降の対前年同月売上高

< 2018～19年の退出データ・企業属性 >

Table 1: Descriptive Statistics of the TSR Data

	Number of firms		LN(sales)	Sales growth	LN(employment)	Firm ages
The first dataset for 2019	Total	Used for estimation	Mean	Mean	Mean	Mean
(1) Active at the end of 2018	3,479,995	1,320,427	11.279	0.007	1.738	29.794
(2) Active at the end of 2019 given (1)	3,431,386	1,306,540	11.293	0.008	1.745	29.791
(3) Exited in 2019 given (1)	48,609	13,887	9.984	-0.099	1.040	30.108
(4) Reasons for exit						
Closure	9,564	4,659	9.402	-0.131	0.719	30.675
Dissolution	32,951	7,047	9.899	-0.092	1.044	29.660
Bankruptcy	6,094	2,181	11.501	-0.051	1.707	30.902

The units of sales, employment, and age are a thousand yen, a person, and a year, respectively. Sales, employment, and age are for year 2018. Sales growth is the change in sales from 2017 to 2018.

< 2019年のreduced-form退出推定 >

Table 3: Reduced-Form Regression of Firm Exits for 2019

2019 Independent variables	Dependent vars =														
	All exits		Closure		Dissolution		Bankruptcy		Bankruptcy with large-debt						
	Coef.	SE.		Coef.	SE.		Coef.	SE.		Coef.	SE.		Coef.	SE.	
Log(sales) in 2018	-0.170	0.002	***	-0.183	0.005	***	-0.190	0.003	***	-0.003	0.005		-0.001	0.005	
Sales growth from 2016 to 2018	-0.262	0.014	***	-0.221	0.023	***	-0.152	0.016	***	-0.371	0.030	***	-0.372	0.030	***
Ages in 2018	0.002	0.000	***	0.003	0.000	***	0.003	0.000	***	-0.001	0.000	**	-0.001	0.000	**
Constant	-0.607	0.046	***	-0.954	0.081	***	-0.666	0.059	***	-2.820	0.086	***	-2.846	0.087	***
# of firms (y=0 or 1)	1,028,529														
# of exit (y=1)	10,192	(0.99%)		2,214	(0.22%)		6,139	(0.60%)		1,839	(0.18%)		1,803	(0.18%)	
Industry dummy	yes			yes			yes			yes			yes		

***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

< 2020年2月以降のreduced-form倒産推定 >

Table 4: Reduced-Form Regression of Firm Exits for 2020

2020 Independent variables	Dependent vars = default								
	February		Exit month =				April		
	Coef.	SE.	Coef.	SE.	Coef.	SE.	Coef.	SE.	
Log(sales) in 2018	-0.003	0.010	0.011	0.008	0.007	0.009			
Sales growth based on survey (industry & prefecture-level in each month)	0.001	0.025	0.049	0.033	0.028	0.062			
Ages in 2018	-0.004	0.001	***	0.000	0.001	0.000	0.001		
Constant	-3.042	0.184	***	-3.365	0.161	***	-3.585	0.226	***
# of firms (y=0 or 1)	854,104		871,198				880,288		
# of exits (y=1)	259		379				328		
Industry dummy	yes		yes				yes		

Different from the previous table, firm exit is considered only in the case of large-sized bankruptcy. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

(F_0, σ_F^2) の推定結果

□ 業種ごとの高い異質性

Table 4: Estimation Results of Firm Growth and Exit for 2019

	μ	σ_s	# of firms	F_0	S.E.	σ_F	SE	b	# of firms		Exit rate
									Exit	No-exit	
Construction	0.037	0.231	264,455	253.26	(21.00)	432.30	(9.09)	0.277	3,107	356,338	0.009
Manufacturing	0.020	0.151	112,673	125.58	(33.31)	512.00	(15.14)	-0.331	1,805	152,832	0.012
Information and communications	0.067	0.238	22,426	-2.48	(111.77)	644.25	(47.81)	-4.538	272	32,849	0.008
Transport and postal activities	0.035	0.141	26,348	314.92	(78.99)	466.08	(33.15)	0.282	260	36,747	0.007
Wholesale and retail trade	0.006	0.161	192,150	-180.54	(44.55)	632.79	(20.84)	-2.642	3,962	262,164	0.015
Real estate agencies and goods rental and leasing	0.048	0.275	59,035	-264.61	(75.30)	636.35	(32.28)	-5.160	775	89,992	0.009
Accommodations, eating and drinking services	0.014	0.168	17,580	-277.68	(259.81)	691.74	(122.36)	-3.961	428	26,334	0.016
Living-related and personal services and amusement services	0.006	0.169	17,484	-894.18	(276.80)	921.08	(126.72)	-9.803	361	26,157	0.014
Education	0.037	0.165	7,100	166.83	(134.92)	479.49	(55.96)	-1.194	64	10,693	0.006
Medical services	0.038	0.181	65,166	339.36	(41.00)	418.35	(16.88)	0.641	538	89,168	0.006
Compound services	0.047	0.261	8,011	-911.44	(338.18)	920.84	(144.36)	-11.733	93	10,935	0.008
Miscellaneous services	0.054	0.309	82,786	-1686.98	(71.63)	1229.59	(31.63)	-19.404	1,191	117,777	0.010
Unweighted mean (sum)	0.049	0.227	939,338	-251.49		665.40		-4.797	12,856	1,211,986	0.010

F_0 と企業属性の相関

□ E.g., 固定費

Table 6: Correlations between the Estimated F_0 and Firm Characteristics

	Fixed costs			Working capital			Debts		
	Ratio to sales	log(costs per firm)	Labor share	Ratio to sales	Ratio to assets	Log(capital per firm)	Liquid debt ratio to sales	Short-term bank borrowings ratio to sales	Bank borrowings ratio to sales
Correlation	0.236	0.316	0.155	0.102	0.461	0.103	-0.165	-0.321	-0.211
Spearman rank correlation	0.236	0.176	0.273	0.309	0.418	-0.018	0.018	-0.382	-0.115

The figures represent the correlation coefficients at the industry level. The number of industries is 10.

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< 2020年2月～の μ & σ_s >

Table 5: Estimation Results of Firm Growth during the Covid-19 Pandemic

μ	2020			σ_s	2020		
	February	March	April		February	March	April
Mean	-0.059	-0.108	-0.223	Mean	0.182	0.218	0.257
10%	-0.165	-0.283	-0.561	10%	0.058	0.071	0.100
25%	-0.100	-0.148	-0.258	25%	0.106	0.143	0.192
50%	-0.052	-0.089	-0.180	50%	0.170	0.204	0.252
75%	-0.011	-0.034	-0.117	75%	0.231	0.279	0.322
90%	0.048	0.037	-0.047	90%	0.317	0.371	0.387

We calculate growth μ and uncertainty σ_s for each industry, prefecture, and month of the survey, and then take quantiles and means for industries and prefectures given month.

< 2020年5月TSRアンケート結果 >

Table 2: Survey Results for Future Firm Sales during the COVID-19 Pandemic

Monthly sales growth $x=(\text{Apr '20}/\text{Apr '19})*100$	Q. Expect $x \leq 50$ from May to Dec for at least one month?				
	Yes	No	Unknown	Total	Share of Yes
$x < 50$	1,866	29	18	1,913	97.5%
$50 \leq x < 60$	896	31	25	952	94.1%
$60 \leq x < 70$	835	160	58	1,053	79.3%
$70 \leq x < 80$	976	617	167	1,760	55.5%
$80 \leq x < 90$	907	1,252	271	2,430	37.3%
$90 \leq x < 100$	592	1,771	226	2,589	22.9%
$100 \leq x < 110$	644	1,475	141	2,260	28.5%
$110 \leq x < 120$	106	319	37	462	22.9%

Note: This survey was conducted between April and May 2020.

シミュレーション結果

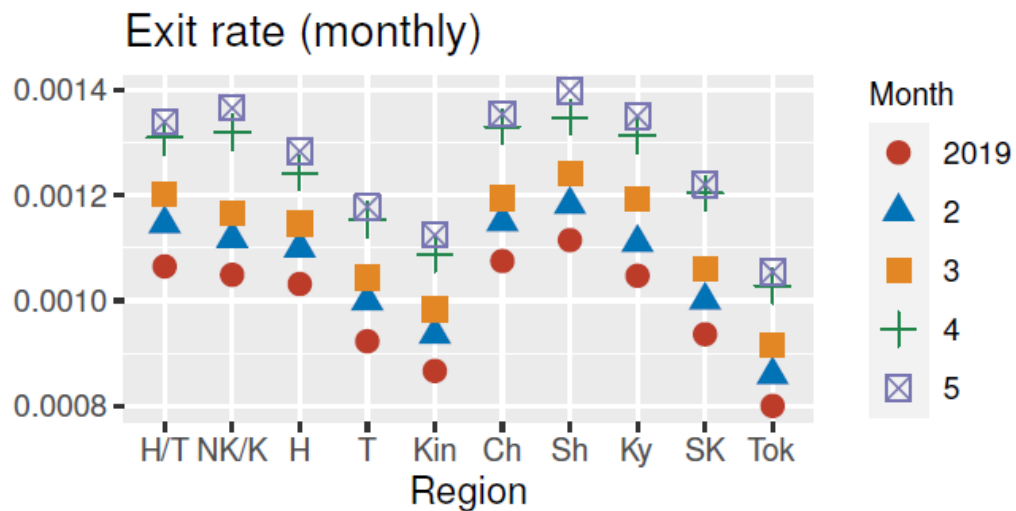
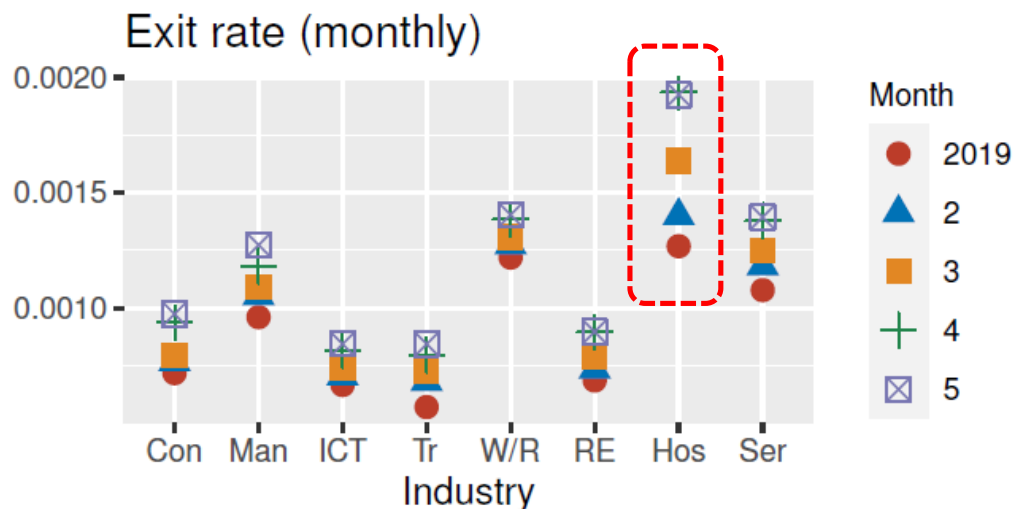
□ ベンチマークケース：20%増

Table 8: Simulation Results on the Number and Rate of Firm Exits in Different Cases

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Benchmark	No effect on growth (optimistic)			Large effect on growth (pessimistic)	Imbalance adjusted	Firm size greater by μ
	($\kappa = 0.02$)	($\kappa = 0$)	($\kappa = 0.01$)	($\kappa = 0.1$)	($\kappa = 1$)		
Firm exit rate (%)							
Ave '19	0.094	0.094	0.094	0.094	0.094	0.120	0.094
Feb '20	0.101	0.097	0.099	0.114	0.177	0.128	0.101
Mar '20	0.106	0.100	0.103	0.126	0.189	0.134	0.106
Apr '20	0.118	0.106	0.113	0.152	0.212	0.149	0.118
May '20	0.121	0.108	0.115	0.159	0.218	0.154	0.121
Ave '20	0.112	0.103	0.107	0.138	0.199	0.141	0.111
# of firm exits							
Ave '19	2318	2318	2318	2318	2318	2949	2314
Feb '20	2486	2401	2444	2800	4367	3160	2481
Mar '20	2623	2474	2550	3099	4655	3313	2618
Apr '20	2916	2622	2775	3752	5236	3679	2910
May '20	2990	2654	2829	3933	5366	3788	2984
Increase from '19	1741	878	1325	4310	10350	2143	1737
Change from 2019 (%)							
	18.8	9.5	14.3	46.5	111.6	18.2	18.8

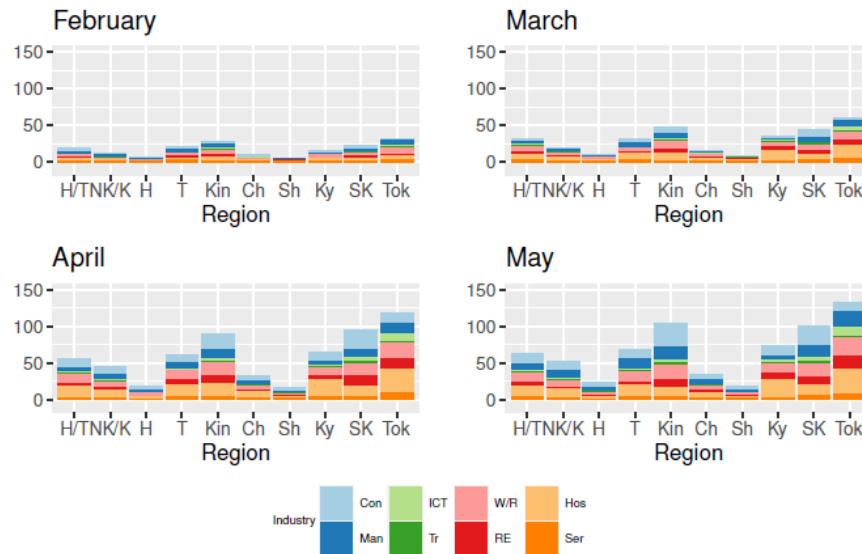
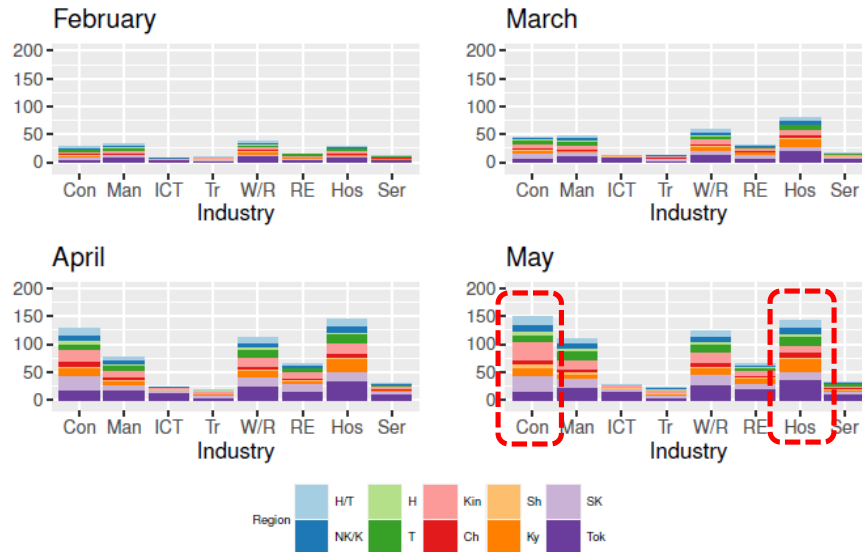
シミュレーション結果

Figure 2: Effects of the COVID-19 Pandemic on Firm Exit Rates by Industry and Region



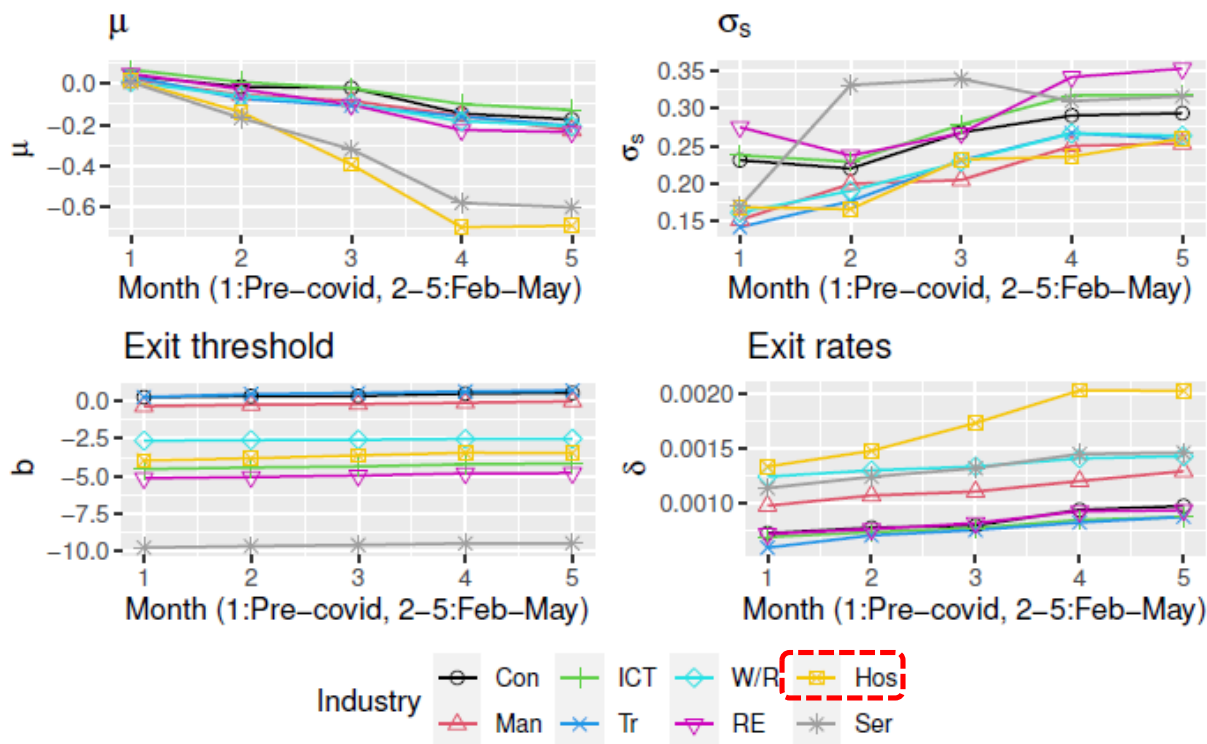
シミュレーション結果

Figure 3: Effects of the COVID-19 Pandemic on the Number of Firm Exits by Industry and Region



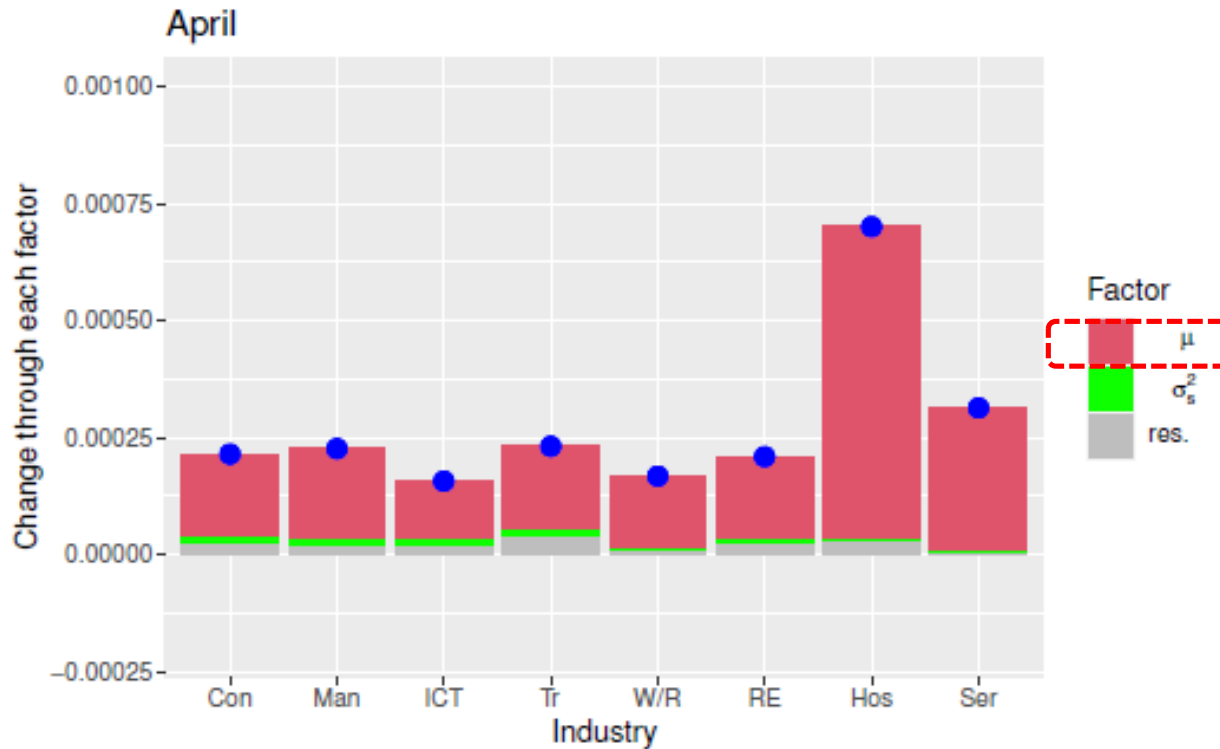
シミュレーション結果

Figure 4: Background for Changes in Firm Exits



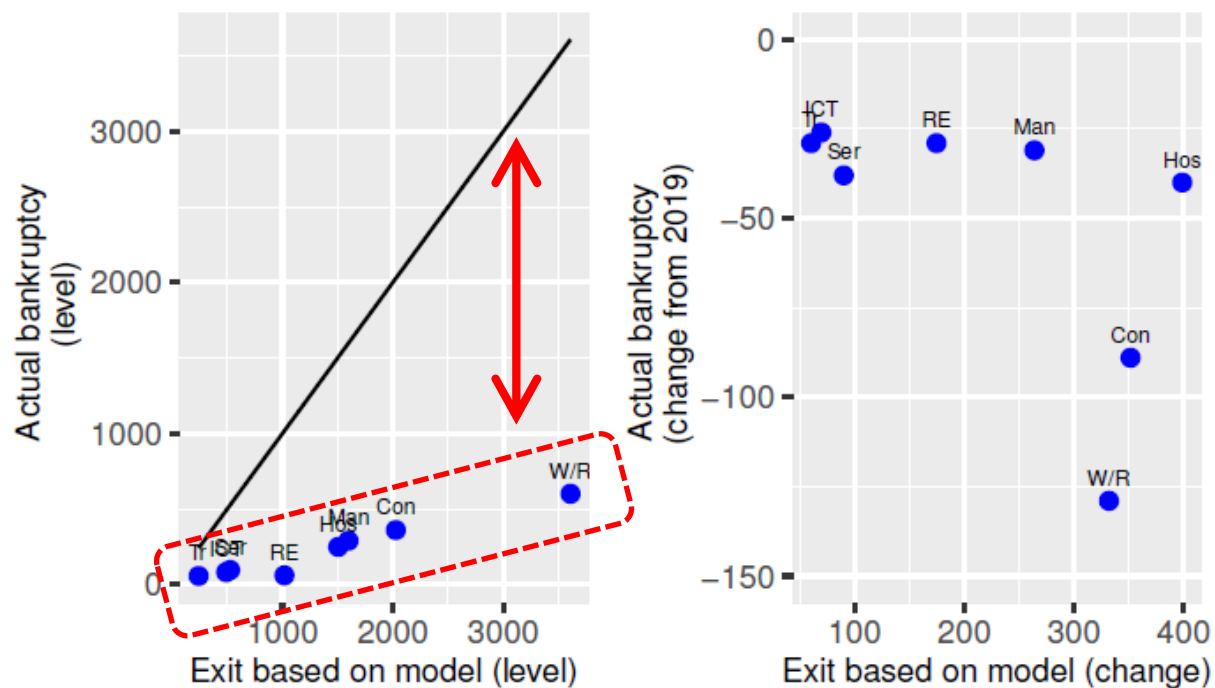
シミュレーション結果

Figure 5: Decomposition of the Reasons for Firm Exit Changes



シミュレーション結果

Figure 6: Actual Firm Bankruptcies versus Simulated Firm Exits by Industry



結論・含意

- 退出数・退出率に関する異質性
 - Sizable impact
 - 足元の低水準の退出（見通し、政策、金融）
 - μ と σ_S^2 の変化を相殺する F_0 の変化を試算
 - 4,600億円 vs. 現状?
-
- 研究テーマ
 - データの更新 & F_0 y ダイレクトな推定
 - 企業退出の描写

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