Multi-Product Establishments and Product Dynamics

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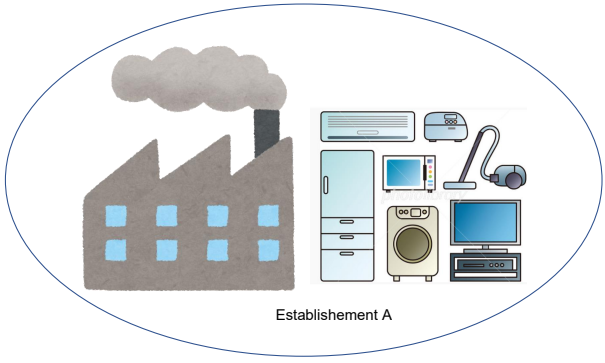
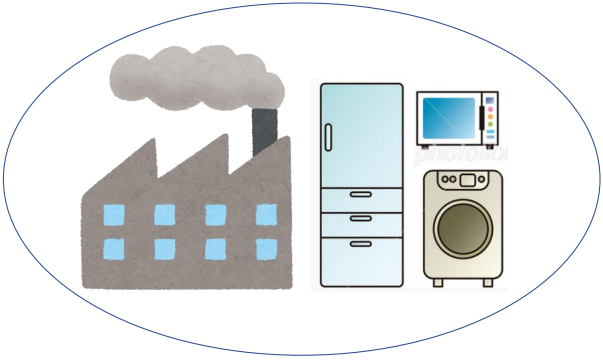
Entry and Exit of What?

- Firms and establishments are producing multiple products.
- The importance to promote simultaneously entry and exit of firms and thus having a dynamic turnover of them is often considered as a good indicator of "creative destruction" (Schumpeter 1942).
- Little is known, however, how firms, establishments adjust their product portfolio over the business cycles.
- What is the general equilibrium consequence of various types of regulation (at entry, establishment or product level)?

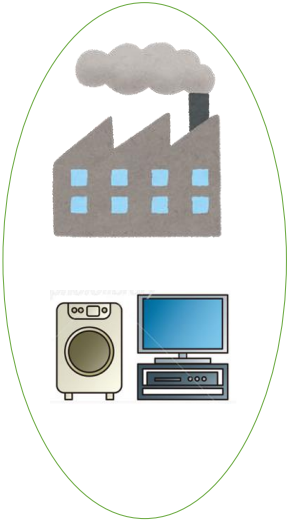
Multiple-Product Producing Firms/Establishments



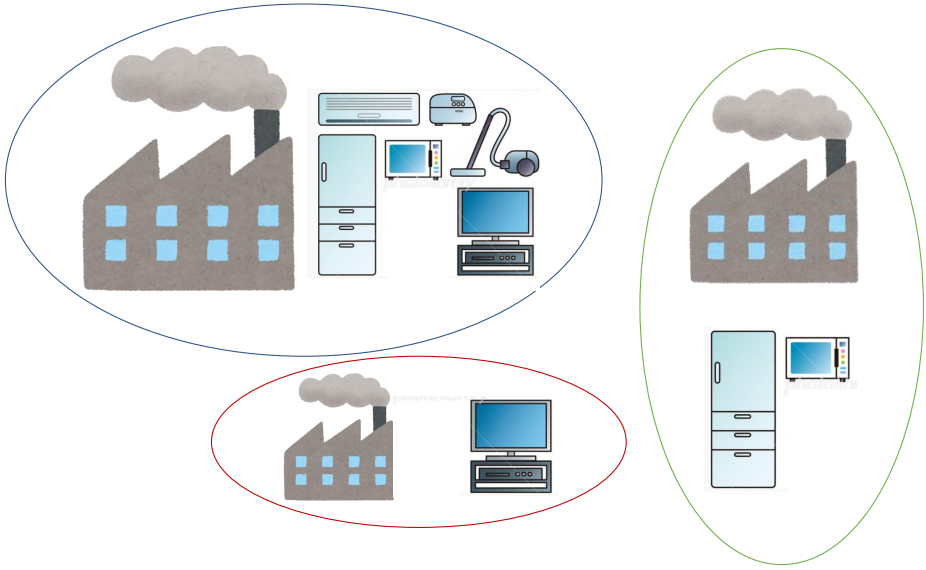
Hit by a Recessionary Shock...



Product dropping in establishment A and establishment B and establishment C exits.



Regulation on Washing Machine...



This paper

- To start, using the underexplored Japanese data, the Current Survey of Production (*Seisan Dotai Tokei* in Japanese), we document extensively a multi-product aspect of establishments or firms and heterogeneous dynamics across products over the business cycle.
- Next, we provide a novel theoretical model that captures the multi product aspect of establishments and the asymmetric product dynamics based on different income elasticities across products.
- The theoretical model is calibrated based on the parameter values used in the literature while the shock processes are estimated relying on the Bayesian methods.

Questions

- What is the consequence of a policy that aims to enhance or regulate entry of establishments?
- Instead of regulating entry of establishments, what happens if a regulation is made for incumbent establishments?
- What is the consequence of these policies on the product mix in the economy?
- How do firms or establishments in the economy react to a policy with which a particular product is targeted?
- The paper tackles these revived questions in a stylized DSGE model.

Literature

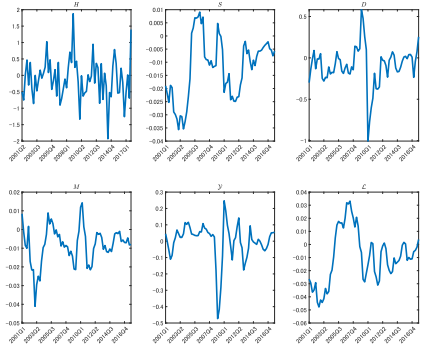
- Firm entry and exit over the business cycle: Bilbiie et al. (2012), Clemnti and Palazzo (2016), Hamano and Zanetti (2017).
- Multi-product firms: Bernard et al. (2010), Miniti and Turino (2013).
- Non-homothetic preference: Hanoch (1975), Matusyama (2015) and Comin et al. (2021).
- Similar data: Lee and Mukoyama (2008), Broda and Weinstein (2010), Dekle et al. (2015), Bernard and Okubo (2016), Hamano and Okubo (2021), Ueda et al. (2019).

Multiple-Product Aspect of Firms/Establishments

	Units		Sales		Employees		Products	
	Number	%	Value (mil. JPY)	%	Number	%	Number	%
(1) Plants								
Single product	3,214	50	12,672,987	24	605,297	38	3,214	20
Multiple product	3,153	50	39,448,775	76	1,002,972	62	13,152	80
Multiple industry	460	7	13,989,518	27	306,627	19	2,292	14
Multiple sector	248	4	8,086,380	16	188,940	12	1,039	6
Total	6,367	100	52,121,762	100	1,608,269	100	16,366	100
(2) Firms								
Single product	2,306	47	5,815,738	11	366,235	23	2,306	14
Multiple product	2,595	53	46,306,024	89	1,242,035	77	14,060	86
Multiple industry	453	9	27,405,368	53	663,260	41	4,179	26
Multiple sector	308	6	21,204,771	41	543,202	34	2,838	17
Total	4,901	100	52,121,762	100	1,608,269	100	16,366	100

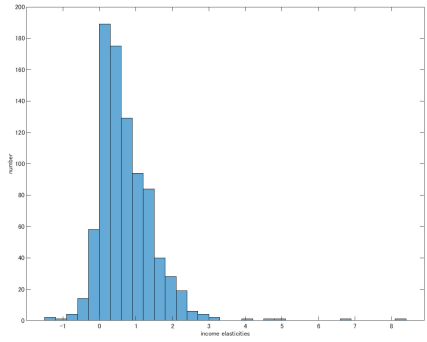
Notes: A single product plant (firm) is a plant (firm) that produces only one type of product at the 6-digit JSIC level. A multiple industry plant (firm) is a plant (firm) that is active in multiple industries (4-digit JSIC level). A multiple sector plant (firm) is a plant (firm) is active in multiple sectors (2-digit JSIC level).

Aggregate Dynamics



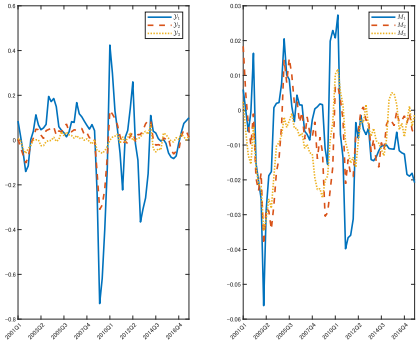
The figure shows the number of new establishments H, the number of producing establishments S, the number of inoperative establishments D, the number of product-varieties M, together with the growth rate of the total sales $\mathscr{Y}$ and total employment $\mathscr{L}$ from a year ago implied by the Current Survey of Production.

Heterogeneous Income Elasticities



The figure shows the histogram of the estimated income elasticities of 905 products registered in the CSP data.

Heterogeneous Product Specific Dynamics



The figure shows the growth rate of the total sales ($\mathscr{Y}_1$,$\mathscr{Y}_1$ and $\mathscr{Y}_3$)and the number of product-varieties of each product group (M_1, M_2 and M_3) from a year ago implied by the Current Survey of Production.

Non non-homothetic Preference

Following Matsuyama (2015), the consumption is defined with *implicitly, additively separable with constant elasticity of substitution (CES)* as

$$\left(\sum^{J} C_t(j)^{\frac{\varepsilon_i - \nu}{\nu}} \alpha_i^{\frac{1}{\nu}} C_{i,t}(j)^{1-\frac{1}{\nu}} di \right)^{\frac{1}{1-\frac{1}{\nu}}} \equiv 1, \tag{1}$$

Multiple-Product Establishments

Real operational establishment-product specific profits:

$$d_{i,t}(\varphi,\lambda_i)=\frac{1}{\sigma}\left(\frac{\rho_{i,t}(\varphi,\lambda_i)}{\lambda_i}\right)^{1-\sigma}\rho_{i,t}^{\sigma-\nu}\alpha_i\int_0^1 C_t(j)^{\varepsilon_i}dj-w_t\frac{f_{i,t}}{Z_t}. \tag{2}$$

where $\rho_{i,t}\equiv\frac{P_{i,t}}{P_t}$ which is the real price of the basket of product i. Total operational profits of producing establishment with productivity φ is thus given by

$$d_{s,t}(\varphi)=\sum^{J} l_i d_{i,t}(\varphi,\lambda_i)\,di-w_t\frac{f_{h,t}}{Z_t}.$$

Drawing of Productivity and Taste

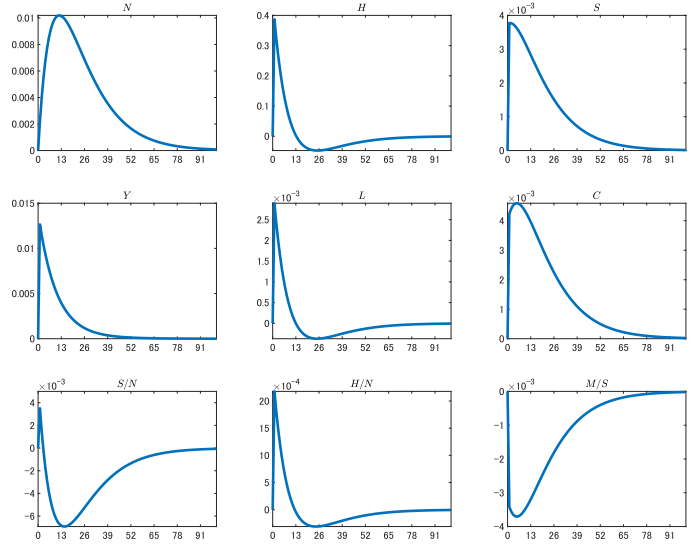
To solve the model, we must assume a distribution of productivity levels, φ and λ_i. We assume the following Pareto distribution for $G(\varphi)$ and $Z_i(\lambda_i)$, respectively as

$$G(\varphi) = 1 - \left(\frac{\varphi_{\min}}{\varphi}\right)^{\kappa}, \quad Z_i(\lambda_i) = 1 - \left(\frac{\lambda_{i\min}}{\lambda_i}\right)^{\upsilon}.$$

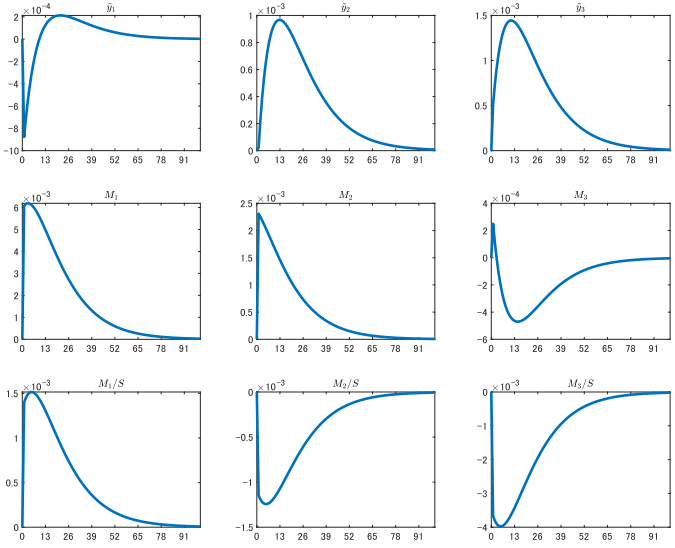
Calibration

β	Discount factor	0.99
ς	Inverse of Frisch elasticity of labor	2.15
σ	Elasticity of substitution of product varieties	3.8
κ	Productivity dispersion	11.51
υ	Taste dispersion	4.18
α_1	consumption weight of product 1	0.49194
α_2	consumption weight of product 2	0.40725
α_3	consumption weight of product 3	0.41862
ε_1	income elasticity of product 1	1.3470
ε_2	income elasticity of product 2	0.5633
ε_3	income elasticity of product 3	0.1346
ν	Elasticity of substitution of products	2
δ	Exogenous death shock	0.0056
f_e	fixed cost for establishment entry	1
f_h	fixed cost for establishement exit	0.0297
f_1	fixed cost for product 1	0.0265
f_2	fixed cost for product 2	0.0080
f_3	fixed cost for product 3	0.0042
χ	disutility in supplying labor	0.9588

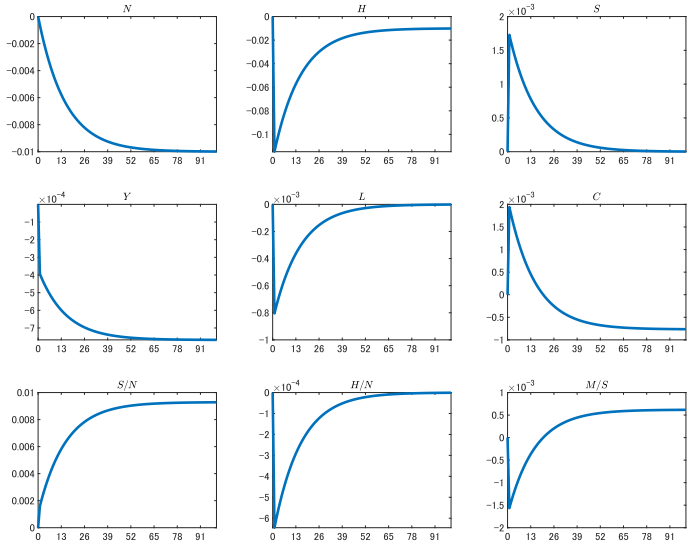
Aggregate Productivity Shock



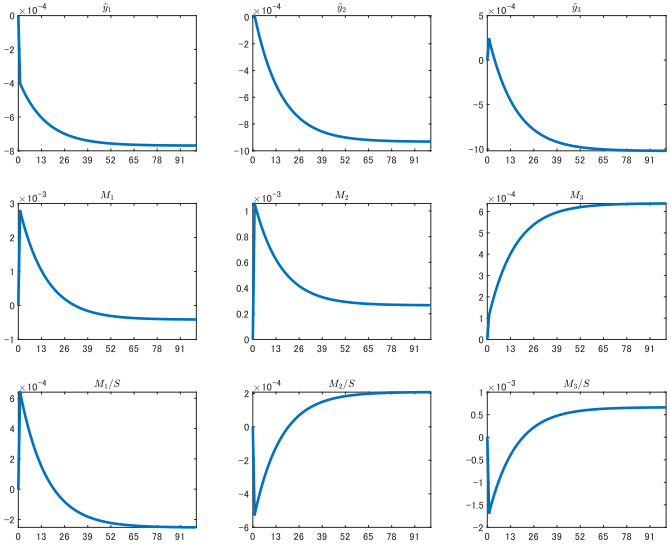
Aggregate Productivity Shock: products



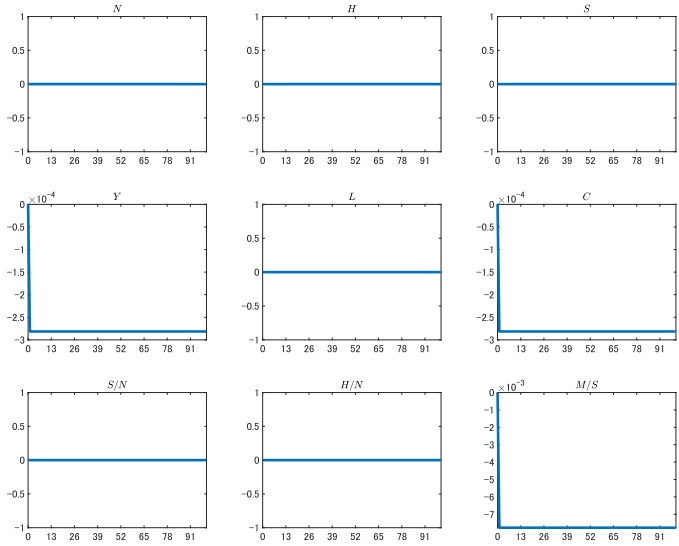
Entry Regulation: Aggregate



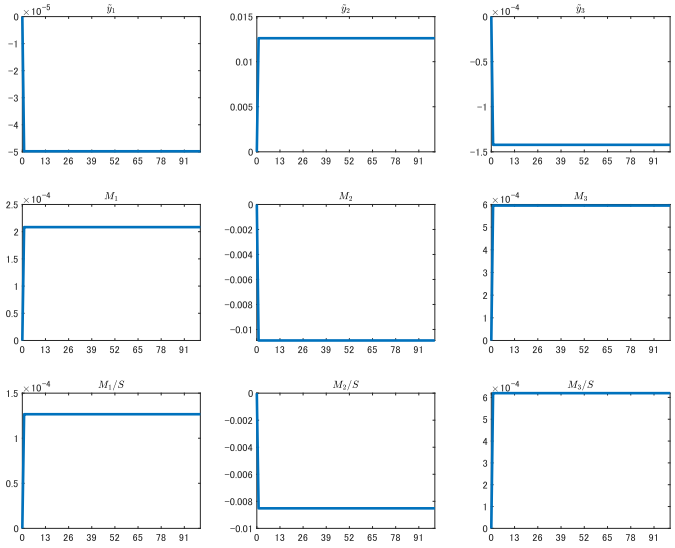
Entry Regulation: Products



Product Regulation (product 2): Aggregate



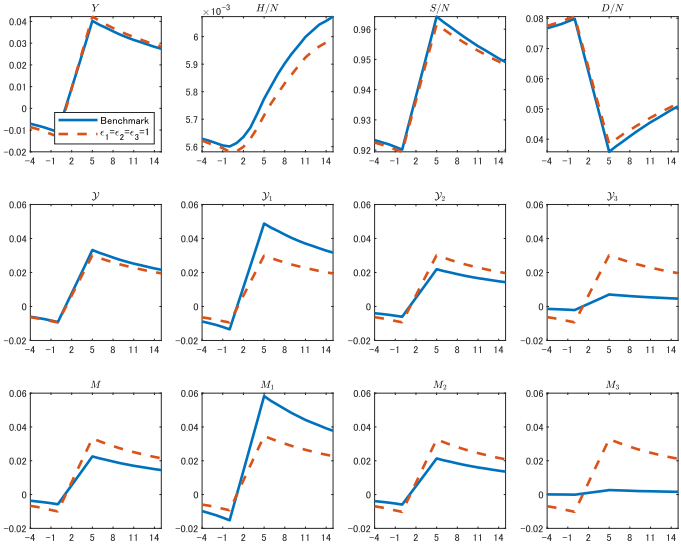
Product Regulation (product 2): Products



Bayesian Estimation

		Priors			Posteriors	
		Distr	Low	High	Mode	90% of CI
σ_A	std D. of preference shock	Invgamma	0.0001	2.00	1.0710e-04	0.0001 0.0105
σ_Z	Std D. of productivity shock	Invgamma	0.0001	2.00	0.0066	0.0003 9.5729
σ_χ	Std D. of labor disutility shock	Invgamma	0.0001	2.00	0.0255	0.0177 0.0594
σ_{f_E}	Std D. of entry regulation shock	Invgamma	0.0001	2.00	0.1505	0.0505 9.0482
σ_{f_h}	Std D. of establishement regulation shock	Invgamma	0.0001	2.00	0.0070	0.0054 0.0125
σ_{f_1}	Std D. of product regulation shock 1	Invgamma	0.0001	2.00	0.0066	0.0028 0.0200
σ_{f_2}	Std D. of product regulation shock 2	Invgamma	0.0001	2.00	2.5030e-04	0.0001 0.0387
σ_{f_3}	Std D. of product regulation shock 3	Invgamma	0.0001	2.00	0.0038	0.0005 0.0049
ρ_A	Persistence of demand shock	Beta	0.0256	0.78	0.1950	0.0000 0.8757
ρ_Z	Persistence of productivity shock	Beta	0.0256	0.78	0.9855	0.2381 0.9903
ρ_χ	Persistence of labor disutility shock	Beta	0.0256	0.78	0.9105	0.7327 0.9783
ρ_{f_E}	Persistence of entry regulation shock	Beta	0.0256	0.78	0.3674	0.0362 0.9362
ρ_{f_h}	Persistence of establishement regulation shock	Beta	0.0256	0.78	0.9825	0.5212 0.9943
ρ_{f_1}	Persistence of product regulation shock 1	Beta	0.0256	0.78	0.9987	0.5691 0.9997
ρ_{f_2}	Persistence of product regulation shock 2	Beta	0.0256	0.78	0.1455	0.0000 0.9689
ρ_{f_3}	Persistence of product regulation shock 3	Beta	0.0256	0.78	0.9983	0.3845 0.9996
θ_E	Adjustment cost for establishement entry	Gamma	1.0000	5.00	2.7573	1.2449 9.4537

Simulation



2d moments

		$\mathscr{Y}$	$\mathscr{L}$	H	S	D	M
St. dev. (%)	Data	11.5	2.04	62.2	1.17	23.6	0.99
	Model	4.64	1.98	38.6	5.70	120	4.66
Relative to $\mathscr{Y}$	Data	1.00	0.18	5.42	0.10	2.06	0.09
	Model	1.00	0.43	8.31	1.22	26.1	1.00
Corr($\mathscr{Y}, X_t$)	Data	1.00	0.23	-0.30	-0.30	-0.62	0.25
	Model	1.00	0.35	0.20	0.77	-0.04	0.27
		$\mathscr{Y}_1$	$\mathscr{Y}_2$	$\mathscr{Y}_3$	M_1	M_2	M_3
St. dev. (%)	Data	18.4	7.78	0.68	1.49	1.18	0.95
	Model	6.69	3.03	1.89	15.7	2.79	7.22
Relative to $\mathscr{Y}$	Data	1.60	0.68	0.23	0.13	0.10	0.08
	Model	1.44	0.65	0.41	3.37	0.60	1.56
Corr($\mathscr{Y}, X_t$)	Data	0.99	0.87	0.49	0.10	0.33	0.20
	Model	1.00	1.00	0.75	0.99	0.97	1.00

Conclusion

- The paper shows that multi-product aspect of firms or establishments and heterogeneous dynamic across products over the business cycles with under-explored Japanese data.
- To account for these stylized facts, we built a general equilibrium model based on heterogeneous firms or establishments that endogenously choose their product mix given different income elasticities across products in consumer preference.
- With estimated shock processes, the theoretical model is calibrated and simulated.
- We find that (de)regulation policy at entry, incumbent firms or establishments and each product level provide substantially different outcomes providing a caveat for policy debate.