Pharmacy Adoption and Supply Constraints in Generic Pharmaceuticals: Evidence from Japan

慶應義塾大学 Keio University

Haruo Kakehi and Ryo Nakajima

Graduate School of Economics, Keio University

Abstract

- We find that authorized generic (AG) adoption promotes generic substitution at pharmacies in Japan.
- Our model explains that the AG adoption depends on both patients' perception and pharmacy's cost factors.
- Our results inform policymakers that for-profit pharmacies play a key role in generic substitution and curbing medical costs.

Background

- Generic substitution can reduce the growing healthcare cost.
  - Two types of generics.
    - **Authorized generic (AG)**: produced by a brand company.
    - Other generic (OG): produced by generic companies.
  - Consumers demand AG rather than OG. (Janssen, 2023).
- **Can AG adoption promote generic substitution?**
  - Model both demand and supply side behavior.
  - Take advantage of Japan's unique practices.
    - Patients can **purchase AG and OG with identical prices.**
- In Japan,
  - The government periodically sets the same retail price for AG and OG.
  - Pharmacy adopts either AG or OG as a prescription drug.
    - Patient's choice sets are either **(Brand, AG)** or **(Brand, OG).**
  - Patients prefer AG but do not know which pharmacies have AG or OG.
  - Pharmacies are **financially incentivized** by subsidies for a higher generic share.

Data

- Claims data provided by Japan System Techniques Co., Ltd.
- Use **antibiotic** generic (Levofloxacin 250mg and 500mg) approved in December 2014.
- **Two periods panel data**
  - 1st Period: 2015 and 2nd Period: 2021.
- AG has a **large market share**, and **adoption differs across pharmacies.**

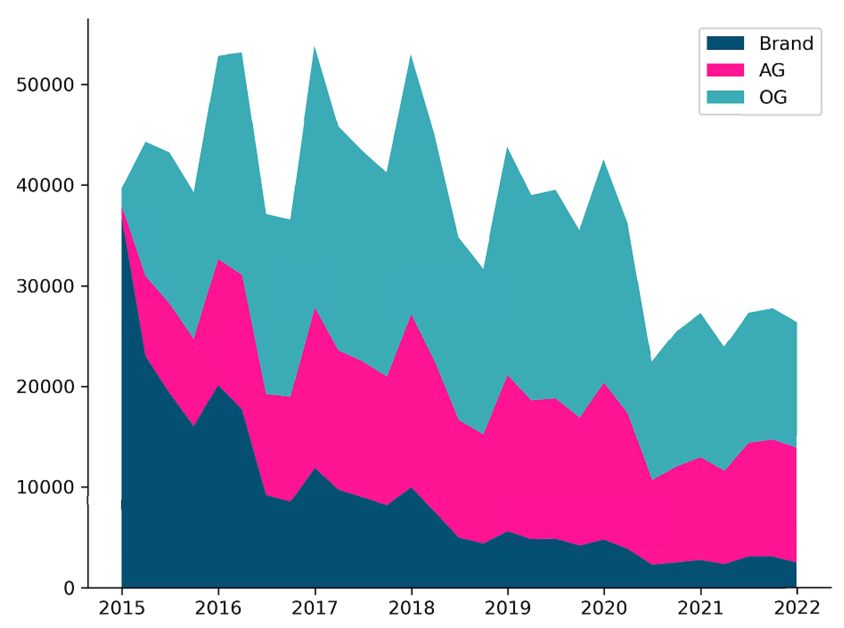

Fig. 1: The number of prescriptions

Adoption Transition 2015	2021	Fraction of Sample (%) (N = 5106)
AG	AG	48.78
AG	OG	4.34
OG	AG	15.70
OG	OG	31.15

Table 1: Pharmacies' adoption pattern

	Ownership small chain	individual	Large chain
Adoption (%)	**0.4103**	**0.4017**	**0.3897**

Table 2: AG share by pharmacies' ownership

Model

- **Pharmacy AG adoption decision**
  - The pharmacy j maximizes profit π^{ℓ}_{jt} by choosing a drug type $\ell \in [AG, OG]$ at time t.

$$\pi^{\ell}_{jt} = subsidy^{\ell}_{jt} \cdot n_{jt} - (f^{b}_{jt} + f^{\ell}_{jt}) \tag{1}$$

  - ⋆ n_{jt}: the number of patients
  - ⋆ f^{b}_{jt} and f^{ℓ}_{jt}: cost of brand, and AG or OG.

$$subsidy^{\ell}_{jt} = s_t 1\left(Y^{\ell}_{jt} r_{jt} + g_{jt} \geq c_t\right) \tag{2}$$

  - ⋆ s_t: the amount of subsidy
  - ⋆ Y^{ℓ}_{jt}**: generic share of antibiotics**
  - ⋆ g_{jt}: generic share of other drugs
  - ⋆ c_t: subsidy threshold
  - ⋆ r_{jt}: weight for antibiotics.
  - The pharmacy adopts AG when $\pi^{A}_{jt} - \pi^{O}_{jt} > 0$ or when

$$1\left(Y^{A}_{jt} \geq \frac{c_t - g_{jt}}{r_{jt}}\right) - 1\left(Y^{O}_{jt} \geq \frac{c_t - g_{jt}}{r_{jt}}\right) \geq \frac{(f^{A}_{jt} - f^{O}_{jt})}{s_t n_{jt}} \tag{3}$$

- **Patient AG demand**
  - Discrete choice demand by patient i after visiting the pharmacy j at time t.
  - Patients have utility for AG and OG.

$$U^{O}_{ijt} = \beta^{O}_{t} + \theta^{O}_{j} + \xi^{O}_{jt} + \varepsilon^{O}_{ijt}$$
$$U^{A}_{ijt} = \underbrace{\beta^{A}_{t} + \theta^{A}_{j} + \xi^{A}_{jt}}_{\text{AG premium}} + \beta^{O}_{t} + \xi^{O}_{jt} + \varepsilon^{A}_{ijt} \tag{4}$$

- We adopt the projection method in Suri (2011)

$$\theta^{O}_{j} = \phi\theta^{A}_{j} + \tau_j$$
$$(\theta^{O}_{j} + \theta^{A}_{j}) = (1+\phi)\theta^{A}_{j} + \tau_j. \tag{5}$$

- Log-share demand equations are

$$y^{O}_{jt} = \beta^{O}_{t} + \phi\theta^{A}_{j} + \tau_j + \xi^{O}_{jt}$$
$$y^{A}_{jt} = \beta^{O}_{t} + \beta^{A}_{t} + (1+\phi)\theta^{A}_{j} + \tau_j + (\xi^{O}_{jt} + \xi^{A}_{jt}), \tag{6}$$

where $y^{A}_{jt} = \ln\left(Y^{A}_{jt}\right) - \ln\left(1 - Y^{A}_{jt}\right)$ and $y^{O}_{jt} = \ln\left(Y^{O}_{jt}\right) - \ln\left(1 - Y^{O}_{jt}\right)$.

Empirical Specification

- We estimate

$$y_{jt} = h_{jt} y^{A}_{jt} + (1 - h_{jt})\, y^{O}_{jt}$$
$$= \beta^{O} + \beta^{A} h_{jt} + \theta^{A}_{j} h_{jt} + \phi\theta^{A}_{j} + \tau_j + \nu_{jt} \tag{7}$$

where $\nu_{jt} = h_{jt}\xi^{A}_{jt} + (1 - h_{jt})\,\xi^{O}_{jt}$ and $h_{jt} = 1$ if pharmacy adopts AG.

  - **Features**
    - ⋆ $(\beta^{A} + \theta^{A}_{j})h_{jt}$ explains heterogeneous adoption effect.
    - ⋆ $\phi\theta^{A}_{j}$ deals with the adoption endogeneity.
    - ⋆ The estimated θ^{A}_{j} may captures both AG perception and adoption cost factors.
- From Suri (2011), we use a projection θ^{A}_{j} on h_{jt} as follows

$$\theta^{A}_{j} = \lambda_0 + \lambda_1 h_{j1} + \lambda_2 h_{j2} + \lambda_3 h_{j1} h_{j2} + v_j. \tag{8}$$

- **Parameter of interests**
  - β^{A}: Average AG perception.
  - θ^{A}_{j}: Heterogeneous AG perception at pharmacy j.
  - ϕ: Correlation of perceptions θ^{A}_{j} and θ^{O}_{j}.

Results

- Table 3 shows
  - β^{A} is **positive.**
    - ⋆ AG adoption increases generic substitution by **20.3% - 26.6%.**
  - ϕ is **negative.**
    - ⋆ Patients who prefer AG do not prefer OG.
- From equation (8), heterogeneous AG perception θ^{A}_{j} depends on h_{jt}.
  - We estimate θ^{A}_{j} for four groups. (i.e. **Never**, **Late**, **Always**, **Early**)
- Figure 2 implies
  - **Always** group pharmacies adopt AG due to the **positive** AG perception (i.e. $\theta^{A}_{j} > 0$).
  - **Never** group pharmacies adopt OG due to the **negative** AG perception (i.e. $\theta^{A}_{j} < 0$).
- Heterogeneous AG **perception** θ^{A}_{j} can explain the heterogeneous AG **adoption** among pharmacies.

	Without Covariates	With Covariates
β^{A}	0.203**	0.266***
	(0.085)	(0.092)
ϕ	-0.411*	-0.547**
	(0.212)	(0.023)
λ_1	1.363**	1.034**
	(0.582)	(0.473)
λ_2	0.284	0.059
	(0.535)	(0.343)
λ_3	-1.364**	-0.943*
	(0.573)	(0.502)
Prefecture FE	Yes	Yes
Observations	10212	10212

Table 3: Estimation results

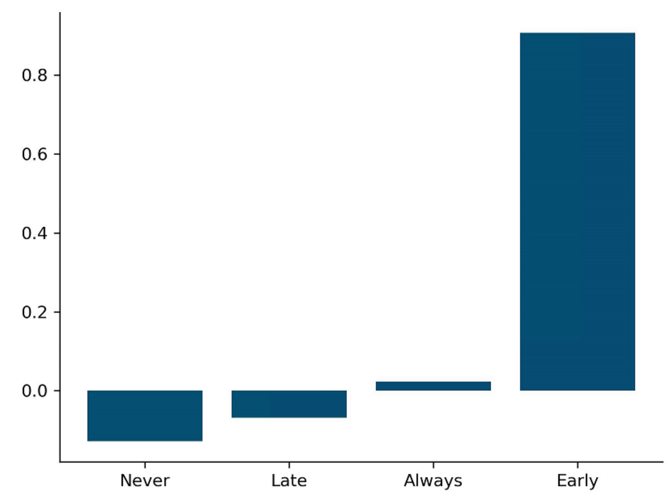

Fig. 2: The predicted AG perception θ^{A}_{j}

Discussion

- **How relevant is the patients' perception?**
  - We remove cost factor effects by the regression of θ^{A}_{j} on cost factors
    1. **Management style**: individual store, small chain, or large chain.
    2. **Pharmacy's size**: the number of prescription.
    3. **Prescription share from hospitals**: Hospital $\text{HHI}_j = \sum_{h=1}^{H}\left(100 \times s_{jh}\right)^2$.
    4. **Types of prescription-issuing hospitals**: small hospital, large hospital.
  - Figure 3 shows θ^{A}_{j} has large variation.
    - ⋆ Cost removed θ^{A}_{j} also exhibits similar pattern as in Figure 2.
- **Who benefits from AG?**
  - Patients benefit from AG adoption (i.e. $\beta > 0$, $\theta^{A}_{j} > 0$).
  - Figure 4 shows
    - ⋆ Smallest incentive for large chains.
    - ⋆ Largest incentive for High HHI pharmacies.
  - **Uniform financial incentives may be inefficient** in AG adoption.

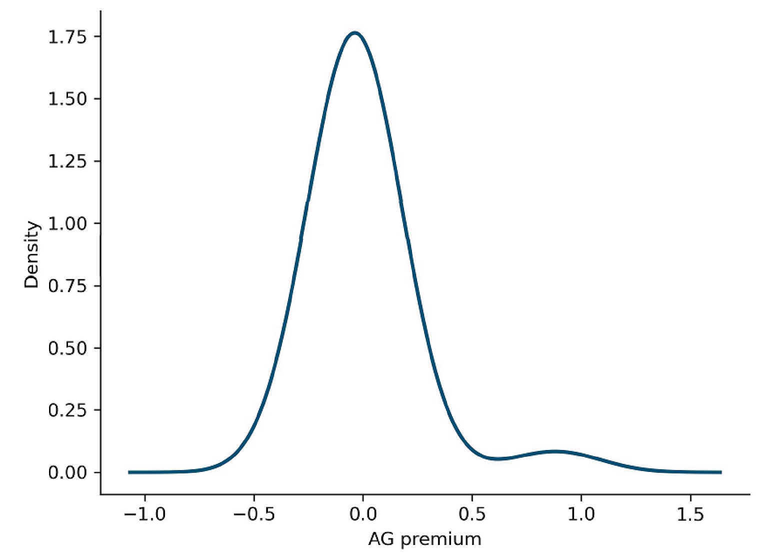

Fig. 3: The cost removed AG perception θ^{A}_{j}

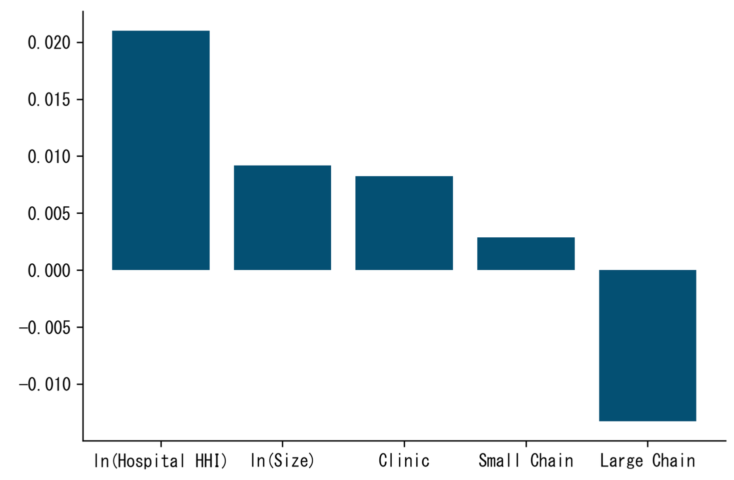

Fig. 4: θ^{A}_{j} by pharmacy characteristics

References & Contact

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- **Contact: haruokakehi@keio.jp**