The influence of reference price policy changes on the pricing of patent and original drugs

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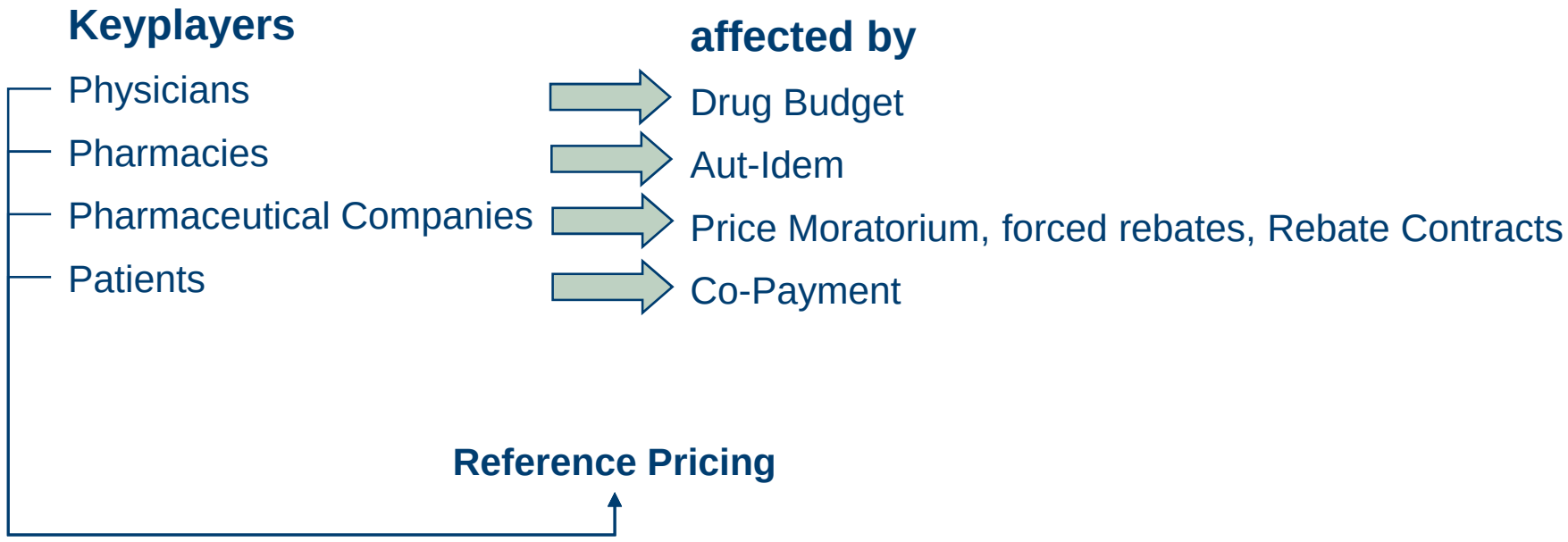
Agenda

- Introduction
- Theoretical Motivation and Theses
- Dataset and empirical model
- Results
- Discussion

Introduction

- **Increase of drug expenses one of the most urgent problems of the German SHI System**
  - Since 1999 average yearly increase 5,34 %
  - 27.8 bill. Euro (2007)
- **Key players and cost control instruments**



The reference price system

- Upper reimbursement limit for prescription drugs in the SHI
- If retail price > reference price:
  patient pays the difference
- Reference price groups determined by Federal Joint Committee (G-BA)
- Reference prices set by central association of SHI,
  adjusted on yearly base
- Different reference price groups (“classes”)
  - including original drugs and their generics
  - **including patent drugs, original drugs and generic drugs**

How do retail prices of patent, original and generic drugs react to the introduction of reference pricing?

Theoretical Motivation

Therapeutic market with one patent drug (P), one off-patent original (O) and one generic drug (G)

- Insured patients have to pay a co-payment of $c_i = \alpha p_i$

  where $i = P, O, G$ and α is the co-payment rate for drug i
- Price of a drug i is p_i where $i = P, O, G$
- Demand for drug i is $D_i(c_p, c_O, c_G)$ where $\frac{\partial D_i}{\partial c_i} < 0$ and $\frac{\partial c_i}{\partial p_i} > 0.$
- Revenues of company i are $\pi_i = p_i D_i(c_p, c_O, c_G)$
- Assume different demand reactions of drug P, drug O and drug G.

$$\frac{\partial D_G}{\partial c_G} < \frac{\partial D_O}{\partial c_O} < \frac{\partial D_P}{\partial c_P} < 0$$

- reference price p_{RP} is set $p_g < p_{RP} < p_O < p_P$
- New cost function: $c_i = \alpha p_i + \max(p_i - p_{RP}, 0)$

Theoretical Motivation

- First order conditions are:

(1.1) Patent drugs: $$\frac{\partial \pi_P}{\partial p_P} = D_P(c_P, c_O, c_G) + p_P \frac{\partial D_P[\cdot]}{\partial c_P}(\alpha + 1)$$

(1.2) Original drugs: $$\frac{\partial \pi_O}{\partial p_O} = D_O(c_P, c_O, c_G) + p_O \frac{\partial D_O[\cdot]}{\partial c_O}(\alpha + 1)$$

(1.3) Generic drugs: $$\frac{\partial \pi_G}{\partial p_G} = D_G(c_P, c_O, c_G) + p_G \frac{\partial D_G[\cdot]}{\partial c_G}\alpha$$

it follows $p_p{}^* > p_O{}^* > p_G{}^*$

- Reference Pricing has different effects on the pricing of patent, original and generic drugs.
- Producers can choose to decrease their prices
  - Patent Drugs decrease their prices less than off-patent originals
  - Price reaction of generics is ambiguous

Dataset and empirical method

- **Data**
  - NVI Data for reference price groups of **statins** and **proton pump inhibitors (PPI)**
  - Prices = (Revenue of product/dispended Defined Daily Doses (DDD))
  - Observation period 2004 – 2007 on monthly base
  - Two Reference Price Policy Changes (RPRC)
    - Introduction of reference prices for statins and PPIs‘ (January 2005)
    - Extraordinary decrease of reference prices (May 2006)
  - Two different measurements of competition
    - Number of competitors within an active ingredient
    - Herfindahl-Index
- **Method**
  - Product level panel data regression (2 Way Fixed Effect Model)
  - Cluster Robust Standard Errors due to heteroskedasticity and first order serial correlation of residuals

Dataset and empirical method

- **The model:**

$$\ln(p_{it}) = \beta_1 RPPC_t + \beta_2 (RPPC_t * Patent_i) + \beta_3 (RPPC_t * Original_i) + FE_i + \delta_t + \varepsilon_{it}$$

with

$RPPC_t$	= Reference Price Policy Change * Generic drug i
$RPPC_t * Patent_i$	= Reference Price Policy Change * Patent drug i
$RPPC_t * Original_i$	= Reference Price Policy Change * Original drug i
δ_t	= Year indicator
FE_i	= Fixed effect product i
ε_{it}	= i.i.d. residuals

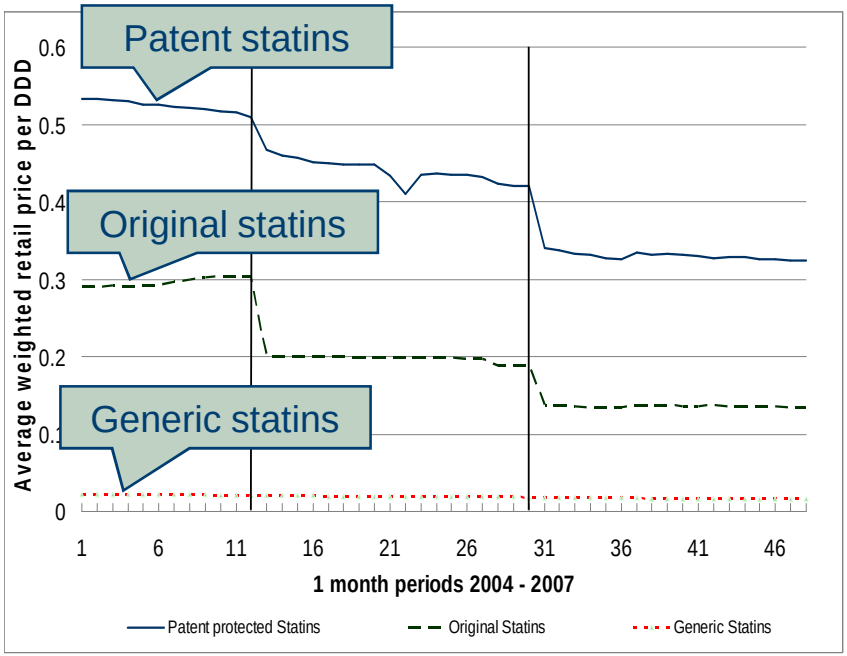
- **The extended model:**

$$\ln(p_{it}) = \beta_1 RPPC_t + \beta_2 (RPPC_t * Patent_i) + \beta_3 (RPPC_t * Original_i) + \beta_4 NC_i + \beta_5 (NC_i * Brand_i) + FE_i + \delta_t + \varepsilon_{it}$$

NC_i	= Number Competitors with same active ingredient
$NC_i * Brand_i$	= Number Competitors with same active ingredient * brand i

Results

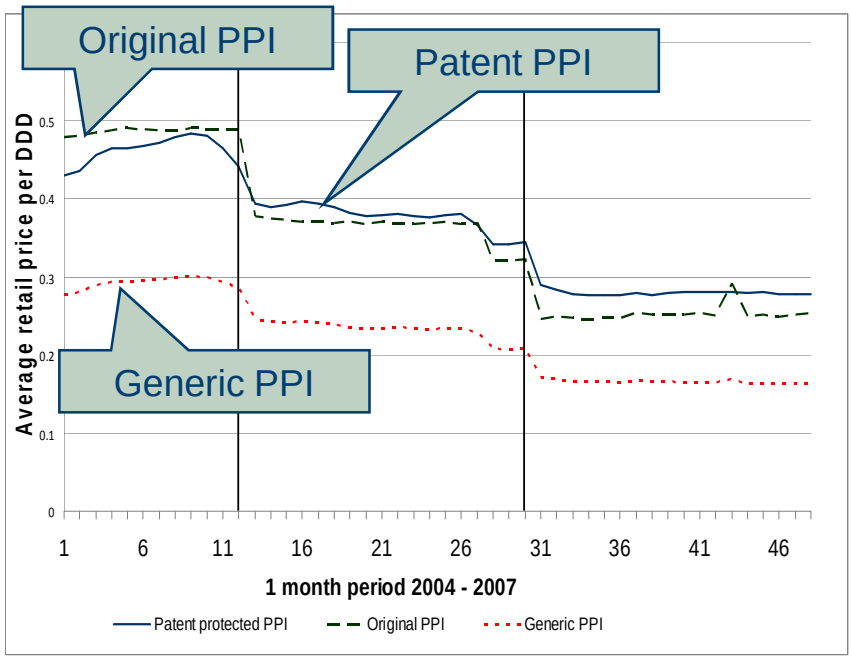
- **Descriptive results**
  - Therapeutic group of statins



Statins under reference price	% price change after RP introduction (weighted average)	% price change after RP reduction (weighted average)
all	**-0.352**	**-0.222**
patented	**-0.265**	**-0.182**
original	**-0.438**	**-0.279**
generic	**-0.158**	**-0.11**

Results

- **Descriptive results**
  - Therapeutic group of proton pump inhibitors



PPI under reference price	% price change after RP introduction (weighted average)	% price change after RP reduction (weighted average)
all	-0.316	-0.225
patented	-0.289	-0.202
original	-0.369	-0.255
generic	-0.319	-0.11

Results

- **Empirical results (statins)**

Introduction reference pricing 2005

Model	1	2	3	4	5
post	-0.105***	-0.0489***	-0.0151	-0.101***	-0.0915***
	-0.014	-0.014	-0.01	-0.015	-0.0094
postundoriginal	-0.288***	-0.263***	-0.365***	-0.276***	-0.300***
	-0.05	-0.048	-0.035	-0.054	-0.055
postundpatent	-0.0793	-0.144***	-0.179***	-0.0975*	-0.110**
	-0.057	-0.054	-0.051	-0.058	-0.052
numbercompetitors		-0.0293***	-0.0454***		
		-0.0054	-0.0032		
numbercompetitorsbrand			0.0378***		
			-0.0066		
herfindalindex				0.242	0.673
				-0.2	-0.56
herfindalindexbrand					-0.521
					-0.65
Observations	2733	2733	2733	2733	2733
Number of produkt	57	57	57	57	57
R-squared	0.68	0.71	0.73	0.68	0.68

Without control for competition:

- Average price decrease
  - generic drugs 10,5 %
  - patent drugs 18.4 % (not significant)
  - original drugs 39.3 %

Controlling for competition:

- Average price decrease
  - generic drugs 1.5 % to 9.2 %
  - patent drugs 18.9 % to 20.2 %
  - original drugs 31.1 % to 39.2 %

- Competition has an negative influence
  - weaker for patent and original drugs

Results

- **Empirical results (PPI)**

Introduction reference pricing 2005

Model	1	2	3	4	5
post	-0.195***	-0.189***	-0.0571**	-0.198***	-0.189***
	-0.012	-0.017	-0.021	-0.012	-0.0051
postundoriginal	0.0947**	0.0979**	-0.067	0.134***	0.0623***
	-0.039	-0.039	-0.047	-0.047	-0.013
postundpatent	0.139***	0.130***	-0.0158	0.118***	0.0696***
	-0.037	-0.039	-0.041	-0.036	-0.011
numbercompetitors		-0.00225	-0.0429***		
		-0.0048	-0.0088		
numbercompetitorsbrand			0.0442***		
			-0.0085		
herfindalindex				0.161*	4.748***
				-0.08	-0.2
herfindalindexbrand					-4.650***
					-0.2
Observations	1824	1824	1824	1824	1824
Number of produkt	38	38	38	38	38
R-squared	0.77	0.77	0.77	0.77	0.82

Without control for competition:

- Average price decrease
  - generic drugs 19.5 %
  - patent drugs 5.6 %
  - original drugs 10.0 %

Controlling for competition:

- Average price decrease
  - generic drugs 5.7 % to 19.8 %
  - patent drugs 5.9 % to 11.9 %
  - original drugs 6.4 % to 12.7 %

- Competition has an negative influence
  - weaker for patent and original drugs

Summary and discussion

- **Price reaction of patent drugs and original drugs after reference price policy changes is different**
  - Producer of patent drugs decrease prices by less than producers of off-patent originals
  - Level of generic price reduction after RPPC differs with competitive environment
  - Competition plays the expected role, increasing competition decreases product prices
- **Possible explanations for the pricing behavior of patent and original drugs**
  - Utility advantage for patent producers through unique active ingredient
  - Role model function for other countries with price regulation mechanisms

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