

Bargaining and International Reference Pricing in the Pharmaceutical Industry

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Motivation

- ▶ Pharmaceutical Sales:
 - ▶ Global revenue $\approx \$ 1.1$ trillion (in 2016)
 - ▶ $\approx 1/3$ spent by the US
 - ▶ US spends 2X per inhabitant than Europe
- ▶ Some countries negotiate or constrain prices—but not the US
- ▶ Policy discussion on price controls in the US with international reference pricing
(Salter 2015, Weiss et al. 2016, OECD, 2017)

Trump Proposes to Lower Drug Prices by Basing Them on Other Countries' Costs



President Trump spoke about prescription drug prices, alongside Alex M. Azar II, the secretary of health and human services, on Thursday. Sarah Silbiger/The New York Times

Objective

- ▶ Simulate the effects of a US International Reference Pricing policy for pharmaceuticals using Canada as reference country

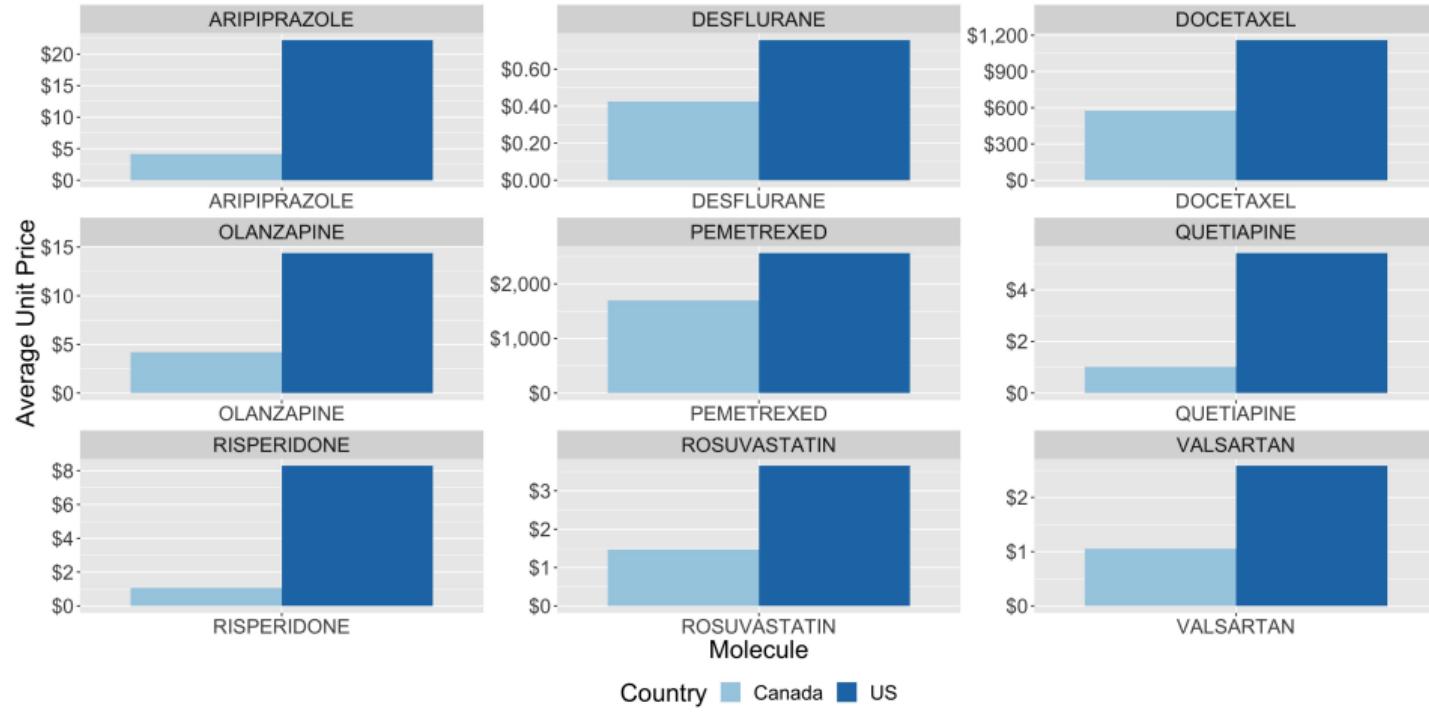
Objective

- ▶ Develop and estimate a structural model of supply and demand in Canada and the US:
 - ▶ Estimate the shape of demand in all markets
 - ▶ Estimate marginal costs of drugs in all markets
 - ▶ Estimate bargaining weights of firms in Canada
- ▶ Simulate counterfactual reference pricing policies across classes of pharmaceutical drugs

Descriptive Statistics:

- ▶ Pharmaceutical spending (OECD, 2015)
 - ▶ US: \$1,162 per capita (USD)
 - ▶ Canada: \$807 per capita (USD)
- ▶ Much higher prices in the US for same drugs
- ▶ Different composition of drugs spent across countries
- ▶ Often more patented drugs in the US, different market structure

Prices of Common Drugs



Data

- ▶ IMS Health data (2002-2013) at product level for US, Canada
 - ▶ Focus on prescription drugs
 - ▶ Aggregate sizes/forms by standard units (smallest single-dose unit)
 - ▶ Aggregate generics for each molecule/corporation
- ▶ Country-level revenue and quantity broken down by: hospital, retail, government, and others. We use the hospital segment.
- ▶ Market by Anatomical Therapeutic Chemical (ATC) classification
- ▶ Example: Metformin (brand names: Glumetza, Fortamet, Glucophage, Riomet)
 - ▶ (A) Alimentary tract and metabolism
 - ▶ (A10) Drugs used in diabetes
 - ▶ (A10B) Blood glucose lowering drugs
 - ▶ (A10BA) Biguanides
 - ▶ (A10BA02) Metformin

Modeling Price Setting with Bargaining in Canada

- ▶ Nash Bargaining model for price-regulated pharmaceutical markets (Canada)
- ▶ Firms maximize profits, while government maximizes consumer welfare
- ▶ Captures trade-offs faced by regulators
 - ⇒ Canadian Patented Medicine Prices Review Board literally negotiates w/ drug manufacturers to ensure that they are not “excessive”

Firm Profits

- ▶ Firm f selling products $j \in F_{fm}$ receives flow profits in market m :

$$\Pi_{fmt} = \sum_{j \in F_{fm}} \Pi_{jmt} = \sum_{j \in F_{fm}} (p_{jt} - c_{jt}) q_{jt}(\mathbf{p}_{mt})$$

where $\mathbf{p}_{mt} = (p_{1t}, \dots, p_{J_{mt}})$

- ▶ Firm f profit across markets:

$$\Pi_{ft} = \sum_m \Pi_{fmt}.$$

Consumer Welfare

- ▶ Government maximizes aggregate welfare in each market m :

$$\begin{aligned} W_{mt}(\mathbf{p}_{mt}) &= M_{mt} \int W_{imt}(\mathbf{p}_{mt}) dF(\nu_{im}; \theta) \\ &= M_{mt} \int \ln \left[1 + \sum_j \exp(u_{ijt}) \right] dF(\nu_{im}; \theta) \end{aligned}$$

- ▶ u_{ijt} : [estimated] random coefficient logit utility

▶ Details

Price Setting with Nash Bargaining

- ▶ Nash bargaining product-by-product maximizes:

$$p_{jt} = \arg \max_{p_{jt}} \left\{ \underbrace{(\Delta_{jm} \Pi_{ft}(p_{jt}, \mathbf{p}_{-jmt}))^{\rho_{jm}}}_{\text{Profit from } j \text{ in } m} \underbrace{(\Delta_j W_{mt}(p_{jt}, \mathbf{p}_{-jmt}))^{1-\rho_{jm}}}_{\text{Welfare gain from } j \text{ in } m} \right\}$$

with bargaining parameter ρ_m , where

$$\begin{aligned}\Delta_{jm} \Pi_{ft}(p_{jt}, \mathbf{p}_{-jmt}) &\equiv \Pi_{ft} - \sum_{j' \neq j, j' \in F_f} \Pi_{j'm(j')t} \\ &= \Pi_{jmt}(p_{jt}, \mathbf{p}_{-jmt})\end{aligned}$$

and

$$\Delta_j W_{mt}(p_{jt}, \mathbf{p}_{-jmt}) \equiv W_{mt}(p_{jt}, \mathbf{p}_{-jmt}) - W_{mt}(\infty, \mathbf{p}_{-jmt})$$

Supply-Side Identification

- ▶ Goal: Identify marginal costs + bargaining parameters
 - ▶ BLP-style demand estimates for u_{ijt} distribution
- ▶ US Price-Setting:
 - ▶ No bargaining $\Rightarrow \rho_{jm} = 1$
 - ▶ Bertrand-Nash first-order conditions identify US marginal costs
- ▶ Canada Price-Setting:
 - ▶ Need to identify bargaining parameter: $\rho_m \in [0, 1]$
 - ▶ Identifying assumption on marginal costs:

$$c_j t(\rho_{m(j)}) = z'_{jt} \lambda_{jt} + \omega_{jt} \text{ with } \mathbb{E}[z_{jt} \omega_{jt}] = 0$$

▶ Details

▶ Results

Counterfactual: International Reference Pricing

Question: What if the US adopted reference pricing re: Canada?

- ▶ Idea: Bound price admissible in the US by prices set in Canada
- ▶ Similar to policies in place in Europe
- ▶ Ambiguous welfare/profit effects:
 - ▶ If interior bargaining solution + no product exits \Rightarrow US prices (weakly) decrease (theorem)
 - ▶ With product exits, the effect is ambiguous
 - ▶ Effects depend on: cross-country market sizes, shapes of demand functions, marginal costs, regulatory constraints

A Policy for International Reference Pricing

- ▶ Firm selling product j negotiates simultaneously with regulatory boards in Canada and the US
 - ⇒ Equivalently: bargain w/ Canada, then set prices in the US
- ▶ US commits to refuse the sale of any price $p_j^{US} > p_j^{CA}$
 - ⇒ Even if there is a welfare improving price higher than p_j^{CA}
- ▶ Canadian price acts as ‘price ceiling’ for p_j^{US} —but is set in anticipation of this

International Reference Pricing

- ▶ Price Nash equilibrium in the US given prices in CA solve:

$$p_j^{US}(p_j^{CA}, \mathbf{p}_{-j}^{US}) \equiv \arg \max_{p \in [0, p_j^{CA}] \cup \{\infty\}} \Pi_j^{US} (p, \mathbf{p}_{-j}^{US}) \mathbf{1}_{\{p \leq p_j^{CA}\}}$$

→ Constrained Nash equilibrium in prices in the US:

$$p_j^{US*}(p_j^{CA}, \mathbf{p}_{-j}^{CA})$$

International Reference Pricing

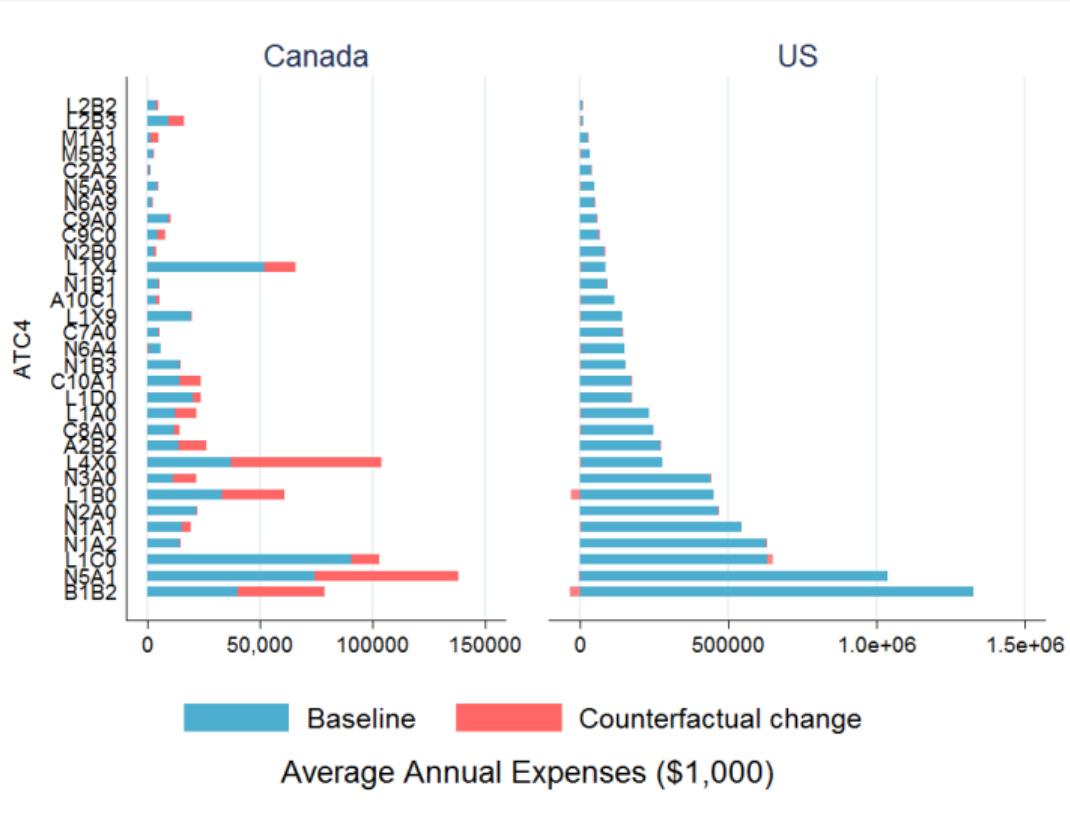
- ▶ Bargaining equilibrium in Canada:

$$\max_{p_j^{CA}} \Delta\Pi_j(p_j^{CA}, \mathbf{p}_{-j}^{US}, \mathbf{p}_{-j}^{CA})^{\rho_j} \Delta_j W_{CA}(p_j^{CA}, \mathbf{p}_{-j}^{CA})^{1-\rho_j}$$

where

$$\begin{aligned} \Delta\Pi_j(p_j^{CA}, \mathbf{p}_{-j}^{US}, \mathbf{p}_{-j}^{CA}) &\equiv \underbrace{\Pi_j^{US}(p_j^{US*}(p_j^{CA}, \mathbf{p}_{-j}^{CA}), \mathbf{p}_{-j}^{US}) + \Pi_j^{CA}(p_j^{CA}, \mathbf{p}_{-j}^{CA})}_{\text{global profit under agreement}} \\ &\quad - \underbrace{\Pi_j^{US}(p_j^{US}(\infty, \mathbf{p}_{-j}^{CA}), \mathbf{p}_{-j}^{US})}_{\text{profit if in US only}} \end{aligned}$$

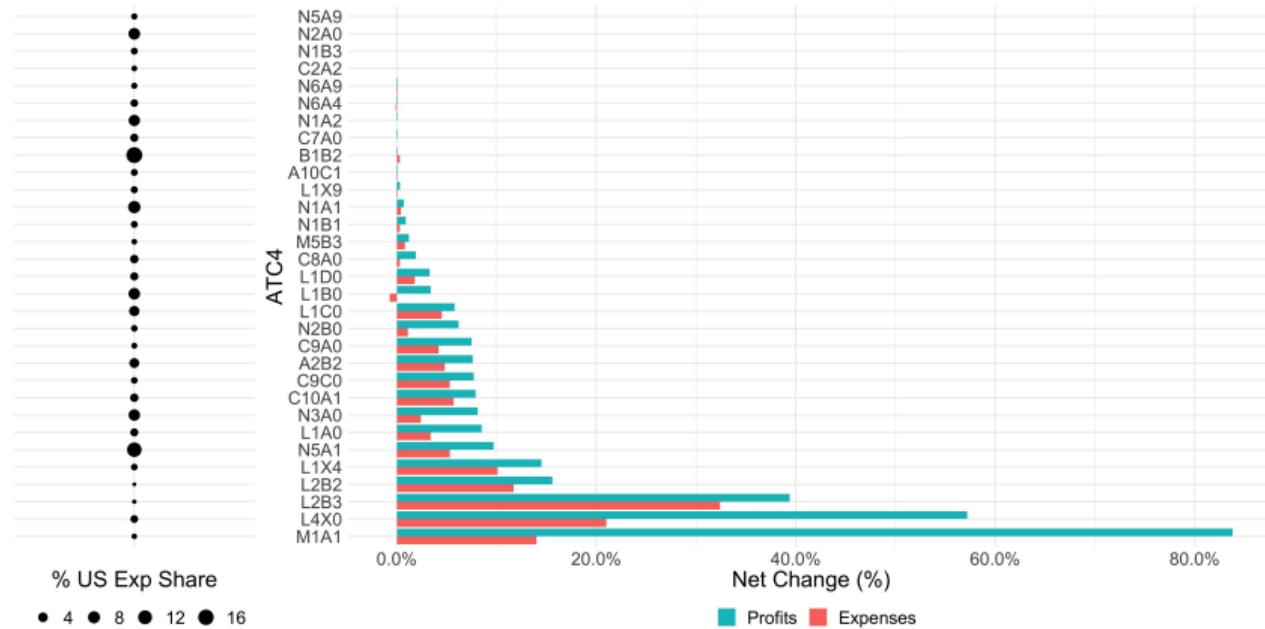
Expenses Changes



► Details

► Patented only

Net Global Changes



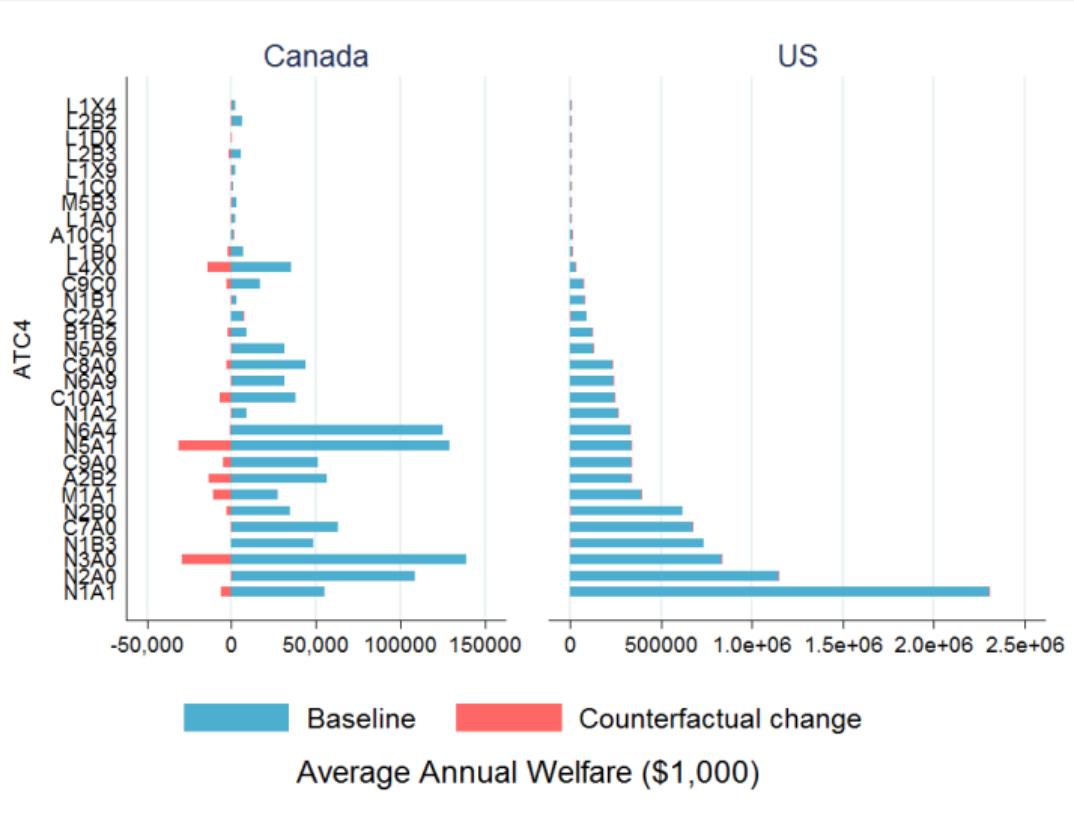
% US Exp Share

● 4 ● 8 ● 12 ● 16

Net Change (%)

■ Profits ■ Expenses

Consumer Welfare Changes



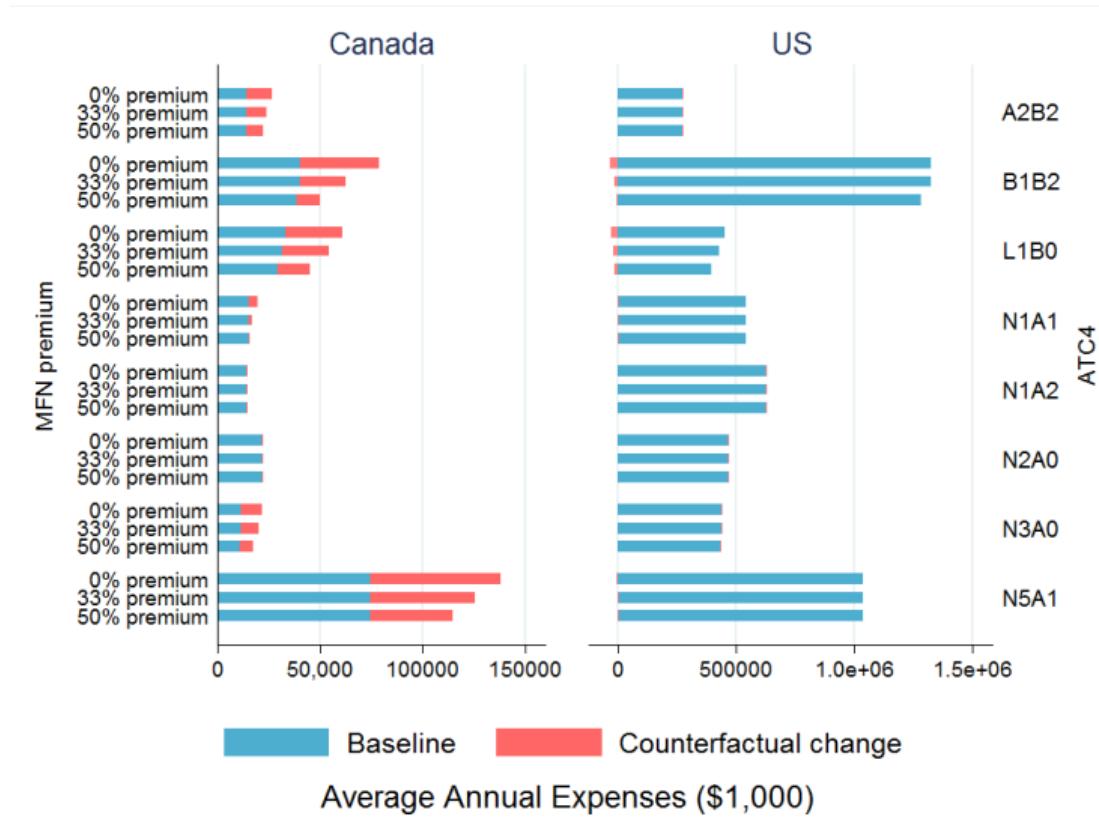
International Reference Pricing

- ▶ Summary of results:
 - ▶ Expenses increase in Canada by 52.4% (with huge variation) and stable in the US (-0.6%) with variation over classes (-6.9% to +3.6%)
 - ▶ Profits increase in Canada by 65% but decrease by 1.9% in the US
 - ▶ Welfare decreases in Canada and only slightly increase in the US for some classes
 - ▶ Overall pharmaceutical expenses increase by 2.7% and profits by 5.1%

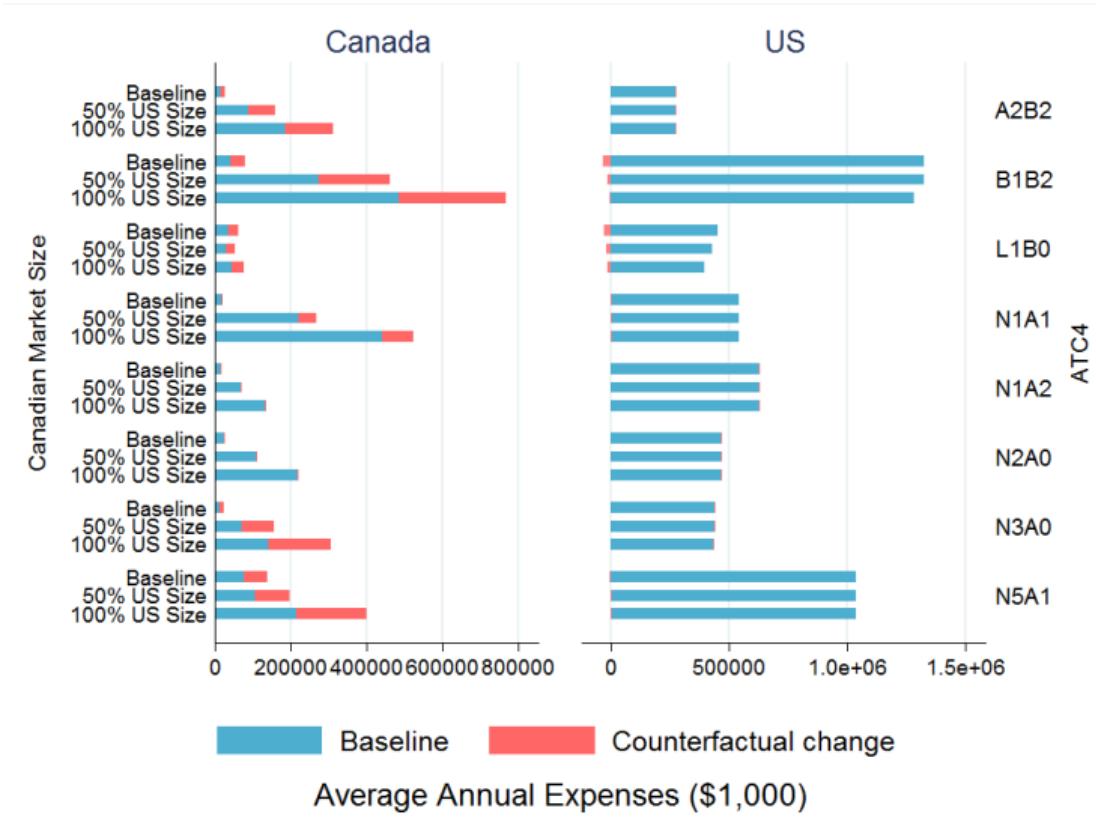
Policy Variants

- ▶ Variants on Strictness of Reference Pricing
 - ▶ Allow a 33% higher price for the US
 - ▶ Allow a 50% higher price for the US
- ▶ Variant on the size of the reference country
 - ▶ Canada enlarged to 50% of the US size
 - ▶ Canada enlarged to 100% of the US size
- ▶ Variant on the number of Reference Countries [preliminary]
 - ▶ Bargain with 1, 2, 5 or 10 “copies” of Canada
 - ▶ Reference the average price (e.g. a price index)

Changes in Expenses by MFN Leniency (Large ATC4s)



Changes in Expenses by Market Size (Large ATC4s)



Conclusion

- ▶ Empirically assess the potential of international reference pricing to reduce drug expenditure in the US
- ▶ A priori, the effect is ambiguous:
 - ▶ It depends on empirical supply, demand and bargaining power
- ▶ We find that expenses in Canada increase by 60% on average, but US prices barely budge
- ▶ Overall, firms profit from the additional leverage in Canadian bargaining;
 - ▶ Consumer welfare decreases
- ▶ Results are largely driven by the relative market size of Canada vs the US
 - ▶ But even a “larger” Canada appears to hurt Canada more than it helps the US

Next Steps

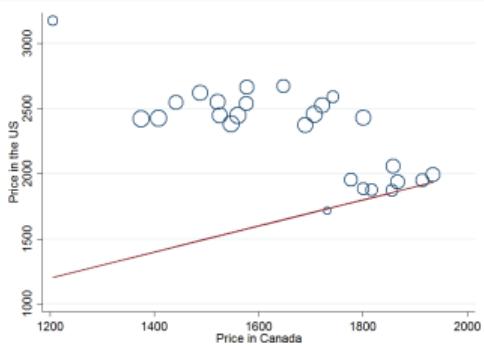
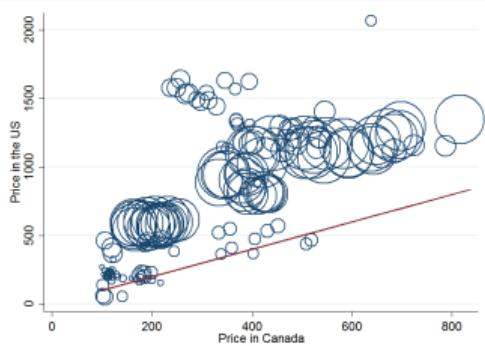
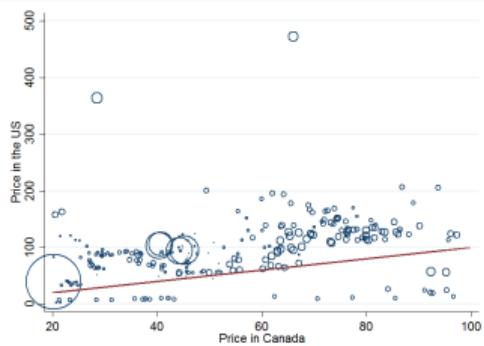
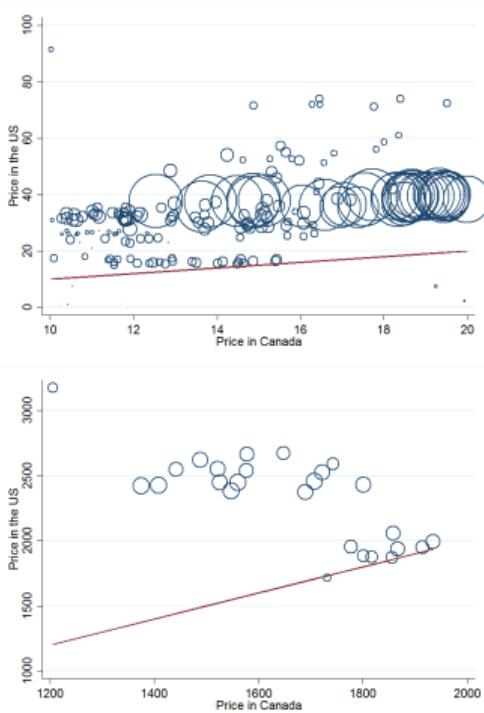
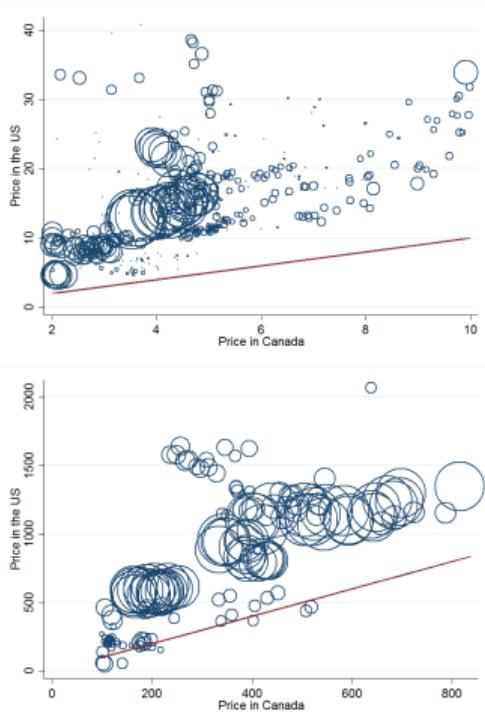
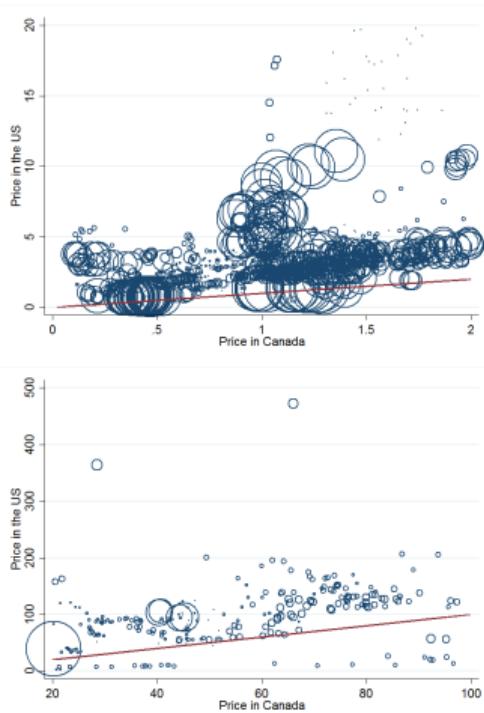
- ▶ Is there a international reference pricing policy that can do more to reduce US prices?
 - ▶ Enforce sale in reference country (e.g. eliminate the option to sell only in the US)
 - ▶ Reference a price index from a set of countries
- ▶ What should we recommend instead?

Thank You!

Number of drugs and expenditure shares by ATC4

ATC4	Label	Canada				US							
		Number	On Patent	Branded	Off Patent	Generics	Expenditure Share (%)	Number	On Patent	Branded	Off Patent	Generics	Expenditure Share (%)
A10C1	H INSUL+ANG FAST ACT	3	0	0	0	0	0.66	3	0	0	0	0	1.16
A2B2	ACID PUMP INHIBITORS	4	1	1	0	3	3.36	6	1	1	0	0	4.12
B1B2	FRACTIONATED HEPARINS	4	0	0	0	0	7.98	3	0	0	0	0	16.81
C10A1	STATINS (HMG-COA RED	3	0	3	0	3	3.19	3	2	3	0	0	2.39
C2A2	ANTIHYPERT. PL MAINLY PERI	1	2	4	0	0	0.32	2	1	4	0	0	0.51
C7A0	B-BLOCKING AGENTS.PLAIN	2	3	10	0	0	1.22	2	10	12	0	0	2.18
C8A0	CALCIUM ANTAGONIST PLAIN	2	3	3	0	0	1.90	3	5	5	0	0	2.50
C9A0	ACE INHIBITORS PLAIN	5	5	6	0	0	1.55	2	6	9	0	0	0.58
C9C0	ANGIOTEN-II ANTAG. PLAIN	5	0	0	0	0	1.10	7	0	0	0	0	0.96
L1A0	ALKYLATING AGENTS	5	2	3	0	0	1.75	9	4	5	0	0	2.06
L1B0	ANTIMETABOLITES	4	4	5	0	0	7.90	7	2	9	0	0	6.84
L1C0	VINCA ALKALOIDS	2	4	6	0	0	10.84	4	2	5	0	0	4.79
L1D0	ANTINEOPLAS. ANTIBIOTICS	3	3	5	0	0	4.07	4	4	5	0	0	2.17
L1X4	A-NEO PROTEIN KINASE INH	9	0	0	0	0	9.31	11	0	0	0	0	0.96
L1X9	ALL OTH. ANTINEOPLASTICS	2	1	2	0	0	2.67	7	0	3	0	0	1.26
L2B2	CYTO ANTI-ANDROGENS	1	2	3	0	0	0.91	2	0	1	0	0	0.11
L2B3	CYTOPHARM AROMATASE INHIB	3	0	0	0	0	1.87	4	0	0	0	0	0.14
L4X0	OTHER IMMUNOSUPPRESSANTS	5	1	2	0	0	3.72	8	2	3	0	0	1.75
M1A1	ANTIRHEUMATICS NON-S PLN	2	2	5	0	0	0.38	3	5	14	0	0	0.40
M5B3	BISPHOSPH OSTEOFOROSIS	2	2	2	0	0	0.59	3	0	0	0	0	0.47
N1A1	INHAL GEN ANAESTHETICS	1	1	2	0	0	3.68	1	2	2	0	0	8.26
N1A2	INJECT GEN ANAESTHETICS	3	3	5	0	0	2.27	2	5	8	0	0	6.36
N1B1	ANAESTH LOCAL MEDIC INJ	2	3	3	0	0	0.98	2	2	5	0	0	1.12
N1B3	ANAESTH LOCAL TOPICAL	1	1	1	0	0	1.73	3	2	3	0	0	1.16
N2A0	NARCOTIC ANALGESICS	2	6	9	0	0	5.19	2	6	16	0	0	7.06
N2B0	NON-NARCOTIC ANALGESICS	3	4	6	0	0	0.56	2	5	16	0	0	0.93
N3A0	ANTI-EPILEPTICS	3	7	11	0	0	2.71	7	7	13	0	0	6.67
N5A1	ATYPICAL ANTIPSYCHOTICS	3	4	4	0	0	14.81	9	1	2	0	0	13.16
N5A9	CONVENTL ANTIPSYCHOTICS	4	1	9	0	0	1.13	2	2	8	0	0	0.71
N6A4	SSRI ANTIDEPRESSANTS	1	4	5	0	0	1.11	2	3	4	0	0	1.70
N6A9	ANTIDEPRESSANTS ALL OTH	2	3	13	0	0	0.54	5	8	12	0	0	0.71

Price Comparisons: US vs Canada



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Demand

- ▶ BLP (1995) style demand model

$$U_{ijt} \equiv u_{ijt} + \varepsilon_{ijt}$$

where

$$u_{ijt} \equiv \alpha_i \ln p_{jt} + \beta_{im(j)} g_j + \gamma_i + \lambda_{m(j)} x_j + \phi_j + \mu_{m(j)t} + \xi_{jt}$$

- ▶ $u_{i0t} \equiv 0$
- ▶ g_j : Indicator for branded vs generic
- ▶ x_j : Indicator for expired patent
- ▶ ϕ_j : Molecule fixed effect
- ▶ $\mu_{m(j)t}$: Market fixed effect

Demand Identification

- ▶ Moment conditions interact inverted demand shocks $\xi_{jt}(\delta_{jt}, s_{jt}, \theta)$ with orthogonal instruments Z_{jt} :

$$\mathbb{E}[Z_{jt}\xi_{jt}(\delta_{jt}, s_{jt}, \theta)] = 0.$$

- ▶ Instruments:
 - ▶ BLP-style (number of drugs within ATC, under patent, sold abroad)
 - ▶ Hausman-style (prices + availability in other countries)

▶ Estimates

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Demand Results

Table: Demand Estimates for US and Canada

Country		US	Canada	
Log Price	α	-2.254 (0.146)	-2.241 (0.206)	
	σ^α	0.024 (0.246)	0.892 (0.224)	
Generic Dummy	σ^β	1.628 (0.169)	0.357 (1.195)	
Constant	σ^γ	0.042 (1.103)	1.562 (0.312)	
Molecule dummies		Yes	Yes	
Off patent * ATC-4 dummies		Yes	Yes	
Generic * ATC-4 dummies		Yes	Yes	
Year * ATC-4 dummies		Yes	Yes	
Quarter dummies		Yes	Yes	

Table: Average Price Elasticities for Canada and US

	US		Canada	
	Own	Cross	Own	Cross
All	-2.033	0.124	-2.017	0.158
Branded	-2.044	0.155	-1.809	0.185
Generic	-2.021	0.147	-2.262	0.163

Bargaining parameters estimates (large markets)

ATC4	ρ_{jm}		
	<i>On Patent</i>	<i>Branded Off</i>	<i>Generic</i>
A2B2	0.55	0.90	0.87
B1B2	0.70		
C10A1	0.54	1.00	0.77
L1B0	0.64	0.50	1.00
L1C0	0.50	0.50	0.98
L1D0	0.99	0.50	0.50
L1X4	1.00	0.50	0.50
L4X0	0.95	0.91	1.00
N1A1	0.45	0.57	1.00
N2A0	0.51	0.78	0.89
N5A1	0.86	0.86	0.94

Margins Estimates (large markets)

Margins		Canada				US			
ATC4	Label	All	On Patent	Branded Off Patent	Generics	All	On Patent	Branded Off Patent	Generics
A2B2	ACID PUMP INHIBITORS	37.81	38.58	28.47	83.87	54.04	53.87	63.67	0.00
B1B2	FRACTIONATED HEPARINS	38.61	40.25	0.00	0.00	96.56	96.95	100.00	0.00
C10A1	STATINS (HMG-COA RED	60.64	59.13	43.99	82.24	54.01	58.66	62.88	0.00
L1B0	ANTIMETABOLITES	8.10	6.93	5.70	19.50	42.26	46.80	45.23	0.00
L1C0	VINCA ALKALOIDS	50.78	45.88	50.09	88.92	42.84	47.19	37.88	0.00
L1D0	ANTINEOPLAS. ANTIBIOTICS	31.08	45.37	20.93	25.08	35.24	46.35	49.96	0.00
L1X4	A-NEO PROTEIN KINASE INH	32.23	31.83	55.66	3.73	52.71	52.90	0.00	0.00
L4X0	OTHER IMMUNOSUPPRESSANTS	19.66	33.59	0.65	2.73	28.20	47.87	48.10	0.00
N1A1	INHAL GEN ANAESTHETICS	62.35	41.64	94.54	17.15	64.71	73.89	45.85	0.00
N2A0	NARCOTIC ANALGESICS	40.15	49.76	47.88	37.55	10.30	11.35	46.03	0.00
N5A1	ATYPICAL ANTIPSYCHOTICS	18.67	9.06	92.70	20.99	50.42	53.94	4.12	0.00

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Margins Differences for on Patent Drugs

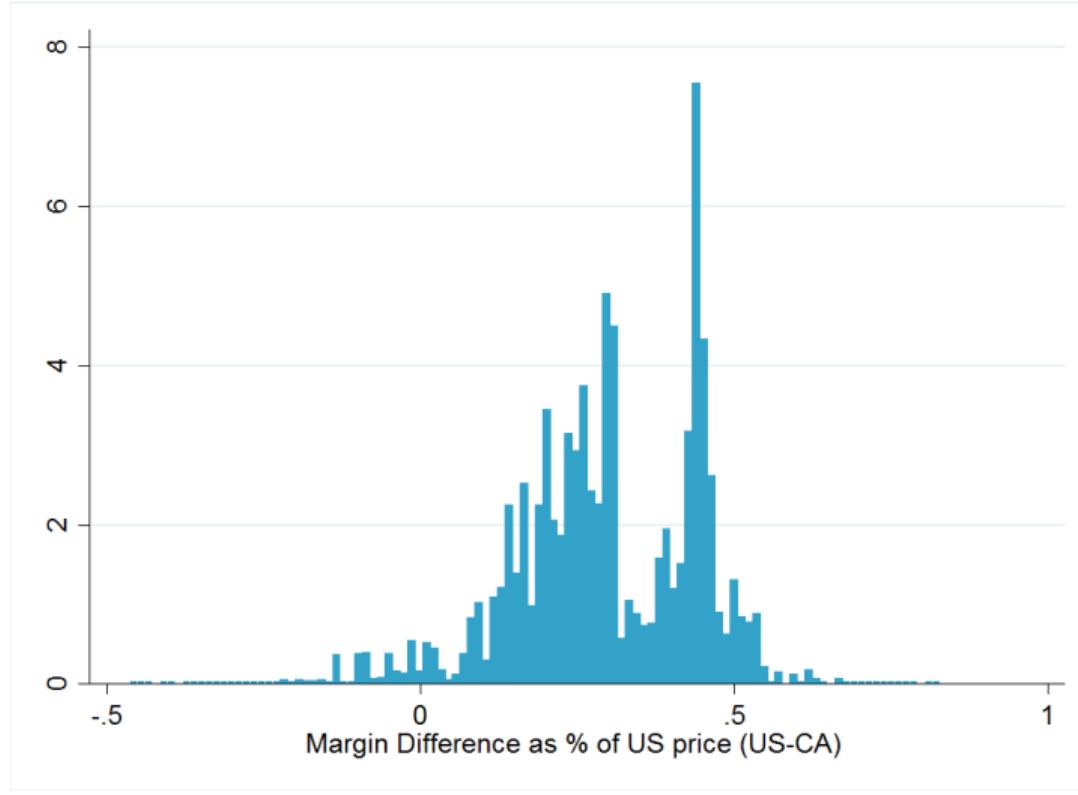


Figure: *

Note: Density of $\frac{(p_{US} - c_{US}) - (p_{CA} - c_{CA})}{p_{US}}$ weighted by Canadian quantities.

Price Setting with Bargaining

- ▶ Identify ρ_m w/ marginal cost restriction:

$$c_{jt}(\rho_{jm(j)}) = z'_{jt}\lambda + \omega_{jt}$$

with

$$\mathbb{E}[z_{jt}\omega_{jt}] = 0$$

- ▶ The orthogonality conditions allow to define

$$\omega_{jt}(\rho_{jm}) = \left[1 - z'_{jt}(z'_{jt}z_{jt})^{-1}z'_{jt}\right] c_{jt}(\rho_{jm})$$

and minimize

$$\{\rho_{jm}\}_{\{j=1,\dots,J\}} = \arg \min_{\{\rho_{jm}\}_{\{j=1,\dots,J\}}} \left[\sum_{j,t} \omega_{jt}^2(\rho_{jm}) \right]$$

where we allow ρ_m to vary across on patent, branded off patent and generic drugs and by ATC-4 class.

CF1: Counterfactual Changes in Annual Expenses by ATC4

ATC4	ρ_{jm}			Canada			US		
	On Patent	Branded Off	Generic	Before	After	Δ (%)	Before	After	Δ (%)
A10C1	0.62			4161	5777	38.8	113984	112471	-1.3
A2B2	0.55	0.90	0.87	14057	26529	88.7	270730	272016	0.5
B1B2	0.70			40084	78711	96.4	1326672	1292428	-2.6
C10A1	0.54	1.00	0.77	14549	24038	65.2	171667	172718	0.6
C2A2	1.00	1.00	0.94	1484	1484	-0.0	36579	36579	0.0
C7A0	0.72	1.00	1.00	5103	5144	0.8	143544	143553	0.0
C8A0	0.56	0.89	0.86	11908	14573	22.4	247149	245348	-0.7
C9A0	0.47	0.95	1.00	9728	10512	8.1	57229	59278	3.6
C9C0	0.60	0.94	0.50	4588	8040	75.2	63460	63616	0.2
L1A0	0.91	0.50	1.00	12525	22054	76.1	232379	231182	-0.5
L1B0	0.64	0.50	1.00	33075	60786	83.8	449600	418495	-6.9
L1C0	0.50	0.50	0.98	90792	103251	13.7	629957	649874	3.2
L1D0	0.99	0.50	0.50	20424	23867	16.9	171677	171784	0.1
L1X4	1.00	0.50	0.50	51978	65939	26.9	83862	83630	-0.3
L1X9	0.92	0.50	0.57	19173	19416	1.3	141652	141573	-0.1
L2B2	0.83	0.94	0.61	3808	4881	28.2	7079	7281	2.9
L2B3	0.70	0.79	0.58	9413	16216	72.3	10846	10606	-2.2
L4X0	0.95	0.91	1.00	37386	103864	177.8	275654	274975	-0.2
M1A1	0.44	0.91	1.00	1604	5179	223.0	26505	26865	1.4
M5B3	0.93	0.95	0.54	2455	2837	15.5	31052	30933	-0.4
N1A1	0.45	0.57	1.00	15417	19358	25.6	543474	541875	-0.3
N1A2	1.00	1.00	0.92	14275	14395	0.8	627990	628001	0.0
N1B1	0.96	1.00	0.75	4917	5142	4.6	88133	88144	0.0
N1B3	0.50	0.50	0.58	14496	14496	0.0	152988	152988	-0.0
N2A0	0.51	0.78	0.89	21736	21737	0.0	464444	464445	0.0
N2B0	0.50	0.96	0.88	3135	4058	29.4	81298	81300	0.0
N3A0	0.87	0.93	1.00	11366	21739	91.3	438695	439107	0.1
N5A1	0.86	0.86	0.94	74422	138244	85.8	1039056	1033974	-0.5
N5A9	0.64	0.97	0.94	4746	4746	0.0	46400	46398	-0.0
N6A4	0.80	0.99	0.91	6183	6110	-1.2	149528	149454	-0.0
N6A9	0.27	0.89	0.99	2245	2258	0.6	46742	46767	0.1
Total				561233	855382	52.4	8170027	8117658	-.6

CF1: Counterfactual Changes in Annual Profits by ATC4

ATC4	ρ_{jm}			Canada			US		
	On Patent	Branded Off	Generic	Before	After	Δ (%)	Before	After	Δ (%)
				3147	5123	62.8	97767	95925	-1.9
A10C1	0.62			3147	5123	62.8	97767	95925	-1.9
A2B2	0.55	0.90	0.87	11212	23988	114.0	143282	142252	-0.7
B1B2	0.70			37401	75708	102.4	1279709	1243295	-2.8
C10A1	0.54	1.00	0.77	12037	21953	82.4	89953	88070	-2.1
C2A2	1.00	1.00	0.94	1439	1439	-0.0	4260	4260	0.0
C7A0	0.72	1.00	1.00	4853	4905	1.1	27738	27734	-0.0
C8A0	0.56	0.89	0.86	9790	12714	29.9	97479	96582	-0.9
C9A0	0.47	0.95	1.00	5921	7716	30.3	14233	13947	-2.0
C9C0	0.60	0.94	0.50	3139	6715	113.9	32509	31673	-2.6
L1A0	0.91	0.50	1.00	12000	21508	79.2	91496	90799	-0.8
L1B0	0.64	0.50	1.00	24193	51007	110.8	190112	170679	-10.2
L1C0	0.50	0.50	0.98	50263	72748	44.7	269879	265900	-1.5
L1D0	0.99	0.50	0.50	14564	17221	18.2	61282	61162	-0.2
L1X4	1.00	0.50	0.50	50602	64535	27.5	43552	43253	-0.7
L1X9	0.92	0.50	0.57	17276	17571	1.7	60304	60223	-0.1
L2B2	0.83	0.94	0.61	3468	4594	32.5	3503	3462	-1.2
L2B3	0.70	0.79	0.58	8559	15482	80.9	6585	5623	-14.6
L4X0	0.95	0.91	1.00	36855	102785	178.9	77871	77508	-0.5
M1A1	0.44	0.91	1.00	1319	4670	254.1	2592	2519	-2.8
M5B3	0.93	0.95	0.54	2151	2532	17.7	19601	19477	-0.6
N1A1	0.45	0.57	1.00	12530	16762	33.8	349549	347992	-0.4
N1A2	1.00	1.00	0.92	13656	13792	1.0	157280	157277	-0.0
N1B1	0.96	1.00	0.75	4678	4904	4.8	20696	20695	-0.0
N1B3	0.50	0.50	0.58	9221	9221	0.0	20075	20075	0.0
N2A0	0.51	0.78	0.89	19276	19278	0.0	45855	45855	0.0
N2B0	0.50	0.96	0.88	2984	3842	28.8	10947	10948	0.0
N3A0	0.87	0.93	1.00	10688	21015	96.6	116621	116554	-0.1
N5A1	0.86	0.86	0.94	69988	133776	91.1	526368	520215	-1.2
N5A9	0.64	0.97	0.94	3851	3852	0.0	3148	3147	-0.0
N6A4	0.80	0.99	0.91	5084	5371	5.6	70404	70171	-0.3
N6A9	0.27	0.89	0.99	1878	1913	1.9	13149	13123	-0.2
Total				464022	768639	65.59	3947799	3870395	-1.9

Welfare Changes

ATC4	ρ_{jm}	Canada			US					
		β_{branded}	β_{off}	β_{generic}	Before	After	$\Delta (\%)$	Before	After	$\Delta (\%)$
		On Patent	Banded Off	Generic						
A10C1	0.62				885	984	11.3	11159	11317	1.4
A2B2	0.55	0.90	0.87		56646	42825	-24.4	337119	339633	0.7
B1B2	0.70				8804	6711	-23.8	120918	123494	2.1
C10A1	0.54	1.00	0.77		37661	30663	-18.6	242072	245518	1.4
C2A2	1.00	1.00	0.94		7111	7111	0.0	88937	88936	-0.0
C7A0	0.72	1.00	1.00		62951	62610	-0.5	675640	675647	0.0
C8A0	0.56	0.89	0.86		44044	40952	-7.0	230677	232046	0.6
C9A0	0.47	0.95	1.00		51194	46325	-9.5	335249	337842	0.8
C9C0	0.60	0.94	0.50		16875	14186	-15.9	72193	73773	2.2
L1A0	0.91	0.50	1.00		2395	1835	-23.4	6204	6220	0.3
L1B0	0.64	0.50	1.00		6643	4688	-29.4	12862	13171	2.4
L1C0	0.50	0.50	0.98		855	773	-9.6	4061	4119	1.4
L1D0	0.99	0.50	0.50		363	336	-7.5	2161	2162	0.0
L1X4	1.00	0.50	0.50		2126	1725	-18.9	2109	2116	0.3
L1X9	0.92	0.50	0.57		2431	2413	-0.8	3561	3562	0.0
L2B2	0.83	0.94	0.61		6150	5700	-7.3	2158	2181	1.1
L2B3	0.70	0.79	0.58		5894	4575	-22.4	2478	2806	13.3
L4X0	0.95	0.91	1.00		35194	20803	-40.9	29593	29734	0.5
M1A1	0.44	0.91	1.00		27343	16265	-40.5	389901	390104	0.1
M5B3	0.93	0.95	0.54		3244	2908	-10.4	5887	5913	0.4
N1A1	0.45	0.57	1.00		55089	49074	-10.9	2307142	2313437	0.3
N1A2	1.00	1.00	0.92		9216	9144	-0.8	260259	260260	0.0
N1B1	0.96	1.00	0.75		2969	2898	-2.4	76524	76527	0.0
N1B3	0.50	0.50	0.58		48316	48316	0.0	736051	736050	-0.0
N2A0	0.51	0.78	0.89		108236	108233	-0.0	1145022	1145022	0.0
N2B0	0.50	0.96	0.88		34712	31972	-7.9	618698	618692	-0.0
N3A0	0.87	0.93	1.00		138685	109393	-21.1	830380	830730	0.0
N5A1	0.86	0.86	0.94		128719	97672	-24.1	335035	337240	0.7
N5A9	0.64	0.97	0.94		31051	31047	-0.0	128193	128195	0.0
N6A4	0.80	0.99	0.91		124721	123535	-1.0	327380	327671	0.1
N6A9	0.27	0.89	0.99		31311	31172	-0.4	240522	240599	0.0
Total					1091834	956844	-12.3	9580145	9604719	.2

« Back

CF1: Counterfactual Changes in Quantities Demanded by ATC4

ATC4	<i>On Patent</i>	<i>Branded Off</i>	ρ_{jm}	Canada			US		
			Generic	Before	After	Δ (%)	Before	After	Δ (%)
A10C1	0.62			349	249	-28.6	3302	3317	0.5
A2B2	0.55	0.90	0.87	19362	16020	-17.3	113244	114653	1.2
B1B2	0.70			2598	2306	-11.2	35354	35556	0.6
C10A1	0.54	1.00	0.77	11349	10431	-8.1	79186	80203	1.3
C2A2	1.00	1.00	0.94	2384	2384	0.0	26882	26882	-0.0
C7A0	0.72	1.00	1.00	23492	23401	-0.4	167276	167278	0.0
C8A0	0.56	0.89	0.86	12760	12477	-2.2	73390	73697	0.4
C9A0	0.47	0.95	1.00	18050	14721	-18.4	101954	103864	1.9
C9C0	0.60	0.94	0.50	4801	4458	-7.1	27227	27982	2.8
L1A0	0.91	0.50	1.00	795	675	-15.1	1793	1795	0.1
L1B0	0.64	0.50	1.00	2320	1591	-31.4	3737	3791	1.4
L1C0	0.50	0.50	0.98	332	299	-10.2	1424	1460	2.5
L1D0	0.99	0.50	0.50	123	116	-5.2	522	522	0.0
L1X4	1.00	0.50	0.50	785	556	-29.3	722	723	0.1
L1X9	0.92	0.50	0.57	755	753	-0.3	994	994	0.0
L2B2	0.83	0.94	0.61	1791	1739	-2.9	677	690	2.0
L2B3	0.70	0.79	0.58	1928	1648	-14.6	917	1033	12.7
L4X0	0.95	0.91	1.00	12181	8232	-32.4	11599	11666	0.6
M1A1	0.44	0.91	1.00	8374	5944	-29.0	99443	99592	0.1
M5B3	0.93	0.95	0.54	1225	1079	-11.9	1823	1826	0.2
N1A1	0.45	0.57	1.00	19107	17776	-7.0	665328	665934	0.1
N1A2	1.00	1.00	0.92	2865	2828	-1.3	69548	69548	0.0
N1B1	0.96	1.00	0.75	1096	1080	-1.4	20315	20315	0.0
N1B3	0.50	0.50	0.58	16254	16254	0.0	145882	145882	-0.0
N2A0	0.51	0.78	0.89	36395	36395	-0.0	343829	343829	0.0
N2B0	0.50	0.96	0.88	10159	9870	-2.8	153266	153266	-0.0
N3A0	0.87	0.93	1.00	42619	39004	-8.5	274813	275012	0.1
N5A1	0.86	0.86	0.94	41625	32705	-21.4	115139	115470	0.3
N5A9	0.64	0.97	0.94	9269	9267	-0.0	36694	36694	0.0
N6A4	0.80	0.99	0.91	13805	12720	-7.9	89527	89578	0.1
N6A9	0.27	0.89	0.99	11944	11890	-0.4	72854	72876	0.0
Total				330892	298869	-9.6	2738661	2745930	.2

Net Changes by ATC4 Class

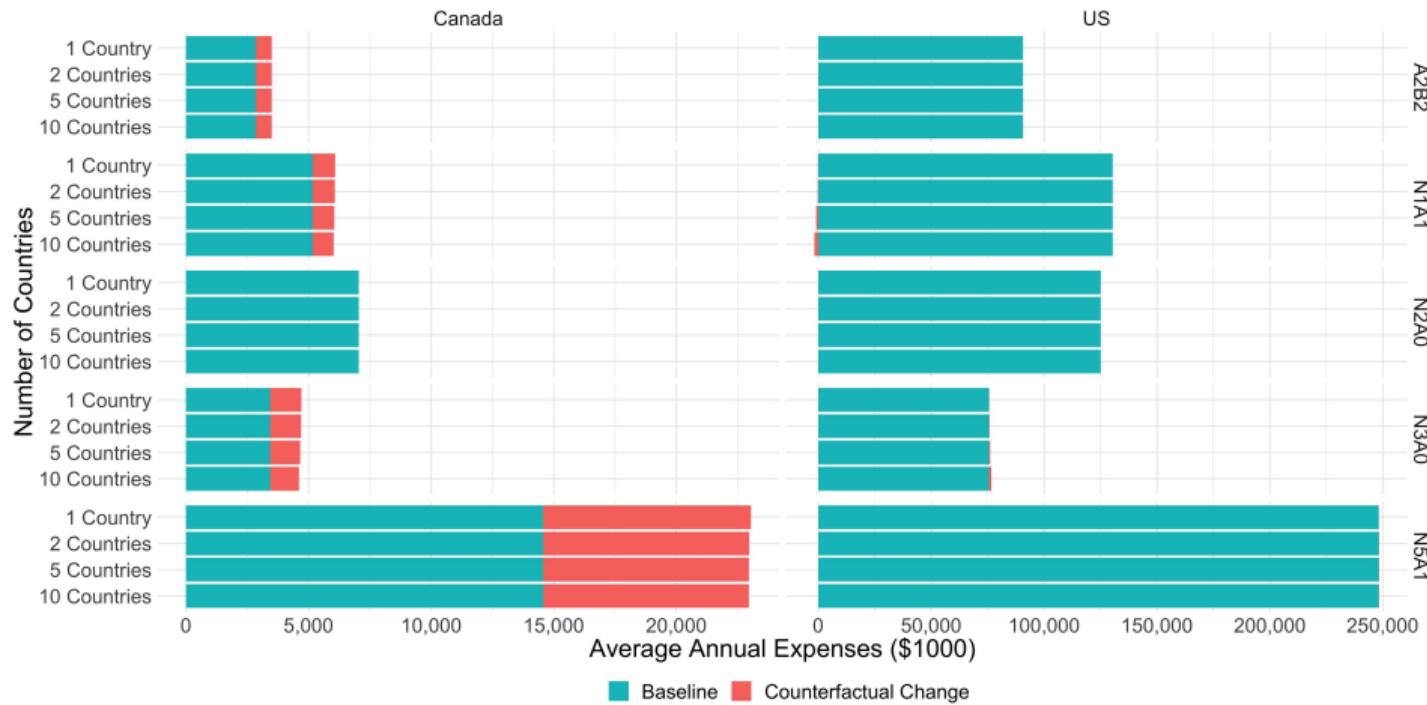
ATC4	Expenses			Profits		
	Before	After	Δ (%)	Before	After	Δ (%)
A10C1	118145	118248	0.1	100914	101048	0.1
A2B2	284788	298546	4.8	154494	166240	7.6
B1B2	1366755	1371139	0.3	1317110	1319003	0.1
C10A1	186216	196756	5.7	101991	110023	7.9
C2A2	38062	38063	0.0	5699	5699	0.0
C7A0	148647	148697	0.0	32590	32639	0.1
C8A0	259058	259921	0.3	107268	109296	1.9
C9A0	66957	69790	4.2	20155	21663	7.5
C9C0	68047	71655	5.3	35648	38387	7.7
L1A0	244904	253235	3.4	103496	112307	8.5
L1B0	482675	479282	-0.7	214305	221685	3.4
L1C0	720750	753126	4.5	320143	338649	5.8
L1D0	192101	195651	1.8	75846	78384	3.3
L1X4	135841	149569	10.1	94154	107787	14.5
L1X9	160825	160989	0.1	77580	77794	0.3
L2B2	10886	12162	11.7	6970	8056	15.6
L2B3	20259	26822	32.4	15144	21106	39.4
L4X0	313040	378839	21.0	114726	180293	57.2
M1A1	28109	32044	14.0	3911	7189	83.8
M5B3	33507	33770	0.8	21752	22009	1.2
N1A1	558890	561233	0.4	362079	364754	0.7
N1A2	642266	642396	0.0	170936	171068	0.1
N1B1	93051	93285	0.3	25374	25599	0.9
N1B3	167484	167484	-0.0	29296	29296	0.0
N2A0	486180	486182	0.0	65131	65133	0.0
N2B0	84433	85358	1.1	13931	14791	6.2
N3A0	450060	460845	2.4	127309	137569	8.1
N5A1	1113479	1172218	5.3	596356	653992	9.7
N5A9	51146	51144	-0.0	6999	6999	0.0
N6A4	155712	155563	-0.1	75488	75542	0.1
N6A9	48988	49026	0.1	15027	15036	0.1
Total	8731260	8973041	2.7	4411821	4639034	5.1

• Details

Expense Changes on Policy Variants

ATC4	MFN	Share market	ρ_{Pzero}	$\rho_{\text{Branded Off}}$	Generic	Canada			US		
						ρ_{jm}			Before	After	Δ (%)
						US	Canada	US	Before	After	Δ (%)
A2B2	0	0	0.55	0.90	0.87	14057	26529	88.7	270730	272016	0.5
A2B2	0	50	0.55	0.90	0.87	87651	156990	79.1	263927	271068	2.7
A2B2	0	100	0.55	0.90	0.87	185358	311647	68.1	268488	278951	3.9
A2B2	33	0	0.55	0.90	0.87	14057	23928	70.2	270730	271609	0.3
A2B2	50	0	0.55	0.90	0.87	14057	22349	59.0	270730	271328	0.2
B1B2	0	0	0.70			40084	78711	96.4	1326672	1292428	-2.6
B1B2	0	50	0.70			273470	462709	69.2	1324179	1152193	-13.0
B1B2	0	100	0.70			485702	767729	58.1	1176227	930594	-20.9
B1B2	33	0	0.70			40084	62512	56.0	1326889	1310894	-1.2
B1B2	50	0	0.70			38563	50214	30.2	1284627	1277971	-0.5
L1B0	0	0	0.64	0.50	1.00	33075	60786	83.8	449600	418495	-6.9
L1B0	0	50	0.64	0.50	1.00	27299	52851	93.6	481761	459276	-4.7
L1B0	0	100	0.64	0.50	1.00	42581	74518	75.0	365435	337062	-7.8
L1B0	33	0	0.64	0.50	1.00	31638	54254	71.5	426957	404204	-5.3
L1B0	50	0	0.64	0.50	1.00	29628	45343	53.0	396918	381692	-3.8
N1A1	0	0	0.45	0.57	1.00	15417	19358	25.6	543474	541875	-0.3
N1A1	0	50	0.45	0.57	1.00	220806	267795	21.3	543474	520339	-4.3
N1A1	0	100	0.45	0.57	1.00	441612	523748	18.6	543474	503817	-7.3
N1A1	33	0	0.45	0.57	1.00	15417	16602	7.7	543474	543058	-0.1
N1A1	50	0	0.45	0.57	1.00	15417	15634	1.4	543474	543459	-0.0
N1A2	0	0	1.00	1.00	0.92	14275	14395	0.8	627990	628001	0.0
N1A2	0	50	1.00	1.00	0.92	65445	66059	0.9	627990	628042	0.0
N1A2	0	100	1.00	1.00	0.92	130890	132107	0.9	627990	628091	0.0
N1A2	33	0	1.00	1.00	0.92	14275	14354	0.6	627990	627998	0.0
N1A2	50	0	1.00	1.00	0.92	14275	14308	0.2	627990	627994	0.0
N2A0	0	0	0.51	0.78	0.89	21736	21737	0.0	464444	464445	0.0
N2A0	0	50	0.51	0.78	0.89	108392	108398	0.0	464444	464446	0.0
N2A0	0	100	0.51	0.78	0.89	216785	216799	0.0	464444	464448	0.0
N2A0	33	0	0.51	0.78	0.89	21736	21737	0.0	464444	464445	0.0
N2A0	50	0	0.51	0.78	0.89	21736	21737	0.0	464444	464445	0.0
N3A0	0	0	0.87	0.93	1.00	11366	21739	91.3	438695	439107	0.1
N3A0	0	50	0.87	0.93	1.00	70808	154260	117.9	438695	441048	0.5
N3A0	0	100	0.87	0.93	1.00	141617	305398	115.7	438695	442809	0.9
N3A0	33	0	0.87	0.93	1.00	11366	19879	74.9	438695	438915	0.1
N3A0	50	0	0.87	0.93	1.00	11056	17249	56.0	432920	432997	0.0
N5A1	0	0	0.86	0.86	0.94	74422	138244	85.8	1039056	1033974	-0.5
N5A1	0	50	0.86	0.86	0.94	104691	197505	88.7	1039056	1031817	-0.7
N5A1	0	100	0.86	0.86	0.94	212643	399326	87.8	1064367	1049939	-1.4
N5A1	33	0	0.86	0.86	0.94	74422	125483	68.6	1039056	1035314	-0.4
N5A1	50	0	0.86	0.86	0.94	74422	114947	54.5	1039056	1036307	-0.3

Changes in Expenditure by Number of Reference Countries



▶ Details

Expense Changes on Policy Variants

ATC4	Countries	ρ_{jm}			Canada			US		
		On Patent	Branded Off	Generic	Before	After	Δ (%)	Before	After	Δ (%)
A2B2	1	0.55	0.90	0.87	2844	3499	23.0	90602	90608	0.0
A2B2	2	0.55	0.90	0.87	2844	3496	23.0	90602	90614	0.0
A2B2	5	0.55	0.90	0.87	2844	3496	22.9	90602	90629	0.0
A2B2	10	0.55	0.90	0.87	2844	3496	22.9	90602	90647	0.0
N1A1	1	0.45	0.57	1.00	5164	6082	17.8	130350	130161	-0.1
N1A1	2	0.45	0.57	1.00	5164	6073	17.6	130350	129969	-0.3
N1A1	5	0.45	0.57	1.00	5164	6050	17.2	130350	129413	-0.7
N1A1	10	0.45	0.57	1.00	5164	6014	16.5	130350	128517	-1.4
N2A0	1	0.51	0.78	0.89	7041	7041	0.0	125140	125140	0.0
N2A0	2	0.51	0.78	0.89	7041	7041	0.0	125140	125140	0.0
N2A0	5	0.51	0.78	0.89	7041	7041	0.0	125140	125140	0.0
N2A0	10	0.51	0.78	0.89	7041	7041	0.0	125140	125140	0.0
N3A0	1	0.87	0.93	1.00	3439	4704	36.8	75574	75706	0.2
N3A0	2	0.87	0.93	1.00	3439	4685	36.2	75574	75828	0.3
N3A0	5	0.87	0.93	1.00	3439	4652	35.3	75574	76148	0.8
N3A0	10	0.87	0.93	1.00	3439	4606	33.9	75574	76575	1.3
N5A1	1	0.86	0.86	0.94	14564	23044	58.2	248284	248295	0.0
N5A1	2	0.86	0.86	0.94	14564	22969	57.7	248284	248303	0.0
N5A1	5	0.86	0.86	0.94	14564	22966	57.7	248284	248326	0.0
N5A1	10	0.86	0.86	0.94	14564	22957	57.6	248284	248355	0.0