# On the Role of Parallel Trade on Manufacturers and Retailers Profits in the Pharmaceutical Sector

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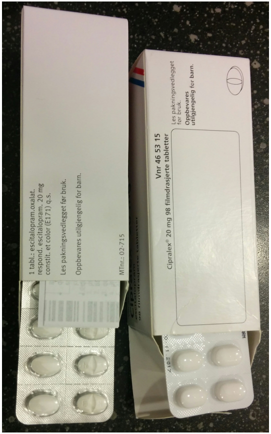
# Motivation

- Financing innovation in pharmaceuticals is mostly based on Patent protected monopoly prices for innovators
- Price discrimination across countries may however incentivize pharmacy retailers to use parallel trade of drugs as an alternative procurement channel to directly importing from producer
- Does it prevent innovating firm to get largest share of profits, versus retailers or parallel traders?
- Why is there parallel trade?
    - Large cross-country price differences because of national price regulations
    - Parallel Trade fully legal within EEA
    - Supply obligations and competition policy prevent rationing

# Parallel traded or directly imported: Example in Norway


- Pharmacist must inform consumers if drug is parallel imported

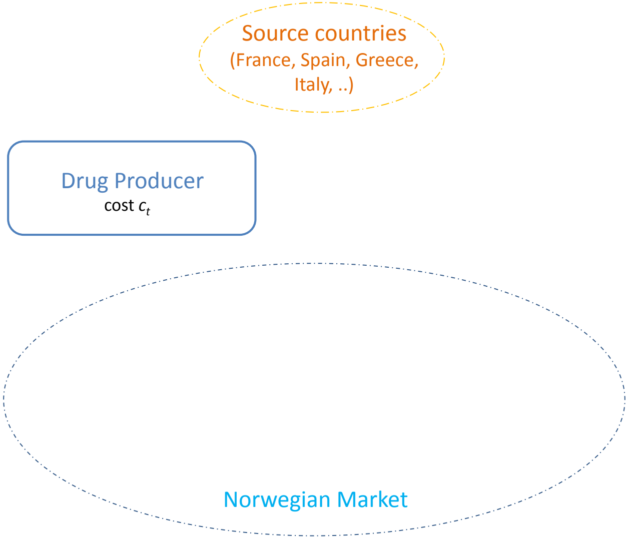
# Norwegian Pharmaceutical Market

- Three large pharmacy retail chains for prescription drugs (Apotek 1, Boots and Vitus) covering 85 % of all pharmacies
- Prescription drugs are subject to a price cap but wholesale price and margins are not regulated
- Co-payment of 36 % for on patent drugs but out of pocket amount capped (520 NOK= 65 EUR in 2013 per three months.
- Data:
  - Transactions from the *Norwegian Directorate of Health* covering all purchases of reimbursable drugs by individuals in Norway
  - Wholesale prices from registry data of *Norwegian Institute of Public Health* Details

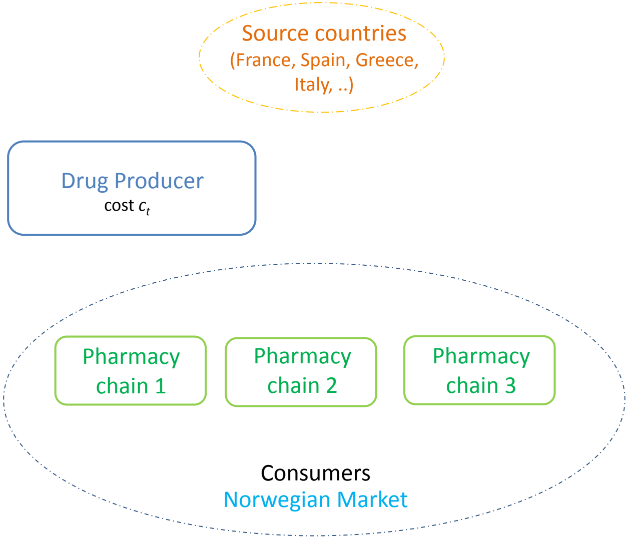
# Market Structure and Parallel Trade

Drug Producer
cost $c_t$

# Market Structure and Parallel Trade



# Market Structure and Parallel Trade



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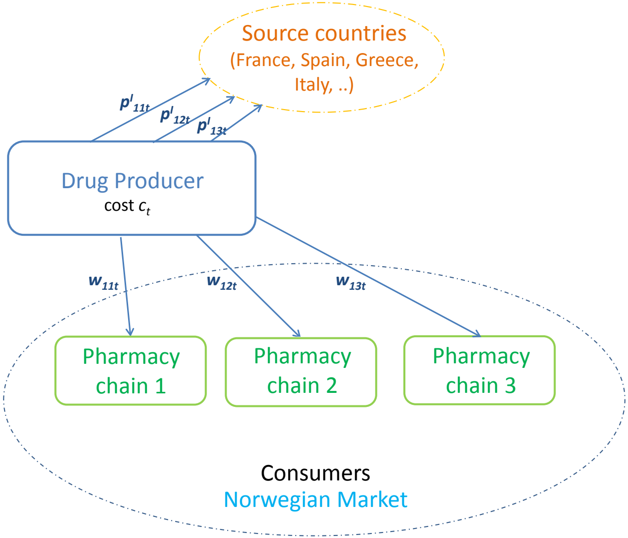

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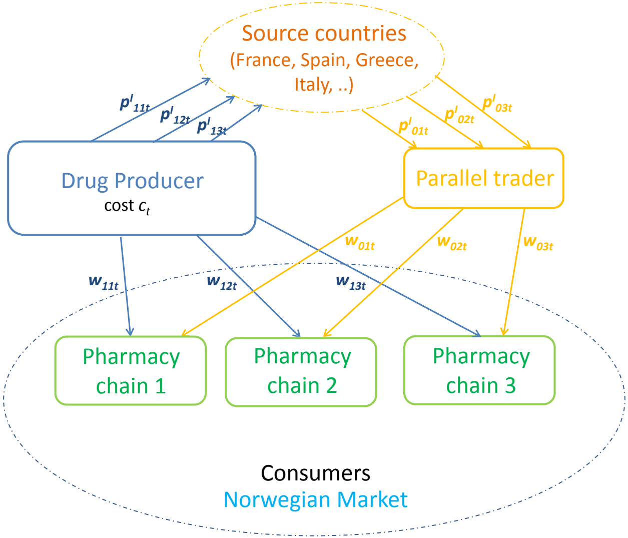

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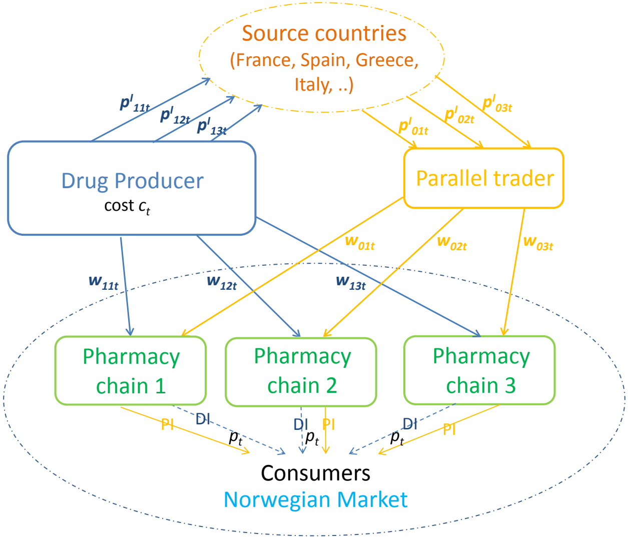


# Outline

- Theoretical Model
  - Consumer Behavior
  - Pharmacy Behavior
  - Manufacturer and Parallel Importer Bargaining with Pharmacies
- Econometrics
  - Demand identification and estimation with unobserved choice sets optimally chosen by pharmacies
  - Bargaining parameters identification and estimation
- Empirical Results on Atorvastatin market 2004-2008 (Lipitor by Pfizer under patent until 2011)
- Counterfactuals
  - Banning parallel imports
  - Banning direct imports foreclosure
  - Decreasing retail price

# Consumer Behavior

- Consumers have exogenous need for a drug but can choose PI or DI
- Consumers fully reimbursed and prices are identical $(p_{0ct} = p_{1ct} = \bar{p}_t)$
- Reduced form evidence shows that relative sales of PI versus DI depends on pharmacist's margins Details
- Pharmacies can restrict access to lower margin version, by proposing choice set $\{PI, DI\}$ or $\{PI\}$
- Denote $\theta_{ct}$ the probability that $\{PI, DI\}$ is proposed
- Utility of consumer $i$ from drug version $k = 0$ or 1 at chain $c$ and $t$ :

$$u_{ikct} = V_{ikct} + \varepsilon_{ict} + \lambda_c \epsilon_{ikct}$$

- Assuming $\varepsilon_{ict}$ and $\epsilon_{ikct}$ are i.i.d. extreme value sequentially observed

# Consumer Behavior

- Individual choice probabilities are then:

$$s_{i1ct}(\boldsymbol{\theta}_t) = \underbrace{\frac{e^{(1-\theta_{ct})V_{i0ct}+\theta_{ct}\lambda_c \ln(e^{\frac{V_{i0ct}}{\lambda_c}}+e^{\frac{V_{i1ct}}{\lambda_c}})}}{\sum_{\tilde{c}} e^{(1-\theta_{\tilde{c}t})V_{i0\tilde{c}t}+\theta_{\tilde{c}t}\lambda_{\tilde{c}} \ln(e^{\frac{V_{i0\tilde{c}t}}{\lambda_{\tilde{c}}}}+e^{\frac{V_{i1\tilde{c}t}}{\lambda_{\tilde{c}}}})}}_{\text{Probability to choose chain } c} \underbrace{\theta_{ct}}_{\substack{\text{prob. both} \\ \text{available}}} \underbrace{\frac{e^{\frac{V_{i1ct}}{\lambda_c}}}{e^{\frac{V_{i0ct}}{\lambda_c}}+e^{\frac{V_{i1ct}}{\lambda_c}}}}_{\substack{\text{probability} \\ \text{prefers DI}}}$$

where

$$E_\epsilon[\max_k(V_{ikct}+\lambda_c\epsilon_{ikct})] = \underbrace{\lambda_c \ln\left(\sum_{k\in\{0,1\}} e^{V_{ikct}/\lambda_c}\right)}_{\text{expected utility preferred version}}$$

- Denoting $F(.|\beta)$ the cdf of $\mathbf{V}_{it} \equiv (V_{i01t},..,V_{iC1t},V_{i11t},..,V_{i1Ct})$:

$$s_{kct} = \int s_{ikct}\, dF(\mathbf{V}_{it}|\beta)$$

# Pharmacy Chains Behavior

- Profit of chain $c$ from PI (good 0) and DI (good 1) is ($p_{kct} = \bar{p}_t$):

$$\pi_{ct} = \sum_{k \in \{0,1\}} (\bar{p}_t - w_{kct}) \, s_{kct}(\boldsymbol{\theta}_t)$$

- Nash equilibrium across firms in $\theta_{ct}$ give $\theta^*_{ct}(\mathbf{w}_{0t}, \mathbf{w}_{1t})$ with:

$$\frac{\partial \pi_{ct}}{\partial \theta_{ct}} \begin{cases} \leq 0 & \text{if } \theta_{ct} = 0, \\ = 0 & \text{if } 0 < \theta_{ct} < 1, \\ \geq 0 & \text{if } \theta_{ct} = 1. \end{cases}$$

- Interior solutions satisfy

$$0 = \int \sum_k (\bar{p}_t - w_{kct}) [ \underbrace{\frac{\partial s_{ikt|c}}{\partial \theta_{ct}}}_{\text{change of } k \text{ in } c} \underbrace{s_{ict}}_{\text{choose chain } c} + \underbrace{s_{ikt|c}}_{\text{choose } k \text{ in } c} \underbrace{\frac{\partial s_{ict}}{\partial \theta_{ct}}}_{\text{change prob. } c} ] dF(\mathbf{V}_{it})$$

# Manufacturer Behavior and Bargaining

- Total sales come from two channels:
  - Direct import channel (good 1) to all chains $c$
  - Parallel imports (good 0) by all chains $c$
- Letting $\boldsymbol{\theta}_t^* \equiv \boldsymbol{\theta}_t^*(\mathbf{w}_{0t}, \mathbf{w}_{1t})$ the manufacturer profit is

$$\Pi_t(\mathbf{w}_{1t}) = \sum\nolimits_c \left[(w_{1ct} - c_t)s_{1ct}(\boldsymbol{\theta}_t^*) + (p_{1ct}^I - c_t)s_{0ct}(\boldsymbol{\theta}_t^*)\right]$$

  with $c_t$ the marginal cost of production, and $p_{1ct}^I$ the manufacturer price in source country used by $c$.
- Assume pairwise negotiation maximize the Nash-product

$$(\Pi_t - \Pi_{-c,t})^{b_{1c}}(\pi_{ct} - \pi_{-1,ct})^{1-b_{1c}}$$

  with bargaining weight $b_{1c}$ and disagreement profits $\Pi_{-c,t}$ and $\pi_{-1,ct}$

# Manufacturer Behavior and Bargaining

- Nash-in-Nash equilibrium first order conditions are

$$b_{1c}\frac{\partial\Pi_t/\partial w_{1ct}}{\Pi_t-\Pi_{-c,t}}+(1-b_{1c})\frac{\partial\pi_{ct}/\partial w_{1ct}}{\pi_{ct}-\pi_{-1,ct}}=0$$

where

$$\pi_{ct}-\pi_{-1,ct}=(\bar{p}_t-w_{1ct})s_{1ct}+(\bar{p}_t-w_{0ct})\Delta_{1c}s_{0ct},$$

$$\Pi_t-\Pi_{-c,t}=\sum_{\tilde{c}}\left(w_{1\tilde{c}t}\Delta_{1c}s_{1\tilde{c}t}+p^I_{1ct}\Delta_{1c}s_{0\tilde{c}t}\right),$$

- Need to take into account $\theta^*_t(\mathbf{w}_{0t},\mathbf{w}_{1t})$ in derivatives
- Allows identify bargaining parameters $b_{1c}$ if all prices known
- Similar for parallel import behavior and parameters $b_{0c}$

# Estimation strategy

Two-step estimation:

1. Demand estimation:
    - Estimate mixed logit discrete choice model with individual data but unobserved choice set ($\theta_{ct}$)
    - Use pharmacies profit maximizing conditions and observed margins to account for pharmacies choice of assortment $\theta_{ct}$
2. Estimate upstream firms bargaining parameters:
    - First order conditions for "Nash-in-Nash" bargaining
    - Use source countries prices and interaction with companies indicators to construct moment conditions for estimating bargaining weights

# Specification

- Estimate discrete choice demand model described using individual choice probability with:

$$V_{ijct} = \alpha_{jct} + \nu_{ijct}$$

where latent groups utility specifications are:

$$\nu_{ijct} = \delta_j^{g_i} + \sigma_j^{g_i} \nu_i^j + \delta_c^{g_i} + \sigma_c^{g_i} \nu_i^c$$

$\delta_c^{g_i}$ and $\sigma_c^{g_i}$ are chain specific utility mean and dispersion terms, $\delta_j^{g_i}$ and $\sigma_j^{g_i}$ are PI or DI specific utility mean and dispersion terms, conditional on individual $i$'s group $g_i$ (unobserved latent group).

- Each group, $g$, has a population share $\tau_g$
- $\boldsymbol{\beta} = (\delta_p^g, \sigma_p^g, \delta_c^g, \sigma_c^g, \lambda_1, .., \lambda_C, \tau_1, .., \tau_G)$

# Demand Identification and Estimation

- Given $(\alpha_{0ct}, \alpha_{1ct}, \theta_{ct})$, estimate $\beta$ by ML using choice sequence $\mathcal{P}_i$

$$L_i(\beta; \alpha_{0ct}, \alpha_{1ct}, \theta_{ct}) = \sum_{g \in \mathcal{G}} \tau_g \int \prod_{p \in \mathcal{P}_i} s_{ik(p)c(p)t(p)}(\nu_i) dF(\nu_i|\beta)$$

where

$$s_{ikct} = \frac{e^{V_{i0ct} + \theta_{ct}\lambda_c\delta_{ict}}}{\sum_{\tilde{c}} e^{V_{i0\tilde{c}t} + \theta_{\tilde{c}t}\lambda_{\tilde{c}}\delta_{i\tilde{c}t}}} \left( 1_{\{k=0\}} + (-1^{\{k=0\}})\theta_{ct} \frac{e^{V_{i1ct}/\lambda_c}}{e^{V_{i0ct}/\lambda_c} + e^{V_{i1ct}/\lambda_c}} \right)$$

with $\delta_{ict} = \ln(1 + e^{(V_{i1ct} - V_{i0ct})/\lambda_c})$

- Use pharmacies optimal behavior to get $\theta_{ct}(\mathbf{w}_{0t}, \mathbf{w}_{1t})$ and define a nested fixed point algorithm

# Nested Fixed Point Algorithm

- Inner loop: solve for $\alpha_{0t}(\beta)$, $\alpha_{1t}(\beta)$ and $\theta_t(\beta)$
  - For given $(\boldsymbol{\theta}, \beta)$, can invert the system (Berry, 1994, BLP, 1995):

$$s_{kct}(\boldsymbol{\theta}_t, \alpha_{0ct}, \alpha_{1ct}, \beta) = \hat{s}_{kct}$$

    and define $\alpha_{0t}(\hat{\boldsymbol{s}}_t, \boldsymbol{\theta}_t, \beta)$, $\alpha_{1t}(\hat{\boldsymbol{s}}_t, \boldsymbol{\theta}_t, \beta)$
  - Then, $\boldsymbol{\theta}_t$ is solution of the fixed point

$$\boldsymbol{\theta}_t(\boldsymbol{\alpha}_{0t}(\hat{\boldsymbol{s}}_t, \boldsymbol{\theta}_t, \beta), \boldsymbol{\alpha}_{1t}(\hat{\boldsymbol{s}}_t, \boldsymbol{\theta}_t, \beta), \beta) = \boldsymbol{\theta}_t$$

    assuming Nash equilibrium existence between pharmacies with

$$\theta_{ct}(\alpha_{0ct}, \alpha_{1ct}, \beta) = \arg\max_{\theta_{ct} \in [0,1]} \pi_{ct}(\boldsymbol{\theta}_{-ct}, \alpha_{0ct}, \alpha_{1ct}, \beta, w_{0ct}, w_{1ct})$$

  - Existence is guaranteed by Brouwer's fixed point theorem if image of $[0,1]^C$ by $\boldsymbol{\theta}_t(\boldsymbol{\alpha}_{0t}(\hat{\boldsymbol{s}}_t, ., \beta), \boldsymbol{\alpha}_{1t}(\hat{\boldsymbol{s}}_t, ., \beta), \beta)$ is $[0,1]^C$
- Outer loop: estimate $\beta$ by ML on individual choices

# Identifying Bargaining Parameters

- Optimality conditions of bargaining game relate demand and bargaining parameters $b_{0c}$ and $b_{1c}$ to prices of drugs in source countries for parallel importer $(\mathbf{p}_{0t}^{I})$ and manufacturer $(\mathbf{p}_{1t}^{I})$
- With $\mathbf{p}_t^I(\mathbf{b}) = (\mathbf{p}_{0t}^I(\mathbf{b}), \mathbf{p}_{1t}^I(\mathbf{b}))$, specify:

$$\mathbf{p}_t^I(\mathbf{b}) = \mathbf{X}_t\eta + \epsilon_t,$$

  where $\mathbf{X}_t$ include wholesale prices in source countries, company fixed effects, interactions with source country prices
- Assume $\mathbf{Z}_t$ such that $E[\epsilon_t|\mathbf{Z}_t] = 0$ and identify parameters $(\eta, \mathbf{b})$ using GMM where $\mathbf{Z}_t$ include exchange rate shocks, price ceiling $\bar{p}_t$, indicators for pharmacy chain identity, interactions, inclusive value of upstream firm

# Demand Estimates: Preference heterogeneity

| Latent groups | $g=0$ | $g=1$ | $g=2$ | $g=3$ |
|---|---|---|---|---|
| $\tau_g$ | 0.07 | 0.26 | 0.29 | 0.38 |
| | – | (0.00) | (0.00) | (0.00) |
| $\eta_g$ | 0.00 | 1.37 | 1.46 | 1.75 |
| | – | (0.07) | (0.07) | (0.07) |
| Drug version specific taste $(\delta_k^g + \sigma_k^g \nu_i^k)$ | | | | |
| $\delta_0^g$ | 0.00 | 0.53 | $-0.35$ | $-0.39$ |
| | – | (0.04) | (0.04) | (0.04) |
| $\sigma_0^g$ | 0.22 | 0.02 | 0.98 | 0.81 |
| | (0.13) | (0.83) | (0.01) | (0.02) |
| Chain specific taste $(\delta_c^g + \sigma_c^g \nu_i^c)$ | | | | |
| $\delta_2^g$ | 0.00 | 4.09 | 1.94 | $-4.30$ |
| | – | (0.03) | (0.05) | (0.11) |
| $\delta_3^g$ | 0.00 | $-0.97$ | 6.46 | $-3.80$ |
| | – | (0.12) | (0.07) | (0.10) |
| $\sigma_2^g$ | 3.01 | 6.50 | 7.96 | 2.67 |
| | (0.13) | (0.23) | (0.10) | (0.13) |
| $\sigma_3^g$ | 2.75 | 3.27 | 3.59 | 2.52 |
| | (0.16) | (0.13) | (0.07) | (0.13) |
| $\lambda_1, \lambda_2, \lambda_3$ | 0.32, 0.54, 0.54 | | | |
| | (0.01), (0.01), (0.01) | | | |

# Demand Estimates: Foreclosure probabilities $\theta_{ct}$

| Strength | | 40mg | | | 80mg | | | |
|---|---|---|---|---|---|---|---|---|
| Chain | Year | 2004 | 2005 | 2006 | 2004 | 2005 | 2006 | 2007 |
| 1 | Mean | 0.008 | 0.522 | 0.404 | 0.037 | 0.041 | 0.016 | 0.358 |
| | p25 | 0.006 | 0.081 | 0.004 | 0.007 | 0.007 | 0.006 | 0.005 |
| | Median | 0.007 | 0.632 | 0.012 | 0.020 | 0.010 | 0.011 | 0.106 |
| | p75 | 0.010 | 0.880 | 1.000 | 0.035 | 0.020 | 0.024 | 0.858 |
| 2 | Mean | 1.000 | 1.000 | 0.437 | 1.000 | 0.839 | 1.000 | 1.000 |
| | p25 | 1.000 | 1.000 | 0.018 | 1.000 | 0.979 | 1.000 | 1.000 |
| | Median | 1.000 | 1.000 | 0.152 | 1.000 | 1.000 | 1.000 | 1.000 |
| | p75 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 | 1.000 |
| 3 | Mean | 0.756 | 0.962 | 1.000 | 1.000 | 0.302 | 0.847 | 0.502 |
| | p25 | 0.438 | 1.000 | 1.000 | 1.000 | 0.035 | 1.000 | 0.208 |
| | Median | 1.000 | 1.000 | 1.000 | 1.000 | 0.055 | 1.000 | 0.308 |
| | p75 | 1.000 | 1.000 | 1.000 | 1.000 | 0.414 | 1.000 | 1.000 |

# Bargaining Parameters Estimates

| | Manufacturer | Importer |
|---|---|---|
| Chain 1 | 0.94 | 0.51 |
| | (0.02) | (0.51) |
| Chain 2 | 0.55 | 0.24 |
| | (0.12) | (0.36) |
| Chain 3 | 0.63 | 0.34 |
| | (0.15) | (0.30) |
| $J$ | 46.11 | |
| P-value $\chi^2(3)$ | 0.00 | |
| $N$ | 462 | |

# Counterfactual Experiments

- Banning Parallel Imports Details
- Banning Direct Imports Foreclosure
- Banning Direct Imports Foreclosure and reducing retail price

# Banning Parallel Imports

| | $\Delta q_0$ | $\Delta q_1$ | $\Delta w_1$ | $\Delta \pi$ |
|---|---|---|---|---|
| Chain 1 | $-12.56$ | 14.68 | $[0.73, 0.77]$ | $[-12.31, -12.98]$ |
| | $-100\%$ | 435% | $[36\%, 37\%]$ | $[-89\%, -94\%]$ |
| Chain 2 | $-5.11$ | 4.05 | $[0.05, 0.41]$ | $[-1.66, -4.24]$ |
| | $-100\%$ | 100% | $[2\%, 20\%]$ | $[-21\%, -54\%]$ |
| Chain 3 | $-6.32$ | 5.25 | $[0.13, 0.47]$ | $[-2.59, -5.27]$ |
| | $-100\%$ | 217% | $[6\%, 23\%]$ | $[-33\%, -66\%]$ |
| | | | | $\Delta \Pi$ |
| Manufacturer | | 23.99 | $[0.30, 0.55]$ | $[15.09, 21.03]$ |
| | | 243% | $[15\%, 27\%]$ | $[22\%, 30\%]$ |
| Parallel | $-23.99$ | | | $-1.27$ |
| | $-100\%$ | | | $-100\%$ |

# Prevent Direct Imports foreclosure by Pharmacies ($\theta_c = 1$)

| | $\Delta q_0$ | $\Delta q_1$ | $\Delta w_0$ | $\Delta w_1$ | $\Delta \pi$ |
|---|---|---|---|---|---|
| Chain 1 | −8.75 | 9.38 | 0.09 | 0.07 | −1.26 |
| | −70% | 343% | 5% | 4% | −10% |
| Chain 2 | −0.23 | −0.13 | 0.01 | 0.01 | −0.38 |
| | −5% | −4% | 0% | 1% | −5% |
| Chain 3 | −1.30 | 1.04 | 0.02 | 0.02 | −0.53 |
| | −21% | 49% | 1% | 1% | −7% |
| | | | | | $\Delta \Pi$ |
| Manufacturer | | 10.29 | | 0.03 | 0.97 |
| | | 120% | | 2% | 1% |
| Parallel | −10.29 | | 0.04 | | 0.36 |
| | −43% | | 2% | | 32% |

# Price decrease ($\Delta p = -20\%$) and no foreclosure ($\theta_c = 1$)

| | $\Delta q_0$ | $\Delta q_1$ | $\Delta w_0$ | $\Delta w_1$ | $\Delta \pi$ |
|---|---|---|---|---|---|
| Chain 1 | $-8.76$ | 9.42 | $-0.04$ | $-0.03$ | $-8.88$ |
| | $-70\%$ | 344% | $-2\%$ | $-1\%$ | $-68\%$ |
| Chain 2 | $-0.27$ | $-0.08$ | $-0.44$ | $-0.17$ | $-3.35$ |
| | $-5\%$ | $-2\%$ | $-22\%$ | $-8\%$ | $-45\%$ |
| Chain 3 | $-1.45$ | 1.15 | $-0.17$ | $-0.08$ | $-4.45$ |
| | $-23\%$ | 54% | $-9\%$ | $-4\%$ | $-62\%$ |
| | | | | | $\Delta \Pi$ |
| Manufacturer | | 10.49 | | $-0.09$ | $-1.92$ |
| | | 122% | | $-4\%$ | $-3\%$ |
| Parallel | $-10.49$ | | $-0.22$ | | $-0.47$ |
| | $-44\%$ | | $-11\%$ | | $-42\%$ |

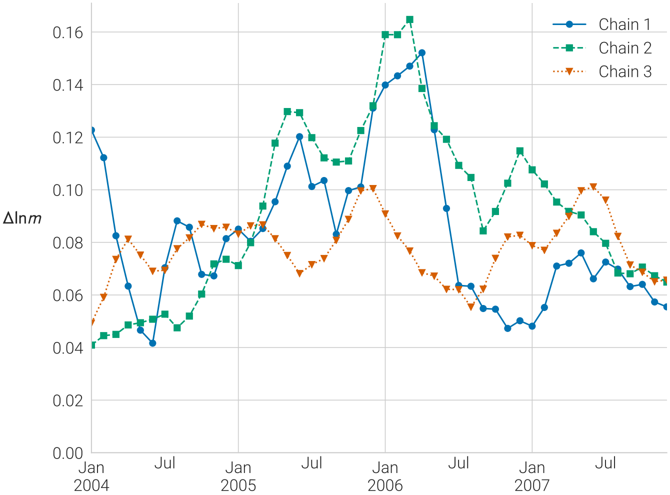
# Price decrease ($\Delta p$) and no foreclosure ($\theta_c = 1$)

| $\Delta p$ | | $-10\%$ | $-15\%$ | $-20\%$ | $-25\%$ | $-30\%$ |
|---|---|---|---|---|---|---|
| $\Delta\pi$ | Chain 1 | -4.95 | -6.93 | -8.88 | -10.81 | -12.66 |
| | | -38% | -53% | -68% | -83% | -97% |
| | Chain 2 | -2.42 | -3.23 | -3.35 | -4.15 | -4.83 |
| | | -32% | -43% | -45% | -56% | -65% |
| | Chain 3 | -2.52 | -3.49 | -4.45 | -5.30 | -6.15 |
| | | -35% | -48% | -62% | -74% | -85% |
| $\Delta\Pi$ | Manufacturer | -0.11 | -0.67 | -1.92 | -2.72 | -3.65 |
| | | -0% | -1% | -3% | -4% | -6% |
| | Parallel | -0.07 | -0.27 | -0.47 | -0.68 | -0.88 |
| | | -6% | -24% | -42% | -60% | -78% |
| Nb of chain-market exits | | 2 | 9 | 19 | 26 | 37 |

# Conclusion and Policy Implications

- Method:
  - Demand estimation method with unobserved choice sets endogenously determined by retailer foreclosure optimal strategy
  - Upstream firms optimal behavior to get bargaining parameters
- Empirical Results and policy implications:
  - Pharmaceutical retailers play prominent role in fostering parallel trade
  - Foreclosure of DI by pharmacy and wholesale price negotiations benefit pharmacies and reduce the manufacturer profits
  - Reducing retail price cap redistributes profits in favor of manufacturer and lowers total expenses

Difference in margins between direct and parallel imports Back



# Chain Sales of Direct versus Parallel Imports of Lipitor

| Dep. Var. $\ln \frac{s_{1ct}}{s_{0ct}+s_{1ct}}$ | (OLS) | (OLS) | (2SLS) | (OLS) | (OLS) | (2SLS) |
|---|---|---|---|---|---|---|
| DI margin $m_{1ct}$ | 2.125** | 1.911** | 2.428** | | | |
| | (0.523) | (0.558) | (0.597) | | | |
| PI margin $m_{0ct}$ | -0.119** | -0.247** | -0.572** | | | |
| | (0.033) | (0.059) | (0.118) | | | |
| Diff. $(m_{1ct} - m_{0ct})$ | | | | 0.175** | 0.329** | 0.717** |
| | | | | (0.043) | (0.057) | (0.097) |
| Chain 1 | -0.412** | -0.415** | -0.390** | -0.485** | -0.474** | -0.453** |
| | (0.085) | (0.089) | (0.089) | (0.085) | (0.089) | (0.093) |
| Chain 2 | 0.135 | 0.087 | -0.026 | 0.112 | 0.055 | -0.081 |
| | (0.072) | (0.073) | (0.091) | (0.076) | (0.078) | (0.089) |
| Year*Month FE | No | Yes | Yes | No | Yes | Yes |
| N | 574 | 574 | 574 | 574 | 574 | 574 |

Instruments: wholesale price in France, Germany, Italy, Spain, United Kingdom, Greece
and exchange rates between NOK and Euro, Swiss Franc and US$.

Back

# Banning Parallel Imports

- Without PI, market share of chain $c$ is

$$s^*_{1ct_{noPI}} = \int \frac{e^{V_{i1ct}}}{\sum_{\tilde{c}} e^{V_{i1\tilde{c}t}}} dF(\nu_i|\beta)$$

- Assume counterfactual demands in other chains $\tilde{c} \neq c$ do not change when $c$ disagrees with manufacturer, Nash bargaining:

$$\max_{w_{1ct}} \left\{ ((w_{1ct} - c_t) s^*_{1ct_{noPI}})^{b_{1c}} ((\bar{p}_t - w_{1ct}) s^*_{1ct_{noPI}})^{1-b_{1c}} \right\}$$

$\rightarrow$

$$w^*_{1ct_{noPI}} = b_{1c}\bar{p}_t + (1 - b_{1c})c_t$$

- However, $c_t$ not identified using only wholesale price equations

# Banning Parallel Imports

- Pharmacy chains use parallel imports if profitable implies, for all $c$:

$$\pi^*_{ct_{noPI}} \equiv (\bar{p}_t - w^*_{1ct_{noPI}})s^*_{1ct_{noPI}} \leq \pi^*_{ct}$$

- Then can bound counterfactual wholesale prices, manufacturer and pharmacy chains profit using:

$$\bar{p}_t - \min_{c\in\{1,..,C\}}\left\{\frac{1}{1-b_{1c}}\frac{\pi^*_{ct}}{s^*_{1ct_{noPI}}}\right\} \leq c_t \leq \min_{c\in\{1,..,C\}}\left\{p^I_{1ct}\right\}$$

where $p^I_{1ct}$ is source country price. Back