The Effect of Input Price Discrimination on Retail Prices: Theory and Evidence from France

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Motivation

- Input price discrimination refers to the behavior of a supplier who applies for the same product different conditions of sales to its buyers when these buyers themselves compete to resell to consumers.
- Input price discrimination arises because:
  1. A supplier is willing to exploit downstream firms' heterogeneity in demand or in cost which results in different price elasticities of demand for the input.
     - Input price discrimination, *as final price discrimination*, is likely to have an ambiguous effect on welfare.
  2. Buyers' demand are interrelated $\Rightarrow$ Buyers with high bargaining power may require from upstream suppliers lower input prices to gain an advantage in the competition with other buyers.
     - Input price discrimination may limit downstream competition and hurt welfare.

Legislation on input price discrimination

- In the U.S., the Robinson Patman Act enacted in 1936 prevents "*a seller from discriminating in prices among its purchasers for good of like grade and quality*" *where the effect "may be to lessen competition or tend to create a monopoly*".
- The Article 102 of the Treaty on the Functioning of the European Union: An abuse of dominant position may consist in "*applying dissimilar conditions to equivalent transactions with other [...] trading parties, thereby placing them at a competitive disadvantage*".
- **In France**
  - The Ordonnance relative à la liberté des prix in 1986 forbids any supplier to offer different conditions to similar buyers.
  - A reform, Loi de Modernisation Economique (LME), took place in 2008 and suppressed this non-discrimination principle in an attempt to reinforce intra-brand competition and lower prices.
- In Norway: current discussions to ban intermediate price discrimination → kolonial.no.

Research Question

▶ We take advantage of this change in the french regulation, the LME reform, to analyse the impact of input price discrimination on retail prices paid by consumers;

- Report for the French Ministry of economics in 2016.

Our Approach

1. Original model of vertical relations featuring imperfect competition in the upstream and downstream markets, multi-product retailers, and secret contracts. We derive theoretical predictions on the effect of authorizing input price discrimination on retail prices.
2. We test these predictions by running a DID analysis on household scanner data and assess empirically the effect of the LME on food retail prices in France. Our model helps us building the **comparison group**.

Theoretical Literature

Effect of intermediate price discrimination on final prices

- Public contracts
  - Discrimination leads the less efficient buyer to receive a discount.
    - Discrimination → Prices + Katz (1987), DeGraba (1990).
    - Discrimination → Prices - Inderst & Shaffer (2009), Arya and Mittendorf (2010), Miklos-Thal and Shaffer (2018).
  - Other arguments: +/- Herweg & Muller (2014) and Johansen and Verge (2017).
- Secret contracts
  - Opportunism problem: with non-linear contracts, wholesale unit price= marginal cost (Hart& Tirole, 1990);
  - O'Brien & Shaffer (1994) , O'Brien (2014): a ban on intermediate price discrimination restores the observability of contracts and the wholesale unit price is above the marginal cost. Discrimination→ Prices -
  - Caprice (2006), competition with a fringe and Cournot competition. Discrimination → Prices + .

Empirical Literature

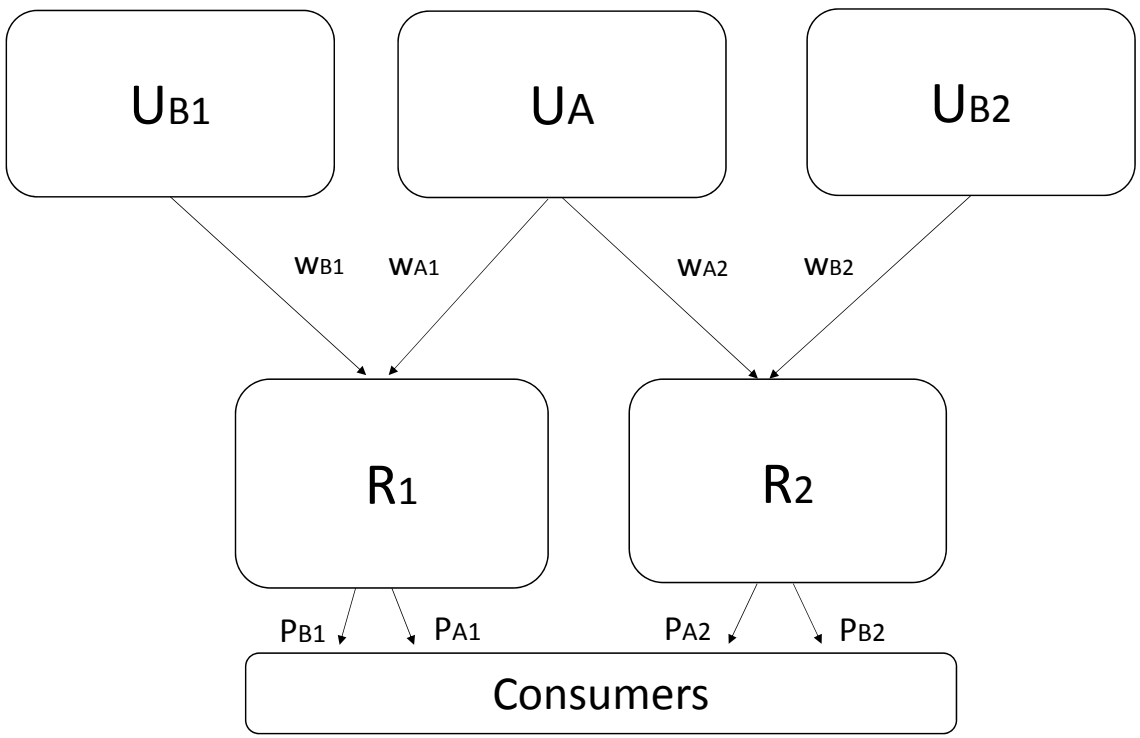
Structural approach

- Berto-Villas-Boas (2009) simulates the effect of a ban through a structural model (in the German coffee market), and assuming public wholesale unit contracts.
  Discrimination $\rightarrow$ prices + or - and Welfare -
- Hastings (2009)'s study on the gasoline market in the U.S. finds that "average prices would rise five cents per gallon under uniform wholesale pricing". Discrimination$\rightarrow$ Prices -
- Greenan (2013) simulates the effect of a ban through a structural model of secret bargaining between hospitals and medical devices suppliers. Discrimination$\rightarrow$ Prices -

A sketch of the Model

Assumptions

- Two imperfectly competing retailers R_i with $i = \{1, 2\}$
- U_A produces A (national brand) at cost c and sells it to both retailers.
- A differentiated product B (private label) is produced by a dedicated supplier (U_{Bi} for R_i) at the same marginal cost c.



A sketch of the Model

Assumptions on demand

- Demands for product $k \in \{A, B\}$ at retailer R_i are symmetric ($j \neq i$):

$$D_{ki}(p_{ki}, p_{li}, p_{kj}, p_{lj})$$

- Products are imperfect substitutes.

$$\frac{\partial D_{ki}}{\partial p_{ki}} < 0, \frac{\partial D_{ki}}{\partial p_{li}} > 0, \frac{\partial D_{ki}}{\partial p_{kj}} > 0.$$

- Cross effects are smaller than direct effects:

$$|\frac{\partial D_{ki}}{\partial p_{ki}}| > |\frac{\partial D_{ki}}{\partial p_{kj}}|, |\frac{\partial D_{ki}}{\partial p_{li}}| > |\frac{\partial D_{ki}}{\partial p_{lj}}|.$$

- An increase in the price of k at store i impacts more total demand for product k than total demand for product l:

$$|\frac{\partial D_{ki}}{\partial p_{ki}} + \frac{\partial D_{kj}}{\partial p_{ki}}| > |\frac{\partial D_{li}}{\partial p_{ki}} + \frac{\partial D_{lj}}{\partial p_{ki}}|.$$

A sketch of the model

Assumption on profits

- Let $P = (p_{ki}, p_{li}, p_{kj}, p_{lj})$ denote the vector of final prices.
- Retailer i's profit is :

$$\pi^i \equiv \sum_{k=A,B} (p_{ki} - w_{ki}) D_{ki}(P) - F_{ki} \tag{1}$$

  and π^i_n is the derivative of function π wrt. the n^{th} argument.
- (i) For $i = 1, 2$, $\pi^i_{11} < 0$, $\pi^i_{22} < 0$, $|\pi^i_{11}| \geq \pi^i_{21} > 0$ and $|\pi^i_{22}| \geq \pi^i_{12} > 0$, which implies concavity of the profit function.
- (ii) For $i = 1, 2$ $\pi^i_{14} \leq 0$, $\pi^i_{13} \geq 0$ with $|\pi^i_{14}| < \pi^i_{13}$, $\pi^i_{24} \geq 0$, $\pi^i_{23} \leq 0$ with $|\pi^i_{23}| < \pi^i_{24}$: the marginal profit of a retailer on product k is positively (resp. negatively) affected by an increase in the price of product k (resp. l) at its rival and cross effects are smaller than direct effects.

A sketch of the model

Stage Game

1. _ National brand producer: U_A offers each R_i secret two-part tariff TIOLIT contracts
   - (w_{Ai}, T_{Ai}) when discrimination is allowed.
   - (w_A, T_{Ai}) when discrimination is banned.

   _ Private label producers: each U_{Bi} (simultaneously) offers a TIOLIT contract (w_{Bi}, T_{Bi}) to its R_i.

2. Each R_i observes only its own contract and chooses its final prices (p_{Ai}, p_{Bi}).

Contract equilibrium à la Cremer and Riordan (1987): passive beliefs and schzyophrenia.

A sketch of the model

Discrimination is allowed/banned

We are going to focus on symmetric wholesale price equilibrium. Ex post, a retailer (either under the ban or not) receives the same w_A as its rival.

- Under discrimination: Due to opportunism, each pair maximizes its joint bilateral profit and this leads to $w_{A1}^d = w_{A2}^d = c$. Similarly, we obtain $w_{B1}^d = w_{B2}^d = c$.

- Under a ban: U_A now has an incentive to raise its wholesale price to relax competition among retailers and set $w_A^{nd} > c$. U_{Bi} sets $w_{B1}^{nd} = w_{B2}^{nd} = c$.

Proposition 1 (input prices)

Lifting the ban on discrimination only decreases the wholesale unit price of A, whereas the wholesale unit prices of B remain unchanged.

Main results

- With a linear demand function: $\frac{dp_{Bi}}{dw_A} = 0$ and $\frac{dp_{Ai}}{dw_A} > 0$.
- With a general demand, we find an ambigous effect on the price of product B.

$$\begin{aligned}\pi_1^i &= D_{Ai}(.) + (p_{Ai} - w_{Ai})\frac{\partial D_{Ai}(.)}{\partial p_{Ai}} + (p_{Bi} - w_{Bi})\frac{\partial D_{Bi}(.)}{\partial p_{Ai}} = 0 \\ \pi_2^i &= D_{Bi}(.) + (p_{Ai} - w_{Ai})\frac{\partial D_{Ai}(.)}{\partial p_{Bi}} + (p_{Bi} - w_{Bi})\frac{\partial D_{Bi}(.)}{\partial p_{Bi}} = 0\end{aligned}$$

A Technical assumptions ensures both that $(\frac{dp_{Ai}^*}{dw_A} > 0)$ and that $|\frac{dp_{Ai}^*}{dw_A}| > |\frac{dp_{Bi}^*}{dw_A}|$.

Proposition 2 (Retail prices)

Under some reasonable assumptions, we predict that removing the ban on input price discrimination:

- decreases p_A;
- may either increase or decrease p_B but to a lower extent than p_A.

The LME should lead to a decrease in NB prices relative to PL prices.

Empirical approach

We use a difference-in-differences (DID) approach to assess the price effect of authorizing wholesale price discrimination – LME in 2008.

- Data
  - Kantar World Panel 2006-2010 survey;
  - Daily purchases of food products by 10 000 households in France.
  - Information on the quantity and the expenditure for each product purchased, product characteristics (brand, retail chain, store type).
  - Product information "Beurre President Gastronomique, unsalted butter, Normandy origin, aluminium packaging, 125g, 82% fat, without Omega 3 and cholesterol"
- How to define the comparison group?
  - Affected group: all national brand products (if sold in at least 2 retailers).
  - The comparison group: private labels (PL) constitute natural candidates. To ensure that comparison products are exposed to similar demand and cost shocks and react identically ("common trend hypothesis"):
    - We restrict our attention to PL only offered by conventional retailers (e.g., Carrefour, Leclerc).
    - We remove all first-price products (FP).

Empirical Strategy and Sample Selection

Sample selection

- **Time period**: we remove the data corresponding to the six months following the introduction of the LME, that is from August to December 2008.
- **Distribution channel**: we only retain food purchases made in food retail chains and their associated online food delivery platforms (e.g. Chronodrive, Ooshop, or Telemarket).
- **Frequency of purchase observations**: each product must be purchased at least one time per month over 36 months to be retained (exclusion of seasonal products or low-sales products).
- **Product category**: each product category retained must be present in both the affected and comparison groups (exclusion of raw agricultural products for which there is no offer of private label products such as fruits and vegetables, fresh meat, and fresh fish).

After selection, the final sample represents more than 70 millions euros of food expenditures (38% of total).

Summary Statistics

	Affected group	Comparison group	Total
Panel A: Product			
Number of products	12,468	13,786	26,254
Number of product categories	168	168	168
Average number of products per category	74.21	82.06	156.27
Number of chain stores	53	41	55
Panel B: Brand type			
Percentage of national brand products	100	–	0.47
Percentage of private label products	–	100	0.53
Panel C: Price			
Mean of monthly average product price	10.27	7.11	9.33
S.D. of monthly average product price	49.67	19.24	43.01
Min. of monthly average product price	0.02	0.02	0.02
Max. of monthly average product price	4501.02	2364.53	4501.02
Panel D: Expenditures			
Number of purchase observations	14,904,852	10,785,417	25,690,269
Total expenditures	46,311,088	23,909,402	70,220,490

Empirical approach

- Statistical test: we test the absence of a specific (linear) trend for the affected group prior to the LME $\rightarrow$ Affected and comparison groups follow parallel trends in the pre-LME period.
- We conduct a simple before and after analysis by running the following weighted OLS regression :

$$\ln(P_{kit}) = \alpha + \beta \times PostLME_t + \mu_{ki} + \varepsilon_{kit}$$

where

- P_{kit} denotes the monthly average price for product k in chain i at month t;
- $PostLME_t$ is a dummy variable equal to one for months following the introduction of the LME;
- μ_{ki} are product-chain fixed effects.
- The observations are weighted by the expenditure shares of food products, calculated at the national level during the pre-LME period.

Empirical Results: Prices changes around the LME

Dependent variable: (log) of monthly average price p_{kit}		
Variable	(1)	(2)
$PostLME_t$	-0.0130***	
	(0.0029)	
$PostLME_t \times$ PL		0.0050***
		(0.0019)
$PostLME_t \times$ NB		-0.0144***
		(0.0032)
Chain-product FE	Yes	Yes
R^2	0.986	0.986
Observations	3050346	3050346

Remark: In 2008 a broad range of agricultural commodities (wheat, maize, rice, and milk) have experienced a sharp price increase (See European Commission, 2008).

We estimate the following weighted OLS regression:

$$\ln(P_{kit}) = \alpha + \beta T_{ki} \times PostLME_t + \delta T_{ki} + \gamma PostLME_t + \mu_{ki} + \varepsilon_{kit}$$

where

- T_{ki} is a dummy variable that characterizes the product-chain pair *ki* as belonging to the affected group;
- Colum (2): Chain-month fixed effects to control for time-variant factors that could affect prices in both groups evenly accross stores of a given chain (promotional activity).
- Colum (3): Category-month fixed effects to control for time-variant factors price changes for all products within a given category (e.g., a rise in inputs prices or a category-specific demand shock).

$\Rightarrow$ The ATE of the LME is captured through the coefficient β.

Empirical Results: Average price effect

Dependent variable: (log) price (P_{kit})			
		With monthly trend	
	Baseline	Chain	Category
Average effect over the post-LME periods			
Treatment × PostLME	-0.0195***	-0.0217***	-0.0336***
	(0.0037)	(0.0036)	(0.0031)
Chain-product FE	Yes	Yes	Yes
Chain-month FE	No	Yes	No
Category-month FE	No	No	Yes
R^2	0.986	0.986	0.987
Observations	3050346	3050173	3050338

Notes: The observations are weighted by the expenditure shares of food products, calculated at the national level during the pre-LME period.

- As predicted by the model, authorizing input price discrimination has reduced the prices of NB *relative* to PL.
- Other scenarii might explain the same result:
  - An increase in the average price of NB and a larger increase of PL prices (dismissed by the Before and After results).
  - A decrease in NB prices and a larger increase in PL prices.

Empirical Results: Prices changes around the LME

- We determine the average price for a given product-chain pair *ki* over the pre-and post-LME period;
- We determine the change in this average price in absolute value and run the following regression

$$|\widehat{P}_{ki}^{post} - \widehat{P}_{ki}^{pre}| = T_{ki} + \eta_c + \varepsilon_{ki}$$

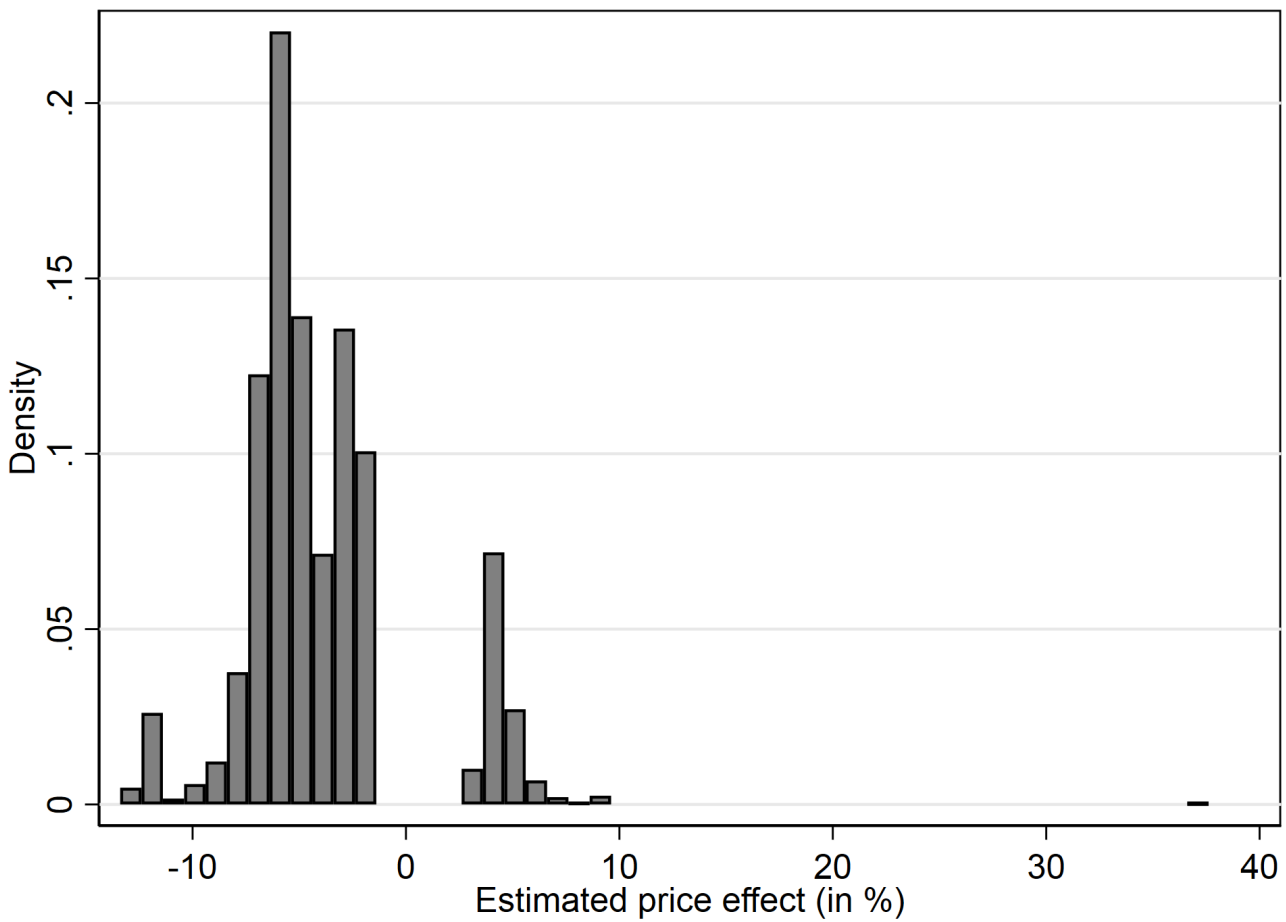
η_c corresponds to product category fixed effects.

Dependent variable: $\lvert\widehat{P}_{ki}^{post} - \widehat{P}_{ki}^{pre}\rvert$		
	Unweighted	Weighted
Variable	(1)	(2)
T_{ik}	0.1067***	0.1555***
	(0.0176)	0.0132
Category FE	Yes	Yes
R^2	0.0681	0.0732
Observations	62028	62028

Empirical Results: Effects by retail chain

Dependent variable: (log) price (P_{kit})			
	(1)	(2)	(3)
Treatment × PostLME	-0.0344***	-0.0352***	-0.0198**
	(0.0031)	(0.0031)	(0.0090)
Treatment × PostLME × R_1	0.0061***		-0.0083
	(0.0015)		(0.0085)
Treatment × PostLME × R_2		0.0076***	-0.0076
		(0.0023)	(0.0087)
Treatment × PostLME × R_3			-0.0110
			(0.0087)
Treatment × PostLME × R_4			-0.0122
			(0.0080)
Treatment × PostLME × R_5			-0.0203**
			(0.0091)
Treatment × PostLME × R_6			-0.0219**
			(0.0087)
Treatment × PostLME × R_7			-0.0214**
			(0.0088)
Chain-product FE	Yes	Yes	Yes
Category-month FE	Yes	Yes	Yes
R^2	0.987	0.987	0.987
Observations	3050338	3050338	3050338

Empirical Results: Effect by product category



- We estimate the price effect for each product category separately.
- 82% of product categories have experienced a price decrease of the relative price of NB products.

Empirical Results: Effect in time

Dependent variable: (log) price (P_{kit})			
		With monthly trend	
	Baseline	Chain	Category
Treatment × Year 1	-0.0120***	-0.0333***	-0.0438***
	(0.0036)	(0.0034)	(0.0032)
Treatment × Year 2	-0.0277***	-0.0095**	-0.0227***
	(0.0039)	(0.0040)	(0.0032)
Chain-product FE	Yes	Yes	Yes
Chain-month FE	No	Yes	No
Category-month FE	No	No	Yes
R^2	0.986	0.986	0.987
Observations	3050346	3050173	3050338

Robustness tests & Extensions

Our results are robust to alternative definitions of:

- the comparison group (Estimates)
  - Private labels offered by discounters only.
  - All private labels (conventional+discounters+ first price products).
- the transitory period (Estimates)
  - Longer transitory period $\rightarrow$ next negotiation round 12/2009.
  - Remove the year 2006.

Conclusions

- We build an original model of vertical relationships with multi-product competition (private labels, national brands) in a secret contract environment.
  - We highlight a differentiated effect of authorizing input price discrimination on both input prices and retail prices of these products' categories.
- We provide the first ex-post analysis of an *input price discrimination rule* on retail prices.
  - We empirically investigate the effect of input price discrimination on a broad range of products (large-scale study).
  - We highlight a significant and negative effect of its lifting on prices by 3.36% on average.

Thank you !

Technical assumptions

To ensure that $\frac{dp_{Ki}}{dw_K} > 0$ and that $|\frac{dp_{Ki}}{\partial w_K}| > |\frac{dp_{Li}}{dw_K}|$, we assume that :

$$\begin{aligned} |\pi^i_{24} + \pi^i_{22}| &> \pi^i_{14} + \pi^i_{12} \\ |\pi^i_{13} + \pi^i_{11}| &> \pi^i_{23} + \pi^i_{21} \end{aligned}$$

A price increase on product k at both stores affects more the marginal profit of a retailer on product k than the marginal profit of the retailer on product l.

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Alternative definitions of the comparison group

Table: Alternative Definitions of the Comparison Group

	$\widehat{\beta}$			
Comparison group	Coef.	S. E.	Obs.	R^2
Baseline (PL)	-0.0336***	0.0031	3,050,338	0.9870
PL-D	-0.0437***	0.0041	2,259,826	0.9940
PL & FP-PL	-0.0393***	0.0034	3,204,530	0.9870
PL, FP-PL & PL-D	-0.0401***	0.0031	3,483,154	0.9873

Alternative definitions of the transitory period

Table: Alternative Time Frames

	$\widehat{\beta}$			
Transitory period	Coef.	S. E.	Obs.	R^2
Baseline (2008/08–2008/12)	-0.0336***	0.0031	3,050,338	0.9870
2008/01–2008/12	-0.0368***	0.0033	2,650,216	0.9866
2008/08–2009/06	-0.0288***	0.0032	2,656,826	0.9869
2006/01–2006/12 & 2008/08–2008/12	-0.0243***	0.0029	2,443,356	0.9873

Empirical Results: Effect by product price positioning

Dependent variable: (log) price (P_{kit})		
	(1)	(2)
Treatment × PostLME	-0.0336***	
	(0.0031)	
Treatment × PostLME × Price gap NB vs. PL Q1		-0.0184***
		(0.0062)
Treatment × PostLME × Price Positioning Q2		-0.0299***
		(0.0049)
Treatment × PostLME × Price Positioning Q3		-0.0475***
		(0.0071)
Treatment × PostLME × Price Positioning Q4		-0.0295***
		(0.0048)
Chain-product FE	Yes	Yes
Category-month FE	Yes	Yes
R^2	0.987	0.987
Observations	3050338	3050338