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"Cost of the mission of transport and delivery of printed press: theory and evidence"

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Cost of the mission of transport and delivery of printed press: theory and evidence[1]

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Abstract

In the first part, we examine from a theoretical perspective how the cost of the mission of postal transport and delivery of newspapers should be defined and by which factors it is determined. In particular we show that a crucial ingredient in the determination of this cost is the variation in *aggregate* demand induced by an increase in the uniform transportation and delivery rate. In the second part, we empirically analyze the French print media market by modeling the existence of a reciprocal effect between the size of the readership and the amount of advertising. For this two-sided platform, we model the impact of the readership on the level of advertising demand and the intensity of advertising on the number of periodicals sold.

Keywords : Cost of public service mission, delivery of printed press, internet, advertisement, two sided market

JEL codes : L11, L86, M37

1 Introduction

As part of its public service missions La Poste Groupe has the obligation to transport and deliver newspaper at a regulated rate which is lower than the (also regulated) universal service rate of comparable products. Consequently, there is an extra subsidy for the press which imposed a cost on the postal operator.

This note consists of two parts. In the first part, we examine from a theoretical perspective how the cost of the mission of postal transport and delivery of newspapers should be defined and by which factors it is determined. In particular we show that a crucial ingredient in the determination of this cost is the variation in *aggregate* demand induced by an increase in the uniform transportation and delivery rate. In the second part, we empirically analyze the French print media market by modeling the existence of a reciprocal effect between the size of the readership and the amount of advertising. For this two-sided platform, we model the impact of the readership on the level of advertising demand and the intensity of advertising on the number of periodicals sold. This crucial two-sided dimension of the market is captured by a two-way interaction between both the demand expressions estimated simultaneously.

2 Cost of the mission of postal transport and delivery of newspapers: definition and determination

2.1 Model: demand and profits

Consider a delivery operator who is required to transport and deliver products x_1 and x_2 at a regulated uniform rate r. The two products are substitutes and can be for instance two newspapers. Consumer (or reader – in the case of newspapers) surplus is given by

$$U = u(x_1, x_2) + m - p_1 x_1 - p_2 x_2, \tag{1}$$

where m is exogenous income, while p_1 and p_2 are prices paid by consumers (or readers).

Maximizing (1) yields the individual demand functions $x_1(p_1, p_2)$ and $x_2(p_1, p_2)$, where

$$\frac{\partial x_1}{\partial p_1} < 0, \quad \frac{\partial x_2}{\partial p_2} < 0,$$

$$\frac{\partial x_1}{\partial p_2} = \frac{\partial x_2}{\partial p_1} > 0.$$

Note that cross price effects are symmetric because of the quasi-linearity of preferences, but this is of no relevance for the results.

We assume that

$$p_1 = c_1 + r,$$

$$p_2 = c_2 + r,$$

where c_i represents all costs other than delivery, so that publishers set their prices at marginal costs. Accounting for a more sophisticated pricing behavior would complicate notation but not change our results.

Profits of the delivery operator are given by

$$\pi = rX - D(X), \tag{2}$$

where X is readers' aggregate demand defined by

$$\begin{aligned} X(p_1, p_2) &= x_1(p_1, p_2) + x_2(p_1, p_2) \\ &= x_1(c_1 + r, c_2 + r) + x_2(c_1 + r, c_2 + r), \end{aligned} \tag{3}$$

while $D(X)$ is delivery cost. We can assume that

$$D(X) = Xd + F,$$

where d is the constant marginal cost, but this is not necessary for the argument presented here.

Note that (3) defines X as a function of r. To avoid multiplying notation we simply write this as $X(r)$. Equation (2) shows that the delivery operator's profits are determined by *aggregate* demand for newspapers because a variation in r affects all prices.

Let r^m denote the price imposed on the operator within the framework of its mission of postal transport and delivery of newspapers. To assess the cost of this mission, one has to compare the operator's profits at r^m with that realized in a counterfactual scenario where the rate is set at r^c. This rate can be for instance the universal service rate applied to a comparable product. Formally we have to compare

$$\pi(r^m) = r^m X(r^m) - D(X(r^m)) \quad \text{and} \quad \pi(r^c) = r^c X(r^c) - D(X(r^c)), \tag{4}$$

so that the cost of the mission would be defined as

$$\Delta = \pi(r^c) - \pi(r^m). \tag{5}$$

Since profits depend on aggregate demand so does of course the cost Δ. We now turn to the study of the properties of this aggregate demand. In particular we analyze the response to a change in r both in absolute term as well as in terms of elasticity.

2.2 Properties of readers' aggregate demand

Since as previoulsy mentioned $\frac{\partial x_1}{\partial p_2} = \frac{\partial x_2}{\partial p_1} > 0$, we have

$$\frac{\partial X}{\partial r} = \frac{\partial x_1}{\partial p_1} + \frac{\partial x_2}{\partial p_2} + \frac{\partial x_1}{\partial p_2} + \frac{\partial x_2}{\partial p_1} > \frac{\partial x_1}{\partial p_1} + \frac{\partial x_2}{\partial p_2}$$

so that

$$\left|\frac{\partial X}{\partial r}\right| < \left|\frac{\partial x_1}{\partial p_1}\right| + \left|\frac{\partial x_2}{\partial p_2}\right|$$

In words, **the aggregate effect in absolute value (the decrease of demand) is smaller than the sum of the (direct) effects on the demand of each of the products**. This is because products are substitutes part of the decrease in demand of good i is compensated by an increase in demand of the competing product j.

In terms of elasticities, define

$$\varepsilon_{Xr} = \frac{\partial X}{\partial r}\frac{r}{X}$$

$$\varepsilon_{ij} = \frac{\partial x_i}{\partial p_j}\frac{p_j}{x_i}$$

$$\varepsilon_{ir} = \frac{\partial x_i}{\partial p_i}\frac{r}{x_i}$$

We have

$$\begin{aligned}\varepsilon_{Xr} &= \frac{x_1}{X}\varepsilon_{1r} + \frac{x_2}{X}\varepsilon_{2r} + A,\\ &= \alpha_1\varepsilon_{1r} + \alpha_2\varepsilon_{2r} + A,\end{aligned}$$

where α_i's are market shares defined by

$$\alpha_i = \frac{x_i}{X} \quad \text{so that}$$

$$\alpha_1 = (1 - \alpha_2)$$

and where $A > 0$ is the term which regroups all the cross-price effects and which is given by

$$\begin{aligned}A &= \frac{r}{X}\frac{x_1}{p_2}\frac{p_2}{x_1}\frac{\partial x_1}{\partial p_2} + \frac{r}{X}\frac{x_2}{p_1}\frac{p_1}{x_2}\frac{\partial x_2}{\partial p_1},\\ &= \alpha_1\frac{r}{p_2}\varepsilon_{12} + \alpha_2\frac{r}{p1}\varepsilon_{21} > 0,\end{aligned}$$

We can rewrite this term by defining

$$k_i = \frac{r}{p_i} = \frac{r}{c_i + r},$$

the share of delivery cost in total cost (price) of product i which yields

$$A = \alpha_1 k_2 \varepsilon_{12} + \alpha_2 k_1 \varepsilon_{21} > 0.$$

Since we are studying a decrease in demand the interpretation is facilitated by rewriting the expressions in terms of absolute values:

$$|\varepsilon_{Xr}| = \alpha_1|\varepsilon_{1r}| + \alpha_2|\varepsilon_{2r}| - \alpha_1 k_2|\varepsilon_{12}| - \alpha_2 k_1|\varepsilon_{21}|. \quad (6)$$

In words, equation (6) shows that **the absolute value of the elasticity of aggregate demand is smaller than the weighted average of the absolute values of the elasticities of the two products**. An alternative writing is

$$|\varepsilon_{Xr}| = \alpha_1 k_1 |\varepsilon_{11}| + \alpha_2 k_2 |\varepsilon_{22}| - \alpha_1 k_2 |\varepsilon_{12}| - \alpha_2 k_1 |\varepsilon_{21}|. \tag{7}$$

Note that in equation (6) the first two terms on the right-hand side depend on the elasticity of the demand of an individual product with respect to r, while in equation (7) the are replaced by terms depending on standard price elasticities.

2.3 Postal operator's profit maximizing price

An alternative and more extreme way to define the counterfactual scenario would be to consider the profit maximizing level of r. Since the delivery operator faces regulation on its universal service products, this is not a realistic scenario to consider. We nevertheless give it for the record to stress the main point that either way the relevant elasticity is that of aggregate demand.

A profit maximizing operator would choose r to solve

$$\max_r \pi = rX(r) - D(X(r))$$

which yields the traditional expression

$$\frac{r-D'}{r} = \frac{1}{|\varepsilon_{Xr}|}$$

or

$$r = \frac{D'}{\left[1-\frac{1}{|\varepsilon_{Xr}|}\right]},$$

which yields a closed form solution when D' and ε_{Xr} are constant (constant marginal cost and demand elasticity).

3 Empirical estimation of readers and advertisers' sensitivity to a price change in the French printed press market

3.1 Modelization of readers' demand

We consider here the choices made by consumers willing to read one of the different periodicals. Consumers first choose the type of periodical that they want to buy, which can be classified into publications with news-related content and entertainment-oriented publications. Second, consumers choose the periodical. The different periodicals are characterized by quality characteristics and price. We assume the existence of an outside alternative, which is characterized by reading a periodical without buying it, as other family members or employees of a firm would do. The outside alternative then captures the potential additional demand for newspapers and magazines. Hence, the total market size is defined as the total readers, which are interpreted as the total potential buyers of the periodicals. A choice for a consumer, then, is a combination of reading topic g belonging to the reading category $G = \{News, Entertainment, Outside\ Good\}$ and a publication title h belonging to the previously chosen category H_g. The consumer choice structure is depicted in Fig. 1.

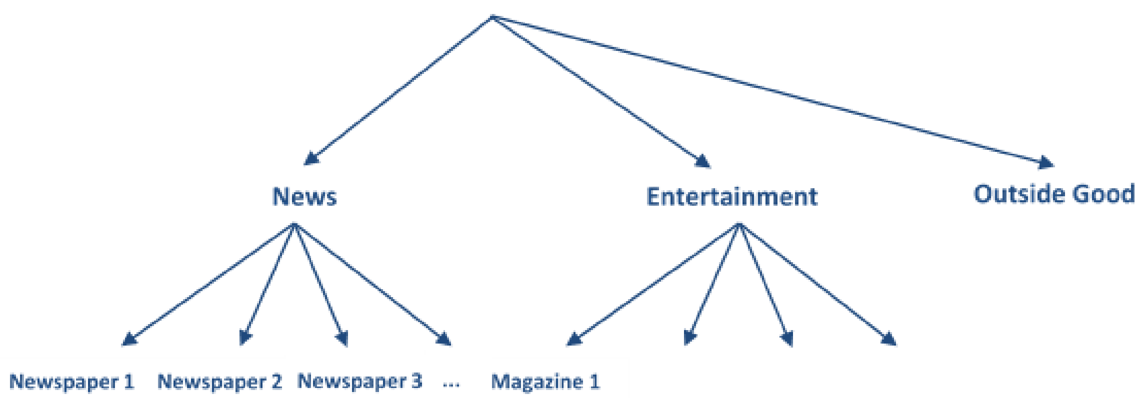

Fig. 1. A reader's decision tree

We adopt here a nested logit specification for random preferences, for which a detailed description is proposed by Ben-Akiva and Lerman (1985). In this framework, products within the same group are closer substitutes than products from different groups. The parameter σ_H, to be estimated, gives a measure of the degree of correlation of alternatives belonging to the same group g. This parameter must lie between 0 and 1. The higher that σ_H is, the higher the correlation between alternatives of the same group is.

$$\ln\left(\frac{q_h}{N-\sum_{h\in H_g,\forall g} q_h}\right) = x_h\beta - \alpha p_h + \beta^{news} q_h^a D_{news_h} + \beta_1^{ent} q_h^a D_{ent_h} + \beta_2^{ent} (q_h^a)^2 D_{ent_h} + \sigma \ln\frac{q_h}{Q_g} + \xi_h \quad (8)$$

where q_h is the quantity of periodical h sold at newsstands; Q_g is the total quantity of periodicals belonging to nest g sold on the market, and q_h^a is the number of advertising pages in publication h. We multiply the variable on advertising quantity, q_h^a, by two different dummy variables, *Dnews* and *Dent*, describing whether the publication belongs to the news or the entertainment category, respectively. Let x be this set of exogenous variables. β is a vector of parameters to be estimated. ξ_h is the random component of the mean utility level common to all consumers. p_h is the price of the selected product, and α is the sensitivity of utility to price, or marginal utility of income.

3.2 Modelization of advertisers' demand

On the other side of the print media market, advertisers select a periodical as a purveyor of their advertisement. For this demand model, we select the simple logit model specification. In this framework, advertisers decide among all the available periodical titles and an outside alternative, namely, choosing another medium as an advertising purveyor instead of any of the periodicals. We apply the same methodology as in Berry [1994] to derive the advertising demand equation by replacing choice probabilities by observed market shares:

$$ln\left(\frac{q_h^a}{A-\sum_{h\in G,G\neq OG} q_h^a}\right) = z_h\gamma - \delta p_h^a + \gamma^{read}(q_h + q_{hsub}) + \xi_h^a, \tag{9}$$

where A is the total size of the market for advertising, q_h^a is the number of advertising pages in periodical h, p_h^a is the price of an advertising page in periodical h, q_h is the quantity of readers buying periodical h, q_{hsub} is the number of readers buying periodical h by subscription, and ξ_h^a is a random term reflecting the effect of the unobserved characteristics of advertising in periodical h on the mean utility level. δ and γ^{read} are parameters of interest to be estimated: δ is advertisers' sensitivity to price, and γ^{read} measures the effect of publication circulation on advertising demand.

Due to the two-sided aspect of this press market, both demand equations are estimated simultaneously. To overcome the issue of endogeneity of prices in our specification, we apply an instrumental-variable procedure, namely the Generalized Method of Moments. Using a dataset covering more than 200 French publication titles over the period 2011-2019, we obtain the estimated parameters presented in annex for equations (8) and (9).

3.3 Computation of the price elasticities

Own-price and cross-price "individual" elasticities can be computed from the estimation of the system of demand equations: the parameter associated to price captures the reciprocal interaction between the two sides of the market. **Own- and cross-price individual elasticities measure the percentage variation of demand for a periodical following a 1% change in price for that periodical or for a different periodical, respectively, all other things being equal** (in particular, the price for all other periodicals remain constant).

With this specification and following Verboven (1996), we obtain the own individual price elasticities of demand as:

$$\eta_h = \frac{dq_h}{dp_h}\frac{p_h}{q_h} = \alpha p_h\left(-s_h + \frac{1}{1-\sigma} - \frac{\sigma}{1-\sigma}s_{h|g}\right)\forall h, \tag{10}$$

and the cross-price individual elasticities as:

$$\begin{aligned} \eta_{h,k} &= \frac{dq_h}{dp_k}\frac{p_k}{q_h} = \alpha p_k s_k \text{ if } h \neq k \;\; k \notin g,\ h \in g, \\ \eta_{h,k} &= \frac{dq_h}{dp_k}\frac{p_k}{q_h} = \alpha p_k s_k\left(\frac{\sigma}{1-\sigma}\frac{s_{k|g}}{s_k} + 1\right) \text{ if } h \neq k \;\; j,k \in g. \end{aligned} \tag{11}$$

When the prices of all periodicals simultaneously increase by 1 %, the percentage variation of the aggregate demand for all the periodicals following this price increase must be measured by computing the aggregated price elasticity.

Following Werden (1997) and Foncel and Ivaldi (2005), this aggregated price elasticity can be computed as:

$$\eta = -\alpha s_0 \bar{p} \quad (12)$$

where $s_0 = 1 - \sum_{h=1}^{H} s_h$ is the market share of the outside good, represented by readers who did not purchase a journal and $\bar{p}$ is the share weighted average price for the inside goods.

By applying equation (12) to the estimated parameters of the readers' demand function presented in annex, we obtain the average aggregated price elasticities over the period 2011-2019 for the different postal press categories presented in table 1, indicating how the overall volume of publications varies when the price of all the titles on the market increase by 1%.

Category	Average aggregated price elasticity
QFRP	-0.038
PIPG	-0.071
CPPAP éco	-0.085
CPPAP non urgent	-0.045
CPPAP urgent	-0.061
Press market	**-0.068**

Table 1: Readers' average aggregated price elasticity of demand over the period 2011-2019 – following the postal classification of publications.

4 Conclusion

In the first, theoretical, part we have shown that the cost of the mission of postal transport and delivery of newspapers is determined by the variation in *aggregate* demand induced by an increase in the uniform transportation and delivery rate. We have shown that the aggregated price elasticities are lower (in absolute value) than the average individual (own) price elasticities. Indeed, a uniform increase in the prices of all titles limits the effects of substitution and of shifting demand to other titles. On the contrary, when the price increase affects only one publication, demand may shift to substitutable publications for which the price has not increased.

In the second part we have presented the methodology which is appropriate to estimate these elasticities considering the two-sidedness of the market. This methodological part is completed by estimates based on French data which confirm the theoretical findings and show that the differences are sizeable.

References

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Annex: Results of the estimation of readers and advertisers' demand functions

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GMM estimation

Number of parameters =  41
Number of moments    =  64
Initial weight matrix: Unadjusted                 Number of obs   =      1,571
GMM weight matrix:     Cluster (groupenum)

                              (Std. Err. adjusted for 95 clusters in groupenum)
```

	Coef.	Robust Std. Err.	z	P>|z|	[95% Conf.	Interval]
b0						
_cons	238.966	5.117106	46.70	0.000	228.9366	248.9953
xb						
newpxnum	-.0356178	.0163521	-2.18	0.029	-.0676673	-.0035683
lnslecg2	.929927	.0189107	49.17	0.000	.8928628	.9669912
mpagespubinfo	-.0124679	.0031991	-3.90	0.000	-.0187381	-.0061978
mpagespubmag	.0074676	.0027902	2.68	0.007	.0019989	.0129363
mpagespubmag2	-.0000746	.0000228	-3.28	0.001	-.0001192	-.00003
numeriques	-1.30e-08	4.93e-09	-2.65	0.008	-2.27e-08	-3.38e-09
region	-.4465403	.0888353	-5.03	0.000	-.6206542	-.2724263
mpages	.0010222	.0002034	5.03	0.000	.0006236	.0014208
annee	-.1197125	.002538	-47.17	0.000	-.1246869	-.114738
grper1	.123593	.0513864	2.41	0.016	.0228774	.2243086
nature	.7686752	.1099867	6.99	0.000	.5531052	.9842452
sport	.7154045	.1058004	6.76	0.000	.5080395	.9227695
artdevivre	.7418194	.1080452	6.87	0.000	.5300547	.9535841
famille	.8089975	.0980662	8.25	0.000	.6167912	1.001204
societe	.9222036	.1116973	8.26	0.000	.703281	1.141126
feminins	.7656489	.1146878	6.68	0.000	.540865	.9904329
artetcult	.7170409	.1128543	6.35	0.000	.4958506	.9382313
infoettech	.6667783	.1094514	6.09	0.000	.4522575	.8812991
connaissances	.7508582	.1038333	7.23	0.000	.5473487	.9543676
c0						
_cons	270.2109	10.08292	26.80	0.000	250.4488	289.9731
xc						
mpxpub	-.0083276	.0027314	-3.05	0.002	-.013681	-.0029743
mvtestot1000	.0004822	.0002321	2.08	0.038	.0000274	.0009371
numeriques	1.55e-08	1.24e-08	1.25	0.211	-8.77e-09	3.97e-08
annee	-.137799	.0050079	-27.52	0.000	-.1476143	-.1279837
region	-1.545189	.2122521	-7.28	0.000	-1.961195	-1.129183
mpages	.0085136	.0004995	17.04	0.000	.0075346	.0094927
connaissances	-.310498	.3046833	-1.02	0.308	-.9076663	.2866704
sport	.0009986	.2362666	0.00	0.997	-.4620754	.4640725
artdevivre	-.1536275	.2608001	-0.59	0.556	-.6647862	.3575313
artetcult	-.1245505	.3824816	-0.33	0.745	-.8742006	.6250995
societe	-.3454144	.137584	-2.51	0.012	-.615074	-.0757547
feminins	.2631887	.2534676	1.04	0.299	-.2335986	.7599761
infoettech	-.0931134	4.913159	-0.02	0.985	-9.722728	9.536501
famille	-.7411765	.2990937	-2.48	0.013	-1.327389	-.1549636
nature	.3441681	.2955444	1.16	0.244	-.2350882	.9234244
hebdomadaire	-.3868352	.1817014	-2.13	0.033	-.7429635	-.0307069
bimestriel	-.3872797	.2514398	-1.54	0.123	-.8800926	.1055332
bimensuel	-.446882	.2626481	-1.70	0.089	-.9616629	.0678989
trimestriel	-.651621	.3100893	-2.10	0.036	-1.259385	-.0438572
mensuel	-.3445504	.2925133	-1.18	0.239	-.9178659	.2287652