Implementation of a GAP Label in a Differentiated-Product Industry: A Welfare Evaluation with a Random Coefficients Model for Mar Del Plata, Argentina[1]

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I. Introduction

In the last decades food safety and food quality concerns have increased worldwide among consumers, which have encouraged the accomplishment of certain quality standards. For example, in the Argentinean processed potato industry some transnational companies have demanded producers to implement Good Agricultural Practices (GAP) protocols. These kind of sustainable practices allow to obtain food products that possess a new attribute, the quality certification, which at present is not identified in their packages, at least when sold in Argentinean domestic markets. However, the potato industry firms could extract more consumer surplus by correctly signaling the GAP attribute through a labeling strategy that makes visible this credence characteristic (Nelson, 1970).

According the Food and Agricultural Organization of the United Nations, GAP refers to practices that address environmental, economic and social sustainability for on-farm processes, and result in safe and quality food and non-food agricultural products (FAO, 2003). One approach to overcome some of these sustainable challenges is Integrated Production and Pest Management (IPPM), a system developed to decrease the net chemical pesticide inputs to agriculture (Bruhn *et al.*, 1992). In 2006, an agronomical national project was launched by the *Instituto Nacional de Tecnología Agropecuaria* in order to encourage the adoption of IPPM. One critical task for the fulfillment of the project is consumers' recognition of and WTP for IPPM fresh potatoes.

The effects of the introduction of a new FFP product, like a GAP-labeled processed potato, can be analyzed with the Random Coefficients Discrete Choice Model (RCDCM) of demand (Berry, 1994; Berry *et al*., 1995) which has gained importance when studying market power, changes in market structure, and the introduction of new goods in differentiated-product markets. The main difference between previous contributions and this one is that we evaluate the introduction of a new product with an attribute that has not been supplied in the market before, namely the GAP label. Therefore, the influence of this attribute on the utility function requires the use of an auxiliary dataset.

II. Objective

The objective of this paper is to evaluate the effect on market shares and consumer surplus of the introduction of a GAP-labeled product in the FFP market. To achieve this goal, we estimate a RCDCM of household demand in Mar del Plata, Argentina, using a scanner data panel and demographic information. Finally, we evaluate a hypothetical scenario in which a GAP-labeled FFP is available.

III. Methodology and Data

i. RCDC Model

The theoretical framework, the RCDCM of demand, allows identifying individual coefficients of the attributes in the following utility function:

$$u_{ijt} = x_j\beta_i^* - \alpha_i^* p_{jt} + \xi_j + \Delta\xi_{jt} + \varepsilon_{ijt} \quad (1)$$

where x_j contains the observable product characteristics, p_{jt} is the price of product j in market t, ξ_j is the mean valuation of the unobserved product characteristics, $\Delta\xi_{jt}$ is a market specific deviation from this mean, and ε_{ijt} is a mean-zero stochastic term distributed i.i.d. with Type I extreme-value distribution. Finally, $(\alpha_i^*\ \beta_i^*)$ are individual-specific coefficients, which depend on consumers' characteristics (Nevo, 2001).

To evaluate the changes in consumer welfare we use the individual compensating variation, CV_i, which does not have an analytical solution here because α_i^* is a function of income. Then, it has to be computed iteratively, and is equal to $-\Delta y_i$, where Δy_i solves

$$u_i(y_i, p) = u_i^*(y_i + \Delta y_i, p) \quad (2)$$

where y_i is the income of individual i and p is the vector of prices in the initial situation.[2] The left-hand side of (2) is the utility of individual i before the introduction of the new product. Unlike $u_i(\cdot)$, $u_i^*(\cdot)$ includes the effect of the GAP label on utility. The mean compensating variation in the population (N) is given by

$$CV = N \int CV_i \, dP_D^*(D) dP_v^*(v) \quad (3)$$

ii. Data

The scanner database was provided by a traditional supermarket chain in Mar del Plata,[3] Supermercados Toledo S. A., and consists of the value of monthly sales and the quantity sold for each product in each of the 23 branches, from July 2005 to December 2009. The sales data cover 18 FFP products supplied by three firms (McCain, Alimentos Modernos, and Granja del Sol) through four brands (McCain, FarmFrites, Granja del Sol, and RapiPap). They are classified in six segments or varieties (bastón[4], golden longs, noisette, rondelles, smiles, and croquettes) and offered in several container sizes. Nutritional information about

[2] The compensating variation is computed assuming that prices remain constant after the introduction of the new product.

[3] Mar del Plata is the second largest city of Buenos Aires Province, the seventh of the country (with 600,000 inhabitants), and the main urban center of the major potato production area of Argentina -located in the southeast Province of Buenos Aires-.

[4] "Bastón" is the name for straight-cut fries in some Latin American countries.

calories, fat, fiber, and sodium was collected from nutrition facts labels. Unit value per serving was used as a proxy for price.

Information on the distribution of household demographics was obtained by sampling cases from the *Encuesta Permanente de Hogares* (EPH), which is carried out by the *Instituto Nacional de Estadísticas y Censos* (INDEC). The socioeconomic variables of interest are per capita income and average age. Since the EPH does not provide the geographical location of surveyed households, a market was defined as an income-month combination. Data were structured in 270 markets and 2,145 observations.

A preliminary descriptive analysis shows that bastón is the most popular variety followed by noisette, despite its relatively high price. On the other hand, croquettes and rondelles are the segments with the least market shares. For all varieties and brands, consumers of high income-level face higher prices than consumers of low income-level for any product variety.

iii. Estimation and identifying assumptions

The key point of the estimation is to exploit a population moment condition that is a product of instrumental variables and a structural error term -defined as $\Delta\xi_{jt}$- to form a nonlinear GMM estimator. The identifying assumption is that, controlling for product-specific means and demographics, income-level-specific valuations are independent across income levels, but are allowed to be correlated within an income level (Nevo, 2001; Hausman, 1994). Given this assumption, the prices of the product in other income levels and months are valid IV's.

Product- and time- dummy variables are included in RCDCM estimation.

iv. Counterfactual simulation: the nitty-gritty

When dealing with a product that possesses an attribute not yet available in the market, its influence on the utility function cannot be recovered with sales data. The utility function for the hypothetical situation, $u_i^*(\cdot)$, results from adding a term to the original function which indicates if the product is labeled as produced following GAP protocols:

$$u_{ijt}^* = x_j\beta_i^* - \alpha_i^* p_{jt} + \gamma_i^* GAP_j + \xi_j + \Delta\xi_{jt} + \varepsilon_{ijt}$$

If we knew the stated WTP of consumers for the GAP attribute, we could calculate the GAP coefficient γ_i^* as follows:

$$WTP_i^* = -\frac{\gamma_i^*}{\alpha_i^*} \Rightarrow \gamma_i^* = -\alpha_i^* \times WTP_i^* \quad (4)$$

The first equality in (4) is a well-known result in the literature (Gil *et al*., 2000; Loureiro & Umberger, 2001).

A measure of the WTP for a GAP-labeled FFP was assessed by employing auxiliary information about consumers' WTP for IPPM potatoes.[5] Since both IPPM and GAP production schemes are closely related, consumers would be willing to pay a very similar amount for both kinds of fresh potatoes. Then, WTP for GAP-labeled FFP is derived from WTP for GAP fresh potatoes in two possible scenarios, each of them postulating different WTP behavior for two consumers' profiles (Table 1).

Table 1. Consumers' WTP for GAP-labeled FFP in each counterfactual scenario

Counterfactual scenario	Consumers of FFP	Not consumers of FFP
Sce1: Optimistic situation	Same WTP as for fresh GAP potatoes	Half WTP as for fresh GAP potatoes
Sce2: Pessimistic situation	Half WTP as for fresh GAP potatoes	Zero WTP

Note: WTP are expressed as price premiums (in percentage terms).

Once we obtained individual WTP for GAP-labeled FFP, we modeled it as a function of the demographic characteristics of the surveyed consumers. We perform the simulation in the high income-December 2009 market assuming that bastón FarmFrites sold in packages of 700 gr. is the GAP-labeled product.

IV. Results

i. Utility function coefficients[6]

The estimates of the mean parameters of the utility function indicate that, on average, consumers' utility increases as the FFP content of fiber and calories increase, and as the content of fat decreases. McCain products were revealed as the least valued FFP. If compared with the base group (golden longs, rondelles, and croquettes), the valuation of bastón is negative, and the valuation of noisette is positive. The sign of the mean price coefficient is negative as expected. Finally, content, sodium, and smiles coefficients are statistically insignificant (though of the expected sign).

Estimates of heterogeneity around these means reveal that individuals are more sensitive to the negative effect of fat and sodium as are wealthier consumers, and are also more sensitive to the positive effect of fiber. Coefficients on the interaction of price with demographics are statistically significant, and indicate that younger and lower-income consumers tend to be more price-sensitive.

[5] This 500-household survey was conducted in Mar del Plata, June 2009, by the Grupo de Economía Agraria, Facultad de Ciencias Económicas y Sociales, Universidad Nacional de Mar del Plata (Rodríguez *et al*., 2010).
[6] The software packages used to obtain the results are Stata 11.2 and MATLAB 7.0.

ii. Counterfactual introduction of a new product: a GAP-labeled FFP

With the addition of a GAP label, bastón FarmFrites in packages of 700 gr. would improve its market share and sales in both scenarios, although in a lesser extent in the pessimistic one. The market share of the remaining FFP would decrease, even for the other FarmFrites products, and mainly among other bastón FFP. However, the total sales of FarmFrites would rise (Table 2). To evaluate the importance of the introduction of the new product, we computed the compensating variation CV_i. Table 3 shows the monthly change in consumer welfare implied by each hypothetical scenario. In Sce1, the introduction of the GAP-labeled FFP would cause an increase in the welfare of the consumers of Mar del Plata of $17,810 a month. In Sce2, the monthly improvement in consumer surplus would only rise to $472.

Table 2. Changes in market shares and sales after the introduction of a GAP-labeled FFP

Frozen Fried Potatoes (FFP)	Initial situation		Sce1		Sce2	
	Share	Sales	Share	Sales	Share	Sales
McCain noisette 500 gr.	0.00480	0.00766	0.00465	0.00742	0.00480	0.00766
McCain smiles 600 gr.	0.00133	0.00173	0.00128	0.00167	0.00131	0.00171
FarmFrites bastón 700 gr.	**0.00066**	**0.00063**	**0.00097**	**0.00093**	**0.00072**	**0.00069**
FarmFrites bastón 1000 gr.	0.00129	0.00108	0.00115	0.00097	0.00127	0.00106
FarmFrites noisette 450 gr.	0.00133	0.00192	0.00125	0.00181	0.00130	0.00188
FarmFrites noisette 1000 gr.	0.00127	0.00151	0.00126	0.00149	0.00126	0.00150
RapiPap bastón 700 gr.	0.00072	0.00068	0.00070	0.00066	0.00072	0.00068
Granja del Sol croquettes 300 gr.	0.00031	0.00085	0.00030	0.00082	0.00031	0.00085
Outside good	0.98830		0.98844		0.98830	

Notes: The table reports FFP available for high income-December 2009 market. Sales (in Argentine Pesos) are calculated as the product of price and market share.

Table 3. Monthly change in consumer welfare due to the introduction of a GAP-labeled FFP

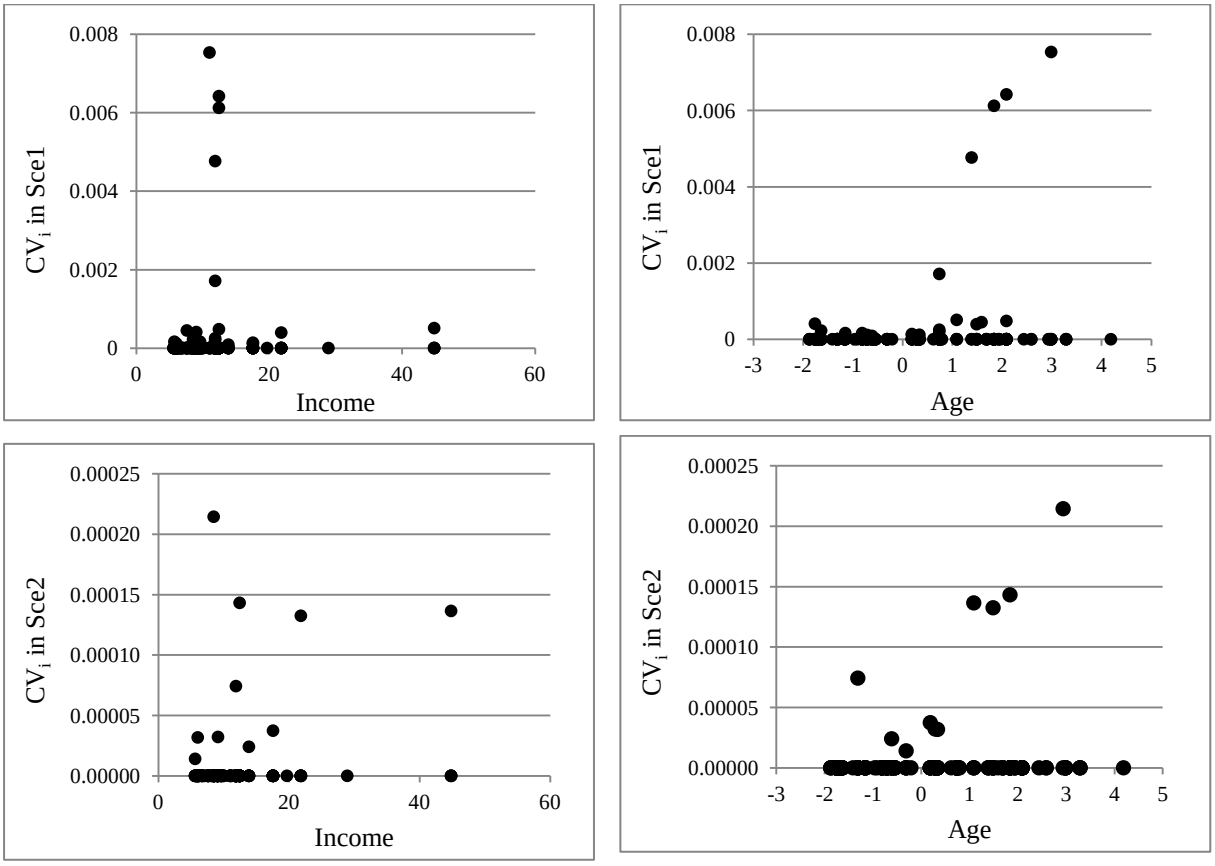
Counterfactual scenario	Average CV_i	Total CV
Sce1: Optimistic situation	0.02968375	17,810.251
Sce2: Pessimistic situation	0.00082131	472.784

Note: Welfare changes are expressed in Argentine Pesos.

In order to analyze the heterogeneous impact of the counterfactual simulation on consumers' welfare, Figure 1 shows the relationship between the individual compensating variation and demographic characteristics. In general, the older the individual, the greater the individual

welfare change due to the hypothetical introduction of the GAP-labeled product. The relationship between CV_i and income seems to be direct too, but is less conclusive.

Figure 1. Welfare change and demographic variables



Later, we compute how much the price of the GAP-labeled product could raise maintaining constant the initial level of welfare, assuming other prices constant. In Sce1, the GAP-labeled FFP price would reach a value of $1.256 per serving, while in Sce2 this maximum price is only $0.999 per serving. Considering the initial non-label price of $0.961, these results imply that the highest price increase that could be charged to the labeled product would be $0.295 for Sce1 and $0.039 for Sce2, if it is not to reduce initial consumer welfare.

We also calculate the maximum increase in marginal cost that FarmFrites would be able to afford if farmers charge higher prices for fresh potatoes obtained by following GAP protocols. Assuming that the marginal cost of the other products remains constant, the highest affordable marginal cost of the GAP-labeled FFP accounts for $0.958 and $0.877 for Sce1 and Sce2, respectively. Considering a non-GAP cost of $0.809, the maximum increase in costs for FarmFrites to make a profitable use of fresh GAP-potatoes would be $0.151 per serving in Sce1. Analogously, the increase of costs should not exceed $0.077 per serving in Sce2.

V. Conclusions

By using a RCDCM of demand estimation and declared consumers' WTP for IPPM fresh potatoes, the article makes hypothetical assessments of a new attribute that FFP could possess, i.e., the quality certification that a GAP label would assure. We argue for and predict the results of a greater consumer surplus extraction, which definitely requires an appropriate signaling of the GAP attribute. Although we found a low impact on welfare due to the still scarce importance of FFP in Argentineans' diet, the results of our work emphasize the importance of both the agronomic issues and consumers' preferences for the success of any strategy that seeks to introduce a credence-attribute product in the food market. The article contributes to the analysis of a market which is rapidly growing in developing countries and, as a consequence, is starting to play a more relevant role in consumers' diet.

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