Firm's adaptation to low consumer sensitivity to nutritional health considerations: What public corrective strategy?

Key words: nutritional policy, public health, MQS, information campaigns, game theory.

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Abstract

Context

Poor diet is considered as a major determinant of the appearance of non-communicable diseases in many developed and developing countries. In fact, changes in dietary patterns[1] resulting from industrialization and changes in life styles are one of the most important factor contributing to the emergence of these chronic diseases. However, the emergence of these diseases and the associated proliferation of health cost requires government intervention (Grifith et al, 2016)[2] in order to preserve the public health. This intervention may take different forms, among others: labeling and informational campaigns aiming to change consumer's choices, standardization by defining minimum quality standards (MQS) and taxation policy. There is a large body of empirical and theoretical works analyzing the impact of these policies. Nevertheless, the available literature dealing with nutritional policies impacts are more oriented to consumer's behaviours analysis and treated this question from demand point of view, whereas they remain less focusing on the supply side by introducing the firms strategic responses in terms of prices and product quality (Duvaleix-Tréguer et al., 2012). For the best of our knowledge, there is no analytical study having taking into account the simultaneous combination of various nutritional policies and their impact on global public health improvement. In this paper, we propose a theoretical model of product differentiation to analyze firm's strategies toward nutritional policies. More precisely, we propose a model where two firms, F_1 and F_0 a second that can strategically produce high nutritional quality product. The model takes into account two characteristics that determine the consumer choice: taste and nutritional quality. Two public regulation tools may be set in order to improve the nutritional quality of the product and consequently public health: **an information policy** based solely on information campaigns relating to consumer awareness, and a policy based on the combination of two regulatory instruments (**MQS and informational campaign**).

[1] From traditional consumption diet based on cereals and vegetables, to a new diet more rich in sugar, fat , salt and less rich in fibre.
[2] By reducing consumption of non healthy product by inciting firms to produce healthier product and by changing consumer's choices, with the principle aim to preserve public health.

Analysis tools and model presentation

As highlighted before, food nutritional quality constitutes one of the major concerns for both public authorities and food operators. Incorporating operators' strategic responses to these nutritional policies are also an important element in the analysis of the effects of food nutritional quality regulation tools. Therefore, regarding the **methodological** considerations, our analysis is based on industrial organization modelling approach using **game theory tools**. This approach allows us to take into account whether public authorities and agri-food operator's strategic reactions. Moreover, we can identify the effect of regulatory changes on complex interconnections between the competitors in the industrial structure. To do so, we consider the following three-stages game:

Stage 1. The Public Authorities determine the type of intervention tool (investing in information campaigns or a combination of too instruments: information campaign with a MQS policy) to be used in order to incite firms to produce healthier products,

Stage 2. The firm F_1 observes the conditions on the market and decides on the nutrient content of its product.

Stage 3. The firms compete in prices.

The game is resolved by backward induction. We first determine the outcome of the stage 3 (optimal prices set by each firms) through the maximization by each firm of his profit with respect to its price. We determine the optimal level of product nutrient content of the law quality firm. After determining the equilibrium of the game, we determine conditions under which one policy is better than the other in terms of health issues and social welfare improvement.

We briefly define the equations and variables of the model

Consumer' utility ($U_i;\ i = 0,1$) is given by:

$U_0 = r - p_0 - (1 - (1-\alpha)(1-s)) - t(x)^2$ when he buys from F_0.

$U_1 = r - p_1 - \big(1 - (1-\alpha)(1-s)\big)\,(1 - x_1) - t(x - x_1)^2$ when he buys from F_1.

r: consumer willingness to pay for the product.

p_i: the price of firm's i product, $i = 0,1$.

$t(x - x_i)^2$: is the transportation costs as in the Hotelling model.

$(1 - (1-\alpha)(1-s))$: is defined as a proxy of the health impact (damages) of the nutrient intake (from the point of view of the consumer).

α : consumer willingness to pay for nutritional quality.

s: investment level of information campaigns.

x_i level of the product nutrient included in the product.

The profits of each firm is given by : $\pi_i = \left(p_i - \frac{1}{2}(1 - x_i)^2\right) * D_i$

D_i : firm's i demand

p_i: price of firm's i product and $\frac{1}{2}(1 - x_i)^2$: the production cost of firm i.

After maximization of profits with respect to prices and the determination of Nash price equilibrium, we determine the level of nutritional content choose strategically by the firms.

We determine health index, consumers surplus and social welfare that we compare in the when one or the other regulation tool is used.

We assume that the Health index is given by :

$$\text{IS} = (1 - x_1)D_1 + D_0$$

The effects on public health issues is determined by both individual health effect of each consumer that represented by $(\mathbf{1} - \boldsymbol{x_i})$, and by the whole supplied quantity of the concerned product (market share of each firm) (D_i).

Consumer surplus is given by :

$$SC = \int_0^{\tilde{x}} (r + (1 - (1 - \alpha)(1 - s)) - p_0 - t(z)^2)dz + \int_{\tilde{x}}^1 (r + (1 - (1 - \alpha)(1 - s))(1 - x_1) - p_1 - t(z - x_1)^2)dz$$

The first integral, represents consumer surplus linked to consumption of high quality product' firm. The second is given when he buys from the low quality firm.

Social welfare is defined by:

$$\text{SW} = \text{Sc} + \pi_0 + \pi_1 - \text{campaigns information costs.}$$

Findings

Notice that we explore some findings of the model among others. Our results show that, information campaigns create incentives leading some consumers to switch from low nutritional quality product to high nutritional quality one. We show how the effectiveness of each of these policies depend on the level of the public investment in information campaigns, the level of the MQS and consumer's preferences for nutritional quality. In particular, a too high investment in informational campaigns indices a better social welfare in comparison with the combination of the two instruments. In other words, a large investment in informational campaigns alone can lead to a better social welfare than when it is associated with MQS. Whereas, facing a low willingness to pay, the health index is better with the combination of informational campaigns and MQS policy.