The product line strategy of a seed company in a context with a licensed GM trait

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Introduction

What are the drivers of the innovators' market power in the case of GMOs?

The focus in this paper : GMOs enable to **price discriminate** differently among farmers. Price discrimination is based on the supply of a larger range of seed products, the price of each product being targeted for one particular group of farmers.

Debate on the range of seed varieties available to farmers:

- Small range with only GM trait $\Rightarrow$ farmer may be "forced" to pay a premium for some GM traits.
- Large range with or without GM trait $\Rightarrow$ farmer pays a higher price for the same (non GM) product.

Here, we use a simple IO model to analyze the price discrimination by a seed company with endogenous license. When does it appear at the equilibrium? What are the welfare implications?

Context: main facts related to this paper

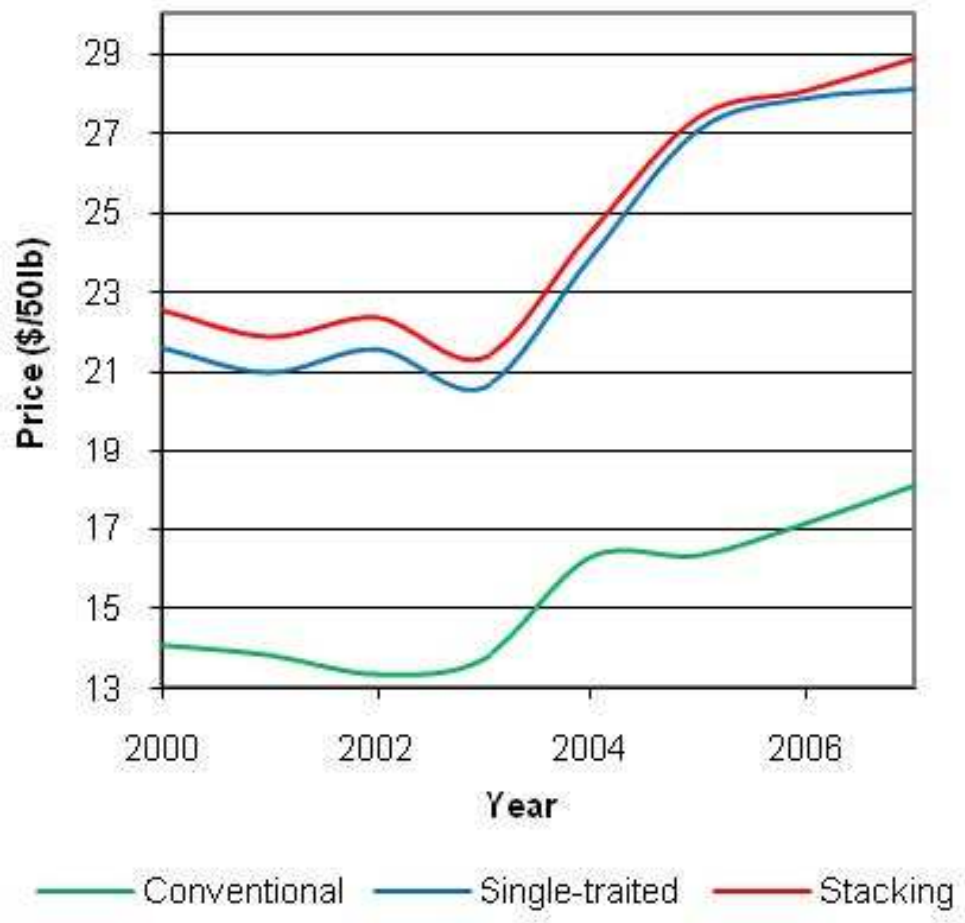
Division of the innovative labor between the agbiotech and the seed companies. Different IPRs on the GM trait and seed genetic base. Vertical integration or (royalty based) licensing agreement between the two types of companies.

GM traits concern pest protection. Farmers face different (expected) pest pressure $\Rightarrow$ heterogeneous willingness to pay for the GM traits.

Multiple traits are available for Corn and Cotton. These traits may be bundled or stacked in the same seed variety.

The number of seed varieties in the catalogs as been increasing, but all the possible combinations of genetic bases and traits are not available. Two arguments : (i) fixed cost for developing a new variety and (ii) strategic interest of the seed companies.

An example : evolution of soybean seed prices



Source : Shy et al. (2009)

The model: economic actors

Two successive monopolies:

- The agbiotech company (upstream) owns a patent on a GM trait and licenses it (linear tariff r)
- The seed company (downstream) has developed initially a conventional variety and can sell also the GM variety if it signs a license with the agbiotech company.

The farmers:

- Distributed in two segments of equal size (1/2). All the farmers in the segment s ($s = 1$ or 2) face a pest problem of magnitude θ_s ($0 \leq \theta_1 < \theta_2 \leq 0.58 < 1$)
- A farmer in one segment can choose among 3 alternatives: the conventional seed n (u_{ns}), the GM seed g (u_{gs}) and the external alternative (u_e)

The model : farmers' utility and demand

Farmers utility from using the product i ($i = n$ or g):

$$u_{is} = 1 - \theta_s(1 - x_i) - p_i$$

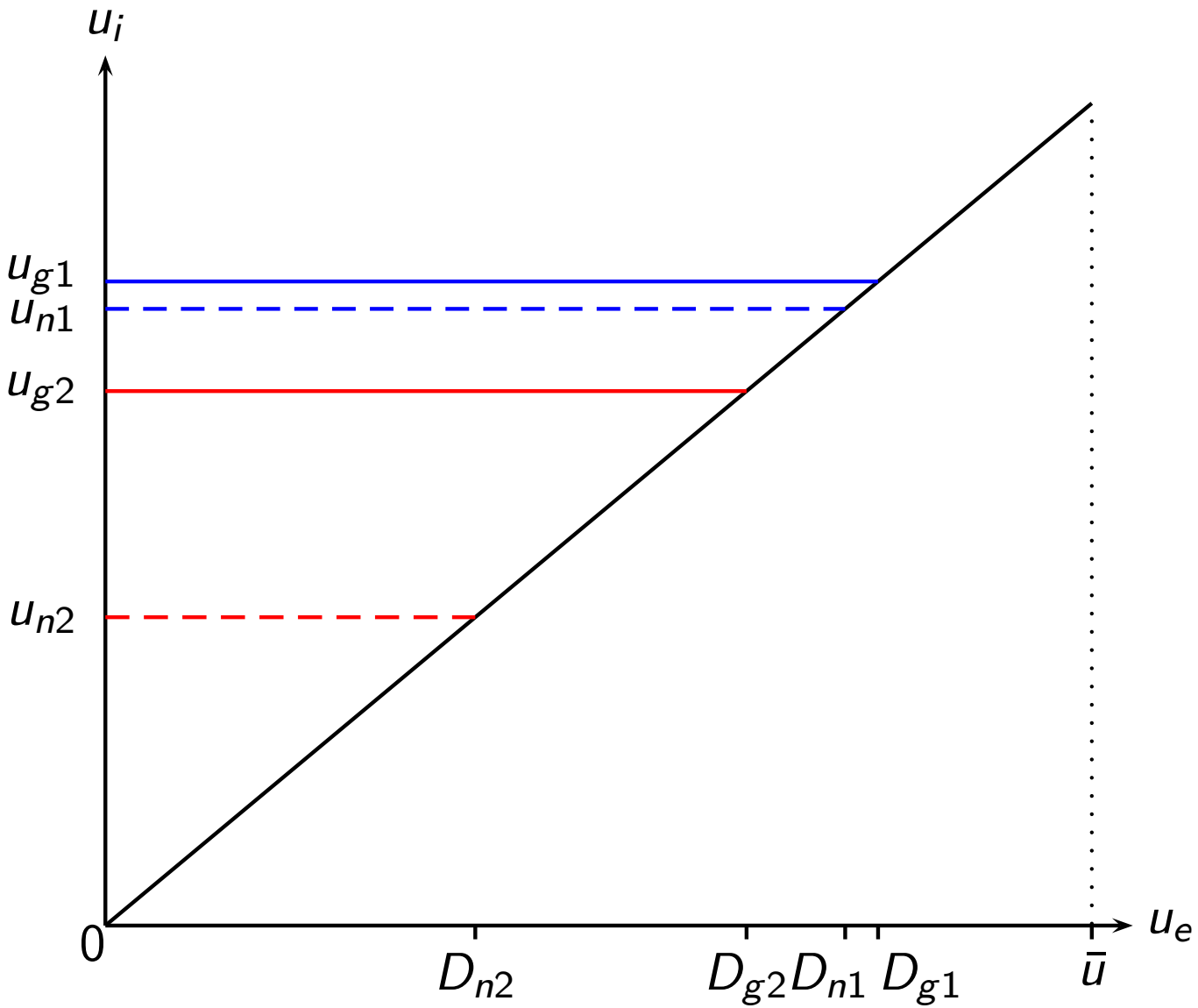
x_i seed efficiency for pest control ($x_n = 0$, $x_g \in [0, 1]$)
p_i price of the seed (endogenous)

External alternative utility uniformly distributed on $[0, \bar{u}]$

The demand for the product i on the segment s:

$$D_{is}(p_i) = \begin{cases} 0 & \text{if } u_{is}(p_i) < u_{js}(p_j) \\ \frac{1}{2}\int_0^{u_{is}} \frac{1}{\bar{u}} du_e = \frac{u_{is}}{2\bar{u}} \end{cases}$$

Representation of the demand



$\theta_1 = 0.1$
$\theta_2 = 0.55$
$x_g = 0.4$
$p_n = p_g = 0$
$\bar{u} = 1.2$

The model : product line and decision sequence

Three possible product lines:

- (N) if only conventional seed (n) is sold,
- (G) if only GM seed (g) is sold,
- (B) if both types of seed (n and g) are sold.

Assumption: the seed company does not know in which group does each farmer belong. Third degree price discrimination is ruled out. Only one price per product.

Three stages of the game:

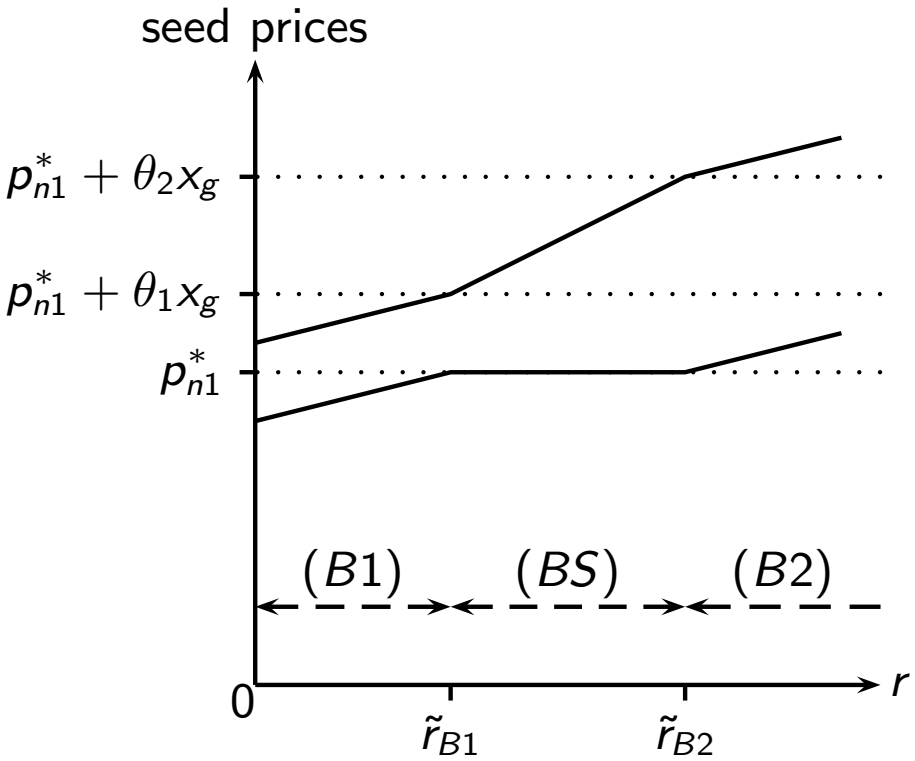
1. The agbiotech company defines the royalty rate r
2. The seed company chooses its product line
3. The seed company decides the prices of each product and sales occur

Seed price equilibrium with a given product line (stage 3)

If only one type of seed is sold, its price is:

$$P_n^* = \frac{1}{2}\left(1 - \frac{\theta_1 + \theta_2}{2}\right) \quad \text{or} \quad P_g^* = \frac{1}{2}\left(1 + r - \frac{\theta_1 + \theta_2}{2}(1 - x_g)\right)$$

If both conventional and gm seed are sold:



Incentive constraints :

$u_{1n}(p_n) > u_{1g}(p_g)$
$\Leftrightarrow p_g - p_n > \theta_1 x_g$

$u_{2n}(p_n) < u_{2g}(p_g)$
$\Leftrightarrow p_g - p_n < \theta_2 x_g$

Seed product line (stage 2): benchmark case

Lemma 3. *A vertically integrated company, that develops both the GM trait and the seed, sells only GM seed.*

Equivalent to the case where the seed company have access to the GM trait for free ($r = 0$).

Supplying only the GM seed is interesting because the demand is higher and the cost is identical to the conventional seed.

Conversely, with discrimination : (B1) configuration $\Rightarrow$ the seed company has to strongly distor its price to bind the incentive constraint on the segment 1.

Remark : welfare always increases in this benchmark case.

Seed product line (stage 2) with a given royalty level

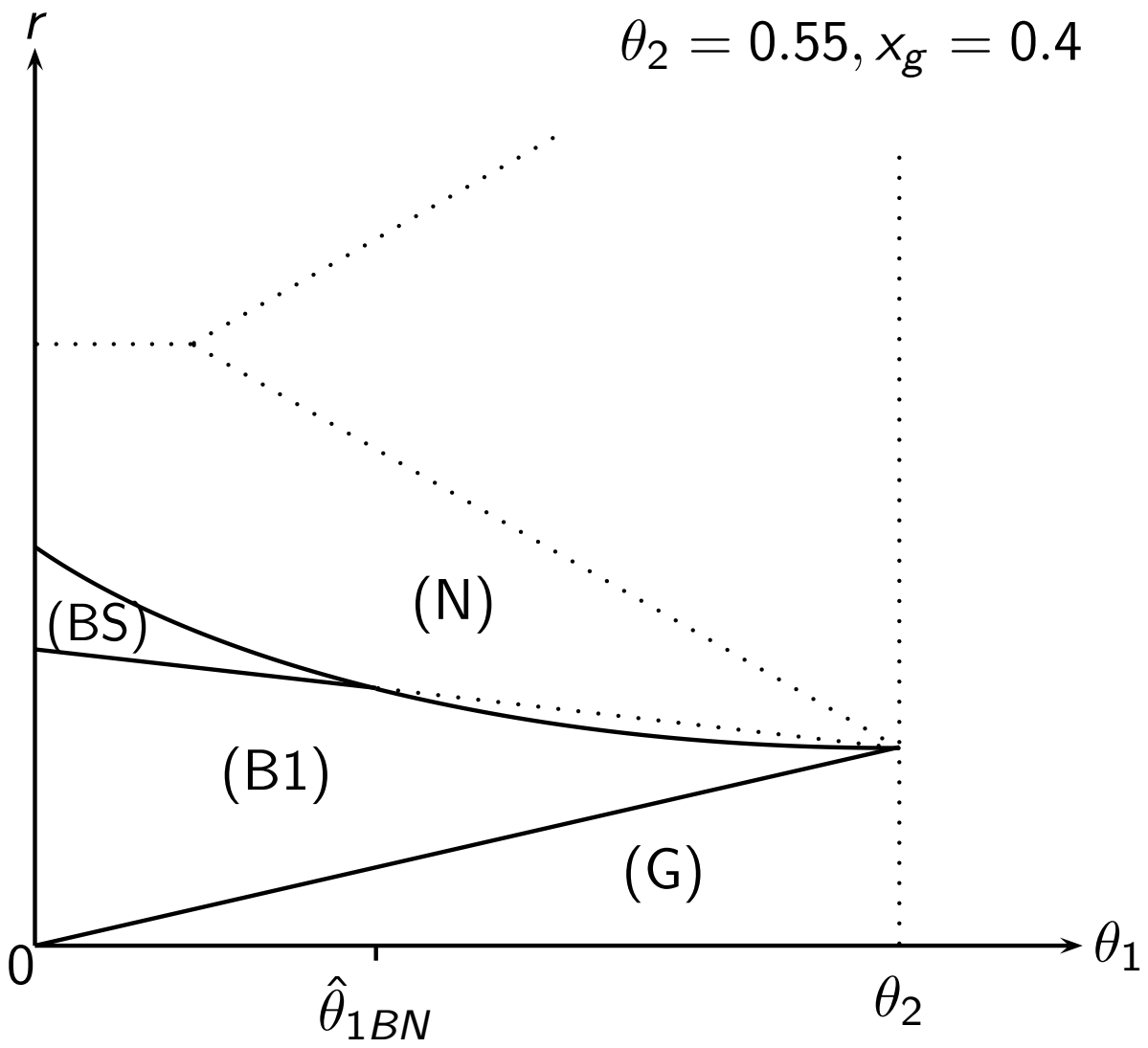
Proposition 1. *If the royalty is small ($r < \theta_1 x_g$), the seed company sells only GM seed. For intermediary royalty level ($\theta_1 x_g < r < \hat{r}_{BN}$), the seed company sells both types of seed. For high royalty level ($r > \hat{r}_{BN}$), the seed company reject the license and sells only conventional seed.*

If $r = 0$, the seed company earns more by supplying only GM seed.

The seed company profit decreases with the royalty level but at a more important rate if only GM seed is sold (the loss concerns larger quantities) $\Rightarrow$ there is an intermediary level where supplying the two types of seed becomes more interesting.

Economic mechanism: as the royalty (r) increases from 0, the distortion of the price to bind the incentive constraint on the segment 1 is less important.

Product line with a give royalty level (stage 2)



Optimal royalty level (stage 1)

Proposition 2. *The optimal licensing strategy of the biotech company leads the seed company to discriminate if θ_1 is small enough compared to θ_2.*

Intuition: larger range of royalty levels with the product line (B) if θ_1 is small, and with the product line (G) if θ_1 is close to θ_2.

When θ_1 is close to 0, the biotech company earns more by defining a royalty that induce a product line (B).

$$\lim_{\theta_1 \to 0} \Pi^G_{btk} = 0 \text{ and } \lim_{\theta_1 \to 0} \Pi^B_{btk} > 0$$

When θ_1 is close to θ_2, the biotech company earns more by defining a royalty that induce a product line (G).

$$\lim_{\theta_1 \to \theta_2} \Pi^G_{btk} = 2 \cdot \lim_{\theta_1 \to \theta_2} \Pi^B_{btk}$$

Impact of the introduction of GM trait on farmers' surplus

If the optimal licensing strategy of the biotech company leads the seed company to discriminate, then :

- *The price of the conventional seed increases (lemma 4),*
- *The total farmers' surplus decreases (lemma 5).*

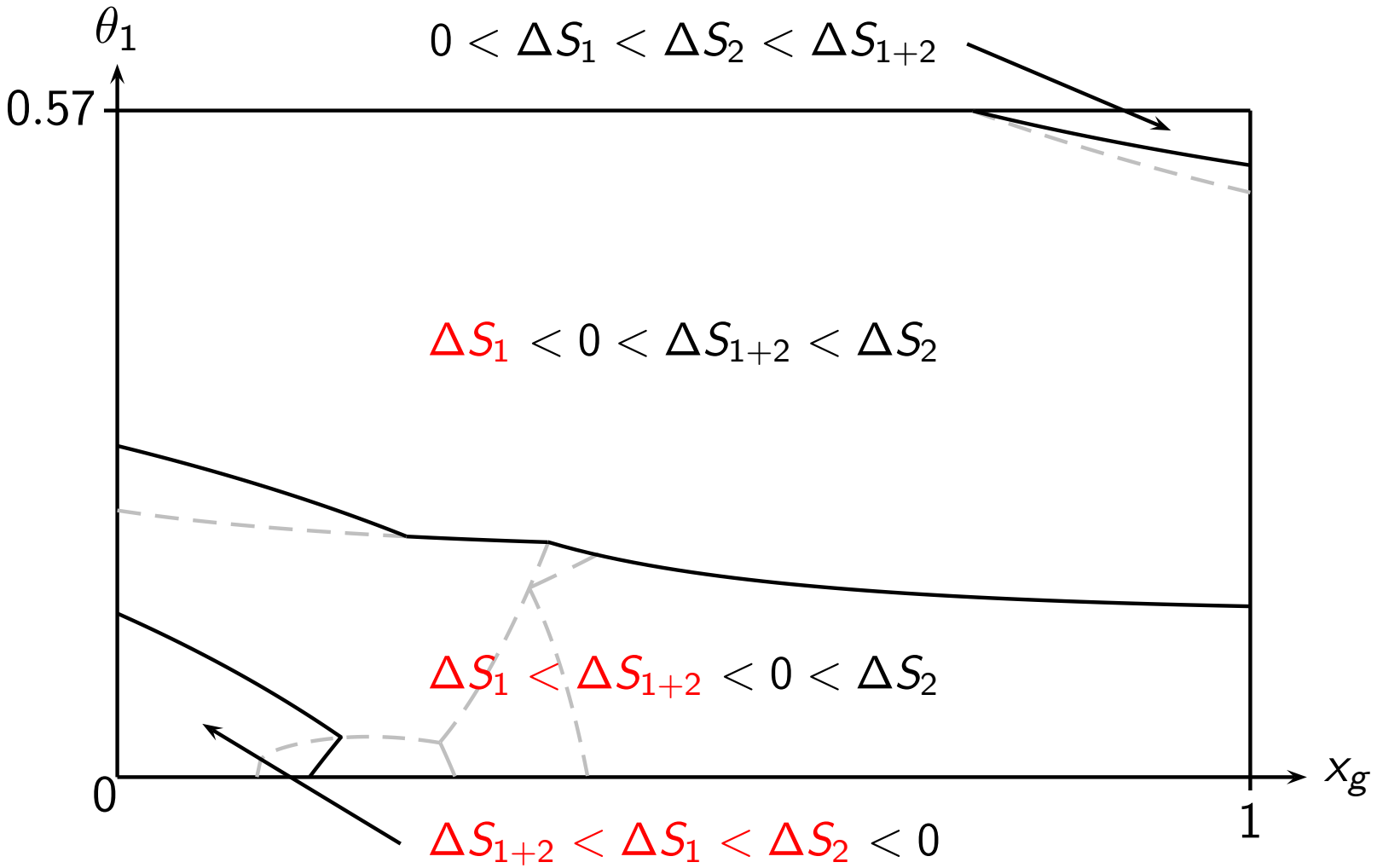
$$S_{is}(p_i) = \frac{1}{2\bar{u}} \int_0^{u_{is}(p_i)} u_{is}(p_i)\, du + \frac{1}{2\bar{u}} \int_{u_{is}(p_i)}^{\bar{u}} u\, du.$$

With respect to the initial equilibrium (N) the seed company defines the conventional seed price to target only the farmers in the segment 1.

The farmer in the segment 2 may also loose (small x_g and θ_1).

The (possible) gain of the farmer in segment 2 never compensate for the loss in the segment 1.

Sign of the farmers' surplus variation ($\theta_2 = 0.57$)



Welfare impact of the introduction of a GM trait

Proposition 3. *The introduction of a more efficient GM trait can lead to a welfare loss. This loss can only be observed if the introduction of the GM seed leads the seed company to discriminate.*

The observation of the welfare gain observed in the benchmark case can be generalized to all the cases that leads to no discrimination.

With price discrimination:

- Welfare loss on the market 1 (price increase, same product)
- Double margin on the market 2 ($r > \theta_1 x_g$) that moderates the welfare gain on market 2.

Synthesis

Benchmark case : vertical integration (or royalty equal to zero). In this case, only GM seed is supplied and the introduction of the GM trait leads to a welfare gain.

With positive endogenous royalty :

- Price discrimination (i.e. seed company supplying both conventional seed and the GM seed) is more likely with more heterogeneous farmers.
- Farmers' surplus decreases if the seed company price discriminate (sufficient condition).
- The agbiotech and seed companies always gain from the introduction of GM seed, but total welfare may decrease.