The environmental impact on the formation of agricultural prices - a study into the soybean supply chain in Brazil

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This paper will investigate price formation in the Brazilian soybean supply chain, considering environmental impact as an additional cost. Two hypotheses are discussed: Is there a difference in market price between sustainability soybean and conventional one? If so, does a higher price compensate for the savings in related natural resources?

Keywords: Sustainable soybean, Sustainable prices, Environmental value

Introduction

Soybean is one of the major sources of protein in the planet, and is the major oleaginous plant produced and consumed worldwide. Its world production increased from 29 million metric tons in 1964/1965 harvest to 263.7 million metric tons in 2010/2011 harvest (more than nine times). In the last ten years, the global production and the soybean and cultivated area grew up 48% and 37%, respectively. With the steady growth in the world population, the demand for protein sources - such as soybean - tends to grow up even more. This statement is based on the importance of the product both for human consumption - as oil and as a basis for food/drink - and for livestock feed, as soybean bran (ICONE, 2011).

Started in the 1970s, soybean production in Brazil began to have a relevant position in agribusiness as observed by increasing cultivated areas and, specially, by intensive new technologies applications causing a significant productivity rise.

The soybean production chain includes all the supplies and processes necessary for producing the grain for bulk exports, as well as the product transformation by the grain milling industry, which processes soybean into soybean bran or oil, both for domestic consumption or for export. Other soybean byproducts are beverages (juice) and food

(cheese and others). See details in Figures 1, 2, 3 and 4.

Figure 1 – Soybean

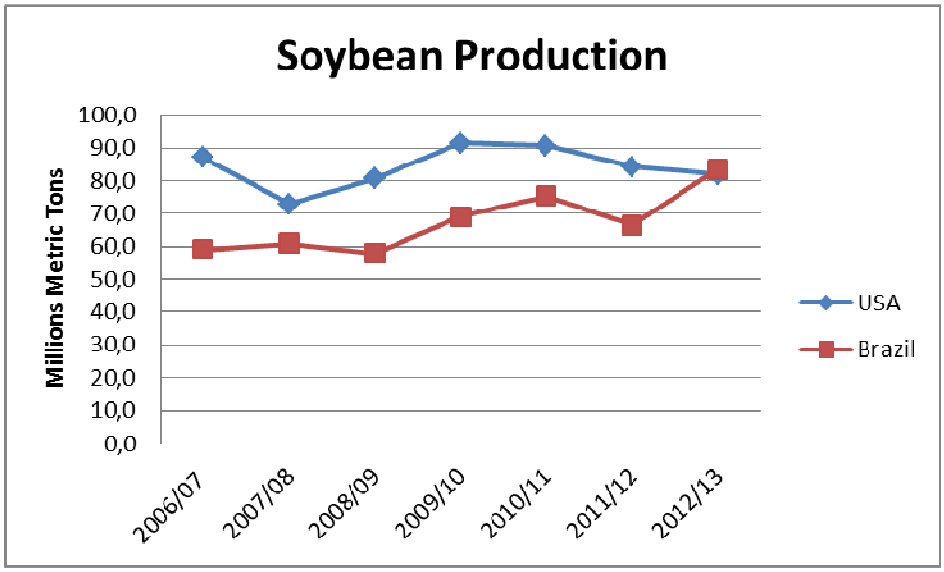
Figure 2 – Soybean oil

Figure 3 – Soybean Juice

Figure 4 – Soybean cheese (tofu)

A strong modernization process by using new technologies was observed since 1990, stimulating major restructuring changes all along its production chain.

From then on, Brazil is increasing productivity making this sector to have a more intense growth and dynamism, culminating when it toppled the USA production in the 2012/2013 harvest, and became the largest soybean producer in the world (see Graph 1).



Graph 1: Evolution of soybean production in Brazil – 2006/07 to 2012/13
Source: USDA-World Agricultural Supply and Demand Estimates (February 8, 2013)

Despite the Brazilian production advantages, due to the great availability of favorable natural resources in the country, Brazilian soybean producers work with a narrow profit margin, depending on the production costs in the farm, transportation costs and the grain price. Also, they face a highly aggressive and excluding competition worldwide. An example of this situation is that some countries, mainly Germany, refuse to purchase GMO (Genetically Modified Organism) soybean.

According to Boletim MERCADO DE GRÃOS: SOJA, 2011, GMO variety presents a slightly lower production cost than the conventional soybean, with the same sales value. As a consequence, the profitability of the GMO soybean is a little higher than traditional soybean profitability (for 2010, the average profitability was 33.75% for OGM soybean against the 31.95% for conventional soybean). The farmer preference for cultivating the transgenic variety can thus be explained.

It is worth highlighting that soybean is a commodity, traded in commodity markets at world prices. Soybean production expansion is necessary due to the increase in consumption, mainly in China. In the last ten years, Chinese soybean grain imports grew by 280% (ICONE, 2011).

Even though China does not make any special requirement on imported soybean regarding sustainability - a factor that may reduce production and incentives for farmers to adapt themselves to the new conditions - soybean and other important agricultural products have been criticized mainly to supposed connection to deforestation and the related environmental impacts such as: greenhouse gas emission (GHG) and biodiversity loss.

Sustainability principles

In Brazil, there is a strong concern about the expansion of soybean occurring with responsibility and according to national laws. European consumers have more and more required that the product purchased is produced according to environmental and social sustainability criteria, and certified by specific programs, such as Roundtable on Responsible Soy – RTRS (see symbols below).

What is RTRS? According to the proper organization (www.responsiblesoy.org), founded in Switzerland in 2006, it is a multi-stakeholder (people and organizations) participating on the soybean value chain, based on voluntary and open initiative, which aims to facilitate a global dialogue on soy production that is economically viable, socially equitable and environmentally sound. It is a market oriented international organization and open to all that supporting production, processes and trading responsible soy production, gathering farmers, social organizations, distributors, business and industry. The goal is to jointly develop the report "Principles and Criteria", leading to responsible soy production, in order to create a global standard.

The synthesis of the bottlenecks (ICONE, 2011) to meet RTRS in Brazil is presented as follows:

- Little use of diversified techniques for good agricultural practices;
- Gap of compliance of labor, health and safety criteria at work;
- Gap of compliance of some environmental criteria related to original plants and waste management;
- Ignoring the real costs of the adaptions for compliance to legal and RTRS standard criteria;
- Land conflicts occur in some specific places and in the agricultural boundaries;
- Lack of technical assistance for the producer to improve: good agricultural practices, environmental adaptations, labor and safety standards at work;
- Lack of information to the producer regarding certification systems and socio-environmental criteria;
- Undefined benefits and lack of an award to farmers are limitations to starting the certification;

- Lack of producers' previous knowledge about certification systems and their criteria prevented a more accurate assessment of interests in the system, besides the difficulties and benefits from adapting;
- Need to improve procedures to include farmers in the process of improving agricultural production, environmental and social regulations and, therefore, allowing a socio-environmental certification process;
- Not fully compliance with legal requirements in agricultural estates, especially in Legal Reserves and inefficiency of public organizations responsible for agrarian and environmental regulation.

It is worth observing that sustainable development seeks to meet current needs, without compromising the capacity of future generations of supplying their own needs. In this sense, sustainable agriculture is concerned with soil conservation, productivity, rational employment of chemical nutrients and pesticides, consciousness irrigation, genetic improvement, power sources, health and education in farming areas, agricultural employment, technologies, in short, the whole scenario comprising sustainable growth in the sector.

Besides the RTRS Program bottlenecks already known, a great challenge is stated: Is it possible theoretically equal products to the consumer to be differentiated considering the way they have been produced?

Supply Chains as a Business Model

Part of the answer to the previous question undergoes the analysis of production chains. One of the possible models is based on three different factors: technology, markets and products. The dynamic view of a production chain is defined by the superposing of these three elements over time. Any modification in one of them may directly affect the others (SOUZA; KLIEMANN NETO, 2002).

Another production chain model is the methodology proposed by EMBRAPA for representing a production chain of vegetal origin, which better fits the present study. According to SILVA (2005), each of this chain links may be defined as (see Figure 5):

• Input suppliers: represent organizations that supply products such as: seed, fertilizers, lime, fungicides, herbicides, machinery, technology and agricultural implements;
• Agriculturists: refer to the agents that use land for agricultural production. This is conducted in a sort of productive system of the ranch, small farm or grange type;
• Processors: represent the agriculturalists that can pre-process, process or transform qualified products such as *in natura*;
• Traders: are divided into wholesalers and retailers. The first ones act as large distributors supplying supermarkets, points of sale and external markets. The second, in turn, act for selling products to end users;
• Market consumer: represents the final trading point which is formed by consumer groups. It can be subdivided into domestic market, if located inside the country, or

foreign market in other countries.

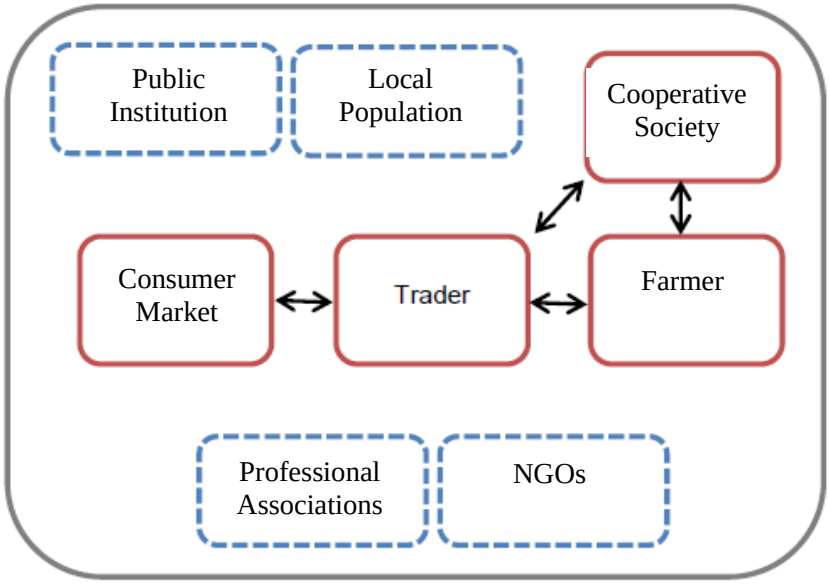


Figure 5 – Institutional scenario and supply chain players Source: ICONE, 2011

All the players in the production chain can be influenced by the organizational and institutional environment. The first refers to entities such as environmental control agencies, credit agencies, research centers, universities and certification agencies. The second, in turn, represents instruments which regulating commercial and labor transactions, namely: the set of environmental, labor, commercial and tributary laws, as well as trade norms and standards (SILVA, 2005).

SOARES (2006) states that economic stability is characterized by conducting economic activities consuming a minimum of raw materials and power, seeking to make a balanced income distribution, so that everyone can get benefits from the economic growth. Thus, it is relevant to mention that important economic dimension of the soybean agricultural sustainability, such as economic analyses; factors such as price, quality, and utility are the ones that better translate the influence of agriculture on physical, economic, cultural, social and political health of the county.

According to AMARAL (2010), sustainability certifications focus on production practices and are, thus, different from the well known ISO 9000 and ISO 14000 - which are management standards - and organic certifications, which deal with the characteristics of the final product. The question thus is: are these certifications specific actions or can they really promote a generalized improvement in production practices?

There are arguments for and against this kind of mechanism. Those who defend them argue that they promote the general progress of responsible practices, so they will differentiate good producers. When time goes on, more and more agents would adopt the best practices, promoting absolute gains for the sector as a whole.

Those who criticize them, in turn, argue that they are generally market niche initiatives. Only the best producers, who have already been developing excellent work, would be certified. Moreover, due to huge bureaucracy and complexity, these certifications would never be attractive enough to small producers. Thus, according to critics, nothing would change, and *business as usual* would continue.

As AMARAL (2010) says, both arguments may be correct. In practice, something intermediary occurs. The results depend on a series of issues, from the complexity of certification to the characteristics of the production and distribution chains. The latest factor is extremely relevant to the model chosen by these initiatives. Strategies may be based on "B2B" (*business to business)* or "B2C" (*business to consumer*) models.

Short production and distribution chains, with large players and in which raw material is an important part of the final product, are liable to models aiming at end consumers (model "B2C"). On the other hand, complex chains, with small players and in which raw material is merely one of the many inputs of the final product, are much more liable to "B2B" models.

The trend is that sustainability certifications for agricultural commodities better fit the second model (B2B). End consumers, those going to the supermarket, will not directly impact the success of these initiatives. It is difficult to imagine they will be fascinated by a biscuit with a label ensuring that "the soybean – processed into soybean bran which fed the hen that laid the egg used in the biscuit – was responsibly produced". A person really concerned about the subject will ask: but what about the wheat, the milk, the plastic package and the biscuit manufacturing process?

Independent of being for strategic choice or for civil society pressures, the intermediary consumption industries will be those really demanding agricultural certification. Thus, even if many people dislike the idea, these initiatives neither need to nor should be elaborated to fascinate a large public. Therefore, this study will consider the markets and products independent variables and the value/cost as dependent variables.

Economic evaluation

According to Boletim MERCADO DE GRÃOS: SOJA, 2011, an estimation of cost, average price and margin over sales was made, with data coming from the producing regions in Brazil in 2009/2010. The following exercise consisted in estimating an equation relating the margin over sale with the variables production cost and sales value.

The result was the equation below (in R$) estimated with the t statistics below the coefficients, in parenthesis:

Profit margin = 0.197 + 0.02*price – 0.03*cost
(6.6) (57.9) (-26.9)

Thus, at every R$ 10 (Real) increase in price, the margin over sale would increase by 0.20 or, at every R$ 10 (Real) reduction in cost, the margin would increase by 0.3, all the other factors being constant. This model, besides t statistics showing the significance of the price variables and the production cost, also disclosed a high explanation power (99%).

First hypothesis: Is there a difference in market price between sustainability soybeans and conventional ones? The answer is: Yes. Organic soybean (in principle, it can be considered sustainable), in December 2012 (ABIOVE, 2013), has an average cost of R$ 1,520.00 (US$ 760) per metric ton (60kg bag = R$ 91.20), whereas conventional soybean is around R$ 1,064.00 (US$ 532) per metric ton (60kg bag = R$ 63.84).

Second hypothesis: Does highest price compensate amount of savings of natural related resources? The answer is: Yes. According to Circular Técnica 85 (2011), results from organic soybean producers of Paraná (a Southern Brazil state), that have a full control of production practices and are integrated in regional markets, due to sale contract with firms of this sector or by using soybean in the development of diary products based on organic plant, were very positive.

It is important to say that organic soybean production is a differentiated activity and a few firms working in this market. The producer depend on these firms because it does not have a production structure in own property. In addition, organic soybean production claims a technical know-how for both production process and available technologies from the producer. It is necessary to emphasize that sale price of organic soybean is, mainly, influenced by sale price of conventional one, and it is 40% to 50% higher.

An application of equation above is to consider the reference prices assumed in the **First hypotheses** and the average cost (according to Circular Técnica 85, 2011) of R$ 500.00 (US$ 250) per metric ton (60kg bag = R$ 30.00) of organic soybean, and cost of R$ 420.00 (US$ 210) per metric ton (60kg bag = R$ 25.11) for conventional soybean

By replacing the values, results are:

Organic soybean: Margin 1 = 0.197 + 0.02*91.20 - 0.03*30.00 = 1.121
Conventional soybean: Margin 2 = 0.197 + 0.02*63.84 - 0.03*25.11 = 0.7205

Ratio = 1.121/0.7205 = 1.56 which means the organic soybean margin increased by 56%!

An interesting hypothesis in a more competitive scenario suggests that the differences in prices between organic and conventional soybean will decrease with the increase of producers. Then, what would be the breakeven point for these two soybean varieties?

As a premise, costs of both soybean types will not be changed and price of conventional soybean becomes unchanged. Thus, matching the margins will result in:

0.02*X – 0.03*30.00 = 0.02*63.84 – 0.03*25.11 where X is the breakeven organic

soybean price.

X = (0.02*63.84 – 0.03*25.11 + 0.03*30.00)/0.02 = (1.2768 + 0.1467)/0.02 = 71.17

This hypothesis can be seen in graph 2 as follows:

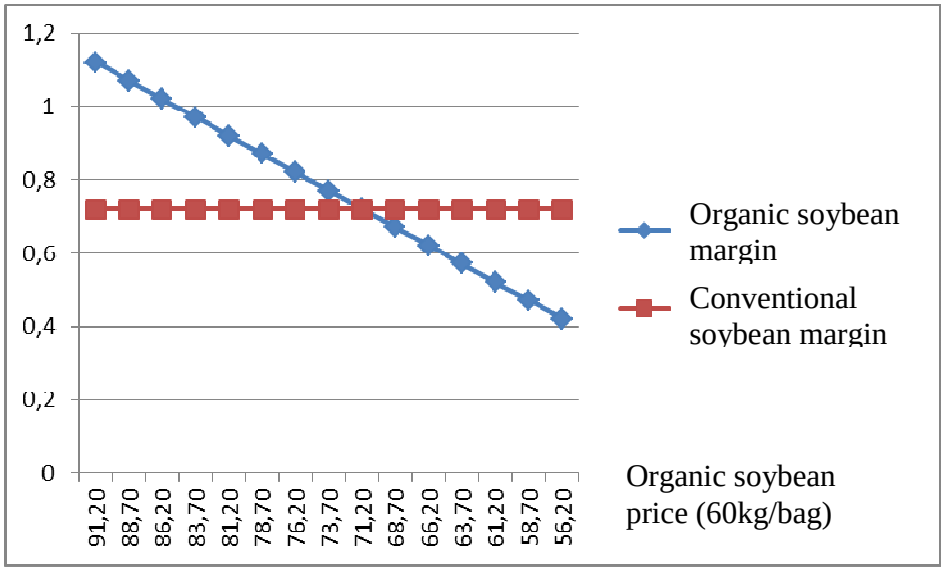


Figure 6 – Determination of breakeven point between organic and conventional soybean prices
Source: Author

Therefore, when organic soybean reaches a value close to R$ 71.17 (about 11.5% higher than that of conventional soybean, whose value was established as R$ 63.84 for 60kg/bag), it will no longer be an economic advantage. Of course, the benefits to the environment are not considered in this calculation way.

Conclusion

From the current market value, organic soybean (considered close to the sustainable model) provides a profit margin 56% above that of conventional soybean, besides causing less damage to the environment. As more producers enter this market niche, prices may fall up from 40 to 50% higher to an 11.5% limit (breakeven point) above the conventional soybean value to keep competitive. As far as it is known, such a low value is likely to take very long time to be attained, in case it ever is. Therefore, this type of sustainable crop production will provide good profits to those who adopt it, increasing the satisfaction of those concerned about sustainability practices.

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