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Harvests' lifespan and North–South market share rivalry

H. Benchekroun [a,*], S. Benchekroun [b]

[a] Department of Economics, CIREQ, McGill University, Canada
[b] Institut Agronomique et Vétérinaire Hassan II, Morocco

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ABSTRACT

We consider a North–South duopolistic competition in the market of a perishable good. North's harvest can be sold over two periods whereas South's harvest can be sold in the first period only, because of the lack of storage technology. We examine the impact of the availability of a storage technology in South that would allow it to sell its harvest over two periods. We identify situations in which both North and South see their profits decrease and situations in which both North and South enjoy larger profits when the lifespan of South's harvest increases. Our findings can be useful to assess the support for policy interventions that aim at transferring better technologies to South. There are cases where North and South's industries will both push for (or both resist) the transfer of a technology to South that will lengthen the lifespan of its product.

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1. Introduction

The objective of this paper is to analyze the incentive of a developing country to acquire a technology that can allow it to sell its harvest of perishable goods over a longer period of time. There are several ways to lengthen the lifespan of a given agricultural product; e.g., gaining access to industrial cooling facilities. For example in Egypt, farmers formed a marketing association called Horticulture Export Improvement Association (HEIA). The objective of HEIA is to facilitate better harvesting practices, postharvest handling, pre-cooling, packaging and cool transport. In 1993 HEIA established a Perishable Terminal, a cold store terminal at Cairo International Airport[1]. The store is used for the export of perishable goods[2].

Exports of fruits and vegetables are typically a source of important revenues for developing countries. For example, in 2012, the value of Morocco's exports was US$ 21.417 billion[3]. Exports of fruits and vegetables represented US$ 1.627 billion, i.e., 7.6% of the country's exports[4]. By far, the European Union represents the major destination of these exports; close to half of these exports

* Corresponding author at: 855 Sherbrooke West, McGill University, Montreal, Quebec, Canada. Tel.: +1 514 398 4400.
E-mail addresses: hassan.benchekroun@mcgill.ca (H. Benchekroun), s.benchekroun@iav.ac.ma (S. Benchekroun).

[1] For more details see http://www.heia.org.eg/termin.htm.
[2] We thank Dr. Lisa Kitinoja for suggesting this example.
[3] Source: United Nations Statistics Division — Commodity Trade Statistics Database (COMTRADE).
[4] In 2009, agricultural products' export share of the value of total exports was 12.2% for Egypt and 23.4% for Morocco. See http://webservices.wto.org/resources/profiles/TP/ZZ/2009/MA_e.pdf and http://webservices.wto.org/resources/profiles/TP/ZZ/2009/EG_e.pdf.

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were to France and Spain alone[5]. Developing countries are important players in the total trade of fruits and vegetables. In 2001, the value of fruits and vegetable exports was US$ 8.18 billion for developing countries, that was close to a quarter of the total world exports estimated at US$ 34.6 billion (see Diop and Jaffee (2005)). Developing countries' export of citrus represents half the total exports of citrus and almost all exports of banana and tropical fruit are from developing countries (see Garcia (2006)). In 2012, Morocco's export of tomatoes to France represented approximately half of France's total imports of tomatoes[6].

It appears intuitive that, for a developing country exporting perishable goods, gaining access to a technology that allows a more flexible sale's schedule is good news. We show that this intuition may be misleading. We address our research question within a North–South framework. We consider a framework where both North and South produce a perishable good (e.g., a fruit or vegetable). We consider two scenarios: one, a la Brander and Spencer (1985), in which sales take place abroad and one in which sales take place in North. The harvest has a lifespan of one period if it is not stored in a cooling facility and two periods if it is. Sales are assumed to take place over two periods if the harvest is stored. North is assumed to have a technology that allows it to have a harvest that has a lifespan of two periods, whereas South has a harvest in which the lifespan is one period. Does South benefit from gaining access to a technology that allows it to have a product with a lifespan of two periods?

For simplicity we focus on the case where the total harvest over the two periods is fixed. Thus our framework can be related to a literature on exhaustible natural resources; more specifically natural resource oligopolies (Benchekroun, Halsema, and Withagen (2010), Chou and Long (2009), Fujiwara and Long (2012)), and storage of a natural resource (Gaudet, Moreaux, and Salant (2002)). Chou and Long (2009) and Fujiwara and Long (2012) formulate a dynamic game model of trade in an exhaustible resource between a cartel supplying the resource and an importing country. They consider different scenarios: simultaneous moves, leadership by the strategic importing country, and leadership by the exporting cartel. For example Fujiwara and Long (2012) examine welfare under different scenarios and show that the world welfare is highest under the importing country's leadership and lowest under the exporting country's leadership. In contrast with our paper the exhaustible resource can be sold at all periods of time and North is assumed not to own any resource. While this may true for some exhaustible resources, in many instances the importing country also has a group of domestic suppliers. In a recent and independent work Wan and Boyce (2014) analyze an exhaustible resource oligopoly within a two period framework similar to ours. Their aim is to fully characterize the equilibrium extraction sequences under Stackelberg competition and compare them to the equilibrium extraction sequences under Cournot competition. In Chou and Long (2009), Fujiwara and Long (2012) and Wan and Boyce (2014) the cost of extraction of each firm is the same in all periods. In our framework the possibility to sell over a longer lifespan comes at an additional cost. Therefore the cost of each firm is not constant over time. Gaudet et al. (2002) consider the possibility of storage of an exhaustible resource (e.g., oil stockpiling; land deforestation). They show that privatization of common property through storage may eliminate inefficiencies. However storage may result in accelerated extraction from the common property and exacerbate inefficiencies. While their focus is on the impact of storage within a common property resource, in our model the harvest can be viewed as a private (but perishable) exhaustible resource. In their model, storage is used to 'privatize' the resource. None of these papers examine the question of the impact of the lifespan of the good extracted.

We show that South's access to a technology that allows it to sell its harvest over two periods instead of one can be detrimental to its profits. This can be rather surprising. The intuition of this result is that by not being able to sell its harvest in period 2, South gives up profits from sales in period 2 but gains a strategic advantage in period 1. This strategic advantage stems from the credibility of the sales of all its harvest in period 1[7]. Thus when South acquires the technology, it gains from increased profits in period 2 but loses its ability to commit to a more aggressive behavior in period 1. The impact of these two effects combined, on South's profits, is therefore ambiguous. The acquisition by South of the technology to sell in period 2 has also an ambiguous impact on North's profits. In particular, the possibility of selling the perishable good over two periods can result in a win–win or loss–loss for North and South. Furthermore we show that even a transfer of the best available technology from North to South results in an increase in South's profits and can result in an increase in North's profits as well, even if such a transfer is free. In terms of the impact on welfare, we show that it is possible that the mere access of South to the possibility of storage can reduce global welfare, i.e., the sum of South's profit, North's profits and consumers' surplus.

Section 2 gives a description of the model when South is not able to sell its harvest in period 2. It also provides the equilibrium outcome under that scenario. Section 3 covers the scenario where South has access to a technology that allows it to sell its harvest over two periods. The impact of the access to such technology on the equilibrium sales and profits is assessed. Section 4 includes a welfare analysis.

2. The model and preliminaries

For simplicity we will consider a three country world: South, North and the Rest of the World (RW). A perishable good can be produced both in North and South and we will assume for simplicity that consumption takes place in the RW. This is a framework a la Brander and Spencer (1985); it is a standard framework to analyze strategic behavior of exporters. This approach is typically used to focus on profits and abstract from local consumption and welfare. In Section 4 we will examine the case where North and

[5] Source: United Nations Statistics Division — Commodity Trade Statistics Database (COMTRADE).

[6] In 2012, Spain and Morocco accounted for close to 80% of France's imports of tomatoes. Source: United Nations Statistics Division — Commodity Trade Statistics Database (COMTRADE).

[7] This advantage is different from the first mover advantage in a Stackelberg game since South's firm in our game takes the strategy of North's firm as given (as in a Cournot game).

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