AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

Accommodating Imperfect Competition in A Model of World Peanut Trade

Authors
Stanley M. Fletcher
National Center for Peanut Competitiveness
Department of Agricultural and Applied Economics
University of Georgia
sfletch@griffin.uga.edu

Denis A. Nadolnyak
National Center for Peanut Competitiveness
Department of Agricultural and Applied Economics
University of Georgia
denis@griffin.uga.edu

Selected Paper prepared for presentation at the American Agricultural Economics Association Annual Meeting, Providence, Rhode Island, July 24-27, 2005

Copyright 2005 by S.M. Fletcher and D. Nadolnyak. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.

ABSTRACT
In this paper, we make an attempt to rationalize the strategic behavior of major peanut exporting and importing countries in the framework of imperfectly competitive markets with the focus on the global and inter-American peanut trade. This study is motivated by the fact that liberalizing imperfectly competitive and often distorted markets can have unorthodox effects, in particular increase the incentives to overuse certain trade policies. The results suggest that the South American peanut producers stand to benefit from the reductions in the U.S. peanut production supports but, paradoxically, preservation of a tariff may still be mutually welfare enhancing. In the broader context of global peanut trade, multi-lateral tariff reduction increases the low-cost exporters' incentives to subsidize export production, which benefits the consumers but hurts the higher-cost producers.

Keywords: trade, peanuts, strategic behavior, tariffs, TRQs, subsidies

Introduction

In the paper, we offer a simple welfare analysis of trade reforms and policies in an attempt to rationalize the strategic behavior of major peanut exporting and importing countries in the framework of imperfectly competitive markets with the focus on the global and inter-American peanut trade. This study is motivated by the fact that, while the trend towards liberalization of agricultural trade is supposed to be welfare enhancing, liberalizing imperfectly competitive and often distorted markets can produce unexpected results and, in particular, increase the incentives of the trade participants to overuse the trade policies that are still available to them. Alternatively, certain distortionary trade policies can be welfare enhancing in imperfectly competitive markets by offsetting the distortionary effects of the history of suboptimal production and strategic interactions.

While complicated nature of peanut trade policies prevents exact modeling, outlining a few notable features help correctly choose among more general trade models that can be used in the analysis. While most of the world peanut production is consumed domestically, a few countries do export a sizeable share of their production. Production for export is concentrated mainly in South-East Asia (China, India, and Vietnam) and South America (Argentina and Mexico). Generally, the exporters enjoy both cost *and* comparative advantage in peanut production. The main importers of edible peanuts are the EU, Japan, the U.S., and Canada. The U.S. is probably the only country that both exports and imports peanuts, most likely due to their differentiated nature.

The main trend among peanut importers has been that of lowering import tariffs and duties under the WTO rules. Besides, peanut tariffs within the NAFTA and FTAA are even lower and member countries enjoy preferential treatment by the U.S., the main American importer.

As for production subsidies, only the U.S. has been consistently supporting its peanut production via the supply management policies and later by the Marketing Loan Program. While these supports do not exactly qualify as production (or export) subsidies, the marketing loan program (together with the counter-cyclical payments) can be considered a "one-sided" subsidy in the sense that it effectively subsidizes production when the prices, or yields, are low. Production supports are increasingly limited by the multi-lateral WTO agreements on agricultural policies, so that it is safe to assume that there is a trend towards lowering production supports. Little is known about agricultural support policies in China, but there are reasons to believe that its government can subsidize production for strategic reasons. The rest of peanut exporters do not offer any significant production or export supports.

An important peculiarity of the peanut (and other agricultural) trade reforms is that they are taking place in largely imperfectly competitive markets that have been distorted by protectionist trade policies. Imperfect competition is likely to exist on both the national level in many countries with concentrated processing and exporting industries, and on supra-national level, whereby governments engage in strategic trade policies.

In analyzing the world peanut trade, it is possible to distinguish the Americas as a (quasi-) separate trading region -sector because the South American countries, although together with China, still export large shares of their production to Northern American countries and enjoy preferential tariffs and other trade advantages. At the same time, both the U.S. and the South American producers compete with China and each other for the EU and other import markets. In the analysis, we consider the North-South American trade in peanuts *and* competition among the

major world peanut producers for the EU and other import markets separately because models of trade with domestic consumption generally differ from those of purely export production.

In what follows, we discuss (perhaps in too much detail at times) the logic of the most important trade models of imperfect competition and apply it to the world and regional peanut markets in the light of their structure and policy changes. The major trade policies analyzed are production subsidies, export subsidies, tariffs, and their combinations. Overall, our findings are consistent with the basic conclusions of the trade theory that liberalizing imperfectly competitive markets has ambiguous effects and is not necessarily welfare improving. A few specific results are worthy of note.

Brief Overview of World Peanut Production and Trade

The world peanut **production** has been increasing since the 1970s, mostly due to increasing yields and increased demand for peanut food products. The leading world peanut producers in 2001-3 were China (45% of the world production), India (19%), followed by the US (5.2%), Nigeria (4.7%), and Indonesia (3.3%). The main world peanut producing regions can be divided into the Americas, Africa, and Asia, (Revoredo and Fletcher, 2003a). Within the Americas, the North American production has increased by about 14%, while production in the South America has decreased by 24.1%. This decrease has mostly been due to reductions in Brazil's production (-68%), while production in Argentina and other countries has increased (Lee, Kennedy, and Fletcher, 2005). In Africa, production increased tremendously in the western region (Chad and Nigeria), while Eastern and South African production fell, accounting for an overall increase of 23%. Most of the growth in the world production occurred in Asia (163% since 1972-1975), mainly due to Chinese production increase of 563%, reaching 14.6 mil tons in 2001-2004.

Peanut **consumption** is almost evenly divided between edible purposes (42.3% in 2001-2004) and crushing for meal and oil (48.6%) and. Peanuts represent about 10% of world production of oilseeds (fourth after soybeans, cottonseed, and rapeseed). Total peanut consumption reached 32 mil metric tons in 2001-2004. North American consumption has increased by 52% mainly due to edible uses, while the South American consumption declined (though edible use increased), making export market more important for the South American producers.

During the last 30 years, South-East Asian peanut consumption for food has increased, while the South-west and East Asian consumption increased mainly due to crush. The EU decreased its peanut consumption due to contracting crushing industry (while food utilization increased). Western African peanut utilization has doubled, mainly due to increased food usage, but the Eastern and South African consumption decreased because of contracting food and crushing industries. Currently, China's consumption is divided between 45% for food and 55% for crush, Indian is 10/90 (similar to Burma, Burkina-Faso, and Argentina), and the U.S. is 79/21. Together, these countries process about 68% of the world production.

The world peanut **trade** can be considered a residual market, as most of the production is consumed domestically. Average share of exports in the total world production has been about 5% since the 1970s, while the total volume has been growing from 1.1 to 1.8 mil metric tons. Most of the U.S. production is consumed domestically – only 6% of the domestic production was exported in 2001-3.

The world's major peanut **exporters** are China (49% of global exports in 2001-3), the U.S., Argentina (13%), India (7%), Vietnam (5%). The major peanut **importers** are the EU

(38%), Japan (8.5%), Indonesia (7.6%), Russia (7.4%), Canada (7%), Mexico (6.6%), and the US (4.9%). Of these, only the US appears to be both importing and exporting peanuts in significant volumes.

Peanuts are more differentiated than staple crops like soybeans, corn, or wheat, as they differ not only by grades, but also in quality (particularly aflatoxin content). This differentiation is reflected by price differences according to the country of origin. Judging by the Rotterdam price (considered representative for peanuts), Chinese and Argentine prices during the last 20 years have been generally lower ($53 and $50, respectively) than the U.S. prices, which has been attributed to differences in quality and export reliability (Revoredo and Fletcher, 2003b).

The trend among the importers in the EU and the South-East Asia has been to lower or eliminate import duties and (in-quota) tariffs. The U.S. replaced import quotas with tariff rate quotas with 9.35c/kg for in-shell and 6.6c/kg for shelled in-quota rates, the over-quota tariffs being prohibitively expensive. The major exporters of peanuts to the U.S. in 2003 were Argentina, Mexico, and China. However, these countries have not been treated equally (see below).

The U.S. policies.

Peanut production in the U.S. is supported by the Marketing Assistance Loan Program, which replaced supply management in the form of the quota program in 2002. The program provides producers with a per-unit revenue floor, which can be considered production subsidy only in case of low world or domestic prices). Peanut imports in the U.S. are subject to tariff rate quotas (TRQs) that cover (1) raw, in-shell peanuts, (2) shelled, blanched, and "other" peanuts, and (3) peanut butter. The Uruguay (and Doha) Round(s) obligated those WTO members who had imposed import bans or other quantitative restrictions to allow market access to no less than 5 percent of domestic consumption by 2000 (minimum access requirement), and to gradually expand it afterwards (de Gorter *et al*., 2001). The minimum access requirement was binding on US peanut imports (Skully, 1999).

Peanut TRQs are a hybrid of two forms of TRQ allocation, as they mix (1) historical allocation and (2) first time first served allocation. The first come first served method allocates the in-TRQ volume to whomever imports first, which led to surges of imports on April 1 each year. In 2001, 78% of the U.S. in-quota allocation went to Argentina (78% of minimum access volume). Argentina, being part of the FTAA, may face an accelerated tariff reduction schedule. Peanuts from Mexico were excluded from the WTO peanut TRQ as they have a separate TRQ under NAFTA, set at 3,377 metric tons in 1994 and increasing by 3% per year until 2008, after which they are eliminated. China, being a member of the WTO, will probably negotiate for a share of the US TRQ, but currently is exporting large quantities of peanuts and peanut products to the US. As an exporter, the U.S. is increasingly challenged by Brazil, South America, and also Australia, particularly in the EU market.

2. Models of Trade with Imperfect Competition and Discussion of Their Applicability to the World Peanut Trade.

In this section, we consider two distinct classes of models of trade with imperfect competition. One is the Brander-Spencer (1985) type of models that assume countries producing for exports only and competing in an import market. The other type of models consider bilateral trade flows between countries that both consume and trade their produce with each other. As argued in the previous section, the first class of models applies to the case of major peanut exporters competing for the import market (mainly the EU and the U.S.). The second type of models corresponds to the general pattern of peanut trade in which most of the production is both consumed domestically and exported, and the trade polices have to account for domestic consumption welfare effects. This situation corresponds to the trade pattern between the Americas.

2.1. Countries producing for exports only

2.1.1. *Cournot competition*.

The conventional models show that export subsidies (or production subsidies in the absence of domestic consumption) benefit the subsidizing country's industry, and therefore reciprocal subsidies result when there are several countries producing only for export. It is important that this logic does not require specific assumptions about the cost function (i.e., it can be concave as well as convex), the only assumptions being behavioral.

In its simplest form, the Brander-Spencer (1985) model is as follows. Assuming two countries producing a certain homogeneous good for export in a third country, the profit function of the "home" country is

$p = P(q+q^*)q - C(q)$,

q and q^* being the domestic and foreign outputs, $P(Q = q + q^*)$ the demand function, and $C(q)$ the cost function. Differentiating the first order condition

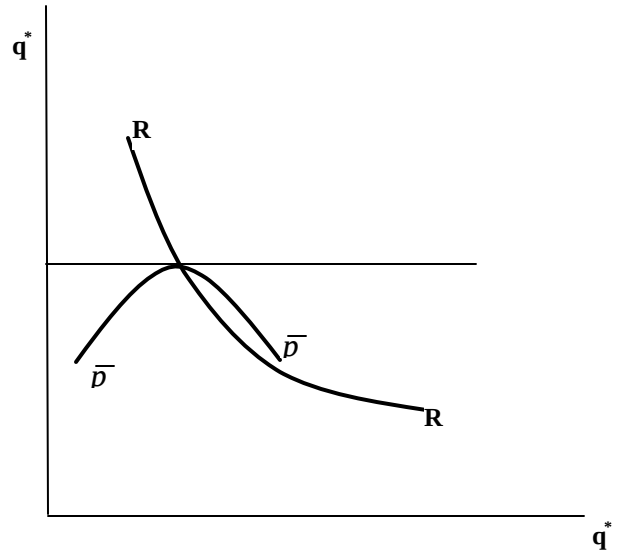
$p_q = P'(q+q^*)q + P(q+q^*) - C(q)$

with respect to q and q^* gives the slope of the "home" country's reaction function

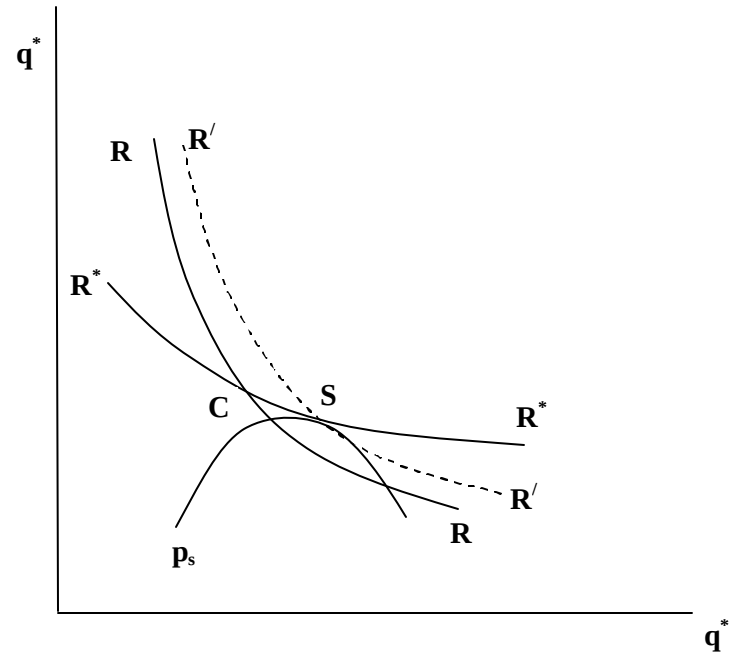
$$\frac{\partial q^*}{\partial q} = -\frac{P''q + 2P' - C''}{P''q + P'},$$

which is negative if $P''q + 2P' - C'' < 0$ (the second-order profit maximization condition) and $P''q + P' < 0$ that holds is the demand is "not too convex".

The property of the reaction function is that it represents the loci of the peaks of the iso-profit curves of the firm (home monopoly), which can be verified by differentiating the profit function. Thus, the reaction function defines the most profitable production response for any given value of the rival's output, q^*. The figure below illustrates.



The slope of the reaction function in the foreign country (R^*R^*) is identical and, given it is flatter than that of the home country, which is a prerequisite for the stability (Dixit, 1986), a Nash-Cournot equilibrium in the absence of government intervention is defined by the intersection of the two curves defined by point C in the figure below:



While the logic of the Cournot equilibrium has been the subject of much controversy (the "dynamic" adjustment argument being intuitively appealing but contradicting the one-shot nature of the game), empirical research shows that it is a robust concept nevertheless.

Now suppose that the home country introduces a *specific* (per unit) production subsidy, in this case equivalent to an export subsidy *s*, thereby decreasing the domestic per unit costs. Adding *sq* to the RHS of the domestic profit function shows that a production subsidy shifts the domestic reaction function to the right. Re-deriving the equilibrium shows that a unilateral export (production) subsidy can be set at such a rate that the new reaction curve crosses the foreign reaction curve at the point where the home iso-profit curve is tangent to it, which is a Stackelberg

outcome for the home country. While the domestic firm/industry chooses profit maximizing output according to a condition

$$P(q+q^*(q))q + P(q+q^*(q)) + s - C(q) = 0,$$

the government chooses *s* to bring the outcome to the point S in the figure above. The home profits in this case rise to p_s, while foreign profits fall due to the fact that, in a Cournot setting, outputs of the two countries are strategic substitutes (an increase in output by one country reduces output by the other). The intuition behind this conclusion is firmly grounded in the notion of commitment and its credibility: if the foreign country believes that the other is a Cournot player, it chooses a Cournot output, and so does the other. However, if the government of either country can precommit to a production subsidy, in will be in the interest of the other to respond by contracting its output. Thus, the home country benefits from the subsidy by shifting profits away from the foreign country, which is worse off as a result. It can be shown that, in general, the cost of the subsidy is more than offset by the gain in profits. The subsidy also expands domestic output more than it contracts the foreign production, which benefits the importing country through an improvement in the terms of trade (lower price and increased consumption).

While an export subsidy constitutes a Nash equilibrium for both countries in the absence of domestic consumption, the joint welfare of the exporting countries is inferior to a Cournot-Nash equilibrium without the subsidies. This inferiority is a result of the inability of the two governments to precommit to not subsidizing exports/production. This is due to the negative terms-of-trade effect that the resulting increase in production entails.

However, in presence of a significant competitive fringe, the change in the terms of trade becomes less important making the subsidy argument stronger. More specifically, a flatter (more elastic) residual demand facing an exporting country is more likely to satisfy the necessary condition for the equilibrium and thus lead to the subsidy outcome. Badyopadhyay (1997) shows that, in a symmetric two-country model, the optimal policy is a subsidy, no intervention, or export tax if the demand is elastic, unit elastic, or inelastic. However, if the domestic constant marginal costs are higher than foreign, the home government has an incentive to precommit unilaterally to an export tax if the foreign government does not intervene. In a simultaneous-move Nash game with asymmetric costs and elastic demand, the high-cost country subsidizes its production at a lower rate than the low-cost country.

Applying this logic to peanut production for export, it is possible to argue that, in order to increase their market share and apart from domestic consumption considerations, major exporters, having both cost and comparative advantages, have an incentive to subsidize their production as it increases their profits. This allows them to make more of the cost advantage. While the demand in the major importing countries not always elastic (according to most recent estimates in Beghin, and Matthey, 2003), the aggregate import demand elasticity is likely to be greater than one, which satisfies the condition for a Cournot-Nash equilibrium and thus a "mutual" subsidizing of domestic exports, which is inferior to the "pure" Nash equilibrium, could result. Assuming convex demand for the exports, further reductions in tariffs and other trade barriers will make demand even more elastic and thus increase the low-cost producer incentives to subsidize even further. The result that countries with smaller production costs should subsidize more might not hold for countries with governments less rich and solvent as other considerations, like budget balancing and liquidity, may be given more weight in the export policy. However, countries with (still) largely centrally planned economies and small production costs, most notably China, may indeed stand to benefit from subsidizing their export production,

which permits taking more advantage of their lower costs, thus hurting other exporters but benefiting the consumers. While little is known about the Chinese agricultural policies, particularly with regard to peanuts, the known facts are somehow contradictory. On the one hand, the Chinese gradual transition to a market economy has been marked by a rather sharp reduction in the state support of agriculture, which caused its temporary decline (Rozelle and Swinnen, 2004). On the other, the government there is still in a position to redistribute national income among production sectors using various means that may not be easily detectable (Diop, Beghin, and Sewadeh, 2004). The enormous share of Chinese peanut exports makes this strategic consideration important.

In the case of **many firms** producing a given product, the model does not change significantly. Assuming n home country firms, n^* foreign firms producing only for export, Cournot behavior, a linear demand function

$$P = a - b\left(\sum_i q_i + \sum_j q_j^*\right), \qquad i = 1,...,n, \quad j = 1,...,n^*,$$

and defining s and s^* as home and foreign production/export subsidy, the first order condition for a domestic firm profit maximization problem

$$\max_q p = (P + s - c)q$$

is

$$P - bq = c - s,$$

the foreign firm profit maximization condition being

$$P - bq^* = c - s^*.$$

Deriving the corresponding reaction functions from the equations above leads to the following comparative statics regarding the domestic and foreign output sensitivities to the subsidies:

$$\frac{dq}{ds} = \frac{n^* + 1}{b(n + n^* + 1)}, \text{ and } \frac{dq^*}{ds} = -\frac{dQ}{ds} = -\frac{n}{b(n + n^* + 1)},$$

i.e., the home subsidy increases the home and reduces the foreign output. As this model disregards domestic consumption, welfare is determined entirely by the profits net of the subsidy: $W=n(P-c)q$. The effect of the subsidy on welfare is

$$\frac{dU}{ds} = n\left[(P - c)\frac{dq}{ds} + q\frac{dP}{ds}\right] = n\left[(bq - c)\frac{dq}{ds} + bq\frac{dQ}{ds}\right], \text{ or}$$

$$\frac{dU}{ds} = \frac{n}{b(n + n^* + 1)}\left[(bq - s)(n^* + 1) - bqn\right].$$

The optimal subsidy is obtained by setting the right-hand side of the equation above to zero:

$$s_{opt} = \frac{bq}{n^* + 1}[(n^* + 1) - n].$$

The sign of the subsidy is the same as the sign of $(n^*+1)-n$, which reflects the fact that the (domestic production) subsidy has two effect on the (domestic firms') profits: a market-share effect (increase in q) and terms-of-trade effect (reduction in P). Setting s=0, a positive subsidy is desirable only when the number of foreign firms is larger. Because the firms are assumed to be Cournot competitors, smaller number of firms corresponds to a stronger oligopoly. Thus, with more competitive foreign production, the expansion of domestic output due to the subsidy causes

a larger reduction in the foreign output, which attenuates the negative terms-of-trade effect. The magnitude of intervention, however, depends on the initial level of output: the larger the q, the larger the optimal subsidy. As the magnitude of the home output depends on the home firms' cost advantage (c-(c^*-s)), the greater the cost advantage, the larger the optimum subsidy or tax.

The constant (but asymmetric) marginal cost assumption fits a short-run equilibrium setup characterized by the absence of entry, and the multi-firm extension of the Brander-Spencer model suggests that countries/producers with smaller production costs, larger per firm output, and smaller number of firms (not necessarily translating into smaller share of exports) have more incentives to subsidize their production. This is consistent with the basic Cournot-Nash case presented above as it also postulates the optimality of an export/production subsidy in countries with (relative) cost advantage. An important feature of the multi-firm model above is that the initial output level per firm matters, i.e., the larger the q, the greater the magnitude of the subsidy (or tax). It is more likely that a subsidy will be more optimal in a country with fewer but larger firms, even when they are competitive.

2.1.2. *Bertrand competition*

If the home and foreign countries produce differentiated products, they might just as well be engaged in **Bertrand** competition, choosing prices instead of quantities (Eaton and Grossman, 1986). Solving the profit maximization problem for a home country,

$$\max_P p(P, P^*) = PD(P, P^*) - C(D(P, P^*))$$

and differentiating the solution shows that sufficient condition for the reaction function to be positively sloped is $D_{PP^*} > 0$ which, together with an additional stability condition ensuring that the rival's reaction curve is steeper (and positive), produces the result that the home government can increase its industry's profits by imposing (committing to) an export tax (same applies to the foreign government). By taxing domestic exports, the government shifts the domestic reaction curve to the right, which enables it to move the curves' intersection point to where the domestic iso-profit curve is tangent to the foreign reaction curve, which is a Stackelberg equilibrium. When the tax raises the domestic product price, the rival raises his, conferring a positive externality. As a result, both foreign and domestic product prices increase and both industries benefit, showing that the Bertrand competition exhibits strategic complementarity, as opposed to strategic substitutability in the Cournot case. The higher price charged by the taxed industry raises also benefits the foreign industry by giving it a larger market. It can be shown that, in a symmetric case, the follower's profit in case of the optimal domestic export tax is higher than that of the Stackelberg leader. The costs of these benefits are born by the importing country.

Overall, the models assuming only-for-export production, Cournot-Nash behavior, and "sufficiently" elastic export demand, advocate the individual rationality of export/production subsidies in the countries that have lower production costs and smaller number of firms. On the other hand, taxing exports is optimal for countries with larger marginal costs and when the demand for exports is "less" elastic. The subsidies are strategic substitutes, as one country's subsidy hurts the competitors but benefits the consumers. The Bertrand model of differentiated products, on the other hand, exhibits strategic complementarity and advocates optimality of export taxes instead of subsidies. Whether Cournot or Bertrand competition is a more realistic assumption depends on a number of factors. Whether the exporting countries, or their firms, set prices rather than choose production quantities depends on how international agricultural

markets operate, *i.e.*, on the actual price discovery mechanism: acceptable bargaining strategies, how long the prices are negotiated, sellers' asking prices, *etc.* However, the Bertrand competition has usually been considered more anti-competitive (confirmed by the results above), and therefore is might be rational to suggest that the international markets, although imperfectly competitive, are more likely to be characterized by Cournot-type competition.

2.2 Trade with Domestic Consumption

The models discussed above assume no domestic consumption and thus no trade between producing countries. Thus, they describe the trade policies of the countries/governments concerned exclusively with exports. The conclusions of these models are relevant for analyzing producer competition for exports to major importing countries, like the EU and the U.S. in case of peanuts. However, a more realistic setup is when countries producing the same commodity consume it domestically as well as trade with each other (especially considering the fact that world peanut trade is "residual"). This setup corresponds to regional trade patterns, such as trade between the North and South Americas within the NAFTA (FTAA).

The most elementary case of oligopoly models that accommodate consumption as well as production is a model of segmented markets with free entry described in Dixit (1984). Assuming two countries, domestic and foreign with n and n^* firms respectively and homogeneous products, linear domestic and foreign demands are

$$P = a - bQ, \qquad Q = nq + n^* q^*$$

$$P^* = a^* - b^* R^*, \qquad R^* = nr + n^* r^*,$$

where q and q^* are the sales of (representative) home and foreign firms in the home market and r and r^* are the corresponding values for the foreign market. The costs of the home (foreign) firms consist of fixed costs f (f^*) and constant marginal costs c (c^*). The available trade policies considered in Dixit are as follows:

- a tariff t imposed by the home country on the foreign imports;
- a domestic subsidy s_q on home sales to domestic firms;
- an export subsidy s_q^* by the foreign country to its firms.

With each firm (potentially) operating in both markets, the representative profits are

$$p = (P - c + s_q)q + (P^* - c)r - f$$

and

$$p^* = (P - c^* + s_q^* - t)q^* + (P^* - c^*)r^* - f^*.$$

Profit maximization under Cournot behavior yields

$P - bq = c - s_q$ and $P - bq^* = c - s_q^* + t$ for the home market sales and

$P^* - b^* r = c$ and $P^* - b^* r^* = c^*$ for the foreign market sales.

(This shows that the home firm's share in the market is inversely related to the difference between $c - s_q$ and $c - s_q^* + t$.)

The solutions for q and q^* are independent from r and r^*, which shows that the markets are segmented, as the domestic and foreign prices P and P^* are different and also independent of each other. This happens because of the absence of entry and exit and because of the constant marginal costs.

The equilibrium home price is

$$P = \frac{1}{n + n^* + 1}\left[a + n(c - s_q) + n^*(c^* + t - s_q^*\right],$$

which shows that P-c varies directly with a.

The equilibrium q and q^* (production for home consumption by a home firm and exports by the foreign one) are

$$q = \frac{1}{b}\frac{1}{n+n^*+1}\left[(n^*+1)s_q + n^*(t-s_q^*)\right]$$

$$q^* = -\frac{1}{b}\frac{1}{n+n^*+1}\left[ns_q + (n+1)(t-s_q^*)\right],$$

the total domestic consumption being

$$Q = \frac{1}{b}\frac{1}{n+n^*+1}\left[ns_q - n^*(t-s_q^*)\right].$$

This suggests that a subsidy on home sales by the home government raises the domestic and total output and lowers the foreign output, which is identical to the case of two firms competing for exports to a third (importing) country. A (home) tariff raises home output and lowers the foreign and total output. Finally, an export subsidy by the foreign government lowers home output and raises the foreign and total outputs.

Measuring welfare by the sum of consumer surplus (CS), profits, and net government revenue,

$U = CS + np + R = [g(Q) - PQ] + n\left[(P-c)q + (P^*-c)r - f\right]$, where $g(Q)$ denotes the area under the domestic demand curve, shows that the domestic subsidy drops out being a pure transfer from the government to the firms.

Analysing the comparative statics of this simple model, it can be shown that a subsidy on home sales (s_q) that raises Q and q but lowers q^* and also lowers P (due to the rise in Q) and thus increases the CS. While the effect on profits is ambiguous (q rises but P falls), the effect on CS *and* profits is positive, as CS increases by QdP and aggregate profits fall by $nqdP$, which is smaller. This effect is identical to the model of exclusively export production with multiple firms (the two instruments work identically). It can also be shown that the domestic profit maximizing tariff is positive, zero, or negative if n is smaller, equal to, or larger than n^*+1. Similar result can be obtained for the foreign country's subsidy.

An increase in the tariff (t) reduces CS (by lowering Q) and increases profits (by raising q). The joint effect on CS and profits is ambiguous. The tariff revenue rises for low initial (tariff) values but falls thereafter.

The foreign export subsidy (s_q^*) raises Q and q^* but lowers q, which increases CS but reduces domestic profits. The joint effect is ambiguous. The tariff revenue rises for $t>0$.

Totally differentiating the F.O.C. of the foreign profit maximization with respect to domestic market sales and substituting it into the (domestic) welfare equation produces the expression for the home welfare that can be used in deriving the optimal domestic policy:

$$U = n(P-c)dq + \left\{(P-c) + [c - (c^* - s_q^*) - 2bq^*]\right\}n^* dq^* + n^* q^* ds_q^*.$$

The policy instruments s_q and t serve to control q and q^*. Because of the segmented nature of the model, q and q^* alone determine Q and P.

Looking at the expression above, the first condition for optimality is P-c=0, which is satisfied by setting $s_q = bq$ (from the profit maximization conditions). The second condition depends on the cost symmetry. If $c < c^* - s_q^*$, the coefficient at dq^* is negative, which is ensured by the optimal domestic subsidy set to yield $P=c$ and, thus, the foreign firms fail to cover their marginal costs. This outcome is Pareto optimal because, in the absence of intervention, the price

exceeds marginal costs and trade is non-optimal. The domestic subsidy corrects both by setting $P=c$ and ousting imports that cost more than c. If $c > c^* - s_q^*$, $P-c=0$ still holds (as long as $q>0$). However, the subsidy does not oust the imports entirely, as $P < c^* - s_q^*$. The coefficient at dq^* is $t - bq^*$ (using the first order conditions for the home firms), which implies that, in order for it to be zero, the optimal trade policy is still to restrict imports by $t>0$, even when the foreign suppliers have a cost advantage (unless it is so big that there is no place for domestic production). The tariff is increasing in the cost difference:

$$t = \frac{c - (c^* - s_q^*)}{2}.$$

The optimum tariff strikes a balance between increases in government revenue and home firms' profits and the reduction in the CS.

So, when both production subsidy and tariff are available as policy instruments and the demand is linear, it is optimal to subsidize domestic production and not to import when there is a cost advantage and to still subsidize and keep a positive tariff when the foreign country has a cost advantage.

When one of the two instruments (subsidy or tariff) is not available, the trade policy changes. Adding up the expressions for $d(CS)$, ndp, and dR and substituting the expressions for dq, dq^*, and dQ produces another expression for dU:

$$\begin{aligned} b(n+n^*+1)dU = {} & n\left[(P-c)(n^*+1) + n^*(bq^* - t)\right]ds_q \\ & + n^*\left[(P-c)n + (n+1)(bq^* - t)\right]dt \\ & + n^*\left[-(P-c)n + n^* bq^* + t(n+1)\right]ds_q^*. \end{aligned}$$

If only the home sales subsidy is available (t and s_q^* =0), it is positive if $c < c^* - s_q^*$ and ensures a pareto efficient outcome. If $c > c^* - s_q^*$, the optimal subsidy must be large enough so that $P<c$ to ensure that the coefficient at ds_q is zero. The optimum subsidy rule is thus

$$P = \frac{n^*+1}{2n^*+1}c + \frac{n^*}{2n^*+1}(c^* - s_q^*)$$

So that the price is in between the domestic and foreign marginal costs. This is because the subsidy substitutes a tariff that would restrict imports beyond $P=c$.

When only the tariff is available, the coefficient at dt should be zero at the optimum, which produces the optimal tariff rule:

$$t = \frac{n}{n+1}(P-c) + bq^* = \frac{2n+1}{n+1}(P-c) + \frac{1}{2}\left[c - (c^* - s_q^*)\right]$$

which suggests that, as long as $P \geq c$, optimal $t \geq 0$. When $c < c^* - s_q^*$, imports are positive but restricted by the tariff (there would be no imports if subsidy were available). If $c > c^* - s_q^*$, the tariff is greater than with the subsidy to make up for the unavailable subsidy.

As for the foreign subsidy, its impact on the home welfare is ambiguous, as it lowers the price thus increasing the consumer surplus but also reduces domestic output thus reducing the profits. Setting the domestic tariff and subsidy equal to zero for clarity and substituting $P - c = bq$ from the FOC, reduces the expression for dU above to

$$\frac{dU}{ds_q^*} = \frac{-n^* b\,(nq - n^* q^*)}{b\,(n + n^* + 1)}.$$

Home welfare rises with the foreign subsidy only when $n^* q^* > nq$ - the larger the foreign share in the market, the smaller the home profit loss due to increased competition. The foreign subsidy effect is ambiguous (lowers P and increases CS but reduces home profits through lower P and q) but positive when the foreign production ahs a large share of the market.

Considering the foreign welfare, a change in policies aimed at the home market affects the foreign welfare only through profits due to the segmented nature of the model. Therefore, the Brander-Spencer conclusion for many firms applies here: the optimal foreign export subsidy is positive, zero, or negative as the number of foreign firms is smaller, equal, or greater than n+1.

The effect of the home sales subsidy on U^* is negative as it lowers q^* and expands Q lowering P.

The effect of the home country's import tariff on U^* is positive, zero, or negative as n+1 is larger, equal to, or smaller than n^*. Recalling the effects of the tariff on the home welfare, both countries benefit from it if $n^* < n$+1 and the initial equilibrium is globally suboptimal.

- $dU^* = (P - c^*)dq^* + q^* dP = (bq^* - s_q^* + t)dq^* - bq^* dQ$

2.3. Product Differentiation and Monopolistic Competition

In this subsection, we briefly mention the models that accommodate product differentiation and monopolistic competition. Due to their complexity, we do not discuss them in this paper.

Markusen and Venables (1988) introducing product differentiation (distinct product in each country) assuming free entry, which necessarily leads to a two-way trade. In their model, tariffs are born entirely by consumers and reduce domestic welfare in the consumer surplus but do not affect profits. Export subsidies by the foreign country benefit the foreign country and harm the home one. Domestic subsidy on the home sales improves the home country's welfare. While peanuts are a differentiated product and their prices differ, the incidences of bi-lateral trade in peanuts are rare.

Models of monopolistic competition in trade were developed by Krugman (1980) and Helpman and Krugman (1989). In monopolistic competition, when there are a number of varieties and producers of each have some monopoly power, tariffs are optimal and depend on the elasticity of substitution between home and foreign products.

Summary and Conclusions

In the paper, we discuss several models of imperfect competition and strategic trade policies that are applicable to agricultural trade, particularly the trade in peanuts. This study is motivated by the fact that, while the trend towards liberalization of agricultural trade is supposed to be welfare enhancing, liberalizing imperfectly competitive and often distorted markets can produce ambiguous welfare results and, what is more, increase the incentives of the trade participants to overuse the trade policies that are still available to them.

Generally, trade models of imperfect competition provide a wide array of explanations and policy recommendations that are often conflicting and, because of their extreme sensitivity to the assumptions, inconclusive. One of the few unambiguous results, however, is that restrictive or otherwise distortionary trade policies can be sometimes be welfare improving when international markets are imperfectly competitive and the players behave strategically.

The peculiarity of the peanut (and other agricultural) trade liberalization is that it is taking place in largely imperfectly competitive markets that have been distorted by protectionist trade policies. Imperfect competition exists on both the national level in many countries with concentrated processing and exporting industries, and on supra-national level, whereby governments engage in strategic trade policies.

Applying these theories to the analysis of international peanut markets, we find that the trend towards elimination of tariff barriers, as well as production or export subsidies, can have different effects on the trade flows, benefit as well as hurt some countries, and does not necessarily always improve welfare.

In analyzing the world peanut trade, we distinguish competition by exporters for an import market (the U.S. and the South American peanut producers compete with the Asian producers and each other for the EU and other import markets) and competition among producers that trade with each other, exemplifying the inter-American peanut trade as a sub-sector because peanut are produced in the South and North America and because the NAFTA and FTAA countries enjoy preferential treatment within the region. For analyzing competition for exports, we use the Brander-Spencer model of Cournot-Nash equilibrium with optimal subsidies (Brander and Spencer, 1985). For analyzing regional intra-industry trade, we employ a model of segmented markets with free entry described in Dixit (1984). Below is a summary of our findings.

The Cournot-Nash competition among exporters with different production costs creates incentives for the governments of low cost exporters to subsidize export production. These incentives are strengthened by increasing demand and reductions in tariffs and other trade barriers. The result that countries with smaller production costs should subsidize exports more might not hold for less rich and solvent countries as other considerations, like budget balancing and liquidity, may be given priority. However, countries with (still) largely centrally planned economies and small production costs, most notably China, may indeed stand to benefit from subsidizing their export production, which permits taking more advantage of their lower costs, thus hurting other exporters but benefiting the consumers.

On the other hand, exporters with larger marginal costs have an incentive to unilaterally tax their export production because, in this case, an improvement in the terms-of-trade effect (world price increase) offsets the resulting contraction in domestic production. However, the small share of high-cost exporters in the total peanut trade volume speaks against any substantial price increases resulting from changes in their production volume thus diminishing the incentives to tax exports.

Different levels of industry concentration (firms' oligopolistic behavior), reflected by the number of firms in a particular country, also have an effect on the incentives to subsidize exports. *Ceteris paribus*, countries with less competitive domestic production (fewer firms in the industry) have greater incentives to subsidize their exports. This is mainly because, with more competitive foreign production, the expansion of domestic output due to the subsidy causes a larger reduction in the foreign output, which attenuates the negative terms-of-trade effect. Moreover, the optimal subsidy varies proportionately with the *initial* level of individual firm production, implying simply that exporters with larger shares have more incentives to subsidize.

It is hard to determine which country's peanut production is more or less competitive within its borders. However, considering the largely centrally planned economy of China and the finding by Lee, Kennedy, and Fletcher (2005) that the Latin American peanut producers are oligopolistic, the US peanut exporting sector can be considered relatively competitive among the other peanut producers and thus to have fewer incentives to subsidize exports.

Overall, models of for-export production with Cournot-Nash behavior suggest that countries/producers with smaller production costs, larger output shares, and more concentrated production (not necessarily translating into smaller share of exports) have more incentives to subsidize their exports, while taxing exports may be optimal for countries with the opposite characteristics. As a rule, export subsidies benefit the importers, but hurt the exporters' profits (because Cournot export subsidies are strategic substitutes). In case of a Bertrand competition, however, taxing exports is an optimal policy for all exporters, which hurts the consumers. The inferiority of multi-lateral export subsidization or taxation can be improved by the ability to commit to not subsidizing.

Introducing domestic consumption (as in Dixit, 1984) so that the producing countries trade with each other shows that, just like in the case of two firms competing for exports to a third (importing) country, a unilateral *subsidy on home sales* raises the domestic and total output and lowers the foreign output. A unilateral tariff raises home output and lowers the foreign and total output. Finally, an export subsidy by the foreign government lowers home output and raises the foreign and total outputs. The welfare implication of this is that a net effect of home sales subsidy is an increase in supply which lowers the price and thus increases the domestic consumer surplus. The effect on home profits is ambiguous (as output rises but the price falls), but the aggregate welfare is positive. This effect is identical to the model of exclusively export production with multiple firms.

Other things equal, the domestic profit maximizing *tariff* is positive, zero, or negative if the number of home firms is smaller, equal to, or larger than the number of foreign firms plus one. That is, the tariff sign and magnitude varies with the level of home oligopoly: the more concentrated the domestic industry, the higher the profit maximizing tariff. The tariff's impact on welfare is ambiguous, as it also reduces the consumer surplus, and the tariff revenue normally rises for low initial values but decreases thereafter. The foreign *export subsidy* raises total domestic consumption and imports but lowers domestic production, thus increasing the consumer surplus but cutting the domestic profits.

When both production subsidy and tariff are available as policy instruments and the demand is linear, it is optimal to subsidize domestic production and not to import when the home costs are lower. There is no need for the tariff, as the optimal home production subsidy equates price to the (lower) home costs and thus ousts the imports. When the foreign country has a cost advantage, it is still optimal to subsidize and also to impose a positive tariff in order to increase

revenue and offset the loss in profits. The net effect of the subsidy and tariff on welfare of the higher cost firm is positive.

These results suggest that, when both tariffs and subsidies are available to the governments as trade instruments, both importing and exporting countries within a trading block have an incentive to subsidize production for domestic consumption. Moreover, it is in the interest of the welfare of the country with higher costs (inevitably the importer) to also impose a tariff on the (cheaper) imports.

When one of the two instruments (subsidy or tariff) is not available, sub-optimal outcomes ensue in the sense that they are not as welfare enhancing for the country administering them as when both instruments are available. A positive home sales subsidy is still (individually) optimal regardless of the cost asymmetry. However, when the home country has higher costs, the subsidy also substitutes for the (unavailable) tariff and thus the equilibrium domestic price is in between the domestic and foreign marginal costs. When only a tariff is available, it is optimal to impose it on imports if the home country has a cost advantage, in which case the domestic price is above the costs but imports are still restricted. If the home country's costs are higher, the magnitude of the tariff is greater than when the subsidy can be used.

As for the foreign subsidy, its impact on the home welfare is ambiguous, as it lowers the price thus increasing the consumer surplus but also reduces domestic output thus reducing the profits. However, home welfare unambiguously rises with the foreign subsidy only when the share of imports is larger than the share of home firms' production in domestic consumption, as it implies smaller home profit loss.

Considering the foreign welfare, the optimal foreign export subsidy varies proportionately with the level of foreign industry concentration relative to that of the home industry (reflected by the number of firms). The effect of the home sales subsidy on the foreign welfare is negative as it lowers foreign exports and expands domestic consumption, thus lowering the price. The effect of the home country's import tariff on the foreign country's welfare varies proportionately with the ratio of home to foreign firms (that is, when the foreign industry is more concentrated, the home country's tariff actually benefits it and vice versa). Combining it with the effects of the home tariff on the home welfare, both countries can benefit from a tariff if the foreign industry is more concentrated and the initial equilibrium is globally suboptimal.

An important general implication of these results is that, in markets characterized by already existing trade distortions, eliminating some of the trade policies that are considered harmful to trade and welfare can actually result in sub-optimal outcomes. The models discussed in this paper show that the elimination of tariffs may provoke excessive subsidies and, alternatively, elimination of subsidies may increase tariffication. Under certain conditions, even a unilateral tariff may be mutually welfare enhancing. Applying this logic to the peanut trade patterns within the two Americas suggests that the South American peanut producers stand to benefit from the reductions in the U.S. peanut production supports but, paradoxically, preservation of a tariff may still be mutually welfare enhancing. In the broader context of global peanut trade, multi-lateral tariff reduction increases the low-cost exporters' incentives to subsidize export production.

References:

Bandyopadhyay, S. 1997. "Demand Elasticities, Asymmetry, and Strategic Trade Policy," *Journal of International Economics*, 42:167-167.

Beghin, J.C., and H. Matthey. "Modeling World Peanut Product Markets: A Tool for Agricultural Trade Policy Analysis," Center for Agricultural and Rural Development, Iowa State, WP 03-WP 332, 2003.

Brander, J.A., and B.J. Spencer. 1985. "Export Subsidies and Market Share Rivalry," *Journal of International Economics*, 18:83-100.

"Issues in Reforming Tariff-Rate Quotas in the Agreement on Agriculture in the WTO," IATRC Commissioned Paper No.13, co-authored by a working group of 16 researchers and chaired by Harry de Gorter and Ian Sheldon, 2001.

Diop, N., J. Beghin, and M. Sewadeh. "Groundnut Policies, Global Trade Dynamics and the Impact of Trade Liberalization," World Bank Policy Research Working Paper 3226, March 2004.

Dixit, A. 1984. "International Trade Policy for Oligopolistic Industries," *Economic Journal*, 94, suppl.:1-116.

Dixit, A. 1986. "Comparative Statics for Oligopoly," *International Economic Review*, 27:107-22.

Dohlman, E., Hoffman, L., Young, E., and W. McBride. *"Peanut Policy Change and Adjustment under the 2002 Farm Act*." USDA-ERS Publication OCS04G01, 2004.

Eaton, J., and Grossman, G.M. 1986. "Optimal Trade and industrial Policy under Oligopoly," *Quarterly Journal of Economics*, 101:383-406.

Helpman, E., and P. Krugman. *Trade Policy and Market Structure*. Cambridge, MIT Press, 1989.

Krugman, P. 1980. "Scale Economies, Product Differentiation, and the Pattern of Trade," *American Economic Review*, 70:950-59.

Lee, Dae-Seob, P. Lynn Kennedy, and Stanley M. Fletcher. 2005. "An Analysis of Latin American Peanut Trade," JARE, forthcoming.

Markusen, J.R., and A.J. Venables. 1988. "Trade Policy with Increasing Returns and Imperfect Competition: Contradictory Results from Competing Assumptions," *Journal of international Economics*, 24:299-316.

Revoredo, C.L., and S.M. Fletcher. "*World Peanut Market: An Overview of the Last 30 Years."* University of Georgia working paper, 2003a.

Revoredo, C.L., and S.M. Fletcher. "Supplier Reputation and Price Premium: The Case of Groundnuts in Rotterdam". Paper presented at the 83rd EAAE Seminar, 2003b.

Rozelle and Swinnen. 2004. "Success and Failure of Reform: Insights from the Transition of Agriculture," *Journal of Economic Literature*, 42:404-456.

Skully, David. "U.S. Tariff Rate Quotas for Peanuts", Oil Crops Situation and Outlook, 1999.