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# Assessing the Impact of Trade Policy Changes. Does Market Structure Matter?

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# Assessing the Impact of Trade Policy Changes. Does Market Structure Matter?

## 1. Introduction

International markets of agricultural products are often highly concentrated. There are several example of markets - cereals, sugar, bananas or coffee - in which few trading firms (private or not) account for a significant share of world trade. While a considerable body of literature has addressed the issue of concentration in the food and retailing industries and its consequences in terms of market power, not many studies have focused on the structure and behavior of firms trading agricultural products in international markets; in fact, there are few empirical studies and they are not recent. However, for more than twenty years, there has been a growing consensus that the assumption of perfect competition may often be restrictive (McCorriston, 2002). Yet, empirical agricultural trade policy analysis mostly relies on the assumption of perfect competition.

The aim of this paper is to address the relevance of the assumptions about market structure and firms behavior in empirical analyses of agricultural trade policies. The paper focuses on the most recent changes in the European Union (EU) import regime for bananas, namely the Economic Partnership Agreements (EPAs) and the December 2009 WTO agreement. This is a good case study to assess to what extent non competitive behaviors matter when evaluating the effects of trade policies. In fact, the banana trading industry is among the most evident examples of high concentration in international markets, with three multinational firms accounting for almost 65% of world trade (Arias *et al*., 2003; Bananalink, 2011). Recently, the EU Commission (EC, 2008) has found that four banana traders - namely, Chiquita, Del Monte, Dole and Weichert - have violated EU rules on competition, and imposed fines on them which amounted to 60 million euro. On the other hand, for several decades the EU import regime for bananas has been the cause of heated political confrontation, both domestically and internationally (Josling and Taylor, 2003). In July 2008 the longest ever meeting in WTO negotiations history failed to reach any agreement to conclude the Doha round, but in the course of these negotiations eleven Latin American countries, the US and the EU reached a tentative provisional agreement to bring an end to the long-standing WTO "banana war". However, the failure of the Doha round meeting left the banana dispute unresolved. In December 2009 the same countries signed an agreement along the lines of what had been agreed 18 months previously. Meanwhile, on 1 January 2008 the EU implemented the EPAs, progressively removing barriers to trade between the EU and regional groupings of ACP countries. For bananas the EPAs have meant the removal of the duty-free 775,000 t quota for imports originating from ACP countries. It is expected that bananas, sugar and rice will be for ACP countries the agricultural commodities that will benefit most from the EPAs.

The paper provides a quantitative assessment, under different assumptions about market structure, first of the impact of the trade preferences the EU granted ACP countries with the EPAs, and then of the erosion of these preferences through the reduction of the MFN import tariff for bananas under the December 2009 WTO agreement. We use a single commodity, spatial, mathematical programming model. Following Samuelson (1952) and Takayama and Judge (1971) a "quasi-welfare" function is maximized subject to a set of constraints. The paper develops two modified versions of the Takayama and Judge (1971) spatial trade model: the extreme case of international trading firms jointly maximizing their profits by forming a cartel and the intermediate case of traders behaving as downstream oligopolists and upstream oligopsonists. A two-step calibration procedure is used to make the models replicate observed

trade data; this allows to address a very relevant issue, that is, which market structure is compatible with observed data.

The paper is organized as follows: the next section presents the model, the calibration procedure used and the outcomes in terms of feasible market structures; the third discusses the results, while the final section offers concluding remarks.

## 2. The model

The model is a modified and updated version of the one used in Anania (2010) to allow for different non competitive market structures; its data base has been updated and the shifting over time of supply functions as a result of technical changes has been modified to take into account, in addition to expected changes in yields, the effects on land allocation for banana production. It is a single commodity, spatial, partial equilibrium, mathematical programming model; an objective function is maximized subject to a set of constraints describing relevant demand and supply functions, price linkages (due, for example, to transportation costs and policy interventions) and policies which cannot be represented through exogenously determined price wedges (such as import quotas). The model includes five sources of domestic supply within the EU, fourteen exporting and four importing countries/regions. Import demand and export supply functions, as well as domestic supply functions in the EU, are assumed to be linear, or to be well approximated by linear functions in the relevant portions for the simulations conducted. Production functions in the EU and import demand and export supply functions in other countries/regions in the base year are obtained from observed produced, imported and exported quantities, observed production, import and export prices, and supply, export supply and import demand price elasticities at the equilibrium in each country/region. The values of the elasticities used are exogenous to the model and are based on those used elsewhere (Anania, 2010; Arias *et al*., 2005; Guyomard *et al.*, 1999a and 1999b; Kersten, 1995; and Vanzetti *et al.*, 2005).[1] Net imports, net exports and average import and export unit values have been computed on the basis of information from the COMTRADE and FAOSTAT databases. Data for Martinique and Guadalupe, Canary Islands, Madeira and Azores, and Crete are based on information from the European Commission.

The modeling of the EU-27 import regime in 2007 includes:[2]

(a) for bananas originating in MFN countries, the "tariff only" import regime introduced in 2006 (the import tariff equals 176 €/t);
(b) for bananas originating in ACP countries, a 775,000 t TRQ, with duty-free in-quota imports and out-of-quota imports subject to the MFN tariff (176 €/t);
(c) for bananas originating in LDCs, unlimited duty-free imports.

For the US and the "Rest of the world net importers" the model includes the tariffs applied in 2007.

In order to assess how the simulation of the effects of policy changes are affected when the assumption that markets are perfectly competitive is relaxed, we consider two other

[1] The basic structure of the model is provided in Anania (2010). Observed produced, imported and exported quantities, observed production, import and export prices, and supply, export supply and import demand price elasticities are not reported here due to the space constraint.
[2] The 2006 reform of the EU domestic policy regime for bananas "decoupled" support for banana producers outside the "outermost regions" of the EU moving it into the "single farm payment" introduced with the 2003 Fischler reform; this means that banana production in Greece, Cyprus and continental Portugal is driven by market forces only, while in the "outermost regions" (France; Spain; Azores and Madeira in Portugal) different regimes apply.

market structures: (a) the extreme case of international trading firms jointly maximizing their profits by forming a cartel exerting monopsony power in their relations with exporters and monopoly power with respect to importers; and (b) the intermediate case of traders behaving as downstream oligopolists and upstream oligopsonists, considering different degrees of imperfect competition. The possibility of exerting market power is limited only to the firms active in the international trading of bananas.

In the 2007 base model the reference scenario with perfectly competitive markets is modeled by maximizing a standard "quasi-welfare" function (Samuelson, 1952; Takayama and Judge, 1971):

$$\text{Max } W(x_{in}, xq_{ie}, xmfn_{ie}) = \sum_j \int_0^{q^d_j} p^d_j(m)\,\mathrm{d}m - \sum_i \int_0^{q^s_i} p^s_i(r)\,\mathrm{d}r - \sum_i \sum_j (TC_{ij}\, x_{ij}) - \sum_i \sum_e (xmfn_{ie}\, TMFN_{ie}) - \sum_i \sum_n (x_{in}\, T_{in}) \quad , \qquad (1)$$

subject to a set of constraints, where: $i$ is an index for exporting countries and for sources of domestic supply in the EU; $j$ is an index for importing countries; $e$ is an index for EU15 and EU12; $n$ is an index for non-EU importing countries; $p^d_j(m)$ is country $j$'s inverse import demand function; $p^s_i(r)$ is country $i$'s inverse export supply function; $q^d_j$ are country $j$'s total imports; $q^s_i$ are country $i$'s total exports; $T_{in}$ is the per unit import tariff imposed by country $n$ on its imports from country $i$ ; $TC_{ij}$ is the per unit international transaction cost for shipments from country $i$ to country $j$ (border to border); $TMFN_{ie}$ is the MFN import tariff imposed by EU member states $e$ on their imports from country $i$ (it applies to imports from MFN importers and on out-of-quota imports from ACP countries); $x_{ij}$ is the trade flow from country $i$ to country $j$; $xmfn_{ie}$ is the trade flow from country $i$ to EU member states $e$ subject to the MFN import tariff; and $xq_{ie}$ is the trade flow from country $i$ to EU member states $e$ within the preferential duty-free TRQ for ACP countries.

The first non-competitive behavior considered is a cartel, that is, the presence of a number of colluding firms which maximize joint profits; this stylizes the EU Commission's (EC, 2008) detection of the existence of a stable cartel among banana traders in Northern European Union countries. We assume that colluding traders are able to exert market power upstream as well as downstream; thus, the cartel is assumed to exert monopsony power with respect to banana exporters and monopoly power with respect to importers. This market structure is modeled by maximizing traders' total profits, given by total revenues across all importing countries minus international transaction costs, banana acquisition costs and tariff expenditure:

$$\text{Max } \Pi(x_{in}, xq_{ie}, xmfn_{ie}) = \sum_i \sum_j (p^d_j - p^s_i - TC_{ij})\, x_{ij} - \sum_i \sum_e (xmfn_{ie}\, TMFN_{ie}) - \sum_i \sum_n (x_{in}\, T_{in}) \quad . \qquad (2)$$

In between perfect competition and the cartel, a range of possible non-competitive behaviors are introduced in the model by considering different mark-up values. The mark-up is defined as:

$$k = \frac{p - c}{c} \qquad (3)$$

where $p$ is the selling price and $c$ is the marginal cost. Let $\lambda_i = \sum_{j \neq i} \frac{dX_j}{dX_i}$ be the conjecture that firm $i$ has on the impact that a change in its output $X_i$ has on the sum of the outputs chosen by each of its rivals, $X_j$. If firms are symmetric, it can be shown (Shapiro, 1992) that:

$$k = \frac{s_i}{\varepsilon}(1 + \lambda_i) \qquad (4)$$

with $s_i$ being the market share of each firm $i$ and $\varepsilon$ the demand elasticity.

Under Cournot behavior the conjectural parameter is equal to 0; when firms are price takers the conjectural parameter is equal to -1 and the mark-up is zero. Under a cartel equation (4) reduces to the usual monopoly equation $k = \frac{1}{\varepsilon}$.

We model firm oligopolistic/oligopsonist behaviors by considering different percentages of mark-up. The values of mark-up under three benchmark market behaviors - perfect competition or Bertrand (under which, if the product is homogeneous, the mark-up is zero), Cournot and a cartel - are reported in table 1 for two different values of the demand elasticity (assuming firms sell bananas on one market only) and under different market structures. We believe that only those in the central columns, that is, a number of (identical) firms equal to 11, 7 and 5, appear to be plausible representations for the world banana trading industry. In our modeling exercise different mark-up values are considered, ranging from 3% to 25%. With the lower value of elasticity, a mark-up equal to 3% is consistent with behaviors that are close to perfect competition. A mark-up equal to 12% corresponds to conjectures that are close to Cournot only when there are more than 16 firms, which is a rather implausible hypothesis for the banana trading industry. However, with a higher elastiticity a mark-up equal to 12% corresponds to Cournot if there are 11 firms. Higher values of mark-up, such as 20%, correspond to an industry which is less competitive than Cournot; this occurs if there are more than 10 and 6 firms, under the lower and higher elasticity value assumptions, respectively.

This third market structure is modeled by maximizing a "quasi-welfare" function (Takayama and Judge, 1971) modified to include trading firm profits calculated using the mark-up:

$$\text{Max } W(x_{in}, xq_{ie}, xmfn_{ie}) = \sum_j \int_0^{q^d_j} p^d{}_j(m)\, \mathrm{d}m - \sum_i \int_0^{q^s_i} p^s{}_i(r)\, \mathrm{d}r -$$
$$- \sum_i \sum_j (TC_{ij}\, x_{ij}) - \sum_i \sum_e (xmfn_{ie}\, TMFN_{ie}) - \sum_i \sum_n (x_{in}\, T_{in}) - \sum_i \sum_j (MU_{ij}\, x_{ij}), \qquad (5)$$

where $MU_{ij}$ is the per unit profit on shipments from exporter *i* to importer *j* obtained by applying the (exogenously determined) percentage of mark-up to total per unit costs, specific to that trade flow, incurred by the trader (acquisition price + international transaction cost).[3]

[3] Spatial models which include imperfectly competitive market structures and assume, as we do, a perfectly homogeneous product have been proposed by Takayama and Judge (1971), Kawaguchi, Suzuki and Kaiser (1997) and Yang *et al.* (2002). Our model differs from these models mainly because market power is here exerted by middlemen and because, by introducing the value of mark-up, we model a range of possible market

One characteristic of mathematical programming spatial models is that predicted bilateral trade flows show an overspecialization with respect to those observed, i.e. the solution includes a smaller number of non-zero trade flows than those observed. This is the result of the optimization procedure used as well as the inability of the constraints included in the model to fully represent the complexity of the market under scrutiny, because of both the poor quality of available information and the simplified representation in the model of market agent behaviors. In models like the one developed in this paper the information which appears weaker is the matrix of bilateral international transaction costs. In our model these have been generated from available industry information on international transaction costs for few specific bilateral trade flows, using distances between countries to explain differences in the variable component of transaction costs. The two step calibration procedure proposed by Paris *et al.* (2010) has been used to make up for the poor quality of per unit transaction costs and improve the capacity of the base model to reproduce observed net trade positions as well as bilateral trade flows. Essentially, information regarding the observed market equilibrium is used to infer the errors in international transaction costs which, once corrected, make the model perfectly calibrate observed country net trade positions.[4] In the first step the model is augmented by a set of constraints imposing predicted bilateral trade flows to equal observed ones. The values of the dual variables associated in the solution to these constraints are then used in step two to correct per unit international transaction costs. The solution of the model in step two perfectly replicates observed country net trade positions; in general there are multiple optimal sets of bilateral trade flows associated to observed net trade positions, observed trade flows being one of these sets (Paris *et al.*, 2010).

When the model assuming a cartel maximizing joint profits is calibrated, even setting the per unit transaction cost equal zero is not sufficient to make the model generate the observed market equilibrium. An adjustment of transaction costs to make them negative is needed for the model to reproduce the observed market equilibrium; this would mean traders receiving for each unit of bananas traded a "subsidy" which exceeds transaction cost. This implies that the hypothesis of traders forming a cartel that acts as a monopolist and a monopsonist in the world market for bananas turns out to be unfeasible, being inconsistent with observed quantities traded and importer and exporter border prices. In fact, the downward adjustments of transaction costs needed to calibrate the model range between 754 and 2,710 US$/t and the resulting corrected transaction costs between -553 and -2,600 US$/t.

This result may not come as a surprise, given that a world cartel, even for the banana market, is a rather extreme situation. However, the findings for the other imperfectly competitive market structures are less predictable. Indeed, a similar outcome also emerges for imperfectly competitive world market structures with a mark-up above 12%. Even when the mark-up was set equal to 12% calibrating the model made two corrected transaction costs be negative; however, in this case their values were judged to be within the range of possible measurement errors in border prices (the largest one in absolute value was – 12 US$/t). We conclude that market structures with international traders acting as non-cooperative oligopolists/oligopsonists with a resulting mark-up exceeding 12% are unfeasible in the banana market, being largely inconsistent with observed border prices and quantities traded. These results crucially depend on the assumptions made regarding the imperfectly

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structures and do not impose a specific mode of competition. Only few papers have assessed the impact of banana policy changes by assuming imperfectly competitive market structures; McCorriston and Sheldon (1996) and McCorriston (2000) have used a non-spatial vertically-related market model in which oligopoly/oligopsony is assumed at each stage.

[4] The calibration procedure implicitly assumes that the only potentially ill-measured information in the model is bilateral international transaction costs.

competitive structures of the banana market. For example, we assume that only international traders are in the position to exert market power. If this assumption is relaxed and it is assumed instead that actors operating downstream (such as retailers) hold market power, our results may no longer hold true.

## 3. Results

All the simulations have been generated with reference to 2019, the earliest time horizon for the completion of the implementation of the December 2009 WTO agreement, assuming that no agreement on the modalities in agriculture in the DDA round is reached by the end of 2013.

The "2019 base" reference model has been obtained from the "2007 base" by modeling changes in production, import demand and export supply functions in all countries/regions as a result of expected shifts in domestic demand and supply functions. Import demand and export supply functions shift according to expected changes, *ceteris paribus*, in quantities produced and consumed in each country/region.[5] Consumption is assumed to vary over time on the basis of observed changes in population and per capita incomes (in constant terms) between 1997 and 2007, and 1995-97 and 2005-07, respectively. Banana production in each country/region is assumed to change over time, *ceteris paribus*, in line with observed changes in production due to technical changes between 1995-1997 and 2005-2007.

The results of the simulations are presented in tables 2 and 3. Five different market structures, found to be feasible given observed traded quantities and prices, have been considered: perfect competition and oligopoly/oligopsony with mark-up percentages equal to 3%, 6%, 9% and 12%. The results for the "2007 base" scenario are the same for all of them, each of the five models being calibrated to reproduce the observed market equilibrium. Two policy scenarios in 2019 have been simulated in addition to the "base" reference one: a scenario in which only the EPAs are introduced, i.e. the EU removes its 775,000 t duty-free import quota on bananas originating in ACP countries and these may enter the EU duty-free and subject to no quantitative restriction, and a scenario in which, in addition to EPAs, the December 2009 WTO agreement is implemented, i.e. the MFN tariff imposed by the EU drops from 176€/t to 114€/t (import tariffs imposed by other countries remain unchanged).[6]

The simulation results obtained under the five market structures appear fairly close (table 2). This comes as no surprise, given the relatively low degrees of market power which have been found to be feasible and have been considered in the analysis. However, differences among the results obtained under the various market structures become more evident when percentage changes are considered (table 3).

Under all market structures the implementation of the EPAs is expected to generate consistent benefits for ACP countries, whose total exports increase by about 80% and export revenue triples, while MFN and LDC exports and export prices decline and imports by countries different from the EU increase; significant trade diversion occurs, with ACP exports

[5] The FAOSTAT data base is the source used for production and apparent consumption (domestic production + imports – exports) in 2007.

[6] It may be useful to underline at the outset that the results under the five market structures should not be compared directly, as the models which generate them differ, not only in the assumptions made regarding the market structure, but in other crucial parameters as well. In particular they differ in the per unit transaction costs, because of the differences in the results of the calibration procedure for the five models; in fact, corrected transaction costs become smaller and smaller as we move from perfect competition to increasing degrees of market power.

previously directed to non-EU countries now being redirected toward the latter, and a consistent share of exports by MFN countries being diverted in the opposite direction. The higher the percentage of mark-up, the higher tend to be percentage changes; this is so because calibrated transaction costs decline with the percentage of mark-up, with the effect of accentuating the impact of the policy change. The most significant differences in trade flows between the results obtained under the five market structures relate to LDC exports. Under perfect competition, in the 2019 base scenario and in the scenario with the EPAs only all their exports are directed towards the EU, and they decline by 7.1% when the EPAs are implemented; when the imperfectly competitive market structures are assumed, LDC do not export to the EU in the 2019 base scenario, but find it profitable to do so when the EPAs are implemented, with their exports declining by between 4 and 6%, less than forecast under the perfect competition scenario. What happens here is that the profitability of LDC exports to the EU and the Rest of the world markets is very close and the reduction of the import price in the latter (because of the outward shift in the export supply towards them by MFN countries) makes exporting to the former more profitable, although LDC are now able to export less.

The increases in the degree of market power make the sign of the expected change for some crucial variables switch. This is the case for the EU import price, and, as a consequence, for EU consumption and imports. This result is driven by the fact that EPAs, on the one hand, make ACP exports on the EU market more competitive, but, on the other, ACP export prices being larger than MFN ones, and per unit profits on ACP exports being larger than those on MFN exports, pushes EU import price for bananas upward. When this effect, which increases the larger the percentage of mark-up, overcomes the effect in the opposite direction of the partial liberalization of banana imports, the EU price increases. This leads us to conclude that as the degree of market power increases, market structure matters not only in terms of the expected magnitude of the impact of policy changes on the different agents involved, but in terms of its sign as well.

Firms' profits increase with the introduction of the EPAs. Again, ACP are less efficient banana producers and show significantly higher export prices than MFN exporters; this makes the positive effect on firms' profits of increased ACP exports and export prices overcome the effect in the opposite direction of lower MFN and LDC exports and export prices.

When the implementation of the December 2009 WTO agreement is simulated (in addition to the EPAs), the effects of the preference erosion for ACP exports are marked and of the same order of magnitude under all market structures. ACP banana exports, all still directed to the EU, decline by around 15%, while MFN exports increase by 3.6%; those directed to the EU expand by over 90%, as trade diversion occurs in addition to trade creation. The increase in import prices in non-EU markets and the decline of EU import price cause LDC exports to be redirected from the EU to the Rest of the world; thanks to the lower transaction costs to this destination compared to the EU, LDC exports increase by 1%. The 2009 WTO agreement causes a decline in firms' profits, although by 2% only, because of the lower volume of ACP exports, which are more profitable for the traders than MFN ones; in addition, the decline in profits comes from the negative effects on per unit profits of the lower imports by the US and the Rest of the world, and those, of the opposite sign, of the larger volume of EU imports and higher export prices in MFN and LDC countries. While the EPAs produced little change in the EU domestic market, the WTO agreement causes the EU domestic price to decline by around 10%, consumption to increase by 5% and imports to increase by a little more than 5%; on the contrary, EU production changes very little, as EU domestic policy for bananas makes only production in Greece, Portugal and Cyprus (which jointly account for a very small share of EU banana production) react to market signals. For

the reasons discussed above, the magnitude of percentage changes in market equilibrium increases with the percentage of mark-up and firms' market power.

The overall impact of the EPAs and the WTO agreement with respect to the "2019 base", which is reported in the five columns at the right end of table 3, shows that the reduction of the preferential margin due to the WTO agreement does not cancel out the benefits to ACP countries from the EPAs; when the WTO agreement is implemented their exports and export revenues remain significantly above those in the base scenario (by more than 50 and 110%, respectively). Analogously, despite the trade creation effect of the reduction from 176 to 114 €/t of their relevant tariff , MFN countries are not able to fully recover from the loss of competitiveness *vis a vis* ACP countries which results from the EPAs and their exports and export revenue remain slightly below those in the base scenario.

## 4. Conclusions

The goal of this paper was to address the importance of the assumptions made about market structure and firm behaviors in empirical trade policy analysis with respect to recent changes in the EU import regime for bananas. We believe the paper's contribution to unraveling this issue is threefold: it develops two original models which incorporate imperfectly competitive market structures in a spatial modeling framework; it provides an assessment of the degree of market power in international banana trade and, finally, it assesses how the expected effects of the most recent EU import regimes for bananas are affected by the assumptions made on the prevailing market structure.

The paper develops two modified versions of the Takayama and Judge (1971) spatial trade model. The first model includes a profit maximizing cartel of the firms which handle international trade. The second model incorporates oligopolistic and oligopsonistic behaviors of trading firms through a mark-up; this modeling framework has the advantage of being flexible, easy to implement and does not require identification of each firm's conjectural variation parameters, which would imply making explicit assumptions about the number and symmetry of relevant firms in each importing market. The percentage of mark-up provides a representation of the degree of market power without having to make too restrictive assumptions about the nature of competition.

The two step calibration procedure used to make the model replicate observed country net trade positions provided insights on a relevant issue, that is: what is the degree of market power in the world market for bananas? Indeed, the result of the analysis presented in the paper is that some market structures hypothesized turn out to be unfeasible, being largely inconsistent with observed traded quantities and border prices. This happens when a cartel maximizing firms' joint profits is assumed, but also for imperfectly competitive world market structures where the mark-up is above 12%. In fact, the results show that observed data are only consistent with market behaviors which are far away from Cournot and, actually, are close to perfect competition under most of the values of demand elasticities and market shares here considered. This result appears even more important given the high concentration of international trade of bananas.

The implementation of the EPAs is expected to increase ACP exports to the EU significantly and generate overall consistent benefits for ACP countries; trade diversion occurs, with ACP exports previously directed to non-EU countries now being redirected toward the latter. The 2009 WTO agreement significantly reduces the preferential margin for ACP countries, but does not offset the benefits from the EPAs; as a whole, with both the EPAs and the WTO agreement in place, ACP countries are better off in terms of both exports

and export revenues. Analogously, despite the trade creation effect of the lower tariff they face on the EU market, the WTO agreement does not compensate MFN countries for the loss of competitiveness *vis a vis* ACP countries as a result of the EPAs. Given the relatively low level of market power, simulation results are quite similar across the five market structures considered. However, the results show that as the feasible degree of market power increases, market structure matters not only in terms of the expected magnitude of the impact on the different agents involved, but in terms of its sign as well.

The findings of this paper, especially those concerning the degree of market power in the world market for bananas, depend upon a number of assumptions, common to most empirical studies on bananas, the most important of which include that: bananas are a homogeneous product; banana traders do not extend their activities downstream, into importing and ripening, or upstream, into producing and exporting bananas; actors different from the firms operating in international trading (importers and, even more important, retailers) have no market power; the policy changes considered have no effect on firm behaviors and market structure. The removal of any of the above is likely to skew the results reached in this paper; however, this would imply the use of a completely different modeling framework and data needs which would be difficult to satisfy.

In conclusion, notwithstanding its limitations, we believe this paper does provide useful insights for the empirical analysis of trade policy effects in imperfectly competitive markets.

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**Table 1: Mark-up values under different market structures**

| | *number of firms* | | | | | |
|---|---|---|---|---|---|---|
| | *20* | *16* | *11* | *7* | *5* | *3* |
| *ε=0.5* | | | | | | |
| Perfect competition/Bertrand | 0 | 0 | 0 | 0 | 0 | 0 |
| Cournot-Nash | 10 | 12.5 | 18 | 28.6 | 40 | 66.7 |
| Cartel | 200 | 200 | 200 | 200 | 200 | 200 |
| *ε=0.75* | | | | | | |
| Perfect competition/Bertrand | 0 | 0 | 0 | 0 | 0 | 0 |
| Cournot-Nash | 6.7 | 8.3 | 12.1 | 19.0 | 26.7 | 44.4 |
| Cartel | 133 | 133 | 133 | 133 | 133 | 133 |

Table 2 - Simulation results.

| | 2007 base | | Perfect competition | | | Mark-up 3% | | | Mark-up 6% | | | Mark-up 9% | | | Mark-up 12% | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 2019 base | EPA only | EPA + Dec 2009 Agreement | 2019 base | EPA only | EPA + Dec 2009 Agreement | 2019 base | EPA only | EPA + Dec 2009 Agreement | 2019 base | EPA only | EPA + Dec 2009 Agreement | 2019 base | EPA only | EPA + Dec 2009 Agreement |
| EU production (000 t) | 626 | | 575 | 574 | 572 | 574 | 574 | 572 | 574 | 574 | 572 | 574 | 574 | 572 | 574 | 574 | 572 |
| EU consumption (000 t) | 5.304 | | 6.415 | 6.451 | 6.753 | 6.441 | 6.451 | 6.762 | 6.470 | 6.451 | 6.771 | 6.498 | 6.451 | 6.781 | 6.572 | 6.451 | 6.790 |
| EU15 border price (euro) | 616,1 | | 600,6 | 593,9 | 536,5 | 596,0 | 593,8 | 534,8 | 591,0 | 593,8 | 533,1 | 586,1 | 593,8 | 531,4 | 571,9 | 593,7 | 529,7 |
| EU imports (000 t) | 4.678 | | 5.840 | 5.876 | 6.181 | 5.867 | 5.877 | 6.190 | 5.895 | 5.876 | 6.199 | 5.924 | 5.877 | 6.208 | 5.998 | 5.877 | 6.217 |
| *EU imports from ACP (000 t)* | *855* | | *950* | *2.433* | *2.068* | *923* | *2.407* | *2.041* | *896* | *2.381* | *2.016* | *867* | *2.357* | *1.992* | *864* | *2.335* | *1.970* |
| *EU imports from MFN (000 t)* | *3.823* | | *3.448* | *2.103* | *4.113* | *4.944* | *2.126* | *4.149* | *5.000* | *2.148* | *4.183* | *5.057* | *2.169* | *4.216* | *5.134* | *2.188* | *4.247* |
| *EU imports from LDC (000 t)* | *0* | | *1.443* | *1.340* | *0* | *0* | *1.344* | *0* | *0* | *1.347* | *0* | *0* | *1.351* | *0* | *0* | *1.354* | *0* |
| USA imports (000 t) | 3.544 | | 4.440 | 4.486 | 4.454 | 4.436 | 4.487 | 4.454 | 4.434 | 4.488 | 4.453 | 4.433 | 4.489 | 4.453 | 4.466 | 4.490 | 4.453 |
| ROW imports (000 t) | 7.250 | | 7.949 | 8.095 | 7.994 | 7.937 | 8.099 | 7.993 | 7.932 | 8.102 | 7.993 | 7.928 | 8.105 | 7.992 | 8.051 | 8.108 | 7.991 |
| ACP total exports (000 t) | 935 | | 1.353 | 2.433 | 2.068 | 1.328 | 2.407 | 2.041 | 1.302 | 2.381 | 2.016 | 1.274 | 2.357 | 1.992 | 1.275 | 2.335 | 1.970 |
| MFN total exports (000 t) | 14.454 | | 15.434 | 14.684 | 15.205 | 15.514 | 14.712 | 15.236 | 15.556 | 14.738 | 15.265 | 15.601 | 14.762 | 15.293 | 15.802 | 14.786 | 15.320 |
| LDC total exports (000 t) | 83 | | 1.443 | 1.340 | 1.356 | 1.398 | 1.344 | 1.360 | 1.404 | 1.347 | 1.364 | 1.410 | 1.351 | 1.368 | 1.437 | 1.354 | 1.371 |
| ACP export revenue (mill US$) | 331,1 | | 489,5 | 1.449,0 | 1.066,7 | 474,0 | 1.419,9 | 1.042,0 | 458,7 | 1.392,7 | 1.019,1 | 443,1 | 1.367,4 | 997,8 | 444,4 | 1.343,7 | 977,9 |
| MFN export revenue (mill US$) | 3.642,1 | | 3.758,6 | 3.443,2 | 3.661,0 | 3.793,3 | 3.454,4 | 3.674,0 | 3.811,6 | 3.465,1 | 3.686,5 | 3.830,8 | 3.475,3 | 3.698,3 | 3.918,9 | 3.485,0 | 3.709,8 |
| LDC export revenue (mill US$) | 16,9 | | 289,4 | 256,2 | 261,2 | 274,7 | 257,4 | 262,5 | 276,6 | 258,5 | 263,8 | 278,6 | 259,6 | 265,0 | 287,7 | 260,6 | 266,2 |
| Traders' profits (mill US$) | | | 0,0 | 0,0 | 0,0 | 250,1 | 289,1 | 282,6 | 484,1 | 561,6 | 548,6 | 703,6 | 819,0 | 799,5 | 693,0 | 1.062,4 | 1.036,4 |

Table 3 - Simulation results. Expected impact of policy changes under different market structures (% changes)

| | 'EPA only' vs. '2019 base' | | | | | 'EPA + Dec 2009 Agreement' vs. 'EPA only' | | | | | 'EPA + Dec 2009 Agreement' vs. '2019 base' | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Perfect competition | Mark-up 3% | Mark-up 6% | Mark-up 9% | Mark-up 12% | Perfect competition | Mark-up 3% | Mark-up 6% | Mark-up 9% | Mark-up 12% | Perfect competition | Mark-up 3% | Mark-up 6% | Mark-up 9% | Mark-up 12% |
| **EU production (000 t)** | -0,2 | 0,0 | 0,0 | 0,0 | 0,0 | -0,3 | -0,3 | -0,3 | -0,3 | -0,3 | -0,5 | -0,3 | -0,3 | -0,3 | -0,3 |
| **EU consumption (000 t)** | 0,6 | 0,2 | -0,3 | -0,7 | -1,8 | 4,7 | 4,8 | 5,0 | 5,1 | 5,3 | 5,3 | 5,0 | 4,7 | 4,4 | 3,3 |
| **EU15 border price (euro)** | -1,1 | -0,4 | 0,5 | 1,3 | 3,8 | -9,7 | -9,9 | -10,2 | -10,5 | -10,8 | -10,7 | -10,3 | -9,8 | -9,3 | -7,4 |
| **EU imports (000 t)** | 0,6 | 0,2 | -0,3 | -0,8 | -2,0 | 5,2 | 5,3 | 5,5 | 5,6 | 5,8 | 5,8 | 5,5 | 5,2 | 4,8 | 3,7 |
| *EU imports from ACP (000 t)* | 156,1 | 160,8 | 165,7 | 171,9 | 170,3 | -15,0 | -15,2 | -15,3 | -15,5 | -15,6 | 117,7 | 121,1 | 125,0 | 129,8 | 128,0 |
| *EU imports from MFN (000 t)* | -39,0 | -57,0 | -57,0 | -57,1 | -57,4 | 95,6 | 95,2 | 94,7 | 94,4 | 94,1 | 19,3 | -16,1 | -16,3 | -16,6 | -17,3 |
| *EU imports from LDC (000 t)* | -7,1 | ... | ... | ... | ... | -100,0 | -100,0 | -100,0 | -100,0 | -100,0 | -100,0 | ... | ... | ... | ... |
| | | | | | | | | | | | | | | | |
| **USA imports (000 t)** | 1,0 | 1,1 | 1,2 | 1,3 | 0,5 | -0,7 | -0,7 | -0,8 | -0,8 | -0,8 | 0,3 | 0,4 | 0,4 | 0,5 | -0,3 |
| **ROW imports (000 t)** | 1,8 | 2,0 | 2,1 | 2,2 | 0,7 | -1,2 | -1,3 | -1,3 | -1,4 | -1,4 | 0,6 | 0,7 | 0,8 | 0,8 | -0,7 |
| | | | | | | | | | | | | | | | |
| **ACP total exports (000 t)** | 79,8 | 81,3 | 82,9 | 85,0 | 83,1 | -15,0 | -15,2 | -15,3 | -15,5 | -15,6 | 52,8 | 53,7 | 54,8 | 56,4 | 54,5 |
| **MFN total exports (000 t)** | -4,9 | -5,2 | -5,3 | -5,4 | -6,4 | 3,5 | 3,6 | 3,6 | 3,6 | 3,6 | -1,5 | -1,8 | -1,9 | -2,0 | -3,1 |
| **LDC total exports (000 t)** | -7,1 | -3,9 | -4,1 | -4,2 | -5,8 | 1,2 | 1,2 | 1,3 | 1,3 | 1,3 | -6,0 | -2,7 | -2,8 | -3,0 | -4,6 |
| | | | | | | | | | | | | | | | |
| **ACP export revenue (mill US$)** | 196,0 | 199,6 | 203,6 | 208,6 | 202,4 | -26,4 | -26,6 | -26,8 | -27,0 | -27,2 | 117,9 | 119,8 | 122,2 | 125,2 | 120,0 |
| **MFN export revenue (mill US$)** | -8,4 | -8,9 | -9,1 | -9,3 | -11,1 | 6,3 | 6,4 | 6,4 | 6,4 | 6,5 | -2,6 | -3,1 | -3,3 | -3,5 | -5,3 |
| **LDC export revenue (mill US$)** | -11,5 | -6,3 | -6,5 | -6,8 | -9,4 | 2,0 | 2,0 | 2,1 | 2,1 | 2,1 | -9,7 | -4,4 | -4,6 | -4,9 | -7,5 |
| | | | | | | | | | | | | | | | |
| **Traders' profits (mill US$)** | | 15,6 | 16,0 | 16,4 | 53,3 | | -2,2 | -2,3 | -2,4 | -2,4 | | 13,0 | 13,3 | 13,6 | 49,6 |