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Assessing the Impact of Recent Trade Policy Changes in the Banana Market under Alternative Market Structures

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Abstract

The paper focuses on the importance of the assumptions made about market structure and firm behaviors in empirical trade policy analysis. It does it with reference to the most recent changes in the EU import regime for bananas, namely the Economic Partnership Agreements and the December 2009 WTO agreement on bananas. The paper's contribution to the literature on the issues addressed 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 analysis of the implications of the most recent changes in the EU import regimes for bananas is affected by the assumptions made regarding the prevailing market structure.

JEL code: Q17, Q18, F13

Key words: Bananas, Economic Partnership Agreements, WTO

1. INTRODUCTION

International markets of agricultural products are often highly concentrated. There are several example of markets – such as 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 the consequences of this in terms of market power, not many studies have focused on the structure and behavior of multinational agricultural trading firms; in fact, empirical studies are very few and rather outdated. However, for more than twenty years, there has been a growing consensus that the assumption of perfect competition - in general terms and in modeling agricultural trade in particular - 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 firm behavior in the empirical analysis of agricultural trade policies. The paper focuses on the most recent changes in the 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, if any, non competitive behaviors matter when evaluating the effects of agricultural 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 over 50% of world trade. Recently, the EC Commission (EC, 2008) has found that four banana traders have violated EU rules on competition, and has consequently imposed fines on them. Although the suspicion that large banana traders behave non competitively is very common, the few empirical studies estimating the degree of market power in the banana market are limited in their time and geographical coverage and provide contrasting results (Deodhar and Sheldon, 1995 and 1996; Herrmann and Sexton, 2001). The

lack of evidence of the exercise of market power by banana traders partly explains the assumption of perfect competition in most papers assessing the impact of EU policy changes (e.g. Anania, 2006, 2008 and 2010a; Guyomard *et al*, 1999a and 1999b; Kersten, 1995; Spreen *et al*, 2004; Vanzetti *et al*, 2005); very few papers have assumed oligopolistic behavior by banana traders (McCorriston and Sheldon, 1996; McCorriston, 2000; Scoppola, 2008).

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 (Anania, 2006; Josling and Taylor, 2003; Read, 2001). In July 2008 the longest ever meeting in WTO negotiations history failed to reach an agreement to conclude the Doha round. In the course of these negotiations eleven Latin American countries, the US and the EU reached a tentative provisional agreement to bring to an end the long-standing WTO banana dispute. 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 before.[1] Meanwhile, on 1 January 2008 the EU implemented the EPAs (EC, 2007), progressively removing barriers to trade between the EU and regional groupings of ACP countries. Agricultural exports from ACP countries which have successfully concluded the negotiations are now entering the EU market duty- and quota-free. For bananas the EPAs 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 are the agricultural commodities that will derive most of the benefits of the EPAs for ACP countries.

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 from the reduction of the MFN import tariff for bananas under the December 2009 WTO agreement. The banana market is possibly the one in which benefits from trade preferences and potential losses from preference erosion are the greatest (Alexandraki and Lankes, 2006; Law, Piermartini and Richtering, 2009; Yang, 2005) and conflicts between different interests are most evident and vocal.

We use a single commodity, spatial, mathematical programming model which is a modified and updated version of the one in Anania (2010a). In addition to perfect competition, the model has been modified to allow for two different market structures: 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. 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 proposes some concluding remarks.

2. THE MODEL

The model is a modified and updated version of the one used in Anania (2010a) to allow for different non competitive market structures; its updated data base now refers to 2007 (in Anania (2010a) the model was constructed with reference to 2005), and the shifting over time of supply

1 The agreement called for a reduction of the EU MFN tariff on bananas from 176 to 114 €/t between January 1 2010 and 2017, with a 28 €/t tariff cut in the first year. In March and June 2010 the EU reached trade agreements with Colombia, Peru and six Central American countries which include relevant provisions on bananas (Anania, 2010b). However, these agreements have not yet been implemented, pending ratification by relevant bodies in all countries involved.

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 allocated 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).[2] Compared to general equilibrium models, partial equilibrium models allow for a better representation of complex policy instruments, a more detailed representation of markets and require less restrictive assumptions. The choice to use a "spatial" model - i.e., a model which generates trade flows between each pair of countries - is motivated by the fact that this is particularly effective in representing policies where different regimes apply to imports from different countries, without having to impose questionable assumptions, such as imperfect substitution between bananas produced in different countries (Armington, 1969).[3] Current and recent previous EU trade regimes for bananas considered in this paper include preferential tariffs and tariff rate import quotas (TRQs) applied on imports from specific groups of countries.

The model assumes bananas are a homogeneous product; this means that the effectiveness of branding in differentiating bananas is ruled out,[4] "fair trade" and organic bananas, which account for a fairly small but significant and growing portion of the market, are ignored and consumers are assumed to be unable to differentiate bananas on the basis of their country of origin. The model includes five sources of domestic supply within the EU,[5] fourteen exporting countries,[6] and four importing countries/regions.[7] 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 (table 1). The values of the elasticities used are exogenous to the model and are based on those used elsewhere (Anania, 2010a; Arias *et al*., 2005; Guyomard, Laroche and Le Mouël, 1999a and 1999b; Kersten, 1995; Spreen *et al*., 2004; and Vanzetti *et al.*, 2005) (table 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 modelling of the EU-27 import regime in 2007 includes:

2 The basic structure of the model's constraints is provided in Anania (2010a).
3 A discussion of advantages and disadvantages of different types of trade models is provided in Anania (2001), Bouët (2008), Francois and Reinert (1997), and van Tongeren, van Meijl and Surry (2001).
4 Some evidence exists that Chiquita is able to exert a price premium (EC, 2008) due to its branding efforts as well as the somewhat higher quality of its bananas.
5 Cyprus, France (Martinique and Guadeloupe), Greece (Crete), Portugal (Madeira and Azores) and Spain (Canary Islands). Banana production in continental Portugal is negligible and has been ignored.
6 Five ACP countries/regions: Belize and Suriname, Cameroon, Dominican Republic, Ivory Coast, and the aggregate of other non-LDC ACP net exporters; eight MFN countries/regions: Brazil, Colombia, Costa Rica, Ecuador, Guatemala, Honduras, Panama and the aggregate of other non-LDC MFN net exporters; and LDC net exporters.
7 EU15, EU12, United States, and the aggregate of Rest of the world net importers.

(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 (0.5 and 22.2%, respectively).

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 of the EU Common Agricultural Policy; 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.[8]

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 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 (exporters and importers are assumed to have no market power); and (b) the intermediate case of traders behaving as downstream oligopolists and upstream oligopsonists, considering different degrees of imperfect competition.

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):

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

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

8 In France banana producers are entitled to receive a direct payment which has been calculated for each farm on the base of the support received by that farm in the past. In order to receive their full entitlements of the direct payments, farms have to produce at least 80% of what they produced, on average, in a reference period; if production is between 70% and 80% of what it was in the reference period, the farm will receive 80% of the entitled direct payment; if it is below 70% it will receive the same percentage of the entitlement. However, the financial incentive is large enough (around 11 600 €/ha) to ensure that farms find it profitable to produce the minimum volume of bananas needed for them to claim the full amount of the payments. A similar support mechanism applies in Spain where, in order to receive their full entitlement of support payments, farms have to produce at least 70% of what they produced, on average, in the reference period. In this case too the financial incentive (around 11 800 €/ha) is large enough for farms to find it profitable to produce the minimum volume of bananas which makes them able to claim their full entitlement of direct payments. In Portugal a fully "coupled" fixed production subsidy is in place. The amount of the per unit subsidy in the model is 455.2 €/t.8 The subsidy expenditure cannot exceed Portugal's financial allocation (€8.7 million); if production is such that expenditure would exceed the maximum allowed, then the per unit subsidy is cut pro rata so that the expenditure equals the budget allocation.

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.

The first non-competitive behavior considered is a cartel, that is, the presence of a number of competing firms which maximize joint profits; this stylizes the EC Commission's (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:

$$\text{Max } \Pi\,(x_{in}\,,\, xq_{ie}\,,\, xmfn_{ie}) = \sum_i \sum_j (\,p^d_{\,j} \;-\, p^s_{\,i} \,-\, TC_{ij}\,)\; x_{ij} - \sum_i \sum_e (xmfn_{ie}\, TMFN_{ie}\,)$$

$$-\sum_i \sum_n (x_{in}\, T_{in}\,) \;\; .^{9} \qquad (2)$$

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 price and c is the marginal cost. We model firm oligopolistic/oligopsonist behaviors by considering different percentages of mark-up (3%, 5%, 10%, 15%, 20% and 25%). 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:

$$\text{Max } W\,(x_{in}\,,\, xq_{ie}\,,\, xmfn_{ie}) \;=\; \sum_j \int_0^{q^d_{\,j}} p^d_{\,j}(m)\,\mathrm{d}m \;-\; \sum_i \int_0^{q^s_{\,i}} p^s_{\,i}(r)\,\mathrm{d}r \;- \qquad (5)$$

$$-\sum_i \sum_j (TC_{ij}\, x_{ij}) - \sum_i \sum_e (xmfn_{ie}\, TMFN_{ie}\,) - \sum_i \sum_n (x_{in}\, T_{in}\,) \;-\sum_i \sum_j (MU_{ij}\, x_{ij})\,,$$

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 + paid import tariff paid).

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, Hwang and Sohng (2002). We believe our model differs from theirs in several ways. Takayama and Judge (1971, chapter 11) extend their standard model to include a profit maximizing monopolist handling production and trade across all regions. In the cartel case our model modifies this framework separating producers from traders (which in our framework are pure middlemen) and assuming the cartel of traders to hold monopolistic as well as monopsonistic power,

9 Takayama and Judge (1971, chapter 11) discuss the potential problem of arbitraging in spatial models with imperfect competition. While procedures exist to address the problem (Anania and McCalla, 1991), in the model proposed in this paper this does not emerge because regions are modeled either as exporters or as importers (they cannot export and import at the same time).

while exporters (and importers) do not have market power. Kawaguchi, Suzuki and Kaiser (1997) analyze interregional exchanges of milk in Japan assuming that regional marketing boards maximize producers sale revenues net of transportation costs and only one agent handles milk produced in each of the regions. They propose a modified Takayama and Judge model which explicitly includes conjectural variation parameters; however, in their modeling of interregional milk trade in Japan they assume these parameters to equal zero, i.e. Cournot competition to occur (with all firms exerting market power or a subset). In our model market power is exerted by traders rather than each country's producers, imperfect competition is represented through the percentage of mark-up and simulate a range of imperfect competition market structures less extreme than Cournot. The adoption of different percentages of mark-up to represent the market structure allows us to avoid having to identify each firm's conjectural variation parameters for each importing country, making explicit assumptions about the number and symmetry of firms. Yang, Hwang and Sohng (2002) propose a linear complementarity programming formulation of the classical Takayama and Judge spatial model for a market characterized by heterogeneous downward sloping demand and upward sloping supply functions (like the one assumed here), while they suggest the standard Takayama and Judge (1971) spatial modeling framework when a common demand function and constant marginal cost are considered. They assume Cournot competition, whereas we prefer to consider other, less extreme, assumptions on firm behaviors and find no reason for avoiding using a modified Takayama and Judge modeling framework.

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 occurs as a 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, Drogué and Anania (2009) has been used to make up for the poor quality assumed 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, the model perfectly calibrates the observed country net trade positions.[10] In the first step the model is augmented by a set of constraints imposing predicted bilateral trade flows to equal observed ones.[11] The values of the dual variables associated in the solution to these constraints are then used in

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

11 Net trade positions and the matrices of trade flows obtained from the Comtrade data base are inconsistent. This is so for several, well known, reasons, including the fact that information obtained using the exporters as reporters differ from the same information obtained using as reporters the importers (because of inconsistencies in the timing of the declarations by the exporting and the importing countries, as well as reporting errors), and that net trade positions are given for each country by the difference between its exports and imports, while trade flow matrices consider all trade. In order to calibrate the model consistent net trade positions and trade flows are needed (i.e. net trade positions have to equal the marginal distributions of the trade flows matrix); thus a two step reconciliation procedure has been used. In the first step net trade positions have been adjusted in order to make total net exports across all countries equal total net imports (for each country the original data collected was from its own reporting, which makes the sum of net imports differ from the sum of net exports);

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, Drogué and Anania, 2009).

To explain how the calibration procedure works in the modeling of the three market structures considered in the paper we shall make use of a few figures. In figure 1 a two country, perfectly competitive market is represented, with no policy intervention; ED_j and ES_i are the importer's import demand function and the exporter's export supply function, respectively, and tc_{ij} is the per unit international transaction cost, assumed not to change with the quantity traded. Point A gives the market equilibrium as generated by the model if no calibration procedure is considered (the solution is such that the quantity traded makes the import price equal to the export price augmented by the per unit transaction cost); the solution generated by the model differs from observed traded quantity, import and export prices[12]. The calibration procedure enables the model to reproduce the observed market equilibrium by correcting the per unit transaction cost (figure 2); in this case by increasing it by an amount equal to λ^*_{ij}.[13] Figures 3 and 4 are analogous to figures 1 and 2 for the imperfectly competitive market where a mark-up is applied (observed traded quantity and prices in the two countries, as well as the per unit transaction cost are kept unchanged). In figure 3 ES^*_i is the mark-up inclusive export supply by the traders; in this case the uncalibrated equilibrium generated by the model would be that in point B. Figure 4 shows what happens when the calibration procedure is applied. In this case the adjustment of the per unit transaction cost, λ^*_{ij} , by correcting the per unit transaction cost, modifies as well the mark-up inclusive export supply by the traders (which becomes ES^{**}_I); this happens because the transaction cost is part of the cost to which the percentage mark-up is applied to obtain the traders' profit per unit of bananas traded. In figure 5 point C represents the equilibrium quantity when traders form a cartel and act as a monopolist/monopsonist on the world market and the model is not calibrated. MR and MC represent the traders' marginal revenue and marginal cost functions, respectively (observed traded quantity and prices and the per unit transaction cost are the same as in the two other market structures represented in figures 1 to 4). In this case the market equilibrium obtained by solving the model with no calibration shows a quantity traded which is below the observed one, suggesting the need to calibrate the model by correcting the transaction cost downward, rather than upward as in the previous two cases. However, even setting the per unit transaction cost equal zero is not sufficient to make the model generate the observed market equilibrium (figure 6). An adjustment of transaction costs which makes them negative is needed for the model to reproduce the observed market equilibrium (figure 7); this would mean traders receiving for each unit of bananas traded a "subsidy" which exceeds transaction cost.

This is exactly what happens when our model assuming a cartel maximizing joint profits is calibrated. This means that the hypothesis of traders colluding by forming a cartel that acts as a monopolist and a monopsonist in the world market for bananas turns out to be an unfeasible market

reconciliation has been obtained by keeping all net trade positions but one unchanged, and adjusting only that of the aggregate "Rest of the world net importers" (table 1). In the second step a minimum least square procedure has been used to obtain trade flows consistent with net trade positions and as close as possible to those obtained by using importers as reporters (these declarations are generally believed to be more accurate than those by exporters). In the least square procedure (a) observed trade flows (different from EU domestic ones) smaller than 15,000 t have been set at zero and (b) in the solution trade flows have been constrained to equal zero if observed ones were equal zero.

12 Observed traded quantity, import and export prices lie on the excess demand and supply functions because of the way these have been obtained.

13 In general, in this as well as in the other cases discussed below, the correction of the transaction cost needed to calibrate the model can either be positive or negative.

structure, because inconsistent with observed quantities traded and importer and exporter border prices. The adjustments needed for the model to reproduce observed net trade positions and import and export prices are of an order of magnitude which rules out any possibility of this result being driven by measurement errors of import and export prices, including those resulting from observed prices possibly being intra-firm transfer prices, rather than prices resulting from market transactions between different firms. In fact, downward adjustments of transaction costs needed to calibrate the model range between 754 and 2,710 US$/t and resulting corrected transaction costs between -553 and -2,600 US$/t.

This result may not come as a surprise, given that a world cartel, even for the banana market, is a rather extreme representation of the world market structure. However, the findings for the other imperfectly competitive market structures are less obvious. Indeed, a similar outcome also emerges for imperfectly competitive world market structures with a mark-up above 10%. When, for example, a 20% mark-up is considered, five of the corrected per unit transaction costs became negative, with the largest one being equal to -50 US$/t; when a mark-up equal to 15% was modeled, the calibration generated two negative corrected transaction costs, the largest one being equal to - 33 US$/t. Even when the mark-up was set equal to 10% 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 - 13 US$/t). We conclude that market structures with international traders acting as non-cooperative oligopolists/oligopsonists with a resulting mark-up exceeding 10% are unfeasible in the banana market, because they are largely inconsistent with observed border prices.

These results crucially depend on the assumptions made regarding the imperfectly 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) also hold market power, the results obtained may no longer hold true.

3. RESULTS

All the simulations have been generated with reference to 2017, the earliest time horizon for the completion of the implementation of the December 2009 WTO agreement, assuming that an agreement on the modalities in agriculture in the DDA round is reached by the end of 2013.

The "2017 base" reference model has been obtained from the "2007 base" by modelling 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.[14] 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;[15] the values used for domestic demand income elasticities are provided in table 1.

14 The FAOSTAT data base is the source used for production in 2007. Information on banana consumption in 2007 for all countries does not exist; the FAOSTAT data base has been used to calculate apparent consumption (domestic production + imports – exports).
15 For country aggregates these are both weighted averages obtained using the shares of population in 2007 as weights. The data source is the World Development Indicators, by the World Bank. Negative percent changes have been set equal zero; percent changes larger than 5 have been set equal to 5.

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.[16]

The results of the simulations are presented in tables 2 and 3.

Four different market structures have been considered, those found to be feasible given observed traded quantities and prices: perfect competition and oligopoly/oligopsony with mark-up percentages equal to 3%, 5% and 10%. The results for the "2007 base" scenario are the same for all of them, each of the four models being calibrated to reproduce the observed market equilibrium.

Two policy scenarios in 2017 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 without being subject to any 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).

It may be useful to underline at the outset that the results under the four market structures should not be compared directly, as the models which generate them differ, not only in the assumption 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 four models; in fact, corrected transaction costs - $tc_{ij} + \lambda^*_{ij}$ in figures 2 and 4 - become smaller and smaller as we move from perfect competition to increasing degrees of market power.[17]

The simulation results obtained under the four 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 considered in the analysis. Nevertheless, some remarkable differences among the results obtained under the various market structures emerge 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 more than 80% and export revenue almost 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 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 most significant differences between the results obtained under the four market structures relate to LDC exports. Under perfect competition they export only to the EU both in the 2017 base scenario and in the scenario with the EPAs only, and their exports decline by 6.9%; when the imperfectly competitive market structures are assumed, they do not export to the EU in the 2017 base scenario, but find it profitable to do so when the EPAs are implemented, with their exports declining by around 3.5%, less than forecast under the perfect competition scenario.

16 The annual rate of growth for production as a result of technical change is given by the annual rate of change in yields plus 1/3 of the annual rate of change in banana harvested area. For country aggregates these are weighted averages obtained using the shares of production in 2007 as weights. The data source is the FAOSTAT database. Negative rates have been set equal zero; rates larger than 5 have been set equal to 5. In Anania (2010a) only the annual rate of change in yields was considered. The dollar/euro exchange rate in 2017 has been assumed to be 1.4 (in the 2007 base model it was 1.371).

17 This means that differences between simulation results referring to, for example, the perfect competition and the 5% mark-up scenario, cannot be interpreted as "the predicted change if the market structure were an oligopoly/oligopsony represented through a 5% mark-up instead of a perfectly competitive one", because it provides "the predicted change if the market structure were an oligopoly/oligopsony represented through a 5% mark-up instead of a perfectly competitive one and transaction costs were lower". In fact, while results presented in Table 3 show, for example, volumes of EU imports under the "EPA + December 2009 agreement" which increase with firms' market power, the contrary would emerge if the models were run using the same per unit transaction costs.

What happens 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 LDCs are able to export less. Firms' profits increase by 15%; in fact, increased ACP exports and export prices overcome the opposite effect on firms' profits of lower MFN and LDC exports and lower export prices and of the elimination of the out-of-quota tariff payments.

What is interesting is that 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 suggests that if it was found feasible for firms to exert higher degrees of market power than those considered here, differences in the results obtained were to be much larger in absolute terms than those presented in table 2.

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 on the different agents involved, but in terms of its sign as well.

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 are of the same order of magnitude under all market structures. ACP banana exports, which all remain directed to the EU, decline by 15%, while MFN exports increase by 3.5% (those directed to the EU expand by 74%, 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, they increase by 1%. In this case firms' profits decline, although by 2% only, because the negative effects on per unit profits of the lower MFN tariff imposed by the EU and the lower imports by the US and the Rest of the world are only partially compensated by those, of the opposite sign, of the larger volume of EU imports and higher export prices in MFN countries. While the EPAs produced little changes in the EU domestic market, the WTO agreement causes the EU domestic price to decline by 10%, consumption to increase by 5% and imports to increase by a little more than 15%; on the contrary, EU production changes very little, as EU domestic policy for bananas, as explained above, makes only production in Greece, Portugal and Cyprus (which jointly account for a very small share of EU banana production) react to market signals. The magnitude of changes in market equilibrium increases with firms' market power.

The overall impact of the EPAs and the WTO agreement with respect to the "2017 base", which is reported in the four 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 accrued by ACP countries with 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 (by around 2% and 3%, respectively).

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 unfolding 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 effects of the most recent EU import regimes for bananas are affected by the assumptions made regarding 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 the relevant firms in each importing market.

The two step calibration procedure used to make the model replicate observed country net trade positions allowed for 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 turn out to be unfeasible, being largely inconsistent with observed 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 10%.

Simulation results confirm those obtained in Anania (2010a). The implementation of the EPAs is expected to increase significantly ACP exports to the EU and generate overall consistent benefits for ACP countries; significant trade diversion also 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 is does not make MFN countries make up from the loss of competitiveness *vis a vis* ACP countries as a result of the EPAs.

Given the relative low level of market power, simulation results are quite similar across the four market structures considered. However, 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, and 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 are, in our opinion 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, it would imply the use of a completely different modeling framework and data needs which would be difficult to satisfy.

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

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Table 1 - Base model input data (2007).

Country/Region	Net Imports[1] (000 t)	Net Exports[2] (000 t)	Import Prices ($/t)	Export Prices ($/t)	Export Supply Price Elasticities	Import Demand Price Elasticities	Domestic Demand Income Elasticities	% Yearly Changes in Supply Due to Technical Changes[3]	% Yearly Changes in Population	% Yearly Changes in Per Capita GDP
EU-15	5055,1		844,7			-0,50	0,5		0,49	1,95
EU-12	249,1		810,8			-0,75	0,5		-0,25	4,23
USA	3544,3		358,0			-0,40	0,4	2,79	1,00	2,01
Other importers	7249,8		491,9			-0,80	0,5	5,00	0,82	5
Spain		361,4		610,0	1,0			0,46		
France		238,8		500,0	1,0			2,10		
Portugal		17,2		1190,0	1,0			0,22		
Greece		2,9		720,0	1,0			2,08		
Cyprus		6,0		700,0	1,0			0,00		
Ivory Coast		290,8		371,0	1,5		0,5	2,95	2,36	0,00
Cameroon		224,5		290,0	1,5		0,5	1,54	2,36	1,63
Dominican Republic		215,1		347,3	1,0		0,5	5,00	1,56	3,81
Belize and Suriname		115,5		373,5	1,0		0,5	3,20	1,98	2,46
Other ACP non LDC		89,4		450,0	1,0		0,5	3,28	2,06	1,06
Ecuador		5285,6		246,4	1,3		0,5	0,33	1,24	1,88
Colombia		1660,7		325,6	1,3		0,5	1,02	1,62	1,20
Costa Rica		2273,4		299,0	1,0		0,5	1,57	2,00	2,95
Panama		436,3		255,6	1,0		0,5	0,06	1,85	3,09
Honduras		514,9		270,0	1,5		0,5	0,27	2,06	1,96
Brazil		185,7		238,5	1,0		0,5	2,58	1,33	1,21
Guatemala		1518,6		211,4	1,5		0,5	2,76	2,46	1,24
Other MFN exporters non LDC		2578,9		195,2	1,0		0,5	3,30	1,57	3,77
LDC		82,6		204,5	1,5		0,5	5,00	2,75	1,70

Source: Comtrade, Faostat.

[1]: For EU-15 and EU-10 apparent consumption (imports + domestic production - exports).

[2]: For France average production in 2005-2007, to smooth the effects of hurricane Dean (August 2007). No data available for Cameroon and Suriname as reporting exporters in Comtrade; Foastat data have been used instead.

[3]: average (05-07/95-97) annual percent change in yields (negative rates have been set equal to zero) + 1/3 of the average (05-07/95-97) annual percent change in harvested area (negative rates have been set equal to zero). For country aggregates, weighted average with share of production in 2007 as weights. Resulting percent annual changes larger than 5 have been set equal to 5.

Table 3 - Simulation results.

	2007 base	Perfect competition			Mark-up 3%			Mark-up 5%			Mark-up 10%		
		2017 base	EPA only	EPA + Dec 2009 Agreement	2017 base	EPA only	EPA + Dec 2009 Agreement	2017 base	EPA only	EPA + Dec 2009 Agreement	2017 base	EPA only	EPA + Dec 2009 Agreement
EU production (000 t)	***626***	**574**	**574**	**572**	**574**	**574**	**572**	**574**	**574**	**572**	**574**	**574**	**572**
EU consumption (000 t)	***5.304***	**6.217**	**6.251**	**6.546**	**6.242**	**6.251**	**6.554**	**6.259**	**6.251**	**6.560**	**6.302**	**6.251**	**6.574**
EU15 border price (euro)	***616,1***	**602,7**	**596,0**	**538,6**	**598,0**	**596,1**	**537,0**	**594,6**	**596,1**	**535,9**	**586,3**	**596,1**	**533,1**
EU imports (000 t)	***4.678***	**5.643**	**5.677**	**5.974**	**5.667**	**5.677**	**5.982**	**5.685**	**5.677**	**5.988**	**5.728**	**5.677**	**6.002**
EU imports from ACP (000 t)	*855*	*889*	*2.302*	*1.954*	*875*	*2.276*	*1.928*	*865*	*2.260*	*1.911*	*844*	*2.222*	*1.873*
EU imports from MFN (000 t)	*3.823*	*3.604*	*2.304*	*4.020*	*4.792*	*2.327*	*4.054*	*4.819*	*2.342*	*4.077*	*4.884*	*2.375*	*4.129*
EU imports from LDC (000 t)	*0*	*1.150*	*1.071*	*0*	*0*	*1.074*	*0*	*0*	*1.076*	*0*	*0*	*1.080*	*0*
USA imports (000 t)	***3.544***	**4.269**	**4.314**	**4.283**	**4.266**	**4.314**	**4.282**	**4.265**	**4.314**	**4.282**	**4.263**	**4.315**	**4.281**
ROW imports (000 t)	***7.250***	**7.904**	**8.048**	**7.948**	**7.895**	**8.051**	**7.947**	**7.892**	**8.054**	**7.947**	**7.886**	**8.059**	**7.945**
ACP total exports (000 t)	***935***	**1.274**	**2.302**	**1.954**	**1.261**	**2.276**	**1.928**	**1.252**	**2.260**	**1.911**	**1.231**	**2.222**	**1.873**
MFN total exports (000 t)	***14.454***	**15.393**	**14.666**	**15.169**	**15.454**	**14.693**	**15.199**	**15.475**	**14.710**	**15.218**	**15.525**	**14.750**	**15.262**
LDC total exports (000 t)	***83***	**1.150**	**1.071**	**1.082**	**1.113**	**1.074**	**1.085**	**1.115**	**1.076**	**1.087**	**1.121**	**1.080**	**1.092**
ACP export revenue (mill US$)	***331,1***	**461,2**	**1.371,4**	**1.008,2**	**453,3**	**1.343,3**	**984,5**	**447,0**	**1.324,5**	**968,5**	**435,3**	**1.285,0**	**935,3**
MFN export revenue (mill US$)	***3.642,1***	**3.790,2**	**3.480,0**	**3.693,3**	**3.817,1**	**3.491,1**	**3.706,0**	**3.826,0**	**3.498,3**	**3.714,2**	**3.848,1**	**3.515,0**	**3.733,4**
LDC export revenue (mill US$)	***16,9***	**234,0**	**208,0**	**211,7**	**221,8**	**209,0**	**212,7**	**222,5**	**209,6**	**213,4**	**224,3**	**211,0**	**214,9**
Traders' profits (mill US$)		**0,0**	**0,0**	**0,0**	**265,2**	**304,2**	**298,0**	**432,7**	**497,2**	**487,0**	**822,3**	**948,9**	**928,4**

Table 4 - Simulation results. Expected impact of policy changes under different market structures (% changes)

	'EPA only' vs. '2017 base'				'EPA + Dec 2009 Agreement' vs. 'EPA only'				'EPA + Dec 2009 Agreement' vs. '2017 base'			
	Perfect competition	Mark-up 3%	Mark-up 5%	Mark-up 10%	Perfect competition	Mark-up 3%	Mark-up 5%	Mark-up 10%	Perfect competition	Mark-up 3%	Mark-up 5%	Mark-up 10%
EU production (000 t)	0,0	0,0	0,0	0,0	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3
EU consumption (000 t)	0,5	0,1	-0,1	-0,8	4,7	4,8	4,9	5,2	5,3	5,0	4,8	4,3
EU15 border price (euro)	-1,1	-0,3	0,3	1,7	-9,6	-9,9	-10,1	-10,6	-10,6	-10,2	-9,9	-9,1
EU imports (000 t)	0,6	0,2	-0,1	-0,9	5,2	5,4	5,5	5,7	5,9	5,6	5,3	4,8
EU imports from ACP (000 t)	158,9	160,1	161,3	163,3	-15,1	-15,3	-15,4	-15,7	119,8	120,3	120,9	121,9
EU imports from MFN (000 t)	-36,1	-51,4	-51,4	-51,4	74,5	74,2	74,1	73,9	11,5	-15,4	-15,4	-15,5
EU imports from LDC (000 t)	-6,9	...	...	...	-100,0	-100,0	-100,0	-100,0	-100,0	...	...	...
USA imports (000 t)	1,1	1,1	1,1	1,2	-0,7	-0,7	-0,7	-0,8	0,3	0,4	0,4	0,4
ROW imports (000 t)	1,8	2,0	2,1	2,2	-1,2	-1,3	-1,3	-1,4	0,6	0,7	0,7	0,7
ACP total exports (000 t)	80,7	80,5	80,5	80,5	-15,1	-15,3	-15,4	-15,7	53,4	52,9	52,6	52,2
MFN total exports (000 t)	-4,7	-4,9	-4,9	-5,0	3,4	3,4	3,5	3,5	-1,5	-1,7	-1,7	-1,7
LDC total exports (000 t)	-6,9	-3,5	-3,5	-3,7	1,0	1,0	1,0	1,1	-5,9	-2,5	-2,5	-2,6
ACP export revenue (mill US$)	197,4	196,3	196,3	195,2	-26,5	-26,7	-26,9	-27,2	118,6	117,2	116,7	114,9
MFN export revenue (mill US$)	-8,2	-8,5	-8,6	-8,7	6,1	6,2	6,2	6,2	-2,6	-2,9	-2,9	-3,0
LDC export revenue (mill US$)	-11,1	-5,8	-5,8	-5,9	1,8	1,8	1,8	1,8	-9,5	-4,1	-4,1	-4,2
Traders' profits (mill US$)		14,7	14,9	15,4		-2,0	-2,1	-2,2		12,4	12,5	12,9

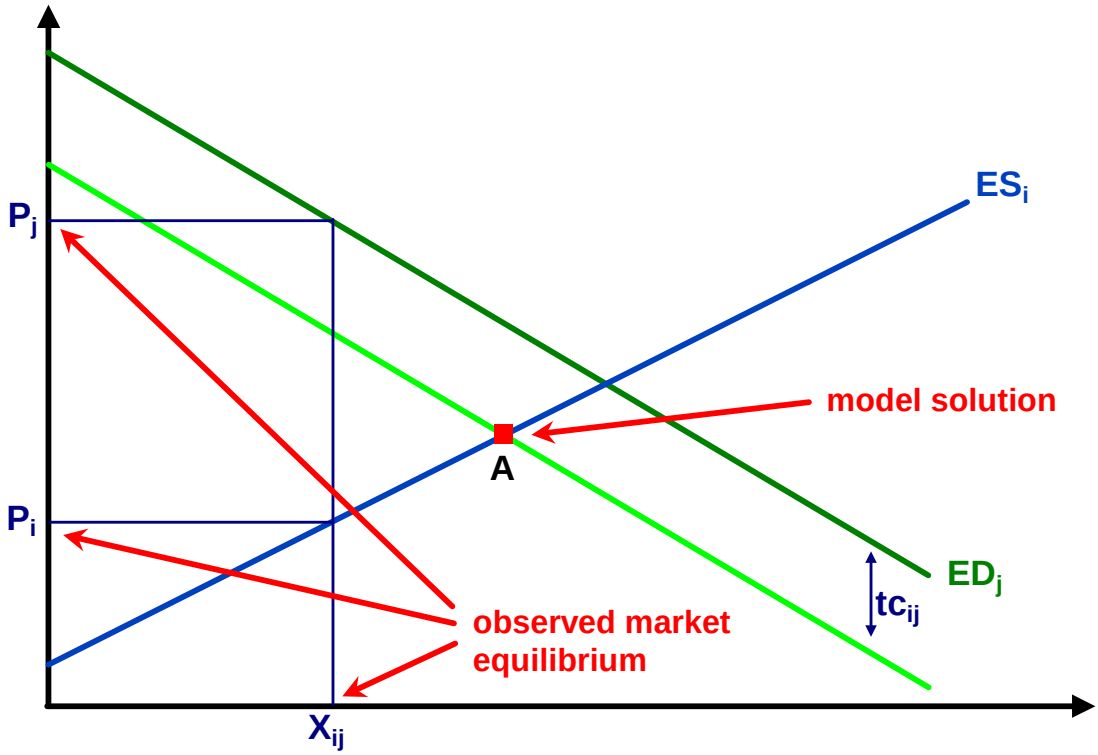

Figure 1 Perfect competition. Observed market equilibrium and uncalibrated model solution.

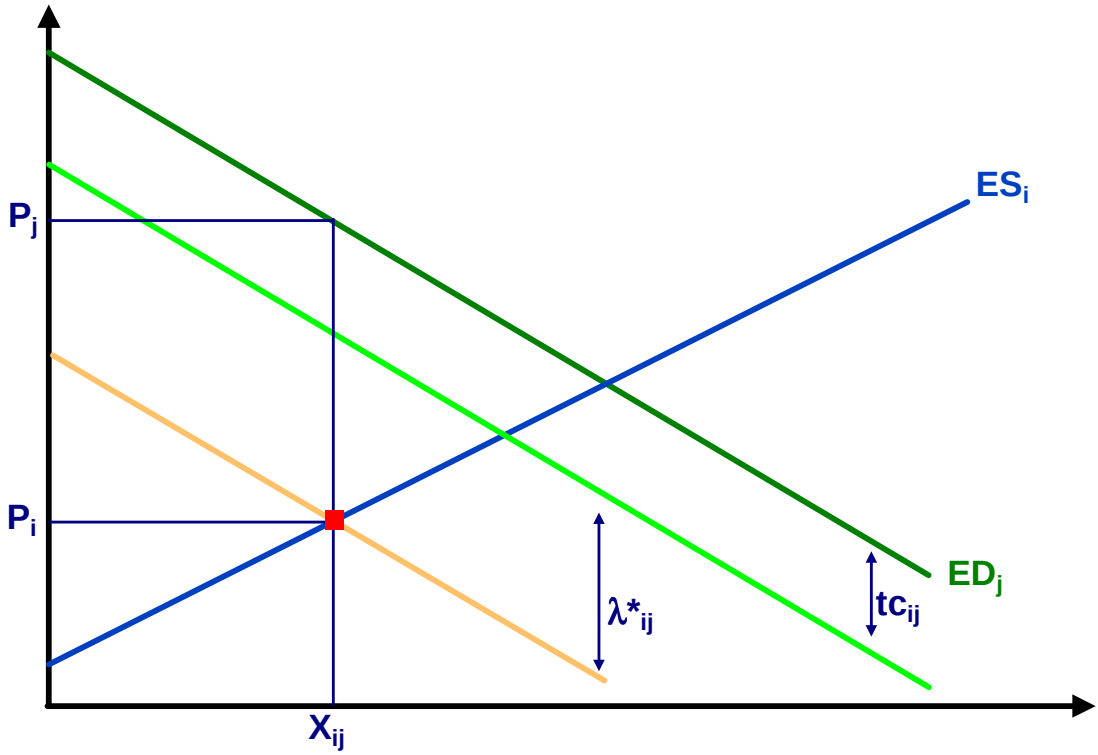

Figure 2 Perfect competition. Calibrated model solution.

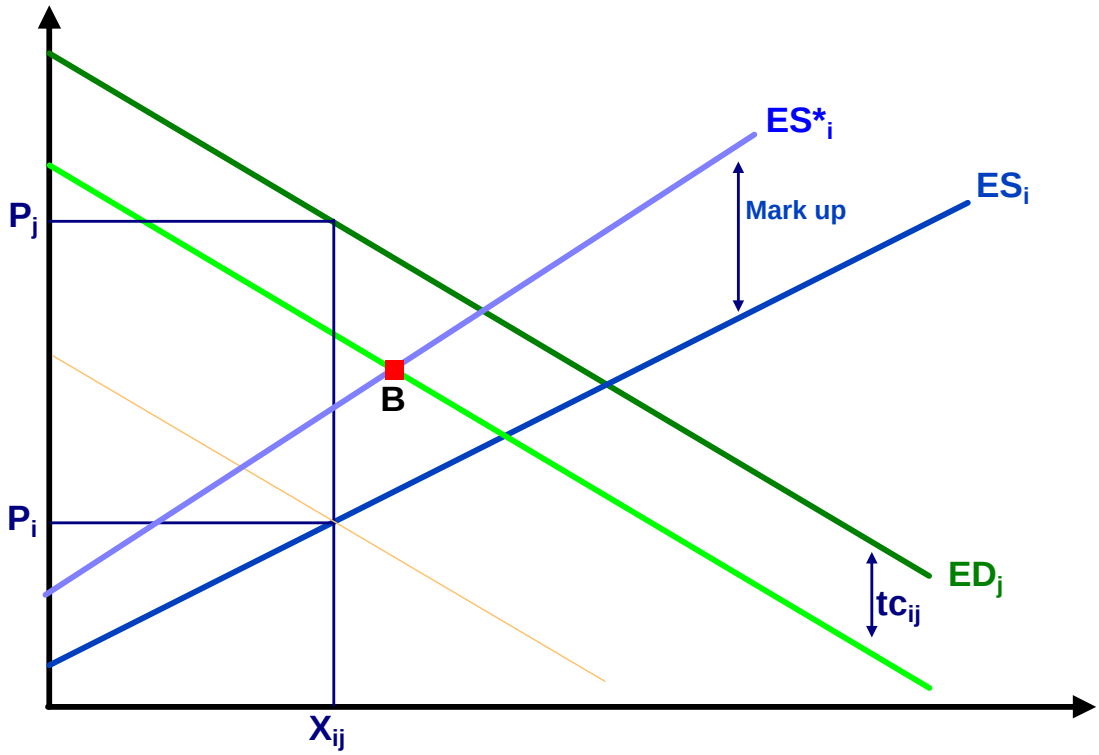

Figure 3 Imperfect competition, mark-up. Observed market equilibrium and uncalibrated model solution.

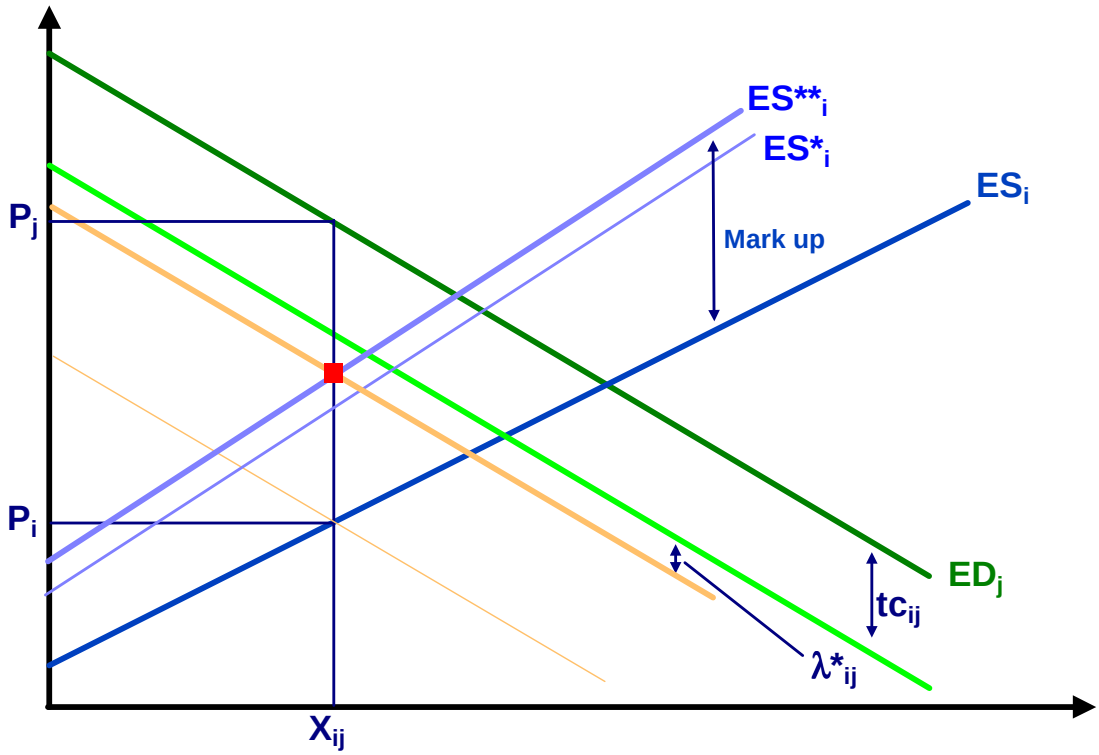

Figure 4 Imperfect competition, mark-up. Calibrated model solution.

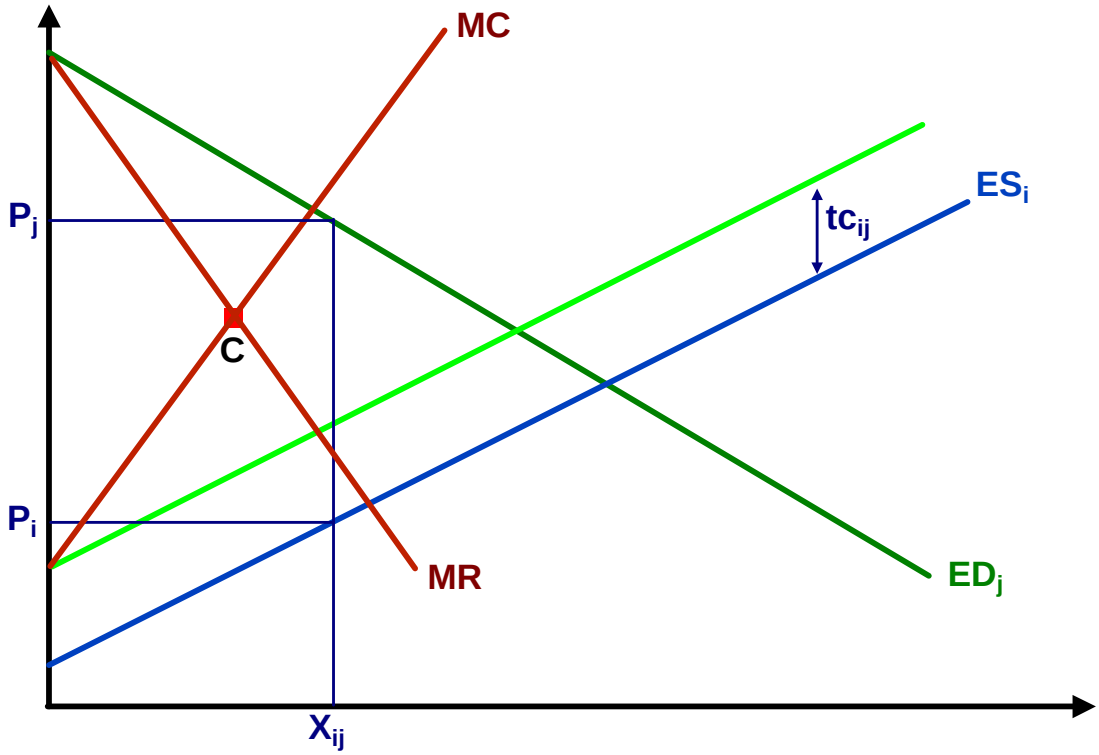

Figure 5 Imperfect competition, cartel. Observed market equilibrium and uncalibrated model solution.

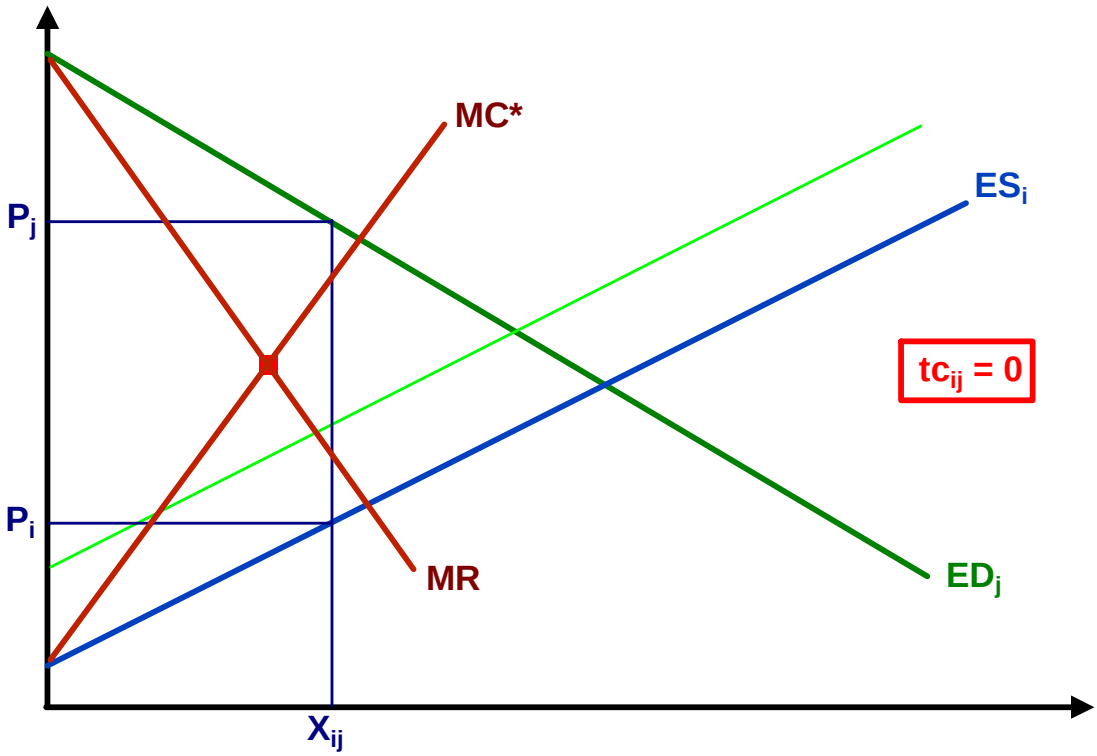

Figure 6 Imperfect competition, cartel. Observed market equilibrium and uncalibrated model solution with the per unit transaction cost set equal zero.

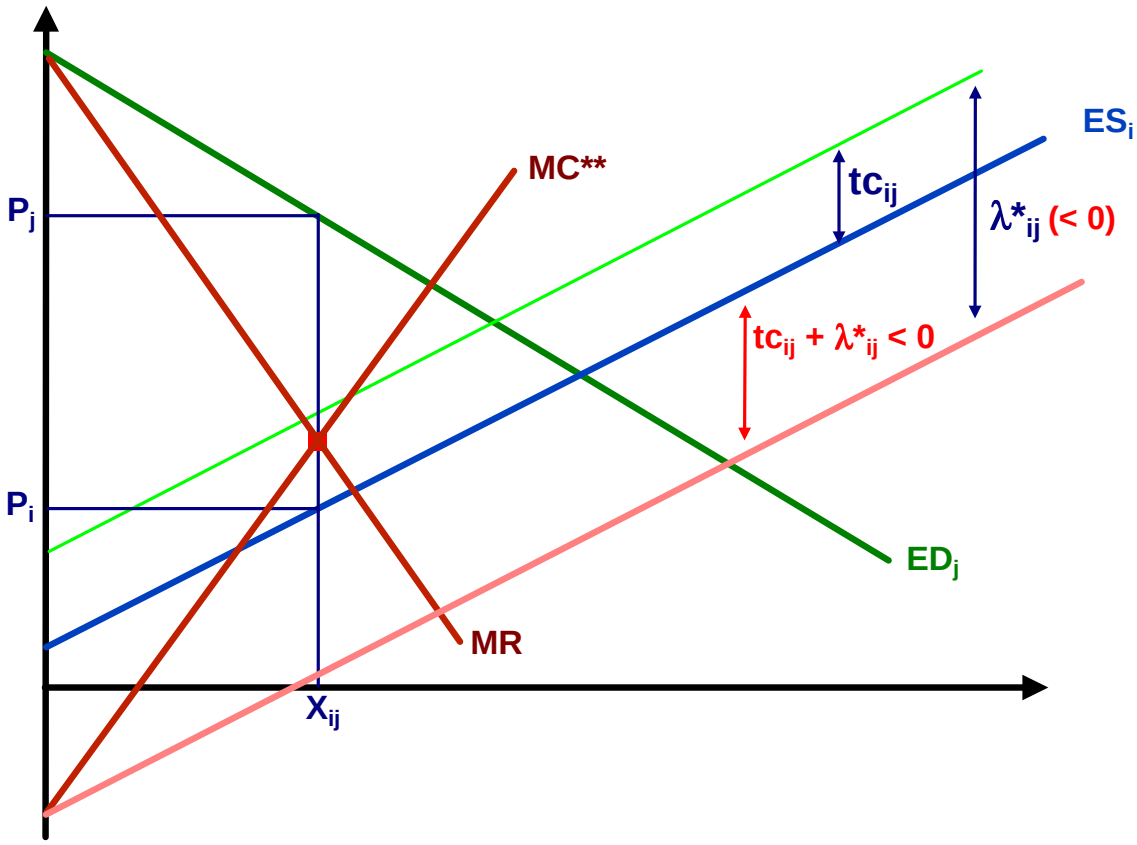

Figure 7 Imperfect competition, cartel. Calibrated model solution (the corrected per unit transaction cost calibrating the model is negative).