Firms' heterogeneity and comparative advantage: an empirical analysis

Ines Buono
UPF

PRELIMINARY AND INCOMPLETE
DO NOT CIRCULATE

March 5th, 2007

Abstract

The aim of this paper is to conduct an empirical analysis of the effect of Turkey-EU Customs Union on French exporting structure, allowing for firms' heterogeneity within sectors and comparative advantage between sectors in the two countries.

Neoclassical comparative advantage models predict that when trade costs fall each country begins to export its comparative advantage sector goods. While, recent firm heterogeneity models, combining consumer taste of variety, increasing return to scale, firm heterogeneity in productivity and fixed and variable costs to export, show that, as trade costs fall, resources are reshuffled from less to more productive firms.

In this paper I try to put together firm and sector heterogeneity. I first build a partial equilibrium model in which trade costs, endowment comparative advantage at sector level and productivity heterogeneity at firm level interact together in an open economy environment. The model shows that falling trade costs asymmetrically affect firms of different sectors.

I then turn to analyze empirically the effects of falling trade costs on the extensive margin for firms that differ in productivity and that belong to sectors with different factor intensity in production. The empirical analysis confirms model main result since firms in comparative disadvantage sectors are more reactive to the formation of Customs Union.

Introduction

One of the main question of international trade is how do economies respond to trade liberalization. Neoclassical theory answers to this question considering the heterogeneity across industries in terms of their factor intensity and the heterogeneity among countries in terms of their factor endowment. When economies open up to trade each country, via a change in factors' rewards, begins to export its abundant factor. In these models firms are homogeneous within each sector. Nevertheless firms' characteristics have proved to be empirically important in explaining facts regarding trade, like the exporting behaviour (in each country only the most productive firms export) or the effects of trade liberalization (effects are asymmetric among firms even in the same industry). A new wave of theoretical papers has incorporated firms' heterogeneity in trade models, trying to explain these facts. A very flexible model has been used by Melitz (2003) to explain the effect of trade between two identical countries whose firms are heterogeneous within each one. When a country opens up to trade, response of firms changes according to their different productivity. There are less productive firms that are not able to enter the exporting market and that loose some domestic share since import competition is now higher. Firms below a threshold of productivity will exit the market after trade liberalization as well as after a reduction of trade cost. There are, on the other hand, firms that are now able to export (the most productive ones) and for which the access in the exporting market more than compensate the loss in the domestic one. Overall the economy will gain welfare in open economy because the less efficient firms who set higher prices will now be out of the market and the number of varieties (considering also foreigner firms who enter the domestic market) will be higher. When trade costs fall, moreover, the interaction among heterogeneous firms, fix cost to enter the domestic and the exporting market, variable iceberg trade cost and love of variety yields a rich set of predictions both on the extensive and on the intensive margin.

Some empirical papers look at the plant-level reaction following a trade liberalization event. Trefler (2001) analyzes the behaviour of Canadian economy after the Canada-US Free Trade Agreement. Even if plant-level data are not available she finds that the source of FTA-induced labour productivity depends on two effects: a favourable plant turnover (entry and exit of firms in the Canadian market) and a rising in technical efficiency (notice that Trefler analyzes both the short run and the long run reactions of the economy). Schor (2004) studies the effect of Brazilian tariffs' decrease on firms that are asymmetric with regards to many characteristics.

She finds that productivity increases at firm level especially for ex-ante low productivity firms, thus the asymmetry in firms' characteristics is reflected in the asymmetry of their reaction after a liberalization episode. Pavnick (2003) finds that in the case of Chile the liberalization of 70's has improved the plant productivity and that the increasing in the aggregate productivity of the country has stemmed from a reshuffling of resources from less to more efficient firms.

However these papers do not analyze the mechanisms pointed by the new heterogeneous-firms theoretical framework with the exception of Bernard, Jensen and Schott (2003) who test the common predictions of models with heterogeneity among firms in the case of US economy, after constructing a measure of tariff reduction at industry level for some years. They found that predictions are supported by data only for some sub-sectors of US economy, mainly for that sectors whose penetration ratio (in terms of imports and exports) toward countries in the European Union is higher. This result points to an interaction between heterogeneity at firm level in each industry and heterogeneity among industries.

In this paper I first show a partial equilibrium model with two countries which differ in endowments, a continuum of sectors which differ in factor intensity and a continuum of firms which differ in productivity. Consumers have a Cobb Douglas utility function over the goods of different sectors and a CES utility function for every variety inside each sector. There is monopolistic competition and firms produce using two factors, skilled and unskilled workers (but one can think also at labour and capital), and according to an exogenous productivity level. All firms in each sector, however, use the same factor intensity and the continuum of sectors is characterized by an index which ranks them according to their intensity in the use of factors. Since the two countries have different endowment there will be sectors which have comparative advantage in each country and these will be the ones which use more intensively the factor country is more endowed with. Finally there are fixed costs both to produce for domestic market and to export and variable trade costs to export modelled as standard iceberg ones.

Assuming that Price Index in each country do not depend on the tariff reduction and abstracting form entry and exit of firms in each market, I obtain the exporting productivity threshold that is the level of productivity a firm needs to have in order to begin to export. This threshold depends on the level of tariffs imposed by the other country and on the comparative advantage of the sector the firm belongs to.

Using the result that skill premium (ratio of skilled labour wage over unskilled labour one) is lower in the country with more skill endowment, I show how exporting threshold and probability to export (the area under a given productivity distribution function at the right of the exporting threshold) react to changes in tariffs in different sectors.

Basic predictions I find are: probability to be an exporter is higher when tariffs decrease (standard heterogeneous firm literature result), higher for firms in comparative advantage sectors (comparative advantage Heckscher-Ohlin kind-of result) and moves differently for comparative advantage and disadvantage sectors as tariffs change.

This last finding is new in literature and somehow puzzling. In fact I find a threshold effect for which firms in comparative disadvantage sector are more reactive to change in tariffs and a distribution effect for which the probability to export when tariffs decrease may change by more in comparative advantage sectors, since the mass of firms in its threshold starting point may be higher[1]. Thus theoretically the reactivity of different sectors to trade reduction does depend on the chosen productivity distribution function.

This model manages to replicate some basic features of heterogeneous-firms models and of Heckscher-Ohlin models and to rise a new point on the interaction between the two.

The most similar paper to mine on the theoretical side is Bernard-Redding-Schott (2006) which builds a general equilibrium framework using a standard Heckscher-Ohlin model with two countries, two factors and two sectors and introducing firms' heterogeneity as in Melitz (2003). Their model however does not reach closed form solutions and its simulation does depend on chosen parameters. Moreover a general equilibrium framework is not suitable to the empirical case I will explore in the second part of the paper.

Predictions of the model are then tested considering the effect of the entrance of Turkey in European Customs Union on French firms.

After many years of negotiations, on March 1995 it was agreed at the Association Council meeting in Brussels that Turkey would enter the European Customs Union (CU), starting on January the 1st, 1996. Among the duties that Turkey has to oblige there is the one regarding tariffs: from this date on Turkey has to eliminate all customs duties, quantitative restrictions, charges having equivalent effect to customs duties and all measures having equivalent effect to quantitative restrictions in trade of industrial goods with EU.

I measure tariffs reduction after CU using "effectively applied rates" from Turkey to France taken from TRAINS-WTO dataset, while firm level data comes from BRN and DOUANE dataset available at INSEE (Institute Nationale de la Statistique et des Etudes Economiques).

In the empirical analysis I construct firm level productivity and industry comparative advantage measures. Firm level productivity is firstly measured as the distance between firm labour productivity and average sector labour productivity. This adjustment is done in order to account

[1] Figure 3 clarify this point representing a higher threshold effect for comparative disadvantage sector and a higher distribution effect for comparative advantage sector.

for sectors which can be more or less labour intensive. This simple measure will allow me to compare some results with the paper by Bernard, Jensen, Schott (2006). However measuring productivity in this simple way may be not reliable for a number of reasons. To check for this I estimate sector production functions using the Olley and Pakes (1996) method which address and solve problems like simultaneity and selectivity or attrition bias. The first problem arises because a part of TFP may be actually observed by the firm at a point in time that allows it to change its factor demand. The second problem may arise because in the dataset we are only observing surviving firms. In order to solve both problems I will use the semi-parametric Olley and Pakes measure which is based on the use of firm's investment decision to proxy for that shocks which are observable to firms but not to the econometrician. Finally I will also provide results using a third measure of productivity according to the Levhinson-Petrin (2003) approach which consider the intermediate input and not the investments as a proxy of unobserved shocks.

The measure of comparative advantage is given by the interaction of skilled (and capital) endowment difference between France and Turkey and skilled (and capital) sector intensity. The endowment difference is taken by estimation of schooling and per worker capital by Caselli, while sector intensity of the two factors is taken by NBER US manufacturing dataset. These two measures suite particularly well with the concept of comparative advantage I am using in the paper, in fact these measures will be high in high skilled or capital intensive sectors located in France (which is more endowed with these two factors with respect to Turkey).

In the data analysis I first show relevant statistics about exporting structure in France before and after CU. I then test the model predictions using both pooled probit regressions and linear probability model. Results suggest that probability to export is increasing in firm productivity and decreasing in tariffs. The coefficient of the interacted term between tariffs and comparative advantage suggests that when CA is high the total effect of tariffs on the probability to export is lower in absolute term, while when CA is low this effect is higher in absolute term. Thus controlling for firm productivity and other firm characteristics we found that firms in comparative disadvantage sectors are more reactive to a tariffs' change. Thus as the model was suggesting the threshold effect is unambiguously negative.

This work improves literature in many directions.

With respect to heterogeneous firm literature the improvement consists in presenting a closed form solution model which is able to explain the entrance of firms in exporting market looking at its own characteristics as well as its sector ones. Basically the model can recoup standard heterogeneity firm models predictions, HO endowment-base comparative advantage predictions and interaction among the two.

With respect to empirical literature I find a new result which is puzzling if one has in mind standard results in comparative advantage literature.
Main result suggests that most productive among comparative disadvantage firms may gain by more after a tariff liberalization episode. This is an anti-intuitive result which is strongly supported by data and which indicates that once heterogeneity of firms is taken into account standard results may be overturned. However from a normative point of view results I get are just an indication since I am not considering a general equilibrium analysis which could allow me to account for a complete welfare analysis.
The paper is organized as follows: the next section deals with the partial equilibrium model; section 2 will then briefly analyze the extent of the EU-Turkey Customs Union of 1996; section 3 will deals with data and the variables' construction; in section 4 I present the econometric framework and the results; section 5 concludes.

1. Model

I consider a partial equilibrium model in which I combine the heterogeneity of firms, the heterogeneity of sectors with respect to their factor intensity and the heterogeneity of countries with respect to their endowment. In building the model I use hypothesis that match with the empirical case I will next turn to explore. I will consider the entrance of Turkey in European Custom Union and I will empirically analyse the effect of this on French exporting structure at firm level.
In developing the model I assume that home country is small enough not to affect the Price Index of foreigner country; I abstract from entry and exit of firms because I consider the reduction in tariff in one trade partner an event too small to influence the exit of firms in the home country and because I am looking at the very short run. Moreover I also abstract from the effect of tariff reduction on both countries' factor prices, because I am looking at the very short run effect of tariff reduction.

Demand

There are two countries which I indicate with H (home) and F (foreign). Home has a higher fraction of skilled (S) over unskilled (L) workers with respect to the other country:

$\left(\frac{S}{L}\right)_H > \left(\frac{S}{L}\right)_F$. These two production factors are supplied inelastically and are mobile inside each country (they are not sector specific) but not between countries, thus respective wages are equalized in each country.

In each country there is a continuum of sectors *i* with $i \in (0,1)$.The index *i* ranks industries by relative factor intensity (S/L). Industries with higher *i* are more skill intensive.

In each industry firms are heterogeneous with respect to their exogenous productivity φ.

All consumers in the two countries are assumed to have identical Cobb Douglas preferences with the fraction of income spent on industry *i* equal to *b(i)* (Equation 1), where the consumption C_i in each industry is a CES function over the continuum varieties of goods ω (Equation 2) and ρ is a function of the elasticity of substitution:

$$U = \int_0^1 b_i \ln C_i d_i \qquad \text{(Equation 1)}$$

$$C_i = \left[\int_0^1 q_i(\omega)^\rho d\omega\right]^{\frac{1}{\rho}} \qquad \text{with } 0<\rho<1 \qquad \text{(Equation 2)}$$

Demand for a particular variety of each sector is:

$$q^D(i,\omega) = \left(\frac{p(i,\omega)}{P(i)}\right)^{-\sigma} \frac{E(i)}{P(i)} \qquad \text{(Equation 3)}$$

where $E(i)=b(i)Y$ is the fraction of income consumer spends in goods of industry *i* and $\sigma = 1/(1-\rho)$ is the constant elasticity of substitution greater than 1, *P(i)* is the Price Index for sector *i* and $p(i,\omega)$ is the price of good ω in sector *i*.

Price Index is given by

$$P_i = \left[\int_0^{N_i} p(i,\omega)^{1-\sigma} d\omega\right]^{\frac{1}{1-\sigma}} \qquad \text{(Equation 4)}$$

where *N* is the exogenous number of firms operating in a given sector.

Production

Firms compete in a monopolistic competition environment. The output of each industry consists of a number of varieties that are imperfect substitutes for one another. Each variety is produced by a firm which a productivity level denoted by φ (so from now on I can substitute index ω with index φ in the equations). In each sector and in each country the distribution of firms' productivity is the same. The total cost function for producing in domestic market or in domestic and foreigner country is given by the following

$$TC(i,\varphi) = f_{i,d} + f_{i,x} + \frac{\hat{q}(i,\varphi)}{\varphi} w_S^{\beta_i} w_L^{1-\beta_i} \qquad \text{(Equation 5)}$$

where $\hat{q}(i,\varphi)$ is the supplied quantity, $f_{i,d}$ is the fixed cost the firm pays to sell in the domestic market, $f_{i,x}$ is the fixed cost the firm pays to sell in foreign market, β_i is the skill-factor intensity in the sector and w_S and w_L are skilled and unskilled wage respectively.

Notice that β_i is higher for sectors which use more intensively skill workers, that is for sectors that are ranked with a higher *i*. Thus in country H, where ratio of skilled over unskilled workers is higher than in country F, sectors with higher β_i are sectors which use more intensively the factor in which country H is more endowed. In other words sector at H with higher β_i have a comparative advantage with respect to F. Thus in the analysis that will follow β_i will be my theoretical measure of comparative advantage.

Finally in this economy there is also variable iceberg cost to export which I will indicate by τ.

From now on we will only consider the export market (the market we are interested in), being the domestic market completely standard. Moreover I will introduce sub-indexes H and F to distinguish between the two countries since we are now in open economy.

Profits in Export Market

Price set by every firm in sector *i* is

$$p(i,\varphi) = \frac{\tau_{i,F} w_{S,H}^{\beta_i} w_{L,H}^{1-\beta_i}}{\rho\varphi} \qquad \text{(Equation 6)}$$

where $\tau_{i,F}$ is tariff that country F imposes on goods in sector *i* coming from country H and is between 1 and 2.

Foreign demand faced by each domestic exporter is given by:

$$q_F(i,\varphi) = \frac{E_{i,F}}{P_{i,F}}\left(\frac{\tau_{i,F} w_{S,H}^{\beta_i} w_{L,H}^{1-\beta_i}}{\rho\varphi P_{i,F}}\right)^{1-\sigma} \qquad \text{(Equation 7)}$$

Thus total export-profits[2] are:

$$\pi_x(i,\varphi) = \tau_{i,F}^{1-\sigma}\frac{\left(w_{S,H}^{\beta_i} w_{L,H}^{1-\beta_i}\right)^{1-\sigma}}{\sigma}\frac{E_{i,F}}{(\rho P_{i,F})^{1-\sigma}}\varphi^{\sigma-1} - f_{i,x} \qquad \text{(Equation 8)}$$

A firm will export if and only if its productivity is higher enough to cover fixed and variable exporting costs having profit higher or equal to zero. From this rule we can get the minimum productivity level for which firms in this economy will be an exporter:

$$\varphi_x(i) = \left[\tau_{i,F}^{\sigma-1}\left(w_{S,H}^{\beta_i} w_{L,H}^{1-\beta_i}\right)^{\sigma-1}(\rho P_{i,F})^{1-\sigma}\frac{\sigma}{E_{i,F}} f_{i,x}\right]^{\frac{1}{\sigma-1}} \qquad \text{(Equation 9)}$$

that is all firms with productivity

$$\varphi > \tau_{i,F}\frac{w_{S,H}^{\beta_i} w_{L,H}^{1-\beta_i}}{\rho P_{i,F}}\left[\frac{\sigma}{E_{i,F}} f_{i,x}\right]^{\frac{1}{\sigma-1}} \qquad \text{(Equation 10)}$$

are exporters.

Price Index in country F can be written (substituting Equation 6 into Equation 4) as:

$$P_{i,F} = \left[\int_0^{N_{i,F}}\left(\frac{w_{S,F}^{\beta_i} w_{L,F}^{1-\beta_i}}{\rho\varphi_F}\right)^{1-\sigma} d\varphi\right]^{\frac{1}{1-\sigma}} = w_{S,F}^{\beta_i} w_{L,F}^{1-\beta_i}\left[\int_0^{N_{i,F}}\left(\frac{1}{\rho\varphi_F}\right)^{1-\sigma} d\varphi\right]^{\frac{1}{1-\sigma}} = w_{S,F}^{\beta_i} w_{L,F}^{1-\beta_i} Z_{i,F}$$

[2] Notice that as in standard heterogeneous firm model if a firm export it is also active in the domestic market and its domestic profits are given by Equation 7 with no variable costs and domestic fixed costs

where $Z_{i,F}$ is a positive constant term given by a function of productivity distribution in each sector of country F. Notice that Price Index in country F is not influenced neither from country H import nor from all other counties imports. This hypothesis may seem strong but it can be easily relaxed without changing following results. In fact the only hypothesis we need to carry on our analysis is that the skill-premium incorporated in goods sold in country F (both domestically produced and imported) is higher than the skill-premium incorporated in goods produced in country H. This is the case if domestic firms in country F have much more market share than foreigner importers, which is plausible since tariffs in country F were high before their reduction.

Thus the exporting threshold becomes

$$\varphi \geq \tau_{i,F} \frac{w_{S,H}^{\beta_i} w_{L,H}^{1-\beta_i}}{w_{S,F}^{\beta_i} w_{L,F}^{1-\beta_i}} \frac{1}{\rho Z_{i,F}} \left[\frac{\sigma f_{i,x}}{E_{i,F}} \right]^{\frac{1}{\sigma-1}} \qquad \text{(Equation 11)}$$

Equation 11 shows how the exporting-threshold varies according to tariffs, comparative advantage and fixed costs to export, given foreign expenditure and productivity distribution in sectors in country F. We can express this result in terms of probability to export. To do this we need to specify a distribution function and express the result in Equation 11 in terms of the mass of firms which, according to the specified distribution, lie to the right of the threshold. Using the standard Pareto distribution function we can write the probability to export for a firm with generic productivity φ as the following

$$\Pr(\varphi) = \left[\frac{K_{i,H}}{\varphi_{i,x}} \right]^{a_{i,H}} = \tau_{i,F}^{\ -a_{i,H}} \left[\frac{w_{S,F}^{\beta_i} w_{L,F}^{1-\beta_i}}{w_{S,H}^{\beta_i} w_{L,H}^{1-\beta_i}} \right]^{a_{i,H}} \left[\frac{\sigma f_{i,x}}{E_{i,F}} \right]^{\frac{a_{i,H}}{1-\sigma}} \left[\rho K_{i,H} Z_{i,F} \right]^{a_{i,H}} \qquad \text{(Equation 12)}$$

where $K_{i,H}$ and $a_{i,H}$ are parameters of the Pareto distribution function.

Testable Predictions

We can now turn to analyze how the exporting threshold and the exporting-pareto-probability react to changes in tariffs, productivity and comparative advantage index.

When tariffs decrease the exporting threshold also decrease and the probability to export increase:

$$\frac{\partial \varphi_{i,x}}{\partial \tau_{i,F}} = \frac{w_{S,H}^{\beta_i} w_{L,H}^{1-\beta_i}}{w_{S,F}^{\beta_i} w_{L,F}^{1-\beta_i}} \frac{1}{\rho Z_{i,F}} \left[\frac{\sigma f_{i,x}}{E_{i,F}} \right]^{\frac{1}{\sigma-1}} > 0$$

and

$$\frac{\partial \Pr(\varphi)}{\partial \tau_{i,F}} = -\frac{1}{(\tau_{i,F})^{2a_{i,H}}} \left[\frac{w_{S,F}^{\beta_i} w_{L,F}^{1-\beta_i}}{w_{S,H}^{\beta_i} w_{L,H}^{1-\beta_i}} \right]^{a_{i,H}} \left[\frac{\sigma f_{i,x}}{E_{i,F}} \right]^{\frac{a_{i,H}}{1-\sigma}} \left[\rho K_{i,H} Z_{i,F} \right]^{a_{i,H}} < 0$$

thus how we were expecting when tariffs go down it is easier to cover the variable costs to export for all firms, so firms who were not enough productive to export with higher tariffs can now begin to export.

What happens when a firm belong to a sector which has higher comparative advantage with respect to the foreigner country? Let's consider the derivative of the exporting threshold with respect to our measure of comparative advantage β_i:

$$\frac{\partial \varphi_{i,x}}{\partial \beta_i} = \tau_{i,F} \frac{1}{\rho Z_{i,F}} \left[\frac{\sigma f_{i,x}}{E_{i,F}} \right]^{\frac{1}{\sigma-1}} \frac{\partial \left(\frac{w_{S,H}^{\beta_i} w_{L,H}^{1-\beta_i}}{w_{S,F}^{\beta_i} w_{L,F}^{1-\beta_i}} \right)}{\partial \beta_i}$$

the sign of this derivative will depend only on the sign of the derivative on the RHS which is equal to:

$$\frac{\partial \left(\frac{w_{S,H}^{\beta_i} w_{L,H}^{1-\beta_i}}{w_{S,F}^{\beta_i} w_{L,F}^{1-\beta_i}} \right)}{\partial \beta_i} = \left(\frac{w_{S,H} / w_{L,H}}{w_{S,F} / w_{L,F}} \right)^{\beta_i} \frac{w_{L,F}}{w_{L,H}} \left(\ln(w_{S,H} / w_{L,H}) - \ln(w_{S,F} / w_{L,F}) \right) < 0$$

Country H has more skilled workers and country F has more unskilled workers. Since there is full employment and since we empirically observe that the two countries produce in all sectors, it must be that country H uses skill labour more intensively than unskilled labour in all sectors. Differentiating total costs with respect to factor prices we have that in order for H to use a

higher ratio of skilled over unskilled workers in all sectors it must be that relative skilled over unskilled factor prices is lower in H than in F. In other words, given the hypothesis we have in this economy we can state that since $\left(\frac{S}{L}\right)_H > \left(\frac{S}{L}\right)_F$ then $\frac{w_{S,H}}{w_{L,H}} < \frac{w_{S,F}}{w_{L,F}}$.

Thus $\frac{\partial \varphi_{i,x}}{\partial \beta_i}$ is negative.

If we analyse the same derivative with respect to equation 12 we get that the sign of the derivative with respect to comparative advantage will be positive since following derivative is positive

$$\frac{\partial \left[\frac{w_{S,F}^{\beta_i} w_{L,F}^{1-\beta_i}}{w_{S,H}^{\beta_i} w_{L,H}^{1-\beta_i}}\right]^{a_{i,H}}}{\partial \beta_i} = a_{i,H}\left(\frac{w_{L,H}}{w_{L,F}}\right)^{a_{i,H}}\left(\frac{w_{S,F}/w_{L,F}}{w_{S,H}/w_{L,H}}\right)^{a_{i,H}\beta_i}\left(\ln(w_{S,F}/w_{L,F}) - \ln(w_{S,H}/w_{L,H})\right)$$

This result means that firms located in country H and in sector which use more intensively skilled workers will export to country F with higher probability given the tariff level for their sector and their productivity. This result is a kind-of HO result since when we have open economies and barrier to trade: every country will export more of its abundant factor.

Finally to know more about the reactivity of sectors with different comparative advantage degree with respect to tariffs we analyze the cross derivatives:

$$\frac{\partial \varphi_{i,x}}{\partial \beta_i \partial \tau_{i,F}} < 0$$

and

$$\frac{\partial \Pr(\varphi)}{\partial \beta_i \partial \tau_{i,F}} > 0$$

The cross derivatives show that as tariffs decrease the exporting-threshold will move more for firms in comparative disadvantage sector (NCA), but the total probability to export will be higher for firms in comparative advantage sectors. The result on the probability to export is sensitive to the distribution function we choose. If we use a uniform distribution function we get the same result we obtain from the threshold. This analysis clearly indicates that there are two effects at work here: the threshold effect which unambiguously indicates that NCA sectors are the more reactive ones and the distribution effect which may be neutral or go in the opposite direction (thus overturning the finding).

This finding is puzzling and completely new in literature. This not only suggests that firm characteristics are important to analyze the consequences of trade liberalization but also that the interaction between firms and sectors characteristics may lead to unexpected results about liberalization gains and losses[3].

The intuition beyond this result is that for each level of tariffs firms which are in comparative advantage sectors have higher probability to export since foreigner demand for every good in the sector is higher, given the cost advantage in producing the goods Home has. Thus when tariffs decrease, more firms in each sector enters the foreigner market, but this number is higher for comparative disadvantage firms which where very penalized by the presence of high tariffs.

The model I have built is intended to be suitable to the empirical case I will analyze where there is a tariff reduction of Turkey (which is the Foreigner country less skilled endowed) with respect to France (which is Home country more skilled endowed). The CU settled between Turkey and EU was mentioned to reduce Turkey's import tariffs, but did not have effects on EU import tariffs from Turkey which were already low. Thus the model abstracts from the effect on tariff reduction on French import market, since there was a unilateral reduction of tariff which had main effects on French exporting and Turkey importing structure.

2. EU-Turkey Customs union.

Turkey and European Economic Community (EEC) relation goes back to 1963 with the signing of Ankara Agreement that specify the three stages through which prepare Turkey to full membership to the Community. In the preparatory stage, lasted five years, the EEC gave unilateral concessions to Turkey in the form of agricultural tariff quotas and direct financial aid. During this stage Turkey did not have to change its trade regime. During the transition stage the Additional Protocol to the Ankara Agreement was signed in 1970, becoming effective in 1973. The aim of this protocol was to set a timetable to reach the Customs Union by 1996. After the Additional Protocol was signed, the EEC abolished tariffs and equivalent taxes on industrial imports from Turkey, with the exception of some sensitive products such as machine woven carpets, cotton yarn and cotton textiles. The EEC also removed all quantitative restrictions on industrial import from Turkey with the exception of imports of cocoons and raw silk. However,

[3] The model presented in this paper does not allow us to conduct a proper welfare analysis, thus this conclusion should be considered as an indication of the fact that once we allow for sector and firm heterogeneity standard results from literature may be not preserved.

it did continue to apply quotas and minimum import price which were within the framework of the Common Agricultural Policy and also non-tariff barriers against some goods (e.g. textiles, iron and steel, raisins, fresh fruit and vegetables) remained high. During the transitional stage some problems arose regarding the inability of Turkey to abolish tariffs as planned. However, on March 1995 it was agreed at the Association Council meeting in Brussels that Turkey would enter the European Customs Union, starting on January the 1st, 1996: this step has been considered very important by both parties for the increasing in their integration.

The basic points of the CU regarding trade with EU are the following[4]:

- Turkey has to eliminate all customs duties, quantitative restrictions, charges having equivalent effect to customs duties and all measures having equivalent effect to quantitative restrictions in trade of industrial goods with EU by January 1, 1996;
- Turkey has to adopt the Common Customs Tariff (CCT) against third country imports by the same date and adopt all the EU preferential agreements with third countries by 2001;
- Common agricultural policy (CAP) is not included in the CUD (even if processed components of agricultural products, considered as industrial products are part of the CUD): articles 22-25 declare that Turkey has to adjust its agricultural policy in order to adopt CAP and let its agricultural products to circulate freely (however on this point there are important issues still under discussion, regarding principally financial aids);
- the " European Coal and Steel Community" (ECSC) products, basically iron and steel, are exempted from the CU. However in 1996 a "Free Trade Agreement" between Turkey and EU implies that also these goods will circulate freely after three years;
- Turkey will finally work toward the harmonization of commercial legislation concerning competition policy, state aids, intellectual and industrial property rights, adoption of new rules on customs classification, valuation, rules of origin, technical regulations, standards and government procurements;
- The CUD (Customs Union Decision) does not face important issues like the supply of service, the establishment and movement of capital, the movement of labour.

What is the real extent on the elimination of trade barriers provided by EU-Turkey CU? Table 1 provides the Nominal Protection Rate (NPR)[5] for different sectors before (1994) and after

[4] This section borrows from Togan (1995), Togan (1997), Ulgen and Zahariais (2004).

(2001)[6] the formation of the CU. It is clear that for all industrial goods tariffs went down to 0, but the effect has been asymmetric between sectors since some of them where quite heavily protected (like "non-alcoholic beverages", "processes tobacco", "cement" and "motor vehicles"). Simple mean among tariffs on goods object of the CU was 13.13%, while the relative standard deviation amounted to 12.67% revealing a quite high differentiation among tariffs between sectors. By 1996 both mean and standard deviation get down to 0.

Nominal Protection Rate gives us an indication of the tariffs reduction but the right way to measure it is using the "effectively applied rates" from Turkey to France taken from TRAINS-WTO dataset which is a more reliable measure of tariffs themselves. According to this database tariffs have been effectively reduced after the CU without being completely eliminated. Moreover the variation in tariffs change has been very pronounced as shown in Figure 1.

3. Data and variables construction.

Data used in this analysis have different sources: data on French firms are taken from INSEE (Institute Nationale de la Statistique et des Etudes Economiques) BRN and DOUANE, data on tariffs come from TRAINS-WTO dataset, finally data from NBER Manufacturing Dataset and Caselli (2003) dataset have been used to build comparative advantage measures.

The first dataset , BRN(Benefice Reels Normaux), contains all accounting variable and total employment information of French firms whose turnover is higher than 3,5 millions of franc (about 530.000 euros) (they are required to compile every year the corresponding declaration), accounting for the 60% of all French firms.

In what follows I describe the variables taken from the BRN dataset.

Employment (L)

It is a full time-equivalent measure that accounts for part-time workers and it refers to the end of the year.

Value added (Y)

It is defined as the difference between production and materials, added to production subsidies minus value added tax and other accrued taxes or credits for production. It is divided by the

---

[5] The NPR for a sector *i* is defined as an average of the NPR for each good in that sector. $NPR_j = \left(\frac{p_j}{p_j^*} - 1 \right) * 100$, where p_j refers to the domestic price of good j, while p_j^* to its border equivalent price.

[6] Notice that except for "agricultural products" and "iron and steel" all tariff on industrial goods are 0 already from 1996

industry value added price index at the two-digit level of the French industrial classification taken by the national accounts.

Labour cost (w)

It is equal to the total labour compensation costs.

Real capital stock (K)

This is measured as the gross book value of fixed assets including construction and other fixed assets. It is adjusted for inflation assuming all the stock was bought in one time at a date computed as the difference between the considered year and the age of the stock of capital. The age itself is defined as the product of an assumed life time of 16 years and the ration of the net to gross book value ratio.

Total sales (CA) and total sales to export (CAEX)

These are measured as total sales at home and in any other destination reported in the balance sheet of each firm.

The dataset DOUANE provides information about sales and countries to which every firm exports. Firms that in a single year are in BRN but not in DOUANE are considered non-exporters of that year.

I consider all manufacturing firms that appear in both datasets and that have positive value added, number of workers and capital. Moreover I eliminate firms for which the two datasets report different information about their exporting status.

The final dataset I will use contains information for 64.000 to 69.000 firms between 1994 and 1999. The number of firms differs from year to year since some of them exit from the domestic market. Accounting for firms exiting will be important in productivity measures. I will use two measures of exits. The first one is the "accounting measure" according to which I will consider as exited those firms that disappear from the BRN record under the working hypothesis that real entry and exit are well measured by the ones in the dataset. However this measure could over-count the number of exited-firms since firms could have changed their SIREN code following some kind of organization restructuring (mergers, acquisitions and so on). To mitigate it I consider a second measure of firm-exiting merging BRN dataset with the information about illiquidity problems at firm level given in the "Defaillance" dataset. This dataset contains the SIREN code of firms that in a specific year underwent a court process aimed to judge if their illiquidity situation is structural (solvability problems) or not (just illiquidity). Firms with illiquidity situation that disappear after one or two years from the BRN dataset are considered out of the market. Contrary to the previous measure, this one leads to an under-counting of the real number of firms who exited the market. Some of them in fact could have exited without passing through a judgment about their accounting illiquidity.

Table 2 reports numbers of observations in the dataset, showing the number of operating firms per year, measured number of exited-firms, and the number of firms which are exporting in Turkey in each year.

In the empirical analysis I will use different measures of firm productivity.

First I consider the distance between labour productivity at firm level and average labour productivity at NES60 sector level (digit-3 level). This allows me to check for structural difference in labour productivity among sectors. I turn then to construct more sophisticated and reliable measures of Total Factor Productivity using Olley-Pakes as well as Levinshon-Petrin techniques. Both these measures allow me to obtain TFP's measure as the residual of a regression on labour, capital and other factors controlling for simultaneity and selectivity bias. Simultaneity bias may arise because firms may adjust one production factor (capital) knowing a part of their productivity. Thus Olley-Pakes suggest to use an investment function that links capital stocks to capital flows and to estimate the coefficient of capital with a non-parametric technique. Levinshon-Petrin technique is very similar to the previous one but it consists in using a function for the demand of intermediate factors (material) instead of an investment function, since in firm level datasets many records for investment are zero. Selectivity bias may arise because in this dataset some firms exit and presumably they are the less productive ones. In order to check for this potential bias I will follow Olley and Pakes and I will incorporate an estimate of the survival function in the non parametric second stage. As explained before I will use two different measures of firm-exiting when dealing with the selectivity bias. Table 3 shows some descriptive statistics on constructed variables.

The second relevant measure in the empirical analysis will be the measure of comparative advantage which I will measure considering skill and capital intensity. The skill-comparative-advantage has been calculated considering the following formulation $SCA_{ijk} = S_{i,US}\left(S_j - S_k\right)$ where i are NES60 or NES15 sectors, j refers to France and k refers to Turkey, S refers to skilled workers in different US sectors and to total endowment of skilled workers in the two relevant countries. An analogue measure has been constructed using capital endowment and capital industry intensity instead of skilled workers[7]. These measures of comparative advantage are indeed very close to their HO theoretical definitions. The first part of the formula is, respectively, the skilled and the capital intensity at sector level, where US sectors are considered as an optimal benchmark toward which sectors in all countries should converge. The second

[7] Measures in the same fashion have been recently used in Cuñat-Melitz (2005), Nunn (2004), Romalis (2004).

part is simply the difference in endowment among the countries. Sectors that are more skilled intensive in their productive structure and are located in the country with more endowment of skilled workers will have more comparative advantage. As in Cuñat-Melitz (2005) the measures of US skilled and capital sector intensity have been building using NBER Manufacturing Dataset. Skilled sector intensity is the logarithm of the non-production over total wages, while capital intensity is given by the logarithm of capital per worker. Measures of total endowments are taken from Caselli (2003): capital abundance is the log of physical capital stock per worker while human skill abundance is calculated as the log average years of schooling in a country with Mincerian non-linear returns to education.

Table 3 shows the measures of the capital and human capital (skills) comparative advantage for 2-digit sector level. French sector with higher level of comparative advantage with respect to Turkish ones are "Drugs, Soap and Cleaners", "Chemicals Products", "Transportation", "Mechanical Equipment" and "Electric and Electronic Components". As expected Turkey has higher comparative advantage in traditional sectors like "Apparel, Textile and Leather Products" and "Textile Mills". Notice that SCA is negative and increasing, thus sectors which reported a SCA near 0 have higher skilled comparative advantage with respect to Turkey[8].

4. The empirical results.

Basic descriptive results.

The EU-Turkey CU has had a great impact on French firm exporting choice. Table 1 reports the number of total French exporters and of French exporters to Turkey in 1995 and 1996. As found in other empirical works, it is the case also for France that only a few percentage of firms export. Data suggests that the 9,61% of exporters choose Turkey as destination in 1995 and this percentage has increased up to 11,32% after the formation of the Customs Union. In table 5 I report the number of new exporters to Turkey in 1996 for total economy and for each sector in absolute terms and as a percentage of new exporters in all destinations. Data suggests that almost 50% of all new exporters decided to export to Turkey. This high percentage varies from 18% in "publishing and printing" sector to almost 70% in "textile mill products" sector.

In table 6 I report the percentage of the French exporting sales to Turkey over total French exporting sales in OECD countries, non-OECD countries, European and Eastern European countries. French exporting sales to Turkey has increased between 1995 and 1996 for all the

[8] In Table 3 I also report an increasing transformation of skilled comparative advantage measure (called measure 1)

reported sub-group indicating an intensive margin reaction to the entrance of turkey in CU. Finally table 7 suggests that on average sales exported to Turkey have increased for firms that were exporting both before and after CU, but the standard deviation of this growth is very high, in fact some firms reported a negative growth rate of their shipped sales to Turkey between different years in the dataset.

This first analysis shows that CU with Turkey has strongly affected French exporting structure.

Results on the extensive margin.

The model presented in section 1 provides three testing hypothesis on the extensive margin. The first two predictions, that hold both considering the threshold and the probability to export, tells that the probability to export increases as tariffs decrease and that it is higher for firms in comparative advantage sectors. The third prediction is on the reactivity of firms to tariffs reduction according to sector they belong to. According to the threshold effect firms in comparative disadvantage sector should be more reactive to a reduction of tariff given their productivity. However if we consider a productivity distribution function this result may be overturned. In fact using a Pareto distribution function I found that probability to export is higher for firms in comparative advantage sectors. Figure 3 helps to clarify how threshold and distribution effects may work: even if the exporting threshold moves more for comparative disadvantage sectors it may be the case that the numbers of firms among the initial and final exporting threshold (given by the area under the distribution function between the two thresholds) is higher for comparative advantage sector depending on the initial level of the threshold. Theoretically we cannot disentangle between these two effects, while empirically this is possible. If the total effect of tariffs on probability to export is higher for comparative disadvantage firms then we can conclude that the threshold effect is negative and that the distribution effect, even if positive, does not overturn the first effect. If the total effect is instead higher for comparative advantage firms then we are not able to know if the threshold effect is empirically negative and the distribution effect is higher in magnitude or if both threshold and distribution effect are positive.

These three predictions will be tested using a probit model and a linear regression one. The basic probit regression I run has the following structure:

$$\Pr\left[\exp\_TURKEY_{i,j,t}\right] = \Phi(\beta_1 \varphi_{i,j,t-1} + \beta_2 T_{t,j} + \beta_3 T_{t,j} * CA_j + \beta_5 Z_{i,j,t-1} + \delta_j + \delta_t + \varepsilon_{ijt})$$

where the dependent variable is a dummy that takes value 1 if a firm is exporting to Turkey in a given year and 0 otherwise, the sub-index i stays for plant, j for industry and t for year. Firm productivity is indicated by φ, T indicates tariffs, CA is the time invariant measure of comparative advantage. Z represents a set of firm level variables which I introduce to perform robustness checks: firm size measured with log of workers, firm capital intensity measured with logarithm of capital stock per year , logarithm of the wages paid by firms and a dummy that indicates if a firm is exporting to other destinations (except Turkey). All firm level variables are introduced with a lag in order to avoid any sort of endogeneity. Finally I introduce sector fixed effects and time fixed effects[9] to control for effects which may be different from CA and from tariffs. In all regressions I consider robust confidence intervals and I cluster the observations at sector digit-3 level. Notice that I can't introduce a direct measure of comparative advantage at 3-digit level since regressions display sector fixed effect at the same level of aggregation, so I can't test the magnitude of the effect of my measure of comparative advantage but I can be sure that there is nothing at sector level which has been omitted from the regressions[10]. Table 8 shows results for this first specification using capital comparative advantage measure and considering different measures of productivity[11] as well as all firm-level control variables[12]. All measures of productivity are positive and significant as I was expecting, in fact more productive firms have more probability to export; tariffs instead have a negative impact on this probability, since they increase the cost to sell abroad. The interacted term among tariffs and comparative advantage is positive and lower in magnitude with respect to the coefficient of the tariffs. This means that when CA is high the total effect of tariffs on the probability to export is lower in absolute term, while when CA is low this effect is higher in absolute term. Thus controlling for firm productivity and other firm characteristics we found that firms in comparative disadvantage sectors are more reactive to a tariffs' change, as the model was suggesting. Notice that exporting to other destinations in the previous period is always significant and very high in magnitude, meaning that firms which were already exporting somewhere else find easier to enter in a new market when tariffs' condition allow for it. Finally control variables capital and total cost of

[9] I call them fixed effects even if there is the incidental parameter problem.
[10] Anyway I have run the same regressions considering the CA measure and omitting the fixed effect. I obtain the same results for the interacted term and I obtain a positive and significant coefficient for the CA measure as was expected.
[11] Labour productivity is the distance of labour productivity at firm level from the average of its NES60 sector of belonging; TFP has been calculated with Olley and Pakes and with Levinshon and Petrin methods. To check for selection bias some measures of TFP have been calculated accounting for exiting firms. Firm has exited from the market according to two different measures which I am referring to with the names "defaillance" and "account".
[12] All regressions without control variables give the same results.

labour (wages) are positive and significant suggesting that firms more capital intensive or using more "high wage" workers have more probability to export to Turkey.

Regressions with the pooled probit model confirm the theoretical results, however when we run a probit and we estimate along with the parameters also dummies to account for unobserved effects we may incur in the so-called "incidental parameters problem" which generate bias and inconsistent estimations. This is the case of regressions presented in table 8 since I am controlling for unobserved sector effect (through the sector dummies) and unobserved time effect (through the time dummies). To overcome this problem I run the same regressions using a linear probability model (LPM) with result presented in Table 9. The baseline regressions I am running with the linear probability model is the following

$$\exp\_Turkey_{i,j,t} = \beta_0 + \beta_1 \varphi_{i,j,t-1} + \beta_2 T_{t,j} + \beta_3 T_{t,j} * CA_j + \beta_5 Z_{i,j,t-1} + \delta_j + \delta_t + \varepsilon_{ijt}$$

where the variable are the same that in previous specification but the regression model is a linear instead that a probabilistic one.

With LPM the fixed effects can be estimated along with the coefficients without creating any bias or inconsistency. The only caveat of this methodology is that results can be higher than one or smaller than zero even if we are estimating a probability, thus unless explanatory variables are restricted LPM cannot be a good description of the population response probability. Therefore the LPM should be seen as a convenient approximation of the underlying response probability which can be estimated with fixed effect. Table 9 suggests that results with this methodology have the same direction that the ones with pooled probit.

Finally in Table 10 results of linear probability model with firm fixed effects are reported. Introducing firm fixed effects instead of sector ones allow me to control for firm unobserved effects which I do not control for using only firm productivity, capital, size and cost of labour. Results do confirm previous findings.

Same set of regressions have been run using skilled (human capital) comparative advantage measure analyzed in section 3. In Table 11 I only report some of the regressions estimated, more precisely the ones using Olley-Pakes TFP measure with both pooled panel model and linear probability model with firm fixed effect. Results are in line with previous findings except for the role of tariffs with covariate positively with probability to export when we use one of the two human capital comparative advantage measure. The interacted term, instead, confirm that there is a non-linear effect and that firms in comparative disadvantage sectors do react more to change in tariffs.

To better assess the basic finding of the paper let's consider the estimated probability to enter Turkey market in Table 12. In the first column I report the 25th, 50th and 75th percentile of capital and human capital comparative advantage measure and in the second column I report the relative estimated increase in the probability to export to Turkey[13]. Estimations tell us that after controlling for firm level characteristics and sector and time fixed effects the probability to export to Turkey after the CU[14] increases by 2% for a firm in the first 25th percentile of capital comparative advantage, by 1.30% for a firm with a median capital comparative advantage and by 0.70% for a firm with higher capital comparative advantage. Similar results hold for human comparative advantage where the change in probability to export before and after CU goes from 11.5% to 3.1% as we consider firms in the first or in the last 25th human comparative advantage percentile.

5. Conclusions.

In this paper I analyze both theoretically and empirically how the extensive margin (i.e. the probability to export) is affected by a reduction of tariffs for heterogeneous firms in sectors with different endowment comparative advantage.

First I derive a partial equilibrium model in which there are 2 countries with different production factors endowments, a continuity of sectors inside each country which use factors of production with different intensity and a continuity of firms within each sector which differ in exogenous productivity. According to the model more productive firms have higher probability to export, firms with the same productivity will have higher probability to export if tariffs are lower and/or if they belong to a sector with higher comparative advantage with respect to foreign country. These first findings are respectively in line with standard firms' heterogeneous models and with standard Heckscher-Ohlin comparative advantage model. A new result suggests that there is a non-linear effect of tariffs reduction on different sectors. In particular exporting threshold moves more for firms in comparative disadvantage sectors. When we turn to analyze the probability to export, however, we need to consider firms' productivity distribution and depending on the selected distribution last result can be overturned. The question is mainly empiric.

[13] More precisely I am using estimations from LPM with sector fixed effect, Olley-Pakes TFP and capital comparative advantage and from LPM with firm fixed effect and human capital comparative advantage with measure 2.

[14] More precisely I am considering a reduction of tariffs from 10.42 (before CU average) to its half 5.21.

In the empirical part I looked at French firms' probability to export to Turkey after Turkey entrance in European Customs Union.

Data analysis suggests that French firms have added new destinations in their "exporting portfolio" between 1995 and 1996 have chosen Turkey in the almost the 50% of the cases. Thus the decreasing of Turkish tariffs has had a great impact on French exporting structure.

As regards the extensive margin different regression models suggest that after CU probability to export has been higher for firms in comparative disadvantage sectors even controlling for firms characteristics, sector and time fixed effects. This means that empirically the threshold effect is stronger for NCA sector.

Results of this paper suggest first that heterogeneity in sectors, associated to heterogeneity in firms characteristics (mainly productivity) are both important in assessing the consequences of tariffs reduction. Secondly theoretical and empirical results challenge the standard view on the way comparative advantage sectors react to falling in trade costs since less comparative advantage sector do react more to change in tariffs.

This paper could be improved and extended in many directions. First, a carefully analysis on the intensive margin is missing. A first analysis on this, which I did not reported, suggests that change in exported quantities from firm who were in Turkish market both before and after CU formation does not depend neither on tariffs nor on comparative advantage measures. Second, a broader experiment using observations for different countries may be helpful to generalize this new finding. Third, from a theoretical point of view the analysis suggests that interacting heterogeneity in firms and heterogeneity in sectors, not only with respect to Hecksher-Ohlin comparative advantage status, is a fruitful area for future research.

References

Arnold, J.M. (2005). "Productivity Estimation at the Plant Level: A Practical Guide", *working paper mimeo*.

Baldwin, R. (2005). "Heterogeneous Firms and Trade: Testable and Untestable Properties of the Melitz Model", *NBER Working Paper* 11471.

Bernard, A.B., Jensen, J.B. and P.K. Schott (2003). "Falling Trade Costs, Heterogeneous Firms and Industry Dynamics", *NBER Working Paper* 9639.

Bernard, A.B., Redding, S. and P.K. Schott (2004). "Comparative Advantage and Heterogeneous Firms", *NBER Working Paper* W 10668.

Bustos, P. (2005). "Impact of Trade on Technology and Skill Upgrading: Evidence from Argentina", *working paper mimeo*.

Caselli, F. (2003). "Accounting for Cross-Country Income Differences", *Handbook of Economic Growth,* forthcoming.

Dornbush, R., Fischer, S. and P.A. Samuelson (1980). "Heckscher-Ohlin Trade Theory with Continuum of Goods", *Quarterly Journal of Economics*, 1980(2), 203-224.

Epifani, P. (2003). "Trade Liberalization, Firm Performance and Labor Market Outcomes in the Developing World: What Can We Learn from Micro-Level Data?", *World Bank Paper series.*

Helpman, E., Melitz, M.J. and S.R. Yeaple (2004). "Export Versus FDI with Heterogeneous Firms", *American Economic Review*, 94(1), 300-316.

Helpman, E. and P.R. Krugman (1985). "*Market Structure and Foreign Trade*", MIT Press. Cambridge MA.

Levinsohn J. and A. Petrin (2003). " Estimating Production Functions Using Inputs to Control for Unobservables", *Review of Economic Studies* 70, 317-342

Melitz, M.J. (2003). "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity", *Econometrica*, Vol. 71, November 2003, pp. 1695-1725.

Melitz, M.J. and A. Cuñat (2005). "Labour Market Flexibility and Comparative Advantage", *working paper, mimeo.*

Olley S. and A. Pakes (1996). "The Dynamics of Productivity in the Telecommunications Equipment Industry", *Econometrica* 64, 1263-1297

Pavcnik, N. (2002). "Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants", *Review of Economic Studies* 69, 245-276.

Romalis,J. (2004). "Factor Proportions and the Structure of Commodity Trade", *American Economic Review*, 94(1), 67-97.

Schor, A. (2004). "Heterogeneous Productivity Response to Tariff Reduction: Evidence from Brazilian Manufacturing Firms", *NBER Working Paper* W 10544.

Togan, S. (1995). "Trade Policy Review of the Republic of Turkey", in S. Arndt and C. Milner (eds), *The World Economy Global Trade Policy*, Blackwell, Oxford.

Togan,S. (1997). "Opening up the Turkish Economy in the Context of the Customs Union with the EU", *Journal of Economic Integration*, 12, 157-159.

Trefler, D. (2001). "The Long and Short of the Canada-US Free Trade Agreement", *NBER Working Paper* W 8293.

Tybout, J.R.(2001). "Plant and Firm-Level Evidence on 'New' Trade Theories", *NBER Working Paper* W 8418.

Ulgen, S. and Y. Zahariadis (2004), "The Future of Turkish-EU Trade Relations: Deepening vs Widening", *EU-Turkey Working Papers, No5, Centre for European Policy Studies*.

APPENDIX : tables, figures and graphs

sector I-O name	NPR with EU in 1994	NPR with EU after CU
Coal mining	3.33	0.00
Crude petroleun	0.00	0.00
Iron and mining	0.00	0.00
Other metalic ore mining	0.13	0.00
Non-metallic mining	9.09	0.00
Stone quaryng	1.95	0.00
Non-alcoholic beverages	56.92	0.00
Processed tobacco	44.40	0.00
Ginning	0.00	0.00
Textiles	21.19	0.00
Clothing	14.75	0.00
Leather and fur production	7.85	0.00
Footwear	24.40	0.00
Wood products	15.25	0.00
Wood furniture	26.22	0.00
Paper and paper products	13.59	0.00
Printing and publishing	8.23	0.00
Fertilizers	8.22	0.00
Pharmaceutical production	3.33	0.00
Other chemical production	10.79	0.00
Petroleum refining	22.54	0.00
Petroleum and coal products	5.62	0.00
Rubber products	19.57	0.00
Plastic products	24.61	0.00
Glass and glass production	16.85	0.00
Cement	30.45	0.00
Non-metallic mineral	18.33	0.00
Iron and steel	8.00	0.00
Non-ferrous metals	4.52	0.00
Fabricated metal products	18.36	0.00
Non-electrical machinery	7.36	0.00
Agricultural machinery	6.98	0.00
Electrical machinery	9.69	0.00
Shipbuilding and repairing	6.13	0.00
Railroads equipment	0.00	0.00
Motor vehicles	27.33	0.00
Other transport equipment	0.01	0.00
Other manufacturing industries	2.92	0.00

Source: Togan (1997)

Table 1. *Nominal Protection Rate of Turkish sectors before and after the formation of CU.*

	Number of observations					
year	1994	1995	1996	1997	1998	1999
Operating firms	69563	64939	65950	68085	66972	67322
of which exporters	*24349*	*24652*	*24475*	*24305*	*24143*	*23608*
of which exporters to Turkey	*2082*	*2368*	*2770*	*2990*	*3096*	*2913*
as % of operating firms	***2.99***	***3.65***	***4.20***	***4.39***	***4.62***	***4.33***
as % of total exporters	***8.55***	***9.61***	***11.32***	***12.30***	***12.82***	***12.34***
Accounting exited-firms		4624	3613	1478	2591	2241
Exited-firms according to "defaillance" measure		1549	1618	1112	729	695

Table 2. *Number of Observations.*

variable	Obs	Mean	Std. Dev.	Min	Max
workers	470452	49.38	352	0	60062
value added in log	467024	7.94	1.57	0	17.8
capital in log	468390	7.58	1.85	0	17.87
materials in log	470188	7.99	1.9	0	18.98
investments in log	323856	5.16	2.14	0	16.43
wage in log	469614	7.65	1.53	0	16.61
labour productivity as a distance from sector average	466101	-0.13	0.51	-5.96	5.64
TFP (OP) (Olley Pakes calculation)	366059	4.55	0.55	0.025	10.11
TFP (OP) j (Olley Pakes calculation accounting for attrition bias)	366059	4.61	0.59	-0.14	10.48
TFP (OP) d (Olley Pakes calculation accounting for attrition bias)	366059	4.62	0.59	-0.07	10.48
TFP (LP) (Levhinson-Petrin)	464508	0.44	0.96	-6.83	7.84

Table 3. *Basic statistics*

Sectors	number of observations in each sector (1994)	phisical capital CA index	human capital CA index (measure 2)	human capital CA index (measure 1)	difference in tariff 95-97
Food, Beverages and Tobacco	11141	7.15	-0.38	0.32	8.99
Apparel, Textile and Leather Products	3889	4.40	-0.41	0.28	-6.88
Printing and Publishing	7550	6.12	-0.19	0.59	-2.87
Drugs, Soaps and Cleaners	907	8.04	-0.18	0.63	-2.87
Furniture and Fixture	4750	5.83	-0.32	0.36	-3.94
Motor Vehicles and Equipment	1031	7.81	-0.53	0.22	-2.10
Transportation Equipment	751	6.43	-0.31	0.40	-1.06
Mechanic Equipment	9687	6.67	-0.29	0.37	-2.38
Electric and Electronic Equipment	4177	6.73	-0.16	0.76	-2.10
Mineral Products (Stone, Clay and Glass Products)	3706	7.30	-0.39	0.29	-2.19
Textile Mill Products	2507	6.64	-0.48	0.24	-2.08
Paper and Allied Products, Lumber and Wood Products	4106	6.25	-0.43	0.26	-3.14
Chemicals and Allied Products	3942	7.32	-0.33	0.36	-2.15
Fabricated Metal Products	9817	7.50	-0.41	0.29	-5.14
Electric and Electronic Components	1602	6.97	-0.27	0.44	-3.31

Table 4. *The Comparative Advantage Measures by 2-digit Sectors*

	Nº of new exporters in Turkey	as a % of new exporters in any destination
Total	937	48.2
by sector		
Food, Beverages and Tobacco	33	32.7
Apparel, Textile and Leather Products	122	60.4
Printing and Publishing	22	17.9
Drugs, Soaps and Cleaners	29	59.2
Furniture and Fixture	95	47.3
Motor Vehicles and Equipment	18	45.0
Transportation Equipment	13	40.6
Mechanic Equipment	139	43.0
Electric and Electronic Equipment	58	45.3
Mineral Products (Stone, Clay and Glass Products)	27	41.5
Textile Mill Products	99	69.7
Paper and Allied Products, Lumber and Wood Products	42	41.2
Chemicals and Allied Products	89	48.4
Fabricated Metal Products	109	42.7
Electric and Electronic Components	42	53.8

Table 5. *New exporters in Turkey in absolute numbers and as a percentage of new exporters in any destination.*

French exporting sales to Turkey						
	1994	1995	**1996**	1997	1998	1999
over French exp sales to OECD countries	0.85%	0.79%	**1.20%**	1.30%	1.29%	1.48%
over French exp sales to non-OECD countries	4.25%	3.70%	**5.56%**	5.40%	5.57%	7.29%
over French exp sales to EU countries	1.02%	0.94%	**1.43%**	1.58%	1.59%	1.81%
over French exp sales to Eastern EU countries	31.18%	24.56%	**29.09%**	28.49%	26.88%	33.21%

Table 6. *French exporting sales to Turkey over French exporting sales to other groups of countries in percentage.*

difference in log of quantity exportd to TK	Obs	Mean	Std. Dev.	Min	Max
firms exporting in both 1995 and 1996	1829	0.26	1.4	-6.63	8.14
firms exporting from 1995 to 1997	1733	0.5	1.58	-7.8	6.8
firms exporting from 1995 to 1998	1639	0.56	1.67	-7.7	8.4
firms exporting from 1995 to 1999	1500	0.43	1.77	-8.3	8.04
firms exporting from 1995 to 2000	1436	0.58	1.86	-7.4	6.68
firms exporting from 1995 to 2001	1285	0.35	1.99	-9.02	7.6

Table 7. *Growth rate of exporting sales to Turkey for firms exporting in different groups of years.*

prob of exporting to Turkey	pooled probit model with sector FE					
	1	2	3	4	5	6
TFP (OP)	0.42***	0.23***				
TFP(OP) (defaillance)			0.22***			
TFP (OP) (account)				0.22***		
TFP (LP)					0.26***	
labour productivity						0.25***
tariff	**(-0.04)*** **	**(-0.038)*** **	**(-0.038)*** **	**(-0.038)*** **	**(-0.037)*** **	**(-0.033)*** **
Capital CA* tariff	**0.005*** **	**0.004*** **	**0.0049*** **	**0.0049*** **	**0.0048*** **	**0.004*** **
exporter in OD	1.68***	1.14***	1.14***	1.14***	1.14***	1.14***
size		(-0.07)	(-0.087)	(-0.088)	(-0.13)**	0.0008
capital		0.10***	0.097***	0.097***	0.27***	0.045**
wage		0.37***	0.38***	0.38	0.33***	0.36***
N· observations	180585	180580	180580	180580	180580	180580
pseudo R^2	0.29	0.4	0.4	0.4	0.4	0.4
pseudo LL	-23285	-19668	-19671	-19672	-19645	-19660
Cluster	NES 3	NES 3	NES 3	NES 3	NES 3	NES 3
Robust CI	YES	YES	YES	YES	YES	YES
year dummies	YES	YES	YES	YES	YES	YES
sector dummies	YES	YES	YES	YES	YES	YES

Notes: Plant-level probit regression. Robust standard errors are adjusted for clustering at the three-digit NES industry level classification. *** means significant at the 1% level; ** means significant at the 5% level; * means significant at the 10% level. Dependent variable is a dummy taking value of 1 if the plant export in Turkey and 0 otherwise. Coefficient for the regressions dummies and constant terms are not reported.

Table 8. *Probability of entering Turkey market with pooled probit model and capital comparative advantage.*

prob of exporting to Turkey	linear probability model with sector FE					
	1	2	3	4	5	6
TFP (OP)	0.029***	0.0168***				
TFP(OP) (defaillance)			0.018***			
TFP (OP) (account)				0.017***		
TFP (LP)					0.019***	
labour productivity						0.234***
tariff	**(-0.0035)****	**(-0.0036)*****	**(-0.0037)*****	**(-0.0037)*****	**(-0.0036)****	**(-0.0033)*****
Capital CA* tariff	**0.000437****	**0.00463*****	**0.00047*****	**0.00047****	**0.00046****	**0.0004*****
exporter in OD	0.093***	0.033^^	0.038***	0.033**	0.033***	0.033***
size		0.008	0.009	0.0087	0.0034	0.019***
capital		0.016***	0.016***	0.016***	0.028***	0.012***
wage		0.015***	0.014*	0.015**	0.013***	0.009**
N· observations	180585	180580	180580	180580	180580	180580
R^2	0.1	0.16	0.16	0.16	0.16	0.16
Cluster	NES 3	NES 3	NES 3	NES 3	NES 3	NES 3
Robust CI	YES	YES	YES	YES	YES	YES
year dummies	YES	YES	YES	YES	YES	YES
sector dummies	YES	YES	YES	YES	YES	YES

Notes: Plant-level probit regression. Robust standard errors are adjusted for clustering at the three-digit NES industry level classification. *** means significant at the 1% level; ** means significant at the 5% level; * means significant at the 10% level. Dependent variable is a dummy taking value of 1 if the plant export in Turkey and 0 otherwise. Coefficient for the regressions dummies and constant terms are not reported.

Table 9. *Probability of entering Turkey market with linear probability model and capital comparative advantage.*

prob of exporting to Turkey	linear probability model with firm FE					
	1	2	3	4	5	6
TFP (OP)	0.005***	0.006***				
TFP(OP) (defaillance)			0.006***			
TFP (OP) (account)				0.006***		
TFP (LP)					0.007***	
labour productivity						0.0067***
tariff	**(-0.002)*** **	**(-0.002)*** **	**(-0.002)*** **	**(-0.002)*** **	**(-0.002)*** **	**(-0.002)*** **
Capital CA* tariff	**0.0003*** **	**0.0003** **	**0.0003** **	**0.0003** **	**0.0003** **	**0.003*** **
exporter in OD	0.002**	0.001	0.001	0.001	0.001	0.001
size		0.008**	0.008**	0.008**	0.006***	0.010***
capital		0.004***	0.004***	0.004***	0.008***	0.003***
wage		0.003**	0.003*	0.003*	0.003*	0.003***
N· observations	180585	180580	180580	180580	180580	180580
R^2 within	0.038	0.004	0.004	0.004	0.004	0.004
R^2 between	0.023	0.14	0.14	0.14	0.14	0.15
R^2 overall	0.014	0.11	0.11	0.11	0.12	0.12
Robust CI	YES	YES	YES	YES	YES	YES
year dummies	YES	YES	YES	YES	YES	YES
firm fixed effect	YES	YES	YES	YES	YES	YES

Notes: Plant-level probit regression. Robust standard errors are adjusted for clustering at the three-digit NES industry level classification. *** means significant at the 1% level; ** means significant at the 5% level; * means significant at the 10% level. Dependent variable is a dummy taking value of 1 if the plant export in Turkey and 0 otherwise. Coefficient for the regressions dummies and constant terms are not reported.

Table 10. *Probability of entering Turkey market with linear probability model, capital comparative advantage and firm level fixed effects.*

prob of exporting to Turkey	pooled probit model with sector FE		Linear Probability model with firm FE		pooled probit model with sector FE		Linear Probability model with firm FE	
	HCA measure 1				HCA measure 2			
	1	2	3	4	1	2	3	4
TFP (OP)	0.41***	0.23**	0.005***	0.006***	0.41***	0.23***	0.005***	0.0065
tariff	**(-0.02)*** **	**(-0.022)*** **	**(-0.001)*** **	**(-0.001)*** **	**0.019** **	**0.018***	**0.0004** **	**0.0004***
human CA* tariff	**0.05*** **	**0.05*** **	**0.002*** **	**0.002*** **	**0.067** **	**0.063** **	**0.002*** **	**0.002*** **
exporter in OD	1.68***	1.14***	0.002***	0.001	1.68***	1.14***	0.002**	0.001
size		(-0.07)		0.008****		(-0.07)		0.008***
capital		0.10***		0.004***		0.10***		0.004***
wage		0.37***		0.003*		0.37**+		0.0035*
N· observations	180585	180580	180585	180580	180585	180580	180585	180580
pseudo R^2	0.29	0.4			0.29	0.4		
pseudo LL	-23287	-19669			-23287	-19669		
R^2 within			0.0037	0.004			0.0037	0.0047
R^2 between			0.0229	0.15			0.0023	0.15
R^2 overall			0.0138	0.12			0.01	0.12
Cluster	NES 3	NES 3	NO	NO	NES 3	NES 3	NO	NO
Robust CI	YES	YES	YES	YES	YES	YES	YES	YES
year dummies	YES	YES	YES	YES	YES	YES	YES	YES
sector dummies	YES	YES	NO	NO	YES	YES	NO	NO

Notes: Plant-level probit regression. Robust standard errors are adjusted for clustering at the three-digit NES industry level classification. *** means significant at the 1% level; ** means significant at the 5% level; * means significant at the 10% level. Dependent variable is a dummy taking value of 1 if the plant export in Turkey and 0 otherwise. Coefficient for the regressions dummies and constant terms are not reported.

(a) results are similar with other TFP measures
(b) HCA measure 1 is positive, increasing and inside the unit interval
(c) HCA measure 2 is negative, increasing and smaller than -1

Table 11. *Probability of entering Turkey market with different models and human capital comparative advantage.*

	CA	increase in prob. to export to Turkey
capital CA		
25 percentile	6.11	2%
50 percentile	7	1.30%
75 percentile	7.3	0.70%
human capital CA		
25 percentile	-0.42	11,5%
50 percentile	-0.34	6,7%
75 percentile	-0.27	3,1%

Table 12. *Estimated probability of entering Turkey market with different models and measures of comparative advantage.*

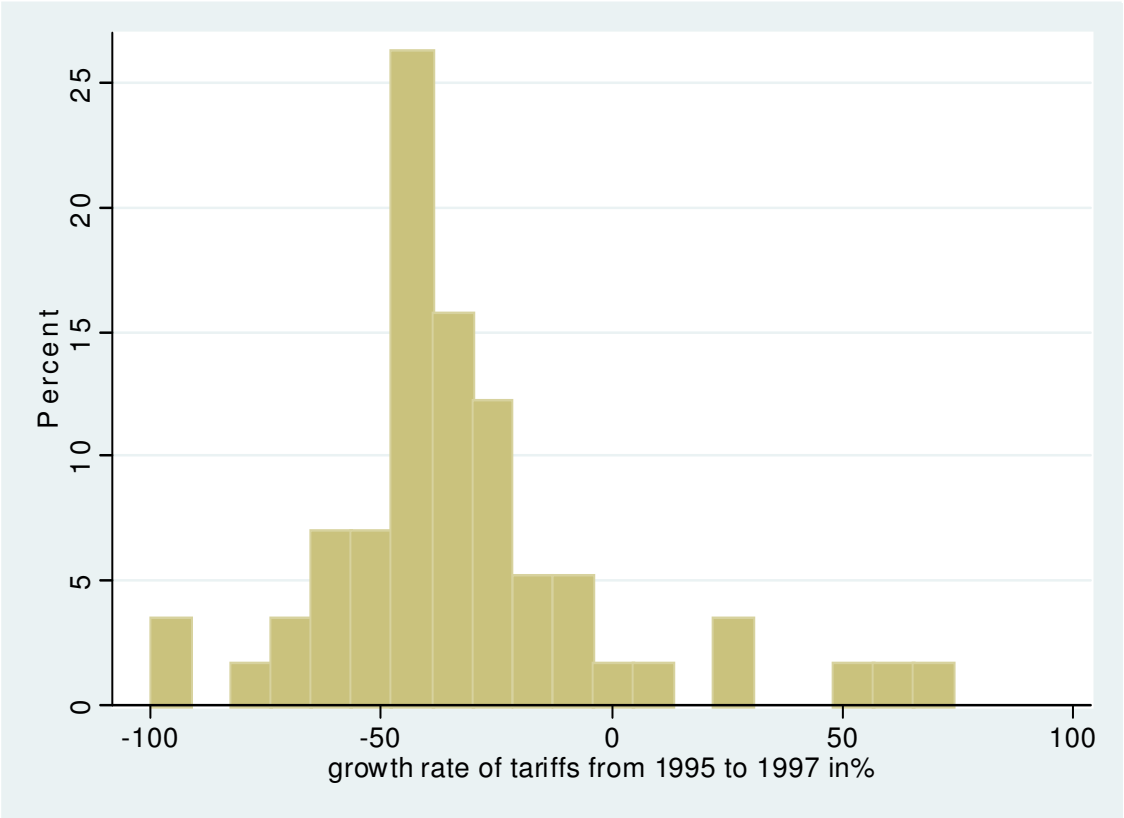

Figure 1. *Change in Turkish import tariffs after the entrance in European Customs Union.*

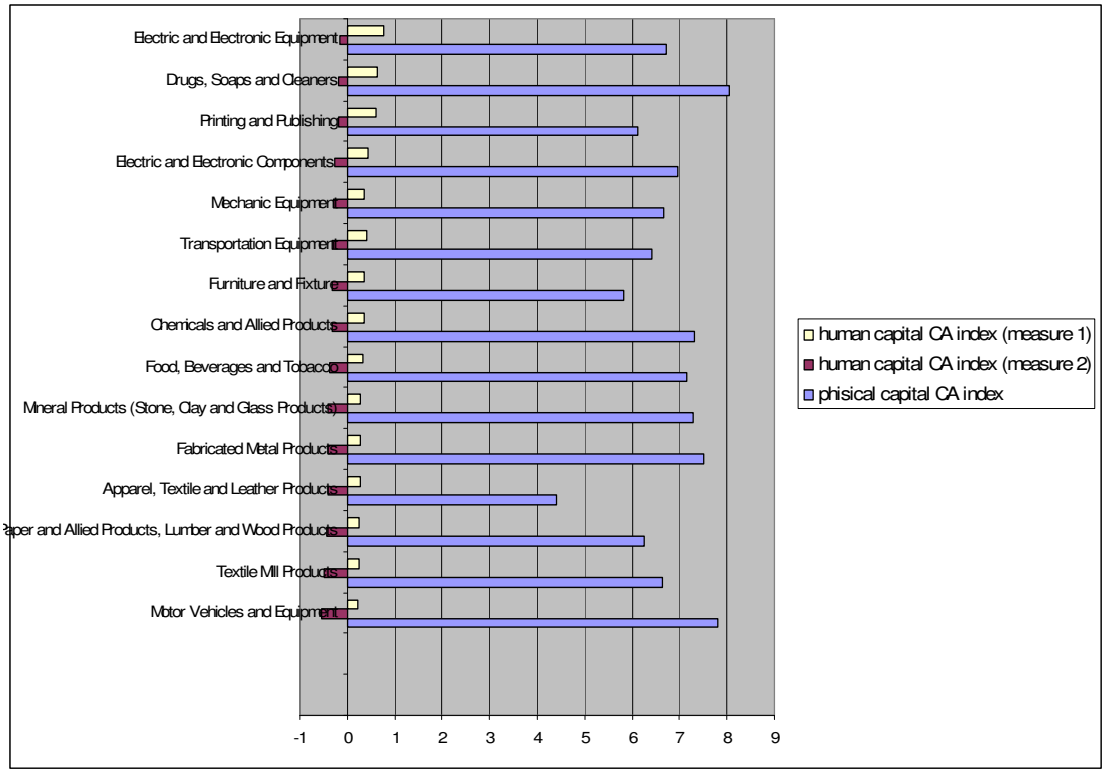

Figure 2. *Comparative advantage measures by sector.*

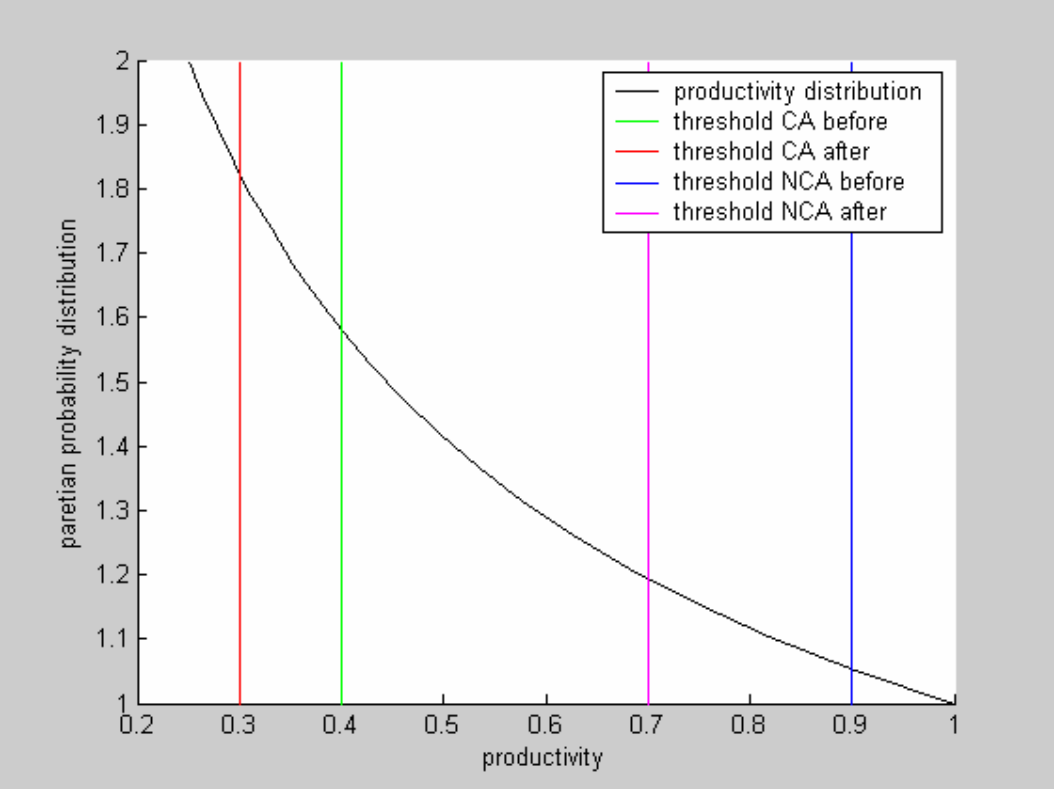

Figure 3. *Threshold and distribution effect on decision to export.*