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Exports and Firm Productivity in Turkish Manufacturing: An Olley-Pakes Estimation

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ABSTRACT: In this study, we examine the effects of exporting on the industry productivity following a two-step procedure using 4-digits industry level data of Turkish manufacturing sectors for the period 2003-2008. First, robust total factor productivity variable is obtained from a Cobb-Douglas production function following the semiparametric method of Olley and Pakes (1996), since productivity estimation by approximating the weighted sum of the inputs by OLS may suffer from simultaneity and selection biases. In the second stage of empirical analysis, the relationship between productivity and being net-exporter is estimated by fixed-effects panel data method. Results show that, productivity level for net-exporters is lesser than the level for net-importers indicating that industries are more prone to import and more competitive on import markets. We also show that when simultaneity and selection biases are not controlled for, the coefficient for the labor input is biased upward and the coefficient for the capital stock is biased downward.

Keywords: Semiparametric estimation; total factor productivity; exports
JEL Classifications: C14; D24; L60; O14

1. Introduction

Trade plays a crucial role in every country's economy. Thanks to international trade, countries benefit from increasing levels of gross domestic product (GDP), advance technologies and ultimately trade impacts the public's perception of the health of the economy. While the role of trade in promoting economic well-being has a long tradition in the trade literature, the interaction between international trade and long run output and productivity movements is less well understood. More importantly, international trade opens up untapped markets for sellers and increases the home country's productivity as workers are employed to make the goods to sell globally. Therefore, the role of trade in the process of growth in general for many countries is in some sense linked to the productivity growth for decades.

In this respect, to address the relationship between trade and productivity, recent studies have found that exporting firms have higher productivity than nonexporting firms (Bernard and Jensen, 1995, 1998, 1999; Baldwin, 2000; Giles and Williams, 2000a, 2000b; Yasar et al., 2006; Loecker, 2007). The empirical literature finds a robust positive correlation between productivity at the firm level and exporting. General approach to theoretical explanations for the relationship of productivity and exporting at the firm level emphasizes one direction of the causal relationship. But Roberts and Tybout (1997), Bernard and Jensen (1999) and Bernard and Wagner (2001) stress the difficulties that firms face in foreign market, due to the existence of sunk cost associated to selling abroad and fiercer competition in international market. According to their findings, above-average performers are likely to be the ones that are able to cope with sunk costs associated to the entry into a distant market, and make positive net profits abroad. Also, competition could be fiercer outside the home market, a feature that would again allow only the most productive firms to do well abroad. This explanation is in line with the assumption made in the theoretical literature of international trade with heterogeneous firms that high-performing firms self-select themselves into foreign markets. An alternative theoretical explanation for the firm-level link between exporting and productivity puts forward learning effects associated to exporting, implying that exporting makes firms more productive. Moreover, the authors spot a difference in labor structure, with more non-production workers for exporting companies, but also a significant higher wage difference which applies to both production and non-production workers. A further look into the causal relationship indicates that exporters are larger, more productive and pay higher wages several years before exporting. Moreover, prior to embracing international markets, they grow at a higher rate than those which will not, confirming that good plants become exporters (Purice, 2011).

Seeking for an answer to the question of which firms are productive and who easily become a competitive exporter, in their seminal work Bernard and Jensen (1999) and Bernard and Wagner (1997) postulate that selling goods in foreign market, in fact, leads firms to incur some additional costs such as transportation costs, distribution and marketing costs, labor costs or production costs. Since these costs [if whose levels are high enough] create barrier to new entry, efficient firms cannot overcome and then must exit from the market[1]. Furthermore, it is stated out that firms who desire to export tomorrow might be competitive on today's foreign market improving their competitive performance, too. So, more productive firms become exporters.

On the other hand, according to their another hypothesis; firms participating in international markets are in a dynamic framework in which knowledge of, for example, the quality, of the production technology and of marketing are being traded-off between international buyers and competitors. In this case, post-entry performance of export starters improves. This is a typical outcome of *learning-by-exporting* mechanism[2].

Greenaway and Kneller (2005) suggest that existence of learning-by-exporting effects creates an interaction with foreign competitors and costumers in which information about process and product reducing costs and raising quality. Thus, firstly, firms engaged in exporting activities take advantage of a spillover effect in which international transmission of technology, knowledge and marketing, e.g., between trade partners, from more agglomerated and more significant regions to relatively less agglomerated and less significant regions. Secondly, exporting firms make high level of profit from economies of scale, reducing production and operational cost which approaches them to the point of minimum efficient scale (MES). In the final stage, international competition forces them to become more efficient and innovative.

In the last decade, a quite limited set of empirical studies have been undertaken which test for potential correlations cross-country trade and productivity growth for Turkish manufacturing industries using micro-level and macro-level data. In a significant study of them, for example, Yasar *et al*. (2006) have tackled the issue on different exporting status (i.e., new exporter versus continuous exporters) of Turkish manufacturing firms using plant level unbalanced panel-data from 1990 to 1996 and estimated a quintile regression equation. Their empirical results have shown that productivity effect of exporting is present at all points along the conditional output distribution and exporting firms that continuously exported throughout the time period have more productivity effects compared to firms in other categories (i.e., new exporting firms, exporting firms that exit, and exporting firms that switch exporting practices). Further, their study not only establishes the relationship between productivity and export status, but also provides insight about its relative variation along the conditional output distribution. Therefore, government policies should target lower volume (sized) firms to improve their export practices.

Kılıçaslan and Erdoğan (2002), on the other hand, investigate the relationship between exporting behavior of the firms' productivity by testing for learning by exporting hypothesis in Turkish manufacturing using the data on the largest 1000 industrial enterprises from 1997 to 2007. Yet, the results from unbalanced dynamic panel data model estimation show that, at the firm level, there is no evidence that exporting fosters productivity. Results show further that the presumption that

[1] For detailed information on how sunk cost affects market structure and firms' rivalry, see Sutton (1991).

[2] Learning by exporting refers to the mechanism whereby firms improved their performance (productivity) after entering export markets. In the study by Clerides, Lach, and Tybout (1998), it is found that relatively efficient firms exporters; however, in most industries, firms' costs are not affected by previous exporting activities. Therefore, positive association between exporting and efficiency is explained by the self-selection of the more efficient firms in the export market.

exporting which leads to higher productivity because of learning and scale effects does not hold for Turkish manufacturing industry. Therefore, they conclude that, based on their findings, there is no evidence of strong positive relation between exporting and productivity.

Ozler and Yılmaz (2007) examine the effects of trade policy changes on the evolution of plant productivity. Plant level productivities are estimated for the 1983-1996 period following OP method. Their results show that industry averages indicate that productivity gains are largest in import competing industries with highest gains reaching to 8% per year during periods of rapid decline in protection rates. They also show that, though reallocation of market shares to more productive plants are important in both export oriented, and import competing sectors, within plant productivity improvements are significant only in export-oriented sectors.

In the study of Taymaz and Yılmaz (2007), it is examined plant-level productivity in the Turkish manufacturing industry between 1984 and 2000, a period of tremendous changes in the Turkish trade regime. Using an unbalanced panel of manufacturing plants for that period, they estimate plant-level productivities by Olley-Pakes method. They observed that productivity gains were largest in import competing industries, compared to export-oriented and non-traded sectors. It is also shown that even though the productivity performance of manufacturing sectors slowed down substantially after 1996, this was mostly due to the worsening macroeconomic environment. But in the aftermath of the CU in 1996, they give evidence for that productivity actually increased in the manufacturing sectors examined along with increased import penetration rates.

Aldan and Günay (2008) investigate the effect of entering into export market on productivity and employment with firm level data using matching and difference-in-difference techniques. They found that, first, larger and more productive firms self select into export market. Second, starting to export further increases labor productivity and employment for Turkish manufacturing.

Filiztekin (2010) investigates the dynamics of productivity growth in Turkish manufacturing industry before and after the liberalization of the economy. Using industry level data, the study shows that the move from import-substituting industrialization to an outward-oriented strategy improved growth performance and productivity is found responsible for almost half of the growth in value added. It is also stated out that increasing import penetration, as well as increased exports enhance productivity performance.

Maggioni (2010)'s findings are parallel to that in Aldan and Günay (2008). Using a rich longitudinal database at the plant level for Turkey, she finds evidence for both self-selection into exporting and learning-by-exporting applying propensity score matching and difference-in-difference estimator. According to the results, a higher labor productivity and TFP growth for exporting firms in the entry year and some years following the entry. Exports seem to place firms on superior productivity path. Another result shows that export starters often start also importing.

Uçak and Arısoy (2011) attempts to investigate the relationship between foreign trade and productivity for Turkish economy for the period of 1980-2007 using quarterly country level time-series data using Johansen-Juselius cointegration test. Results show that both export and import tend to have positive impact on productivity in the long run. Findings also suggest that there is a bi-directional causal effect from exports and then from imports to productivity growth suggesting an export-led and import-led productivity growth in Turkish economy. Yet, this conclusion they assert might be the result of industrial liberalization policy which adopted by Turkish government after 1980s.

Except some, most studies regarding Turkish case frequently use ordinary least squares (OLS) regression analysis in which the expected value of the dependent variable (such as production output, export or import volume) is expressed as a function of the independent variables (i.e., labor, capital stock, investment). Therefore, as Yasar *et al.* (2006) pointed out, if there is significant firm heterogeneity, the average output effect of exports may not describe how the output of each type of firm is affected by explanatory variables. Therefore firm heterogeneity across industries matters in a developing country like Turkey where important contributions are made by small sized plants as well as large plants, a configuration in which inter-industry variation in capital stock, productivity and efficiency is likely. Another estimation problem with OLS may arise from the outlier effect of the few largest firms. An industry's output or export performance with a few firms can be higher than that of another industry having a large number of firms.

Taking these estimation problems together into consideration, this study aims to provide further understanding about the relationship between exports and productivity growth in Turkish manufacturing using Olley-Pakes estimation method (*OP* method). Since productivity is widely estimated as the deviation between observed output and output predicted by a Cobb-Douglas production function estimation by applying OLS to a panel of firms, estimation results may suffer from the simultaneity (or endogeneity) and selection biases. Olley and Pakes (1996), to solve selection and simultaneity biases when computing productivity, developed a semi-parametric estimator which deals with correlation between idiosyncratic firm level productivity and input quantities by using investment as a proxy for unobserved productivity shocks. Simultaneity or endogeneity arises because productivity level is known to firms (but not to the econometrician) when they decide to choose their input levels (Marschak and Andrews, 1944). That is, choice of inputs is not under the control of the econometrician, but determined by the individual firms' choices. If the firm has prior knowledge of productivity (ω_{it}) at the time input decisions are made, endogeneity arises because input quantities will be partly determined by prior beliefs about its productivity (Olley and Pakes, 1996). Therefore, a positive productivity shock will likely lead to increased variable input usage introducing an upward bias in the input coefficients for labor and materials (Loecker, 2007).

Given the expected biases introduced by the simultaneity problem in the estimated factor elasticities (opposite for fixed and variable inputs), it is hard to predict what its impact on estimated TFP will be. Specifically, if the coefficients for the variable inputs are biased upward, while the capital coefficient is biased downward, the labor coefficient on the right-hand side of a production function will be biased downwards, whereas the unobserved productivity term and unexpected deviations from the mean (the error term) are biased upwards. For industries relying heavily on variable production factors, this implies that a failure to correct for endogeneity of input choice will likely introduce a downward bias in estimated TFP, although the opposite is true for sectors making more intensive use of capital (Van Beveren, 2012: 101). So, in that case a fixed-effect estimator would solve the simultaneity problem only if we are willing to assume that unobserved, firm-specific productivity is time-invariant (Yasar *et al,* 2008).

Selection bias, on the other hand, results from the relationship between productivity shocks and the probability of exit from the market. To provide an intuitive interpretation of this bias, first, consider the case of very large firms. Firms with a large capital stock are very likely to survive, even if the firm receives a bad productivity shock. Therefore, for large firms, endogenous exit induces little censoring in the distribution of productivity shocks. Consider now the case of very small firms. Firms with a small capital stock have a large probability of exiting, even if their productivity shocks are not too negative. For small firms, exit induces a very significant left-censoring in the distribution of productivity, i.e., we only observe small firms with good productivity shocks and therefore with high levels of output. If we ignore this selection, we will conclude that firms with large capital stocks are not much more productive than firms with small capital stocks. Therefore, the negative correlation between capital stock and probability of exit for a given productivity shock will cause the coefficient on the capital variable to be biased downward unless we control for this effect (Yasar *et al*, 2006; Aguirregabiria, 2009).

The paper organized as follow: In section two, the empirical model of the link between exports and productivity is set out; section three introduces the data set and some descriptive statistics, while section four evaluates the obtained results, and finally section six concludes the paper.

2. Econometric Framework

Since competition on the global markets is tougher than on the domestic market, and exporting activity needs more knowledge, experience, marketing, product differentiation and efficiency; we expect exporters to be more productive than non-exporters. Moreover, exporters face some additional costs[3] in order to enter in foreign market and therefore to export. To start with, first, it is necessary to correctly estimate total factor productivity (TFP) which is the difference between the current and expected level of output. Since output growth includes both growth in factors of production (capital and labor) and the increase in efficiency of utilization of these factors (Purice, 2011), we use a production function specified by Olley and Pakes (1996). Their method has three main advantages: First, the unobserved heterogeneity is considered by means of an individual effect that also varies over

[3] To address the role which sunk cost plays on decision to export, see the seminal work by Roberts and Tybout (1997).

time. Second, this method allows controlling for a potential selection bias- due to exits- in estimates of the production function. Third, it deals with the endogeneity of labor input, which can bias estimates of the input coefficient, without to be confronted with the problem of weak instruments arising by using IV (Instrumental Variable) or GMM (Generalized Method of Moments) methods (Purice, 2011; Griliches and Mairesse, 1995). Moreover, according to Yasar *et al.* (2006), production function analysis allows for controlling the effects of observed plant-specific characteristics and enables inference about productivity differences between exporters and non-exporters.

OP approach assumes that incumbent firms decide at the beginning of each period whether to continue participating in the market. If the firm exits, it receives a liquidation value of Φ dollars and never appears again. If it does not exit, it chooses variable inputs (such as capital, labor, material and so on) and a level of investment. Firms i's decision to maximize its future profit is characterized by the Bellman equation which implies that a firm exits the market if its liquidation value exceeds its expected discounted returns. And solution to this equation results in a Markov perfect equilibrium strategy defining rules for exit and for investment decisions.

So, firm i will decide to stay in the market ($\chi_{it} = 1$) or exit the market ($\chi_{it} = 0$) if its productivity is greater than or less than some threshold subject to the firm's current stock (K_{it}) and age (a_{it}). This exit rule is written as follows:

$$\chi_{it} = \begin{Bmatrix} 1 & if\,\Omega_{it} \geq \underline{\Omega}_{it}(K_{it}, a_{it}) \\ 0 & \text{otherwise} \end{Bmatrix} \tag{1}$$

Ω_{it}, a productivity indicator or shock, is assumed to follow a first order Markov process.

Following Purice (2006), Van Beveren (2008) and Yasar et al. (2008), we replicate the model adding additional variables representing material costs. Now, assume that the production technology is represented by a production function that relates output to inputs and the productivity residual or shock:

$$Y_{i,t} = f(K_{it}, L_{it}, M_{it}, E_{it}, \Omega_{i,t}) \tag{2}$$

For estimation purposes, we assume Cobb-Douglas technology[4]

$$Y_{i,t} = A_{it}\, K_{it}^{\beta_k}\, L_{it}^{\beta_l}\, M_{it}^{\beta_m}\, E_{it}^{\beta_e} \tag{3}$$

where $Y_{i,t}$ represents the aggregate output of a firm i in period t; K_{it} is the capital input; L_{it} is the labor input, M_{it} is the material inputs and E_{it} accounts for energy costs. $\Omega_{i,t}$ is a productivity indicator or shock which is known by the firm but not by the econometrician, which case is depicted by A_{it} in equation (3), implying the Hick-neutral efficiency level of firm i in period t. A simple logarithmic transformation of (3) gives the following form:

$$lnY_{i,t} = \beta_0 + \beta_k lnK_{it} + \beta_l lnL_{it} + \beta_m lnM_{it} + \beta_e lnE_{it} + u_{it} \tag{4}$$

$$lnA_{it} = \beta_0 + u_{it} \tag{5}$$

where ln represent natural logarithms and u_{it} is the usual error term, associated for instance with a non-predictable productivity shock. The latter one can be further decomposed into two components;

$$u_{it} = \Omega_{it} + \xi_{it} \tag{6}$$

In equation (6), Ω_{it} , as noted before, is the productivity shock that is observed by the decision-maker in the firm but not by the econometrician; and ξ_{it} is an unexpected productivity shock that is observed by both the decision-maker and the econometrician and is considered an *i.i.d.* process accounting for unexpected deviations from the mean. Thus ξ_{it} has no effect on the firm's decisions,

[4] Since the history of TFP estimation dates back to the seminal paper by Solow (1957), he uses a Cobb-Douglas production function to seperate growth in factors of production from the increase in efficiency of using these factors. Since the advantages of using the Cobb-Douglas function for estimation purposes are many, such as one can obtain the different level of returns (increasing, decreasing and diminishing) and the productive elasticity of inputs, it is widely used in theoretical and empirical studies.

but Ω_{it} is a state variable that does affect the firm's decision-making process, leading to the well-known simultaneity problem in production function estimation. Therefore, estimators like OLS ignoring this correlation between inputs and this unobservable factor will yield inconsistent results (Petrin et al., 2004). After estimating the output equation, productivity can thus be computed as the exponential of Ω_{it}.

$$\Omega_{it} = Y_{i,t} - \hat{Y}_{i,t} \tag{7}$$

or, more functionally

$$\Omega_{it} = Y_{i,t} - \hat{\beta}_k lnK_{it} + \hat{\beta}_l lnL_{it} + \hat{\beta}_m lnM_{it} + \hat{\beta}_e lnE_{it} \tag{8}$$

This method of measure is generally used as the basis for computing industry level TFP, but has not been completed yet for our analysis.

For employing OP method, a set of assumptions made by Olley and Pakes (1996) need to be addressed: First, the model assumes that the only unknown variable is productivity, while other variables such as capital, labor, materials and investment can be observed by the econometrician. Second, the investment proxy which is affected by productivity should be monotonically increasing in productivity, conditional on the rest of variables. This means that only positive investment levels can be considered, which should at least apply to known subset of the sample. In the standard OP method, the investment is a proxy for unobserved efficiency.

Correspondingly, to control for the correlation between the error term and the inputs, OP method first involves using investment decision rule for the purpose that future productivity is strictly increasing with respect to Ω_{it} , since firms that observe a positive productivity shock in period t will invest more in that period, for any K_{it} , and a_{it} which now proxies the firm's age (Yasar *et al*, 2008). Provided that the firm's decision to invest in further capital, I_{it} depends on Ω_{it} , K_{it} , and a_{it}

$$I_{it} = I(\Omega_{it}\,, \mathrm{K}_{it}\,, a_{it}) \tag{9}$$

and under the assumption that I_{it} is strictly positive, we can compose the inverse function for the unobserved shock, Ω_{it} , as

$$\Omega_{it} = I^{-1}(I_{it}\,, K_{it}\,, a_{it}) = g(I_{it}\,, K_{it}\,, a_{it}) \tag{10}$$

This equation now can be used to control for the simultaneity problem. Substituting (6) and (10) into (4) yields

$$lnY_{it} = \beta_l lnL_{it} + \beta_m lnM_{it} + \beta_e lnE_{it} + \varphi(I_{it}\,, K_{it}\,, a_{it}) + \xi_{it} \tag{11}$$

In equation (11), $\varphi(I_{it}\,,\ K_{it}\,, a_{it}) = \beta_0 + \beta_k lnK_{it} + \beta_a ln a_{it} + g(I_{it}\,, K_{it}\,, a_{it})$, and following Yasar *et al* (2008), we approximate $\varphi(\cdot)$ with a second-order polynomial series only in capital and investment, omitting firm's age variable since we carry out our analysis at industry level, not at plant level. Partially linear equation (11) now can be estimated by OLS since the coefficients estimates for variables (labor, material, and energy) will be consistent because $\varphi(\cdot)$ controls for unobserved productivity and the error term will be no longer correlated with the inputs.

Basically, the usual practice of analyzing the relationship between productivity and exports is a two-step estimation with which TFP first derived from equation (11) and then estimated with a final equation where TFP is regressed on exports variable and some control variables. Apart from the previous works, following Olley and Pakes (1996) and Yasar *et al.* (2008), this study incorporates an interim phase at which a possible unobserved effect that includes productivity might affect the coefficients of the factors, thus biasing TFP derivation, is controlled introducing state variables. On the other hand, endogeneity problem that might arise from unobserved heterogeneity is corrected, again, by OP method. Thus, the study engages in a three-step estimation where at the final step, following Wilhelmsson and Kozlov (2007), and Bigsten and Gebreeyesus (2009), TFP is hypothesized to depend, among other things, on whether or not industry is a net exporter.

$$\ln \mathrm{TFP}_{it} = \alpha + \beta_1 Exp_{it} + \beta_2 \ln emp_{it} + \delta_i + \lambda_t + \varepsilon_{it} \tag{12}$$

In equation (12), $\ln \mathrm{TFP}_{it}$ is the natural logarithm of the total factor productivity of industry i at time t which is obtained from equation (11) ; Exp_{it} is a dummy variable equal to one if industry i exports at time t; $\ln emp_{it}$ is the natural log of the number of employees included as a measure of the size of the industry. δ_i and λ_t are industry and year dummy variables.

As we expect exporting industries to be more productive entering the export market, we would expect the estimated coefficient of Exp_{it} to be positive for Turkish manufacturing industries. Besides, we also would expect that productivity is a monotonically increasing function of industry size, thus β_2 is expected to be positive.

There are two constraints in this study. First, we were able to use industry level data (4-digit) instead of firm level data. This is largely because we are constrained by the data. In order to reach the firm or plant level data, a protocol needs be signed with Turkish Statistical Institute (STI) by which data set only can be gathered at the relevant department, a process consuming much of time. Second, in our study we exclusively focus on exports putting aside the import part of trade and productivity relationship unexplored. We know from the literature on industry trade that imports and exports tend to move together at the industry level[5]. To the extent that imports and exports have similar effects on productivity, we may mistakenly confound the impact of exports and imports. We avoid this possible problem in part by working from the plant level to the industry in determining the relationship between exporting and productivity.

3. Data Source and Descriptive Statistics

In this study, to obtain unbiased and more robust estimation of TFP, equation 10 is estimated with annual unbalanced panel-data of 189 manufacturing industries of Turkish economy according to four digit level of industries from 2003-2008. However, because of a methodological change in statistics, we are not able to extent the data set including the years prior to 2003 since survey data is classified according to Classification of Economic Activities in the European Community (NACE). After 2001, the new data were organized by *establishment approach* which neither can be integrated nor be transformed to the previous data set. The data were collected by Turkey's State Institute of Statistics from the Annual Surveys of Manufacturing Industries, and the data are classified based on the NACE Rev. 1.1. The data consists of industry-level information about output, labor inputs, capital inputs, material inputs and investment. The reported descriptive statistics for industries consisting of establishments employing more than 25 employees in the year 2003 to 2008 show that there is a significant variation in all of the log variables in Table 1.

Table 1. Descriptive Statistics for Main Variables
(Constant quantities at 2003 Prices, in 1000 Turkish Liras)

Continous variables (logarithmic)	Mean	St. dev.	Min.	Max.
Output (Y)	20.28	1.64	13.57	24.53
Capital (K)	17.90	1.66	11.05	22.04
Labor (L)	8.49	1.47	3.33	12.30
Material (M)	20.07	1.66	13.40	24.40
Investment (I)	17.72	1.72	8.00	22.03
Note: All numbers in Million's of TL and inflated to 2003 levels.				

Output (Y) is the value of aggregate output deflated by the corresponding price index. Investment is calculated from yearly changes in gross investment in machinery and equipment. Labor input is the number of employees at the end of the year. Material input is proxied by total purchases of goods and services for production.

As for the calculation of capital stock (K), following Yasar *et al* (2004), investment data, fixed assets and a depreciation rate are employed based on perpetual inventory method (PIM) which requires estimated years of lifetime capital equipment: $K_t = k_{t+1}(1-\delta) + I_{t-1}$, where K is the capital stock in period t; δ is the depreciation rate of capital and determined as 10% for each year; and I_t is the level of the investment during the period.

[5] For detail information, see Bernard and Jensen (1999).

In addition to these variables, for OP method, a dummy variable is constructed to show the effects of firms' exit and enter decision on investment. So, exit dummy takes 1 if the number of establishments in an industry is increased in the current period, and 0 otherwise. Year is a trend variable in an effort to capture the effect of a variable (e.g., a technological change) that affects the independent variable and is not directly observable, but is highly correlated with time.

For the second step, to estimate the relationship between productivity and exporting, we constructed export dummy (Exp) which takes the value 1 if industry is a net exporter at the period of *t*, or 0 otherwise. A positive sign show exporting activities increases the level of productivity and this level is greater than that level of net importers.

4. Results

In this section, we use a two step analysis to examine two main issues: (i) can a robust and healthy measure of total factor productivity be estimated from a Cobb-Douglas production function using a different techniques?, and (ii) do more productive industries become net exporters? Finally, we present empirical evidence whether a productivity difference exists in terms of net exporters and net importers.

Estimating Cobb-Douglas production function

The main results obtained from Olley−Pakes estimation and OLS methods (by comparison) are reported in Table 2. We report coefficients of all input factors for each individual estimation method. As the results show, coefficients vary depending on the method used. Therefore estimated results follow our a priori expectations regarding the bias caused by simultaneity and selection problems. Once these biased are not controlled for, the coefficients associated with quasi-fixed inputs (e.g., capital) are expected to be biased downward or upward (Olley and Pakes, 1996). This might be due to the fact that the assumption of no correlation between TFP and choices is violated. Olley−Pakes however performs best as far as the impact of capital is concerned and according to previous researches provides consistent coefficients (Purice, 2011: 25).

Table 2. Estimated coefficients from Cobb-Douglas production function (Equation 11)

Variables	Olley−Pakes[a]	OLS
Capital (K)	0.005 (0.012)	0.003 (0.010)
Labor (L)	0.032 (0.010)***	0.045 (0.005)***
Material (M)	0.927 (0.008)***	0.939 (0.005)***
Trend Num. of obs. *For OP estimation:* State: LnK Free: lnL, lnM Control: year Proxy: lninv	-0.035 (0.002)*** 764	0.001(0.002)* 823
*** p < 0.01, ** p < 0.05, * p < 0.1 Robust standart errors in parentheses. Standart errors in OP model are bootstrapped using 250 replications. [a] Replications based on 144 clusters in data.		

After estimating equation (11) the obtained residuals from the regression, in which simultaneity and selection biases are controlled for, clearly gives the more robust estimation of TFP compared to OLS results.

Estimating effects of exporting on productivity

Our main interest here is to estimate effects of exporting on productivity obtained from equation (11). A priori, we expect that net exporters to be more productive than net importers since competition abroad is tougher than on the domestic market. In order to analyze the difference in detail we estimate equation (12) by fixed effects panel data method. Applying this method, we obtain the estimated coefficient of the export dummy variable indicating the difference between net exporting and net importing industries. If net exporters are large and more productive as indicated by previous studies, using the data from other countries, the coefficient of the export dummy variable will be positive. Since the dependent variable is in logarithms, the estimated coefficient has been transformed (since the estimator of the percentage change in lnTFP will be biased due to a change in Exp dummy from 0 to 1) to indicate the difference in percent between net exporters and non-net exporters[6].

Table 3. Estimating productivity and exporting relationship (Equation 12) (Dependent variable: lnTFP)

Variables	Fixed Effects (FE)	Between Effects (BE)	Random Effects (RE)
Exp	-0.009 (0.005)*	0.013 (0.009)	-0.001 (0.004)
lnL	0.071 (0.006)***	0.084 (0.003)***	0.0806 (0.004)***
dum_03	-0.042 (0.003)***	-0.149 (0.038)*	-0.038 (0.002)***
dum_04	-0.027 (0.002)***	0.191 (0.097)*	-0.025 (0.002)***
dum_05	-0.020 (0.001)***	0.217 (0.079)	-0.019 (0.001)***
dum_06	-0.008 (0.001)***	0.098 (0.095)	-0.007 (0.001)***
dum_07	-0.006 (0.001)***	0.181 (0.095)*	-0.006 (0.001)***
cons.	1.882 (0.055)***	1.683 (0.069)***	1.794 (0.041)***
Industry effects	Yes	Yes	Yes
R^2			
Within	0.773	0.663	0.771
Between	0.822	0.860	0.825
Overall	0.795	0.544	0.800
Num. of obs.	759	759	759
Trans. coeff. of Exp	**-0.897**	**1.307**	**-0.100**
Trans. se of Exp	**(0,245)****	**(0.831)**	**(0.159)**

lnL is included in the regression with size controls. Industry dummies are not reported here to save place. Parenthesis gives robust standard errors. To avoid dummy variable trap, dum_08 is dropped from the regression. The fixed effect model is estimated with fixed individual (industry) and time effects. *** p < 0.01, ** p < 0.05, * p < 0.1

Table 3 gives more robust and unbiased coefficients of productivity and exports equation. Year dummies are included to the regression in order to capture both observed and unobserved year fixed effects in fixed effect model (any change of the coefficient of the key variables over time). Within and random effect models estimation results are given by comparison purposes. Among estimators, fixed effect estimator is more efficient and gives more robust coefficients and standard

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[6] Since the dummy variable is not continues and the standard transformation is likely to be biased, we apply the method for the exact interpretation of dummy variables in semilogarithmic equations by Garderen and Shah (2002), to derive the % effect of the relevant dummy on the dependent variable ant its standard errors: $\hat{p}_i = 100\left[exp(\hat{c}_i - \frac{1}{2}\hat{v}(\hat{c}_i)) - 1 \right]$ and $\hat{v}(\hat{p}_i) = 100^2 exp(2\hat{c}_i)\left[exp(-\hat{v}(\hat{c}_i)) - exp(-2\hat{v}(\hat{c}_i)) \right]$; where $\hat{p}_i$ is the transformed coefficient to calculate; $\hat{c}_i$ is the standard coefficient belonging to the relevant dummy; $\hat{v}(\hat{c}_i)$ is the estimated variance of the same dummy variable.

errors. All of year dummies, on the other hand, are found statistically significant just in fixed and random effect models, but the coefficient of Exp dummy is statistically insignificant in between effect and random effect models (-0.100 and 1.307, respectively).

Once looking at the literature referred before, a priori, it is expected to have a positive sign of the coefficient of exports variable, hence indicating a positive impact of exports on productivity. But the results presented in table 3 clearly illustrate a negative sign (-0.897) for the transformed statistically significant coefficient of export dummy, showing that net-importing industries are less productive than net exporting industries and relatively productive industries become importers since the sign of constant, which defines net-importers, is positive (1.882). Based on these results, one can conclude that higher productivity might not be important when a firm decides to enter the export market for the Turkish case. If high productivity do not induce firms preferably to enter the export market, we would expect decreasing productivity in the periods prior to entry. However, the opposite might be true if the export decision is taken several years before entry, or *vice versa*, firms preparing to enter the export market might divert resources away from production to information collection, searching for new markets, advertisement opportunity, import channel and so on; hence productivity might fall for Turkish net-exporting manufacturing firms. In conclusion, even after controlling for some of the differences among industries, by fixed effects, the difference between net exporters and net-importers remains significant.

The coefficient of the natural log of the labor (***lnL***) which is included as a measure of the size of the industry is found statistically significant in three types of models but slightly upward biased in BE and RE models. Based on the result obtained by FE model, a one percent increase in the number of employees leads a 0.071 percent increase in total factor productivity indicating that as the size of industry gets larger, willingness to export activity monotonically increases with the size.

5. Conclusion

Since 1980, Turkish policy makers, like in many developing countries made fundamental and crucial decisions to abandon import substitution-based development strategy and adopted an export-led growth approach with a view to primarily restore current account balance, lower inflation rate, reduce public sector deficit and increase income growth rate which was already at the negative rates early in the 1980s. Thanks to liberalization approaches to international trade, export growth rate has been increased to significant levels alongside with growth in imports. All of these developments have moved Turkish manufacturing sectors to a competitive fringe. Clearly, change in trade pattern and regime in Turkish economy result in productivity growth at firm and industry level for the last recent decades.

In this paper we have examined the relationship between the productivity of manufacturing industries and participation in export markets. Using and balanced panel of 144 industry year observation for the 2003-2008 period, we estimate a Cobb-Douglas production function. For this purpose, at the first hand a robust measure of total factor productivity is obtained by using the Olley−Pakes method (1996) from production function so as to eliminate potential simultaneity biases that are present in OLS estimations. Once the unobserved individual efficiency (TFP) has been estimated for each industry from a Cobb-Douglas production function, it is regressed on a binary variable (Exp) and continuous variable (lnL) to investigate if there is a link between export decision and productivity. Obtained results show that significant differences appear between the results obtained with the different estimators[7]. If we consider simultaneity bias, one may consider that biased estimates (such as the OLS) capture both the real effect of the variable and that of the omitted variable, which is the unobserved individual productivity in this case (Blanchard et al., 2011).

Because productivity is expected to be positively linked with labor and capital, when comparing the OLS to OP estimates, one should find upward-biased values. This is the case with our results: the estimate of labor equals *0.045* using the OLS and *0.032* using OP estimators. In the case of capital, Levinsohn and Petrin (2003) suggest that, if there is a positive correlation between the two inputs, capital and labor, then the simultaneity bias will lead to underestimate the coefficient of capital leading to downward-biased values. This seems to be the case, as the value when this bias is corrected

[7] Such differences are consistent both in value and sign, with those found in Olley and Pakes (1996) in the case of the Telecommunications Equipment Industry.

is *0.005* by OP versus *0.003* by the OLS. When considering selection bias, the exit decision is not taken into account in OLS, while the OP estimator includes the estimated probability of exit at the next period as an argument.

Searching for productivity differences between net-exporters and net-importers, our results based on cross industry level data show that in Turkey, productivity is growing in both types of industries; however it is found higher in net-importing industries type. This being the case, it is obvious that productivity is growing both in exporting and importing industries during the period in consideration. The stylized fact that importing still accounts for about two-thirds of total trade, may explain why productivity is still higher in importing industries. Our results are in the line with the findings estimated in the study of Taymaz and Kamil (2007) which based on the 1984-1990 period.

Several extensions and improvements can be made with respect to the present study. Firm level data might show a different picture of the link between productivity and exports for the selected period. Some concern the measurement of exit variable. It would be useful to introduce a distinction between exits that correspond to a failure situation (i.e. closure) and that signify a success (i.e. selling, merging and acquisition), rather than taking an increase or a decrease in the number of establishment in the current period. Sunk costs might be an important reason to explain why productivity is decreasing with exporting since the critical level of sunkness creates a barrier to entry on international market leading to productivity differences across industries (i.e. Hopenhayn, 1992; Aw et al., 2001; Farinas and Ruano, 2004) . Therefore, a detailed analysis of the relationship between net exporting and productivity of industries is left for further research.

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APPENDIX

NACE Rev. 1.1

Section	Manufacturing	Type Net Exp = 1 Net Imp = 0
15.11	Production and preserving of meat	1
15.12	Production and preserving of poultry meat	0
15.13	Production of meat and poultry meat products	0
15.20	Processing and preserving of fish and fish products	1
15.31	Processing and preserving of potatoes	1
15.32	Manufacture of fruit and vegetable juice	1
15.42	Manufacture of refined oils and fats	1
15.61	Manufacture of grain mill products	1
15.62	Manufacture of starches and starch products	1
15.81	Manufacture of bread; manufacture of fresh pastry goods and cakes	1
15.83	Manufacture of sugar	1
15.84	Manufacture of cocoa; chocolate and sugar confectionery	1
15.85	Manufacture of macaroni, noodles, couscous and similar farinaceous products	1
15.86	Processing of tea and coffee	1
15.87	Manufacture of condiments and seasonings	1
15.88	Manufacture of homogenized food preparations and dietetic food	1
15.89	Manufacture of other food products n.e.c.	1
15.93	Manufacture of wines	1
16.00	Manufacture of tobacco products	1
17.11	Preparation and spinning of cotton-type fibres	0
17.12	Preparation and spinning of woollen-type fibres	0
17.15	Throwing and preparation of silk, including from noils, and throwing and texturing of synthetic or artificial filament yarns	0
17.16	Manufacture of sewing threads	1
17.21	Cotton-type weaving	1
17.22	Woollen-type weaving	1
17.25	Other textile weaving	1
17.30	Finishing of textiles	1
18.22	Manufacture of other outerwear	1
18.23	Manufacture of underwear	1
18.24	Manufacture of other wearing apparel and accessories n.e.c.	1
18.30	Dressing and dyeing of fur; manufacture of articles of fur	1
19.10	Tanning and dressing of leather	0
19.30	Manufacture of footwear	0
20.10	Sawmilling and planing of wood; impregnation of wood	0
20.30	Manufacture of builders' carpentry and joinery	1
20.40	Manufacture of wooden containers	1
20.51	Manufacture of other products of wood	1
21.22	Manufacture of household and sanitary goods and of toilet requisites	1
21.25	Manufacture of other articles of paper and paperboard n.e.c.	1
22.11	Publishing of books	1
22.22	Printing n.e.c.	0
22.23	Bookbinding	0
22.24	Pre-press activities	0
22.25	Ancillary activities related to printing	0
24.13	Manufacture of other inorganic basic chemicals	0

24.15	Manufacture of fertilizers and nitrogen compounds	0
24.16	Manufacture of plastics in primary forms	0
24.30	Manufacture of paints, varnishes and similar coatings, printing ink and mastics	0
24.51	Manufacture of soap and detergents, cleaning and polishing preparations	1
24.52	Manufacture of perfumes and toilet preparations	1
24.61	Manufacture of explosives	1
24.62	Manufacture of glues and gelatines	1
24.63	Manufacture of essential oils	1
24.65	Manufacture of prepared unrecorded media	1
24.66	Manufacture of other chemical products n.e.c.	1
25.11	Manufacture of rubber tyres and tubes	1
25.12	Retreading and rebuilding of rubber tyres	1
25.13	Manufacture of other rubber products	0
25.21	Manufacture of plastic plates, sheets, tubes and profiles	1
25.22	Manufacture of plastic packing goods	1
25.23	Manufacture of builders' ware of plastics	1
25.24	Manufacture of other plastic products	1
26.12	Shaping and processing of flat glass	1
26.13	Manufacture of hollow glass	1
26.21	Manufacture of ceramic household and ornamental articles	1
26.22	Manufacture of ceramic sanitary fixtures	1
26.26	Manufacture of refractory ceramic products	0
26.30	Manufacture of ceramic tiles and flags	1
26.40	Manufacture of bricks, tiles and construction products, in baked clay	1
26.51	Manufacture of cement	1
26.52	Manufacture of lime	1
26.53	Manufacture of plaster	1
26.61	Manufacture of concrete products for construction purposes	1
26.62	Manufacture of plaster products for construction purposes	1
26.63	Manufacture of ready-mixed concrete	1
26.70	Cutting, shaping and finishing of ornamental and building stone	1
26.81	Production of abrasive products	0
26.82	Manufacture of other non-metallic mineral products n.e.c.	0
27.10	Manufacture of basic iron and steel and of ferro-alloys	0
27.22	Manufacture of steel tubes	0
27.33	Cold forming or folding	0
27.43	Lead, zinc and tin production	0
27.44	Copper production	0
27.51	Casting of iron	0
27.54	Casting of other non-ferrous metals	0
28.11	Manufacture of metal structures and parts of structures	1
28.12	Manufacture of builders' carpentry and joinery of metal	1
28.21	Manufacture of tanks, reservoirs and containers of metal	1
28.22	Manufacture of central heating radiators and boilers	1
28.30	Manufacture of steam generators, except central heating hot water boilers	0
28.40	Forging, pressing, stamping and roll forming of metal; powder metallurgy	0
28.52	General mechanical engineering	0
28.61	Manufacture of cutlery	0
28.62	Manufacture of tools	0
28.71	Manufacture of steel drums and similar containers	1
28.72	Manufacture of light metal packaging	1
28.73	Manufacture of wire products	1
29.11	Manufacture of engines and turbines, except aircraft, vehicle and cycle engines	0
29.12	Manufacture of pumps and compressors	0
29.21	Manufacture of furnaces and furnace burners	0

29.22	Manufacture of lifting and handling equipment	0
29.23	Manufacture of non-domestic cooling and ventilation equipment	0
29.24	Manufacture of other general purpose machinery n.e.c.	0
29.31	Manufacture of agricultural tractors	0
29.32	Manufacture of other agricultural and forestry machinery	0
29.41	Manufacture of portable hand held power tools	0
29.42	Manufacture of other metalworking machine tools	0
29.43	Manufacture of other machine tools n.e.c.	0
29.51	Manufacture of machinery for metallurgy	0
29.54	Manufacture of machinery for textile, apparel and leather production	0
29.55	Manufacture of machinery for paper and paperboard production	0
29.56	Manufacture of other special purpose machinery n.e.c.	0
29.71	Manufacture of electric domestic appliances	1
29.72	Manufacture of non-electric domestic appliances	1
30.01	Manufacture of office machinery	0
30.02	Manufacture of computers and other information processing equipment	0
31.10	Manufacture of electric motors, generators and transformers	0
31.30	Manufacture of insulated wire and cable	1
31.50	Manufacture of lighting equipment and electric lamps	0
31.61	Manufacture of electrical equipment for engines and vehicles n.e.c.	0
32.20	Manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy	0
32.30	Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods	1
33.10	Manufacture of medical and surgical equipment and orthopaedic appliances	0
33.20	Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment	0
33.40	Manufacture of optical instruments and photographic equipment	0
34.10	Manufacture of motor vehicles	0
34.20	Manufacture of bodies (coachwork) for motor vehicles; manufacture of trailers and semi-trailers	0
34.30	Manufacture of parts and accessories for motor vehicles and their engines	0
35.11	Building and repairing of ships	1
35.12	Building and repairing of pleasure and sporting boats	1
35.20	Manufacture of railway and tramway locomotives and rolling stock	0
35.30	Manufacture of aircraft and spacecraft	0
35.41	Manufacture of motorcycles	0
35.42	Manufacture of bicycles	0
35.50	Manufacture of other transport equipment n.e.c.	0
36.11	Manufacture of chairs and seats	1
36.12	Manufacture of other office and shop furniture	1
36.14	Manufacture of other furniture	1
36.15	Manufacture of mattresses	1
36.30	Manufacture of musical instruments	0
36.40	Manufacture of sports goods	0
36.50	Manufacture of games and toys	0
36.61	Manufacture of imitation jewellery	0
36.62	Manufacture of brooms and brushes	0
36.63	Other manufacturing n.e.c.	0