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History Matters for the Export Decision

Plant Level Evidence from Turkish Manufacturing Industry*

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Abstract

In a dynamic panel data framework, we investigate the factors influencing the export decision of the Turkish manufacturing plants over the 1990-2001 period. Our results support the presence of high sunk costs of entry to export markets, as well as the hypothesis that the full history of export participation matters for the current export decision. We further show that the effect of the past export experience on current export decision rapidly depreciates over time: Recent export market participation matters more than the participation further in the past. Finally, we show that while persistence in exporting helps lower the costs of re-entry today, there are diminishing returns to export experience. Our results are robust to plant characteristics (plant size, technology, composition of the employment), the spillovers from the presence of exporters in the same industry, as well as industry and year effects.

JEL Classification: F14, D21

Keywords: Export decision, productivity, sunk costs, plant characteristics

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1 Introduction

Since the early-1990s, there has been a growing body of empirical research focusing on manufacturing sectors of industrial and developing countries, using plant-level data. One of the areas of investigation has been the differences in the behavior of exporting and non-exporting plants, and the transition dynamics to becoming an exporter. Given the importance attributed to export performance and the role of manufacturing sectors in the development process, it is not surprising that the topic has generated considerable interest among academics and policy makers alike.

There are several important findings in the empirical literature on export activity. The first finding concerns efficiency differences between exporting and non-exporting plants. In numerous studies using data from several different countries it is reported that exporting plants are more efficient than non-exporting plants (see Aw and Hwang (1995); Bernard and Jensen (1995); Chen and Tang (1987); Haddad (1993); Handoussa, Nishimizu, and Page (1986); Tybout and Westbrook (1995); Roberts, Sullivan, and Tybout (1995)). This finding, however, is not very informative for policy design since it does not address potential simultaneity between exporting and productivity. This concern led to a second set of studies.

Bernard and Jensen (1995) and Clerides, Lach and Tybout (1998) are first to analyze whether more productive firms become exporters (self-selection hypothesis) or exporting causes efficiency gains (learning-by-exporting hypothesis). The assertion in the learning-by-exporting hypothesis is that exporters become more productive over time, because export markets are far more competitive than domestic markets (Van Biesebroeck (2005)). Pressure to increase productivity is also intensified as developing country exporters face competition from other labor-abundant developing countries (Mody and Yılmaz (2002)). However, there is only weak empirical support for the learning-by-exporting hypothesis. For example, while Delgado, Farinas and Ruano (2002)) suggest that learning effects from exporting are limited to younger exporters, Bernard and Jensen (1999) and Clerides, Lach and Tybout (1998) find only very weak evidence, if any, indicating that past history of exporting increases efficiency. The self-selection hypothesis, on the other hand, states that more productive firms self-select to enter the export market. Empirical results reported by Clerides, Lach and Tybout (1998), Bernard and Jensen (1999) and Greenaway and Kneller (2004) indicate that high plant efficiency increases the probability of becoming an exporter, supporting the self selection hypothesis.

The third set of findings in the literature concerns the presence of sunk costs of entry into the export markets. Indeed, in their specifications of the export participation decision Roberts and Tybout (1997) and Clerides, Lach and Tybout (1998) assume that there are sunk entry and exit costs in the export markets. These can be the costs of international marketing, establishing a distribution system, the cost of gathering information about the demand conditions in export markets, hiring employees with language skills, training employees for new markets, etc. Once these costs are incurred, they cannot be recovered. In other words, costs incurred during the entry to export markets are sunk costs. Empirical findings indicate that the size of the sunk cost can be considerably high. For example, Roberts and Tybout (1997) report that the previous year's export experience increases a plant's likelihood of exporting today by 60 percentage points.

While the empirical research has provided ample evidence for the role of plant heterogeneity in international trade, there are also attempts to develop theoretical models that are consistent with the empirical findings. Melitz (2003) develops a model of monopolistic competition with heterogeneous firms.[1] Relying on the interaction between productivity differences across firms and the fixed cost of exporting, Melitz (2003) shows that while high productivity firms become exporters, firms with lower productivity produce for the domestic market only, as they cannot generate profits in export markets to cover fixed cost of entry. Helpman, Melitz and Yeaple (2004) extended the Melitz model to include horizontal FDI as an option for the firm. Firms with even higher productivity levels can afford to pay for higher fixed cost of investment in another country, and serve the other country market with the production taken place in its subsidiary.

[1] In another contribution, incorporating Bertrand competition into a Ricardian model of productivity differences across plants and countries, Bernard, Eaton, Jensen and Kortum (2003) establishes the links between plant productivity, size, and export participation to underlying plant-level heterogeneity in efficiency.

In this paper, we investigate export market participation decisions of Turkish manufacturing plants for the period from 1990 to 2001. Our paper is not the first attempt to measure the effect of history on a firm's export market participation decision. Roberts and Tybout (1997) also controlled for initial conditions, using a method proposed by Heckman (1981). We use a simpler approach proposed by Wooldridge (2005) to control for initial conditions. By including the interaction of past export market participation indicators in the export decision equation, we are able to differentiate not only between exporting and non-exporting plants, but also between plants that have different export histories.

The results strongly support the presence of sunk costs in the entry (and re-entry) of Turkish manufacturing plants into the export markets. We show that the longer is the export market experience of a plant the lower would be the sunk costs of re-entry and hence the higher its likelihood of exporting relative to a plant that has no prior export experience. Besides providing more evidence for the presence of sunk new entry and re-entry costs, our contribution to the literature lies in our findings about two distinct characteristics of the export market experience. The first is the rapid depreciation of the past export market experience effect on sunk re-entry costs. Plants that have never exported before face very high levels of sunk costs when they enter the first time around. Plants that exported further in the past (at $t-3$ or $t-2$) and stopped exporting in the mean time also face sunk costs of re-entry, but their costs are lower relative to the new entrants. The recent export market experience (at $t-1$) matters more for a plant's likelihood of export market participation than the export market experience further in the past (in our case, at $t-2$ or at $t-3$).

Second, we show that while persistence in exporting helps lower the costs of re-entry today, there are diminishing returns to experience in export markets. The gains from exporting over the last two years in terms of the increase in the likelihood of exporting today are not greater than the product of the increase in the likelihood of exporting today due to exporting only at t-1 and the increase in the likelihood of exporting today due to exporting only at t-2. Our findings about the rapid depreciation of the past export experience and the diminishing returns to past export experience indicate strong support for a more general hypothesis: The full export history of a plant matters for its current export decision.

Our results are robust to macroeconomic effects (for which we use year indicators as proxy), industry effect as well as the plant characteristics that are expected to have an influence on the export market participation decision. These plant characteristics are the size (as measured by employment), average wage rate, capital-labor ratio, share of imported machinery in the capital stock, the composition of labor force and export spillovers at the four-digit industry level.

The rest of the paper is organized as follows. In the next section, we briefly summarize Turkish export performance and policies to promote exports. In section 3 we present the data and the export decision model. In section 4 the empirical model and results are reported and discussed. Section 5 concludes the paper.

2 Export Performance of Turkey in the 1990s

In this section we provide background information about the export performance of Turkey during the period of our analysis, 1990-2001. Turkey pursued export promotion policies in the 1980s along with efforts to liberalize imports. As part of the export promotion policies the government implemented direct export subsidy, tax rebates and export credit schemes, simplified export procedures and maintained a competitive real exchange rate throughout the 1980s.

In the 1980s total export subsidies were quite high, reaching as high as 33.8% in 1989 (Aktan (1996)). The reliance on the export incentive schemes have been reduced over time in order to comply with the provisions of the GATT agreement in 1988, the WTO agreement of 1994 and the customs union agreement with the EU in 1996. Despite this downward trend in subsidies in the second half of 1980s, total subsidies through direct payments, export credits, duty and tax allowances had never fallen below 20% until 1994 (Uygur (1998)). While some of the major incentive schemes have been marginalized over time from 1996 to 2001, the subsidized export credits remained as the most significant scheme in implementation (Uygur (2000)).

Another important dimension of the export promotion policies was the competitive

Table 1: **Exports of the Turkish manufacturing Industry (1990-2001)**

Variable	1990	991	1992	1993	1994	1995
Manufacturing Exports (bil. US$)	10.5	10.8	12.4	12.9	15.7	19.3
Real Exchange Rate	121.5	126.5	124.4	132.1	100.0	108.5
Number of exporters	1116	1202	1214	1354	1441	1585
Proportion of exporters	0.219	0.244	0.219	0.237	0.260	0.265
	1996	1997	1998	1999	2000	2001
Manufacturing Exports (bil. US$)	20.5	23.3	24.1	24.0	25.5	28.8
Real Exchange Rate	112.5	120.0	131.1	138.5	150.6	121.4
Number of exporters	1336	1278	1667	1641	1686	1765
Proportion of exporters	0.208	0.181	0.215	0.228	0.232	0.242

real exchange rate policy. Vigorously pursued in the first half of 1980s, the competitive exchange rate policy was gradually subdued due to the government's efforts to keep the inflation under control while facing a souring government budget deficit.

As a result of intense political competition government budget deficit increased rapidly in the late 1980s and early 1990s . With rather small and shallow financial markets, the government decided to open the capital account in 1989 in order to attract foreign portfolio investors and increase the funds available to finance public sector borrowing requirements. Following the capital account liberalization coupled with a managed exchange rate regime, Turkey attracted large sums of foreign capital inflows in the first half of 1990s.

As a result, starting from the late 1980s the Turkish economy went through boom and bust cycles. As part of these cycles, the country experienced periods of real exchange rate appreciation followed by sharp devaluations. The Turkish Lira appreciated by 26% in real terms from 1989 to 1993 (Table 1). Following this real appreciation period, TL depreciated sharply by 24% in 1994 due to the financial crisis that erupted at the end of January 1994. Another period of real appreciation started in 1995 and lasted until the 2001 economic crisis. From 1994 to 2000 TL appreciated by 50% in real terms, before depreciating by 19% in 2001 as a result of the worst economic crisis in the country's history (Table 1).

During this period, the behavior of the total exports is partly affected by the behavior of the real exchange rate. Export growth slowed down during the periods of real appreciation that lasted four to five years and jumped up immediately following the real depreciation that had taken place in a matter of months. As expected, the real appreciation of TL in the early 1990s had its toll on exports. Manufacturing exports increased from $10.5 billion in 1990 to only $12.9 billion in 1993. Following the devaluation of TL in 1994, exports increased to $19.3 billion in 1995. Increasing slowly to $23 billion in 1997 it stabilized around $24-25 billion before increasing to $28.8 billion in 2001 (see Table 1).

While the number of exporting plants increased over time from 1116 in 1990 to 1765 in 2001, their share in all manufacturing plants has not increased as much because of net entry by new plants. While only 22% of plants exported in 1990, the proportion of exporting plants increased to 26% and 26.5% in 1994 and 1995 during and immediately after the 1994 economic crisis. During the second half of 1990s the proportion of exporting plants declined to 18% in 1997, before increasing back to 24.2 % in 2001 (see Table 1).

A closer look at the Turkish export data reveals that not only the total exports increased, but there has been a significant change in the composition of Turkish exports (using 4-digit SITC categories) over time. Following the Customs Union with the EU in 1996, the intra-industry trade has increased substantially. Moreover, those products that had not accounted for significant export share have over time climbed up the ladder, perhaps produced by plants that had not hitherto exported. These observations about the changing composition of Turkish exports suggest that it is not only the incumbent exporters exporting the same goods over time.

3 Empirical Analysis

3.1 Data

In this study we use a data set, collected by the Turkish Statistical Institute (TURKSTAT) for the Turkish manufacturing industry. TURKSTAT periodically conducts Census of Industry and Business Establishments (CIBE).[2] In addition, TURKSTAT conducts Annual Surveys of Manufacturing Industries (ASMI) at establishments with 10 or more employees.[3]

[2] Since the formation of the Republic of Turkey in 1923, the CIBE has been conducted eight times (in 1927, 1950, 1963, 1970, 1980, 1985, 1992, and 2002).

[3] TURKSTAT also collects data on establishments with less than 10 employees. However, up to 1992 data on these establishments were collected only during CIBE years. Since then TURKSTAT has collected

The set of addresses used during ASMI are those obtained during CIBE years. In addition, every non-census year, addresses of newly opened private establishments with 10 or more employees are obtained from the Chamber of Industry.[4] For this study we use a sample that matches plants from CIBE and ASMI for the 1990-2001 period, for which export statistics was collected by TURKSTAT surveys. Unfortunately, not all the key variables needed for this study (such as the export status) have been collected for establishments with 10-24 employees.[5] Thus our sample consists of plants with 25 or more employees. Finally, we limit the sample to only private establishments. In the resulting sample we have 68,473 plant years for 12,931 plants in 28 three-digit SIC industries for the period 1990-2001. [6]

The data includes values of sales, number of employees, wage payments, values of material inputs, electricity, fuels and investment. In 1990, TURKSTAT started to collect information on exports of the plant and purchase of imported investment goods as well as domestic ones. Aside from these, information on various plant characteristics, such as R&D investment, purchase of licensed foreign technology, are being collected since 1990.

3.2 Exporters and Non-Exporters

We present average annual entry rates into export markets for the whole manufacturing and eight 2-digit ISIC sectors in Table 2. The entry rates are also calculated for four size groups to check the impact of plant size on export decision. Looking at the first column and the first row of the table we observe that 79.2 % of plants that exported in the past two years continue to export, which implies that almost one-fifth of those plants exit from the export markets. The entry rate declines to 61.4% if the plant exported last year but not exported a year earlier ($E_{t-1} = 1, E_{t-2} = 0$). Export experience two years ago ($E_{t-1} = 0$, $E_{t-2} = 1$) has a much weaker impact on export participation decision (the entry rate is only 28.6 %

annual data for a sample of establishments with less than 10 employees.

[4] Thus plant entry can be observed in every year of the sample. Though not reported here, in the CIBE years we observe a larger number of new plants, and a higher fraction of smaller plants. Both of these observations reflect the concerted effort by TURKSTAT to include all establishments in the CIBE years.

[5] Prior to 1992, 10-24 and 25+ size groups were administered different survey forms.

[6] In this study, by using plant-level data we implicitly assume the plant to be the decision making unit with respect to exporting. Obviously this assumption does not hold in the case of multi-plant firms. However, given the fact that an overwhelming majority of Turkish manufacturing firms are single-plant firms, any bias that might arise due to the use of plant-level data would be negligible. For that reason, throughout the paper we use the terms "establishment" and "plant" interchangeably.

Table 2: **Empirical probability of exporting given the export status (E) in the past two years (%)**

E_{t-1}	E_{t-2}	All Plants	ISIC 31	32	33	34	35	36	37	38
1	1	79.2	80.3	76.9	67.7	74.4	81.7	80.8	81.9	81.3
1	0	61.4	60.8	60.3	56.9	59.3	66.0	61.1	58.1	63.1
0	1	28.6	30.5	28.1	18.8	20.7	32.6	34.5	31.0	27.5
0	0	7.7	5.8	10.0	6.3	6.4	8.6	2.8	8.0	8.3
Observations		49,015	6,685	15,869	1,540	1,838	4,849	4,414	2,030	11,790

E_{t-1}	E_{t-2}	Size 1 [a] (25-49)	Size 2 (50-99)	Size 3 (100-249)	Size 4 (250+)	Size 1&2 (25-99)	Size 3&4) (100+)
1	1	73.2	77.3	80.1	83.3	75.6	81.7
1	0	53.6	60.7	63.6	71.7	57.3	66.7
0	1	21.2	27.6	30.9	36.6	24.6	33.2
0	0	4.9	8.2	11.6	15.6	6.1	12.7
Observations		19,117	13,461	10,176	6,261	32,578	16,437

[a] Size groups are determined by the average employment throughout 1990-2001.

for those plants), but plants with no export experience at all in the last two years has a very low probability (7.7%) to participate in export markets.

There seems to be a high degree of persistence in export status. Another way of measuring the degree of persistence is to compare the ratio between the exporting and non-exporting plants' likelihood to export in the subsequent year. For example, on average, while only 9.5 % of non-exporting plants in a given year ($E_{t-1} = 0$) export in a subsequent year, this ratio is 74.3 % among the exporting plants ($E_{t-1} = 1$), indicating that exporters are 7.8 times more likely to export in the subsequent year than a currently non-exporting plant.[7] A likelihood ratio of 7.8 is a clear indication of persistence in exporting behavior.

A comparison of the export entry-exit patterns for Turkey with that of Columbia reported in Roberts and Tybout (1997) reveals that a change in status to become an exporter is easier in Turkey. Whereas an average of 3.3% of Colombian non-exporters become exporters in the subsequent year over the period from 1982 to 1989, in Turkey this rate is 9.5% for the manufacturing sector as a whole. Turkey differs from Colombia also in terms of the ease with which to exit the export market. Approximately 25.7% of all

[7] The numbers referred in this sentence applicable when the export status in the previous year is considered only. They are not presented in Table 2.

manufacturing plants that exported in a given year exit the export market in the consecutive year. This ratio is twice as high as the one for Colombia which is only 12.8%.

In order to emphasize the role of sector and plant characteristics in determining the likelihood of becoming an exporter, we calculated export status transition probabilities for ISIC (Revision 2) 2-digit industries and four size groups based on plants' average employment levels throughout the period. There are significant inter-sectoral differences in export market entry and exit rates. For example, a textile plant (ISIC 32) that has no export experience in the previous two years is almost four times more likely to export in the current year than a plant operating in non-metallic mineral products industry (ISIC 36). On the other hand, export status seems to be less persistent in the textile industry which has the highest share of exporting plants (33.2 %, see Table A.1 in the Appendix).

The period averages of transition probabilities for each size group are also presented in Table 2. As we move from small to large plants (from size-based group 1 towards group 4 in Table 2), the probability of exporting increases, irrespective of the past export experience of the plant. However, it is more interesting to observe that the ratio of former exporters' and non-exporters' likelihood of exporting in the current year is also decreasing with size. While a former exporter ($E_{t-1} = 1$, $E_{t-2} = 0$ or 1) in group 1 (25-49 employees) is 11.5 times more likely to export this year relative to a plant that did not export in the previous year, this ratio drops to 4.0 in the largest size-group (250+ employees). The drop in the likelihood ratio with size shows that large plants have the resources, the scale and scope of operations to overcome high sunk cost barriers to export markets.

Instead of calculating the transition probability matrices for all categories determined on the basis of some other plant characteristics, we now turn to the investigation of the export participation decision in a multivariate setting.

3.3 Export Decision and Export History

The empirical analysis is based on a dynamic model of export market participation decision commonly used in the literature.[8] Here we briefly summarize the framework for empirical analysis. Assuming that a plant can always produce the profit maximizing level of output, its profit maximization problem is transformed into a decision to export or not. The plant's export decision today influences future exports and therefore future profits. It will choose to export today if the sum of current and expected future revenues from exporting exceeds the costs of entry today and possible future exit. Under these assumptions, export participation decision takes the following form:

$$E_{it} = \begin{cases} 1 \quad if \quad \pi^*_{it} - F_{it}(1 - \frac{1}{2}\sum_j \sum_{k \geq j} \gamma_{jk} E_{i,t-j} E_{i,t-k}) \geq 0 \\ 0 \quad otherwise \end{cases} \tag{1}$$

where E_{it} is a binary variable that denotes whether or not the i^{th} plant is exporting in period t, π^*_{it} is the expected gross profit increment (not adjusted for the sunk costs of export market entry) that will accrue to plant i if it were to export in period t, F_{it} is the sunk cost of entry/re-entry into export market, and γ_{jj} is the proportion of the non-recurring part of the entry cost at time $t-j$.[9] Thus, if a firm had already exported at time $t-j$, but not in any other time, sunk costs of exporting it incurs at time t will be γ_j percent less compared to a plant that had not exported at $t-j$. Interaction terms ($\gamma_{jk},\ j \neq k$) are used to capture non-additive effects. Given that the maximum number of observations in our data set is 11, we also consider the case with a maximum of 3 lags for each plant. Equation 1 implies that plant i exports at t if profits from exporting net of (re-) entry costs is non-negative.

Our formulation of the export market participation decision in equation (1) expands Roberts and Tybout (1997) approach to the analysis of sunk costs of entry in export markets. By including the interaction terms in equation (1), we are able to differentiate not only between exporting and non-exporting plants in the previous year or the year before, but also between plants that have different export market participation records.

There are several reasons to expect the full history of a plant's export market partic-

[8] For a more detailed treatment of the model see Roberts and Tybout (1997) and Bernard and Jensen (2004).

[9] In order to simplify the notation, from here on we write γ_j instead of γ_{jj}.

ipation to matter for the current export decision. Cost savings due to past export market participation may well be generated through several different channels. Among these we can count productivity improvements driven by intense international competition, the establishment of long-term buyer-supplier relationships, existing and past exporters' preferential access to government-subsidized inputs and credit towards future exports, and increased familiarity with and reputation in export markets.[10] It is the common practice of governments all around the world to use information about the past export performance of the plants in the allocation of quotas, licenses to import inputs with duty drawbacks, export credits, and export marketing subsidies.[11] In many cases the past experience means more than just exporting in the preceding year.

If all the costs (and benefits) of entering an export market are one-time sunk costs, then γ_j will be equal to 1 for the first year it exports. In such a case, the information on any prior export status would be sufficient to estimate the cost of entry at time t. For example, if the firm exported at time $t-1$, its export status at time $t-2$ will not provide any additional information. However, as our discussion in the preceding paragraph shows, some of the costs (and benefits) of entry into export markets are recurring, possibly with a declining impact over time, i.e., $1 > \gamma_1 > \gamma_2 > 0$ and $1 > \gamma_1 + \gamma_2$.

At the beginning of period t the plant manager observes all available information and makes necessary calculations. Based on the level of expected net profits, s/he decides whether to export or not. As researchers we do not observe the incremental profits from exporting. Instead we observe the outcome of the manager's participation decision: $E_{i,t}$.

[10] "Most foreign buyers prefer to give orders to firms that already have considerable export experience and require little instruction and assistance. This is one reason success is cumulative" (Thomas and Nash (1991), p. 128).

[11] Selective government support to exporting firms is a policy choice that has been observed in many countries. As part of export-oriented growth strategy, since late 1950s the Taiwanese government granted credit lines to firms based on their past export performance and future plans (Aberbach, Dollar, Sokoloff (1994)). Korean government still provides small business export credit "to small & medium size companies that manufacture exporting goods or supply materials needed by their primary exporters on the basis of past export performance." The most important eligibility criterion for the South African government's Export Marketing Assistance (EMA) program is the firm's past export performance. Indian government is more explicit about what is meant by the past export performance: "Exporters having past export performance in the preceding three licensing years may also apply for Advance Licence and Advance Intermediate Licence.... An Advance Intermediate Licence (AIL) is granted to a manufacturer-exporter for the import of inputs required in the manufacture of goods to be supplied to the ultimate exporter holding an Advance Licence/Special Import Licence." Export Import Policy 1997-2002 http://www.ieo.org/ex007.html

We are going to estimate a dynamic discrete choice model where $E_{i,t}$ is the dependent variable, and its lagged values $E_{i,t-1}$ and $E_{i,t-2}$ are among the explanatory variables. If the sunk costs of entry to export markets are negligible, then it would not matter for the current export decision whether the plant had exported previously or not. Consequently, statistically significant coefficient estimates for the export participation indicators $E_{i,t-1}$ and $E_{i,t-2}$ would imply that sunk costs do actually matter for the current export market participation decision.

In order to capture the role of the full export history on the current export participation decision (and consistent with equaiton 1) we allow for the interaction of $E_{i,t-1}$ and $E_{i,t-2}$ in our estimating equation. Statistically significant coefficient estimates for the interaction terms will be interpreted as evidence supporting the full history matters hypothesis. A positive coefficient of the interaction term implies that there are super-additive returns (in terms of the probability of exporting at time t), whereas a negative coefficient indicates the existence of diminishing returns in participating export markets over time.

Aside from the binary variables as indicators of past export market participation, one needs to control for macroeconomic factors that influence plants' likelihood of becoming exporters. We use year indicators in order to control for the effect of real exchange rate movements, business cycle fluctuations and other possible macroeconomic shocks on export decision.

In a dynamic panel data model with unobserved firm-specific effects, as the model we use in this paper, the initial observations of the lagged dependent variable ($E_{i,t-1}$ and $E_{i,t-2}$ in our model) are not likely to be independent of unobserved effects. Therefore, the usual random effects logit estimator could be inconsistent and biased. Wooldridge (2005) has developed a new method to handle the initial observations problem, which is much simpler compared to Heckman method used by Roberts and Tybout (1997). He proposes to include the initial value of the dependent variable and the mean values of the explanatory variables for each plant as additional explanatory variables. After obtaining the dynamic random effects logit estimators, we also regress the model with Wooldridge (2005) correction to check whether initial conditions correction matters in our case.

3.4 Plant Characteristics and the Export Decision

There is a wide range of possible plant characteristics that could affect the decision to export. In our estimations, we try to account for as many plant characteristics as possible for which we have data so as to have better estimates for the past export experience indicators. We start with the size variables. In previous research large plants were found to be more likely to become exporters than small plants. Under the presence of economies of scale (or scope) the size of the plant matters for average cost of production. To the extent that low cost plants enter the export market earlier and/or large firms could spread sunk costs over large volume of output, the size would matter for the export decision. We use employment as a measure of plant size. The quadratic employment term is also included in the model to account for non-linear effects.

Another plant characteristic that we include in our regressions is the (log) real wage rate paid by the plant. Efficiency wage literature shows that plants tend to pay a wage rate above the market clearing wage rate in order to provide incentives for workers to show more effort. Another reason for paying higher wages is to attract and keep high quality labor. Those plants that take a special interest in paying higher wage rates are likely to be more efficient and/or produce better quality products. Consequently, if this linkage is strong one is likely to get a significant positive coefficient on the log wage rate.

We have data on direct measures of labor composition in terms of tasks and gender. In our regression, we include shares of technical and female employees in labor force. If Turkish manufacturing plants are more competitive in activities that require home-based, "feminine" skills, the share of female employees will have a positive impact on export decision (see, for example, Ozcelik and Taymaz (2004)). In a similar way, the coefficients of the variables on technical employees will indicate if Turkish manufacturing plants are more competitive in technical skill intensive activities.

We also include a measure of the capital intensity of production. Turkey is a labor abundant country and as such has comparative advantage in labor-intensive sectors. However, this does not imply that less capital intensive plants are more likely to export. To the contrary, assuming that capital intensity is closely related to the technology level, plants with higher capital intensity can produce better quality products, attain lower unit cost of labor and, therefore, likely to become an exporter. In addition, plants with higher capital intensity are likely to use more advanced technology in both embodied and disembodied forms compared to less capital intensive plants. Advanced technology plays a critical role in producing higher quality products that would have better chance in international markets.

Capital intensity by itself is not sufficient as a measure of the use of advanced technology by a plant. In the case of Turkey how advanced the technology used also depends on whether it's domestically produced or imported. For that reason, we use the imported machinery share of capital stock to capture the impact of imported technology on the export decision. Using data for the whole manufacturing sector, Mody and Yılmaz (2002) showed that facing with increased competition from low income competitors manufacturing sector producers in export-oriented developing countries invest heavily on imported machinery a means to increase labor productivity, and, hence, to lower unit costs while improving the quality of their products.

As shown by Bernard and Jensen (1995) it is possible that the change in export status takes place contemporaneously with changes in one or more plant characteristics, such as plant size, employment composition and wages. In order to avoid the simultaneity problem that we cannot address directly, in our regressions we use one year lagged plant characteristics and spillover variables as explanatory variables.

4 Empirical Results

Based on the export participation decision equation (1) and the ensuing discussion, we estimate the following equation of export market participation using random effects logit regression:

$$E_{i,t} = \delta_1 E_{i,t-1} + \delta_2 E_{i,t-2} + \delta_{12} E_{i,t-1} E_{i,t-2} + \Phi\ \mathbf{S}_{i,t-1} + \Gamma\ \mathbf{Z}_{t-1} + \alpha_i + \varepsilon_{it} \qquad (2)$$

where the dependent variable E_{it} is a binary variable, indicating the export status (1 for exporter, 0 for non-exporter) at t. The first three variables in equation (2) are the export status indicators for year $t-1$ and $t-2$ and their interactions with each other. The coefficients of the past export status indicators and their interaction term $\delta_1,\ \delta_2, \delta_{12}$ reflect the corresponding γ's in equation (1) that capture the sunk cost reducing effect of past export market experience. Plant characteristics that have a potential influence on the export decision (as of year $t-1$) are all included in the vector $\mathbf{S}_{i,t-1}$. Macroeconomic (captured by year indicators) and sectoral factors that influence the plant's export decision are included in the vector $\mathbf{Z}_t$. Finally α_i is the unobserved plant-specific random effect which is assumed to be uncorrelated across plants ($Cov(\alpha_i, \alpha_j) = 0$), and ε_{it} is the error term which is uncorrelated over time.

4.1 Export Participation Decision

The results of the dynamic RE logit estimation of equation (2) for all manufacturing plants are presented in Table 3.[12] The coefficient estimates for the exporter status at $t-1$ and $t-2$ are 2.699 and 1.259, respectively, whereas the coefficient estimate for the interaction term is -0.565. They are all statistically significant at the 1% level. The logit model allows us to obtain the odds ratio (the ratio of the odds of exporting for a plant, for example, that exported in the previous year and the odds of exporting for another plant that did not export in the previous year) as an exponential function of the coefficient estimate in the case of a binary variable, and as an exponential function of the product of the coefficient estimate and the standard deviation in the case of a continuous variable. As a result, it is possible to obtain the impact of a change in one or several of the variables on a plant's likelihood of exporting.

The odds ratios for all binary and continuous explanatory variables are also presented in Table 3. When the interaction term of the lagged indicator variables is not included in the regressions, the coefficient estimates for the one- and two-lagged export indicators become 2.458 and 0.953 (see Table A.2 in the Appendix).[13] Even though these estimates are lower

[12] Descriptive statistics for the variables used in the regressions are presented in Table A.1 in the Appendix.
[13] Our empirical analysis relies completely on the dynamic RE logit model as the coefficients can be used to obtain odds ratios that can be interpreted very intuitively. However, we have estimated the dynamic RE probit model as well. The results of the RE probit model are presented in Table A.4 of the Appendix. As can be seen in Table A.4, the coefficient estimates from the random effects probit model are quite similar in

Table 3: **Random effects logit estimates of the export participation equation (All manufacturing plants, 1990-2001)**

				Odds ratio		
Dependent variable: E_t	Variable [a] type	Estimated [b] coefficient	z-statistic	% change	% std. of X	Std. Dev of X
Explanatory variables						
E_{t-1}	0-1	2.699**	60.0	1486	—	—
E_{t-2}	0-1	1.259**	25.2	352	—	—
$E_{t-1} * E_{t-2}$	0-1	-0.565**	-8.4	57	—	—
log(labor)	cont.	1.186**	9.1	—	307	0.945
log(labor) squared	cont.	-0.09**	-6.9	—	43	9.484
log(wage)	cont.	0.032	1.3	—	103	0.830
log(K/L)	cont.	0.15**	10.7	—	123	1.380
Imported M&E share	cont.	0.405**	4.9	—	109	0.215
Export Spillovers	cont.	0.471**	4.8	—	239	1.847
Female employee share	cont.	0.453**	5.75	—	110	0.216
Technical employee share	cont.	0.296**	1.7	—	103	0.098
Log likelihood		-16,796				
Observations		46,674				

[a] In the "Var. type" column "Cont." indicates the variable is continuous and its effect on odds ratio is measured after one standard deviation change. In the case of binary (denoted by 0-1) variables, the effect on odds ratio is measured in column 4 assuming that the variable is equal to one.

[b] The model includes year and 3-digit ISIC industry indicators. **, * and + indicate that the coefficient is significant at the 1, 5, and 10% levels (two-tailed test), respectively. This footnote applies to other Tables where regression results are presented.

than the estimates obtained with the interaction term in the equation, it would not be correct to compare the coefficient estimates with and without the interaction term in the export equation. To interpret these coefficients and to see the difference that the inclusion of the interaction term makes, we compare the odds ratios obtained with and without the interaction term.

Actually, in a framework with interaction terms, the empirical analysis of the "full history matters" hypothesis involves more than just focusing on a single coefficient estimate and the corresponding odds ratio. Considering up to two years of past experience, there are five possible cases where the effect of a plant's past export experience on its current export decision can be analyzed.[14] Odds ratios for the manufacturing industry as a whole obtained from the dynamic random effects logit estimates and the Wooldridge dynamic RE

magnitude to the ones obtained in the random effects logit model.

[14] When we consider three years of the export history with interaction terms, we identify 13 cases for which we calculate the odds ratios. We will present and discuss these results later.

Table 4: **Random effects logit estimates of the export odds ratios for manufacturing industry (with and without the initial conditions correction a la Wooldridge)**

	Plant i		Plant j		RE logit		Wooldridge		Implied by
					Interaction		Interaction		Transition
	E_{t-1}	E_{t-2}	E_{t-1}	E_{t-2}	with	without	with	without	Probabilities
OR1	1	1	0	0	29.8	30.3	15.1	15.2	10.3
OR2	1	0	0	0	14.9	11.7	10.7	8.6	8.0
OR3	0	1	0	0	3.5	2.6	2.3	1.8	3.7
OR4	1	1	0	1	8.4	11.7	6.6	8.6	2.8
OR5	1	1	1	0	2.0	2.6	1.4	1.8	1.3
Rate of depreciation $= 1 - OR3/OR2 = 1 - e^{\hat{\delta}_2 - \hat{\delta}_1}$					76.3	77.8	78.7	79.7	53.5
Returns to export experience $= OR1/(OR2 * OR3) = 1 - e^{\hat{\delta}_{12}}$					56.8	100	61.8	100	34.6

logit estimates are presented in Table 4. We present odds ratios obtained from estimates with and without the interaction term included.[15] In each column we consider five odds ratios. In each case, we assume that there are two plants, i and j, that are identical in every aspect except for their past export market experience.

The first three lines of Table 4 compare plant i's likelihood of exporting today that exported in either or both of the preceding two years with a plant j that had no export experience in the preceding two years. Cases 4 and 5, on the other hand, compare the likelihood of exporting today of a plant i that exported in each of the preceding two years with a plant j that exported only once in the past two years. Everything else being the same, we can summarize the scenario of Case 1 by the following: $E_{i,t-1} = E_{i,t-2} = 1$ vs. $E_{j,t-1} = E_{j,t-2} = 0$. According to the random effects logit estimates with the interaction term, with two consecutive years of export market participation, plant i's likelihood of exporting at t will be 29.8 (OR1=$e^{\hat{\delta}_1+\hat{\delta}_2+\hat{\delta}_{12}}$) times the likelihood of exporting for plant j that had no export market experience in the previous two years. From the equation without the interaction term we obtain the odds ratio for a plant that exported in both periods (OR1) to be 30.3, a value which is not very different from the one that is obtained with the interaction term.

As emphasized correctly by Roberts and Tybout (1997) the dependence of the lagged

[15] The odds ratios for both binary and continuous variables at the 2-digit ISIC level are presented later.

dependent variable on the unobserved firm-specific effects could possibly lead to estimates that exaggerate the role of sunk costs and the export market participation history. In order to control for the robustness of our results from the random effects logit model, we have estimated equation 2 using the initial conditions correction method proposed by Wooldridge (2005). The estimated odds ratios for export status variables are also presented in Table 4. The coefficients for the export status variables (E_{t-1}, E_{t-2} and $E_{t-1}E_{t-2}$) turn out to be statistically significant.

The comparison of the Wooldridge results with random effect logit results show that their conjecture was indeed correct for the Turkish manufacturing industry: Random effects logit model produces estimates that exaggerate the role of sunk costs when the lagged dependent variable is present on the right hand side. Despite the sharp decline in the odds ratio with the initial conditions correction a la Wooldridge, their pattern and magnitude do still show that the full history of export participation matters for the current export decision and there are diminishing returns to experience in export markets. Therefore, our qualitative results are robust to initial observations correction.

Wooldridge random effect logit estimates of odds ratios for case 1, on the other hand, are 15.1 and 15.2, respectively, and are more in line with the odds ratios implied by the empirical transition probabilities from Table 2, presented again in the last column of Table 4. Random effects logit estimates without the Wooldridge's initial conditions correction, on the other hand, produce odds ratios that are quite higher than the odds ratios derived from the transition probabilities. For this reason, from here on we will discuss the odds ratios from Wooldridge random effect logit estimates only.

In case 2 we observe that a manufacturing plant i that exported at $t-1$, but had not exported at $t-2$ is 10.7 (OR2=$e^{\hat{\delta_1}}$) times more likely to export at t compared to a plant j that had no past export experience. In the third case, a manufacturing plant i that exported at $t-2$, but not at $t-1$ is 2.3 (OR3=$e^{\hat{\delta_2}}$) times more likely to export at t compared to a plant j that had no past export experience.

When we compare the odds ratios with and without the interaction term for cases

2 and 3, the difference the inclusion of the interaction term makes becomes clear. When the interaction term is not taken into account the odds ratio for a plant that exported at $t-1$ but not $t-2$ (OR2 under the "without interaction" column in Table 4) is 8.6, lower than 10.7 obtained when the interaction term is included. Similarly, when the interaction term is not included the odds ratio for a plant with export experience at $t-2$ but not at $t-1$ (OR3) is measured to be 1.8, again lower than 2.3 obtained with the interaction term. Based on the comparison of the first three odds ratios ,we can conclude that ignoring the interaction term spuriously results in lower odds ratios for plants that had participated in export markets in one of the past two years relative to a plant that had not exported at all.

In the last two cases of Table 4 we compare a plant that exported at both $t-1$ and $t-2$, with a plant that exported only at $t-1$ (case 4) or only at $t-2$ (case 5). Both cases support the results we obtain on persistence: Plants with longer export market experience are more likely to continue exporting. While plant i that exported in both periods is 1.4 times more likely to export at t compared to the plant j that exported at $t-1$ only, it is 6.6 times more likely to export at t compared to another that exported at $t-2$ only.

The major shortcoming of the specification without the interaction term is revealed in the equality of odds ratios OR2 and OR3 to the odds ratios OR4 and OR5, respectively. It basically means that the relative importance of one-lagged ($t-1$) experience is the same irrespective of whether the comparison is between a plant that exported in the last two years and a plant that exported at t-2 only or it is between a plant that exported at $t-1$ and a plant that had not exported in the last two years. The same observation is true for the two-lagged experience.

Finally, we compare the odds ratios from the Wooldridge estimates with the interaction term with the odds ratios derived from the export transition probabilities from Table 2. These odds ratios are presented in the last column of Table 4. The odds ratios from the transition probabilities take values different from the ones derived from the Wooldridge estimates. Only in case 4 the transition probabilities produce a value (6.6) exactly equal or very close to the ones derived from the Wooldridge estimates.

Five possible cases of export history in the manufacturing industry presented in Table 4 help us draw three conclusions about the behavior of the past export experience effect on sunk entry costs to export market. First, the degree of persistence in export market participation is actually stronger than previously shown. A comparison of OR1 with OR2 and OR3, clearly shows that the longer is the past export market experience of a plant, the higher its likelihood of exporting relative to a plant that has no experience in the preceding two years. Actually, when we expand the export history in equation (2) to three years, we obtain an odds ratio of 24.5 for a plant that exported in the past three years compared to a plant that had not exported at all (see Table 7).

Second, the comparison of odds ratios OR2 and OR3 reveals that the plant that exported more recently is more likely to export at t. The more recent export market experience (at $t-1$) matters more for a plant's likelihood of exporting than the export market experience further in the past (in our case, at $t-2$). In other words, the effect of export market experience on sunk costs declines over time. To be more specific, we define the depreciation rate of the export experience effect as one minus the ratio of odds ratios in cases 3 and 2 (1-OR3/OR2).[16] In the case of the Wooldridge random effects logit model for the whole manufacturing industry, the rate of depreciation of the export experience from $t-2$ to $t-1$ is 78.7 % (Table 4). The likelihood of exporting for a plant that exported two years ago is 78.7% lower than the likelihood of exporting for a plant that exported one year ago. The rate of depreciation of export experience increases slightly to 79.7% when we estimate the regression equation without the interaction term. Both measures indicate a rather rapid depreciation of the export experience in terms of its effect on the future likelihood of exporting.

We can also define the rate of depreciation of export experience using odds ratios OR4 and OR5, which produces exactly the same rates of depreciation as the odds ratios OR2 and OR3. For a plant's likelihood of exporting in the current period the more recent export experience counts more than export experience in the distant past. The plant j will be less

[16] Note that OR3/OR2 is equal to $e^{\hat{\delta}_2-\hat{\delta}_1}$. For purposes of presentation, in Tables 4 through 6 we multiply the rate of depreciation as well as the measure of returns to export experience by 100.

disadvantageous relative to the plant i in exporting at t if it exported at $t-1$, instead of $t-2$, irrespective of whether the reference plant exported or did not export at all over both years in the past two years.

The third result we obtain using the odds ratios in Table 4 is directly related to the negative coefficient estimate for the interaction term in equation (2). This negative coefficient estimate implies that there are diminishing returns to export market experience. In order to express the measure of returns to experience in terms of odds ratios, we can define the returns to past export experience as the odds ratio OR1 divided by the product of odds ratios OR2 and OR3, which is by definition is equal to $e^{\hat{\delta}_{12}}$. In the case of constant returns to experience the odds ratio for a plant which exported in both $t-1$ and $t-2$ should be equal to the product of the odds ratios for the plants that exported only in $t-1$ and only in $t-2$ and the measure of returns to experience should be equal to 1. As can be seen from Table 4, irrespective of the initial conditions correction, random effect logit estimates indicate that there are diminishing returns to export experience as long as the interaction term included in the regressions. The returns to experience measure is only 61.8% for the Wooldridge RE logit estimates, indicating that two-years' of export experience of a single plant is 38.2% lower effect on exporting probability compared to single year export experiences of two plants in different years.

In Tables 5 and 6, we present the odds ratios, the rate of depreciation and the returns to experience obtained from the Wooldridge (2005) random effects logit model estimates for two-digit ISIC industries and plant-size groups, respectively. As can be seen in Table 5, the results we obtain for the manufacturing industry as a whole also apply to most of the two-digit ISIC sectors.[17] Altogether these results provide strong evidence supporting the presence of large sunk costs of entry to export markets as well as the role of the full history of export market experience. Plants that have never exported before would face large sunk costs when they enter the first time around. Plants that exported further in the past (at

[17] Different results are obtained in industries 33, 34 and 37, where the interaction term turns out to be statistically insignificant (See Table 5). As a result, for these industries the odds ratios estimated with the interaction term are exactly the same as the odds ratios estimated without the interaction term. This is evident from Table 4, as the odds ratios for these industries in cases 2 and 3 are exactly equal to the odds ratios in cases 4 and 5.

Table 5: **Random effects logit (Wooldridge) estimates of the export odds ratios for 2-digit ISIC sectors**

	Plant i	Plant j	Random effects logit model with initial conditions (correction a la Wooldridge)							
	$E_{t-1} E_{t-2}$	$E_{t-1} E_{t-2}$	31	32	33	34	35	36	37	38
OR1	1 1	0 0	16.7	15.0	8.6	37.8	14.8	21.3	17.4	21.5
OR2	1 0	0 0	12.2	9.9	8.6	15.3	10.7	17.1	8.4	13.4
OR3	0 1	0 0	2.9	2.2	1.0	2.5	2.3	4.9	2.1	2.4
OR4	1 1	0 1	5.8	6.8	8.6	15.3	6.5	4.4	8.4	8.9
OR5	1 1	1 0	1.4	1.5	1.0	2.5	1.4	1.2	3.1	1.6
Rate of depreciation $= 1 - OR3/OR2 = 1 - e^{\hat{\delta}_2 - \hat{\delta}_1}$			76.2	77.8	88.4	83.9	78.8	71.6	75.4	82.0
Returns to export experience $= OR1/(OR2 * OR3) = 1 - e^{\hat{\delta}_{12}}$			47.4	68.8	100	100	60.7	25.5	100	66.8

Table 6: **Random effects logit (Wooldridge) estimates of the export odds ratios for different plant-size groups**

	Plant i	**Plant j**	**Plant size by Employment**					
	$E_{t-1} E_{t-2}$	$E_{t-1} E_{t-2}$	**25-49**	**50-99**	**100-249**	**250+**	**25-99**	**100+**
OR1	1 1	0 0	18.8	14.7	13.4	14.9	16.5	13.8
OR2	1 0	0 0	13.0	10.5	8.5	10.3	11.8	9.1
OR3	0 1	0 0	2.6	2.3	1.9	2.2	2.5	2.0
OR4	1 1	0 1	7.3	6.3	6.9	6.7	6.7	6.8
OR5	1 1	1 0	1.4	1.4	1.6	1.4	1.4	1.5
Rate of depreciation			80.1	77.8	77.2	78.4	79.0	77.7
Returns to export experience			55.9	59.9	81.1	65.0	56.4	74.2
Number of Observations			17,536	12,961	9,973	6,204	30,497	16,177

t-2) and stopped exporting in the meantime (at t-1) also face sunk costs of re-entry, which are not as high as costs of new entry.

As can be expected, sunk costs faced by new entrants are lower (OR1 is lower) in chemicals, petroleum and plastic products (ISIC 35), textiles, clothing and leather (ISIC 32), which is the leading export sector throughout the period, food, beverages and tobacco (ISIC 31) and basic metal industries (ISIC 37). It is quite high in paper products, printing and publishing (ISIC 34), non-metallic mineral products (ISIC 36), and fabricated metal, machinery and equipment industry (ISIC 38). ISIC 33 (wood products) is a special case because the coefficient estimates for the one and two lagged export indicator variables turn out to be statistically insignificant.

The results for the two-digit ISIC industries show that in some industries, such as wood products (ISIC 33), paper products, printing and publishing (ISIC 34) and fabricated metal, machinery and equipment (ISIC 38) industries, there is even faster depreciation of the export experience effects. There is also a wide variation among industries in terms of the degree of returns to experience. While wood products (ISIC 33), paper products, printing and publishing (ISIC 34) and basic metal industries (ISIC 37), have constant returns to experience, there is a strong diminishing return to experience in non-metallic mineral products (25.5%, ISIC 36) and food, beverages and tobacco (47.4%, ISIC 31) industries.

In order to see whether the plant-size matters for the relative importance of sunk entry and re-entry costs to export markets, we estimated the model separately for four categories of plants (those employing 25-49, 50-99, 100-249, and 250+ employees). Since the results are similar for the first and second as well as third and fourth groups (there seems to be a threshold around 100 employees), we re-estimated the model for only two groups, small (25-99 employees) and large (100+ employees) plants (Table 6). The results indicate that the sunk costs are even more important in influencing small plants' export market participation decision. A small plant (employing 25-99 people) with two years of export experience is 35.8 times more likely to export at the current year than a small plant with no prior export experience. The corresponding odds ratio for large plants is 23.8 (see OR1, Table 6). The same pattern is also observed in comparing a plant with one year export experience with a plant with no experience (cases 2 and 3). However, if the plant has any export experience, the difference between small and large plants disappears (cases 4 and 5). In other words, the first experience in the export market makes the difference between small and large plants' exporting behavior rather negligible.

As we have already referred to above, we have also estimated the export decision equation with three lags of the export history. We first write the equation of export decision with three lags of the dependent variable:

$$\begin{aligned} E_{i,t} \quad = \quad & \delta_1 E_{i,t-1} + \delta_2 E_{i,t-2} + \delta_3 E_{i,t-3} + \delta_{12} E_{i,t-1} E_{i,t-2} + \delta_{13} E_{i,t-1} E_{i,t-3} + \delta_{23} E_{i,t-2} E_{i,t-3} \\ & + \delta_{123} E_{i,t-1} E_{i,t-2} E_{i,t-3} + \Phi \mathbf{S}_{i,t-1} + \Gamma \mathbf{Z}_{t-1} + \alpha_i + \varepsilon_{it} \qquad (3) \end{aligned}$$

Table 7: **Random effects logit (Wooldridge) estimates of the export odds ratios for different (All manufacturing plants; 3-years lag)**

	$E_{t-1}E_{t-2}E_{t-3}$		With interaction		Without interaction	
	Plant i	**Plant j**	**RE Logit**	**Wooldridge**	**RE Logit**	**Wooldridge**
OR1	**1 1 1**	**0 0 0**	46.2	24.5	44.5	22.9
OR2	**1 1 0**	**0 0 0**	26.7	18.3	23.4	15.8
OR3	**1 0 1**	**0 0 0**	23.5	15.1	21.7	13.6
OR4	**0 1 1**	**0 0 0**	4.9	3.1	3.9	2.5
OR5	**1 0 0**	**0 0 0**	16.8	13.7	11.4	9.3
OR6	**0 1 0**	**0 0 0**	3.8	3.1	2.1	1.7
OR7	**0 0 1**	**0 0 0**	3	2.3	1.9	1.5
OR8	**1 1 1**	**0 1 1**	9.4	7.9	11.4	9.3
OR9	**1 1 1**	**1 0 1**	2	1.62	2.1	1.7
OR10	**1 1 1**	**1 1 0**	1.7	1.33	1.9	1.5
OR11	**1 1 1**	**1 0 0**	2.7	1.8	3.9	2.5
OR12	**1 1 1**	**0 1 0**	12.1	8	21.7	13.6
OR13	**1 1 1**	**0 0 1**	15.2	10.7	23.4	15.8

There are seven coefficients in equation 3 that are related to the past export history of the plant. The odds ratios for the three year lag equation estimation are presented in Table 7[18].

The difference between the random effects logit estimation with and without initials conditions correction a la Wooldridge (2005) is quite apparent in the model with three lags. Similarly, the presence of the interaction term in the estimations makes substantial difference in the derived odds ratios. as we have already briefly discussed above, a plant that exported for the past three years is 24.5 times more likely to export this period compared to a plant that had no export experience in the past three years. When we compare the plant with three years of experience to plants with two years only, we observe that it is 1.33, 1.62 and 7.9 times more likely to export relative to a plant that exported at $t-1$ and $t-2$, at $t-1$ and $t-3$ and at $t-2$ and $t-3$, respectively (OR8, OR9 and OR10). There is not much change when the reference point is the plants with a single year of experience only. The plant with three years of experience is 1.8, 8.0 and 10.7 times more likely to export relative to a plant that exported at $t-1$, $t-2$, and $t-3$, respectively (OR11, OR12 and OR13).

The rate of depreciation is very high when we compare plants with one-year experience only at $t-1$ and $t-2$, but subsides down when we compare single year experience at $t-2$

[18] Estimation results are presented in Table A.3 in the Appendix.

and $t-3$. The odds ratio of a plant that exported at $t-1$ is 4.5 times the odds ratio of a plant that exported at $t-2$ (OR5/OR6). The odds ratio of a plant that exported at $t-2$, on the other hand, is only 34% more than the odds ratio of a plant that exported at $t-3$.

In order to obtain probability measures comparable to toher studies, we obtain average predicted probability of exporting for plants with different export history. We calculated the average probability of exporting in Table A.5 in the Appendix. Our predicted probabilities for the whole manufacturing sector shows that the plants that have the longest (in our case 3 years) export market experience in the past have 80% probability of exporting in the current year.

Analyzing the export decision by U.S. firms, Bernard and Jensen (2004) obtain a current export probability of 53% for a plant that exported in the previous year. In our case, export experience in the past three years leads to a current export probability of almost 80% (See Table A.5 in the Appendix). In the case of a plant that exported only the previous year, the current export probability drops dow to 56.5%, a value which is close what was found by Bernard and Jensen (2004).

4.2 Plant Characteristics

Coefficients of other explanatory variables that measure various plants characteristics have usually expected signs. Plant characteristics such as the size (as measured by employment level), capital intensity of the production technology (as measured by the capital/labor ratio), labor productivity (relative to U.S. manufacturing industry) as well as the wage rate (as a measure of the efficiency labor) increase a plant's likelihood of becoming an exporter. As we expected the coefficient on the squared employment term is negative, implying that an increase in the employment will increase the probability of becoming an exporter at a decreasing rate.

A one standard deviation increase in log employment (which is equal to 0.945) leads to 31 % increase in the probability of a plant to become an exporter (which is defined as $e^{\hat{\phi}_l \sigma_l + \hat{\phi}_{l^2} \sigma_{l^2}}$. In other words, let's take two plants that are exactly the same in every charac-

Table 8: **Random effects logit model: Percent change in odds ratios (ISIC 2-digit sectors)**

	31	**32**	**33**	**34**	**35**	**36**	**37**	**38**
E_{t-1}	1808**	1206**	1430**	1696**	1607**	3023**	1161**	1653**
E_{t-2}	478**	298**	241**	285**	368**	983**	307**	324**
$E_{t-1} * E_{t-2}$	44**	66**	68	52	51**	23**	71	64**
Log Labor (Net effect)	136	130	134	109	124	126	155	126
Log (labor)	219+	226**	192	238	358**	296	4948**	360**
Log (labor) squared	62	58**	70	46	35**	42	3**	35**
Log (wage)	91	104	89	127	107	116	113	101
Log(K/L)	132**	116**	108	127**	126**	174**	125**	122**
Imported M&E share	104	110**	112	126**	105	105	108	110**
Export Spillovers	129**	111**	109	116	112	93	105	101
Female employee share	130**	108**	101	126**	92	119**	102	100
Technical emp. share	99	105+	121**	109	107	94	94	100
Log Likelihood	-1,953	-6,358	-459	-517	-1,775	-775	-681	-4,101
Observations	6,388	15,092	1,463	1,767	4,674	4,035	1,945	11,310

teristics, but the employment level. If the plant with fewer employees has 10% probability of becoming an exporter, the plant with one standard deviation higher employment level (85 % larger than the former firm) will have 13.1 % (1.31 times the plant with fewer employees) chance of becoming an exporter.

When we undertake the regressions for 2-digit ISIC industries, the coefficient estimates on lagged export indicators have the same sign as the whole manufacturing sector and in most cases they are statistically significant. However, the 2-digit ISIC industries with fewer observations (37, 34 and 33) in general do not have statistically significant coefficient estimates other than the one-lagged exporter status indicator.

The impact of plant size on plant's likelihood of exporting is larger in iron and steel (ISIC 37), machinery and transport equipment (ISIC 38), and chemicals (ISIC 35) industries compared to the food and beverages (ISIC 31) and clothing and textiles (ISIC 32) industries (see Table 8). The increase in odds ratio due to a standard deviation increase in log employment and squared log employment become 30% in textiles and clothing, 24% in chemicals, 55% in iron and steel, and 26 % in machinery and transport equipment industry industry.

The wage effect is statistically insignificant for the whole manufacturing industry as well as for the two-digit ISIC industries (see Table 8). We interpret this result to be an evidence that efficiency wage hypothesis with respect to the export decision does not receive much support from the data for most of the sectors in the Turkish manufacturing industry.

Capital intensity of the production technology has a modest role in increasing the likelihood of exporting in the subsequent year. In the case of the whole manufacturing industry a one standard deviation increase in lagged K/L ratio raises the odds ratio of exporting at year t by 23%. Among the two-digit ISIC sectors, a one standard deviation increase in the K/L ratio increases the likelihood of exporting between 16% and 32% in six of the industries. In the case of the non-metallic minerals (ISIC 36), the effect of K/L ratio on the likelihood of exporting is 74%. In the case of ISIC 33, there is no statistical effect of the K/L ratio on the likelihood of exporting.

Next we consider the share of imported machinery in total capital stock as an indicator of foreign technology diffusion. The share of imported machinery in capital stock matters for the export decision for the manufacturing sector as a whole. However, a one-standard deviation increase in the imported machinery share of the capital stock increases the probability of exporting at t by a mere 9%. Relative to other factors the impact of imported machinery is not large. Looking at the estimates at the 2-digit level, imported machinery share does have a significant positive impact on the export decision in printing and publishing (26% increase in the odds ratio), machinery and equipment industry (10 %) and clothing and textiles industry (10%).

The last group of the plant characteristics we cover is the composition of employment. The estimates indicate that employment composition of a plant matters for the export decision, but the effect is not very significant both economically and statistically. For the whole manufacturing sector, a one-standard deviation in the share of technical employees increases the probability of exporting next period by 3%, whereas the increase in the share of female employees increases the exporting probability by 11%. At the two-digit industry level, the share of technical employees has a positive effect on the likelihood of exporting only in the wood products (ISIC 33) industry, and the female employee share helps improve a plant's chances of exporting substantially in the food processing (ISIC 31), the textiles and clothing (ISIC 32), and the non-metallic minerals industry (ISIC 36).

Finally, we included a number of spillover variables into our model to control for the effects of various types of spillovers (due to the presence of exporters, foreign firms, users of licensed foreign technology, etc. in the same industry), but only the export spillovers variable has a significant impact on the likelihood of exporting. Actually, a one- standard-deviation increase in the output-share of exporters in the same 3-digit ISIC industry increases the likelihood of future exporting by 139%. When we analyze the effects of exporting activity by other plants in the same industry on the likelihood of future exporting, it turns out to be statistically significant only in the food and beverages (ISIC 31) and the clothing and textiles (ISIC 32) industry.

5 Conclusions

We analyzed the export participation decision of Turkish manufacturing plants during 1990-2001. Our results support the findings of previous contributions such as Roberts and Tybout (1997), Bernard and Jensen (2004), Bernard and Wagner (2001) and Campa (2004) on export decision: Even after the initial conditions correction a la Wooldridge (2005) our results show that Turkish manufacturing plants faced quite high sunk costs of entry to export markets. In addition to this finding which is consistent with the earlier literature, we also have several important contributions. First, we show that there are sunk re-entry costs to those plants that try to re-enter the export market a couple years after they quit the export market. The longer is the plant's past export market experience the higher its likelihood of exporting relative to a plant that has no prior export experience. Second, our formulation of the export decision equation that includes the interactions of the lagged dependent variable enables us to show that there are diminishing returns to export market experience. Last, but not the least, the more recent export market experience (at $t-1$) matters more for a plant's likelihood of export market participation than the export market experience further in the past (in our case, at $t-2$ or $t-3$) .

Aside from the past exporter status, several plant characteristics have crucial effect on export decision. First and perhaps foremost, plant size, measured by the employment level, matters for the export decision. As the size of plant increases the likelihood of being an exporter increases, but at a decreasing rate. Second, we use various measures of technological characteristics of plants to understand the relationship with export decision. First of these is the capital-labor ratio. Plants that use more capital-intensive technology have a higher likelihood of becoming an exporter. Furthermore, the higher is the imported share of machinery and equipment stock, the higher the likelihood of becoming an exporter. We are not able to find any support for the effect of foreign ownership and the use of licensed technology on export decision, at least for the period of our analysis, 1990-2001. Everything else being constant, the employment share of female employees is positively correlated with a plant's chances of export participation, while the share of administrative (white collar) workers has a negative correlation.

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Appendix

Table A.1: **Descriptive statistics for the manufacturing industry and ISIC 2-digit sectors (1990-2000)**

	All [a]	**ISIC 31**	**32**	**33**	**34**
Number of observations	46,674	6,388	15,092	1,463	1,767
Current year's export dummy	0.2782	0.2506	0.3324	0.1675	0.1681
Log (labor)	4.4834	4.4322	4.6311	4.2951	4.3382
Log (wage)	4.3494	4.3435	4.0624	4.0985	4.564
K/L ratio	3.509	3.4658	3.3655	3.1702	3.9428
Imported M&E share	0.1487	0.0845	0.2157	0.1081	0.2063
Export spillovers	0.4472	0.4164	0.4934	0.3755	0.282
Female employee share	0.2298	0.2045	0.3744	0.1381	0.1598
Technical employee share	0.1056	0.1028	0.079	0.0968	0.1427
		35	**36**	**37**	**38**
Number of observations		4,674	4,035	1,945	11,310
Current year's export dummy		0.3083	0.1556	0.3013	0.2804
Log (labor)		4.4324	4.3922	4.462	4.4195
Log (wage)		4.8017	4.3224	4.7517	4.488
K/L ratio		4.0276	3.3235	3.9142	3.4833
Imported M&E share		0.1549	0.0839	0.1063	0.1196
Export spillovers		0.3917	0.33	0.59	0.4781
Female employee share		0.1951	0.1086	0.0859	0.1564
Technical employee share		0.1293	0.1047	0.1097	0.1276

[a] Mean values for all observations for the period 1992-2001, as the lagged values of explanatory variables are used in the regressions.

Table A.2: **Random effects logit model of export participation (Manufacturing industry)**

	No interaction of lagged dependent var.		interaction of lagged dependent var.	
Explanatory variables	2-lags	3-lags	2-lags	3-lags
E_{t-1}	2.458**	2.432**	2.699**	2.823**
	[0.036]	[0.038]	[0.045]	[0.055]
E_{t-2}	0.953**	0.720**	1.259**	1.336**
	[0.036]	[0.042]	[0.050]	[0.079]
E_{t-3}	—	0.644**	—	1.110**
		[0.040]		[0.066]
$E_{t-1}E_{t-2}$	—	—	-0.565**	-0.874**
			[0.067]	[0.106]
$E_{t-1}E_{t-3}$	—	—	—	-0.778**
				[0.117]
$E_{t-2}E_{t-3}$	—	—	—	-0.853**
				[0.113]
$E_{t-1}E_{t-2}E_{t-3}$	—	—	—	1.068**
				[0.161]
	All plant characteristics listed below are as of t-1			
Log (labor)	1.239**	1.140**	1.186**	1.043**
	[0.131]	[0.135]	[0.130]	[0.133]
Log (labor) squared	-0.094**	-0.091**	-0.090**	-0.083**
	[0.013]	[0.013]	[0.013]	[0.013]
Log (wage)	0.028	-0.026	0.032	-0.019
	[0.026]	[0.027]	[0.025]	[0.027]
K/L ratio	0.155**	0.130**	0.150**	0.122**
	[0.014]	[0.015]	[0.014]	[0.014]
Imported M&E share	0.407**	0.392**	0.405**	0.394**
	[0.082]	[0.083]	[0.082]	[0.083]
Export Spillovers	0.479**	0.442**	0.471**	0.417**
	[0.099]	[0.105]	[0.099]	[0.105]
Female employees share	0.473**	0.366**	0.453**	0.328**
	[0.083]	[0.089]	[0.083]	[0.088]
Technical employees share	0.301+	0.251	0.296+	0.222
	[0.171]	[0.187]	[0.171]	[0.187]
Log likelihood	-16,831	-13,377	-16,796	-13,310
Number of obs.	46,674	36,776	46,674	36,776

Table A.3: **Random effects logit model of export participation with initial conditions correction a la Wooldridge (Manufacturing industry)**

	No interaction of lagged dependent var.		interaction of lagged dependent var.	
Explanatory variables	2-lags	3-lags	2-lags	3-lags
E_{t-1}	2.157**	2.235**	2.371**	2.617**
	[0.038]	[0.041]	[0.049]	[0.060]
E_{t-2}	0.562**	0.525**	0.826**	1.119**
	[0.040]	[0.045]	[0.055]	[0.085]
E_{t-3}	—	0.372**	—	0.824**
		[0.045]		[0.073]
$E_{t-1}E_{t-2}$	—	—	-0.481**	-0.827**
			[0.071]	[0.111]
$E_{t-1}E_{t-3}$	—	—	—	-0.729**
				[0.123]
$E_{t-2}E_{t-3}$	—	—	—	-0.809**
				[0.119]
$E_{t-1}E_{t-2}E_{t-3}$	—	—	—	1.002**
				[0.170]
	Initial values of export indicators			
E_0	0.435**	0.221**	0.436**	0.222**
	[0.052]	[0.052]	[0.051]	[0.051]
E_1	0.706**	0.322**	0.674**	0.291**
	[0.054]	[0.055]	[0.054]	[0.054]
E_2	—	0.368**	—	0.340**
		[0.054]		[0.054]
	All plant characteristics listed below are as of t-1			
Log (labor)	1.179**	1.241**	1.137**	1.149**
	[0.276]	[0.305]	[0.276]	[0.304]
Log (labor) squared	-0.123**	-0.130**	-0.120**	-0.123**
	[0.027]	[0.030]	[0.027]	[0.030]
Log (wage)	0.036	0.036	0.034	0.031
	[0.042]	[0.046]	[0.042]	[0.046]
K/L ratio	-0.170**	-0.189**	-0.175**	-0.204**
	[0.066]	[0.072]	[0.066]	[0.073]
Imported M&E share	0.312	0.453	0.303	0.445
	[0.299]	[0.327]	[0.298]	[0.326]
Export Spillovers	0.454**	0.445**	0.450**	0.426**
	[0.107]	[0.113]	[0.107]	[0.113]
Female employee share	0.133	0.228	0.143	0.223
	[0.153]	[0.167]	[0.153]	[0.167]
Technical employee share	0.286	0.316	0.281	0.276
	[0.236]	[0.261]	[0.236]	[0.261]
Log likelihood	-16,605	-13275	-16,582	-13,222
Number of obs.	46,674	36776	36,776	36,776

Table A.4: **Random effects Probit model of export participation decision with and without initial conditions correction a la Wooldridge (Manufacturing industry)**

	Wooldridge Initial conditions correction	
	without	with
E_{t-1}	1.564**	1.345**
	[0.027]	[0.030]
E_{t-2}	0.695**	0.434**
	[0.029]	[0.032]
E_{t-1} E_{t-2}	-0.274**	-0.222**
	[0.039]	[0.041]
Initial values of export indicators		
E_0	–	0.256**
		[0.030]
E_1	–	0.409**
		[0.033]
Plant characteristics as of t-1		
Log (labor)	0.664**	0.646**
	[0.071]	[0.152]
Log (labor) squared	-0.050**	-0.067**
	[0.007]	[0.015]
Log (wage)	0.014	0.023
	[0.014]	[0.023]
K/L ratio	0.083**	-0.089*
	[0.008]	[0.036]
Imported M&E share	0.227**	0.188
	[0.045]	[0.167]
Export spillovers	0.267**	0.261**
	[0.054]	[0.060]
Female employee share	0.260**	0.073
	[0.045]	[0.085]
Technical employee share	0.154	0.137
	[0.094]	[0.131]
Log likelihood	-16760.7	-16533.4
Number of obs.	46674	46674

Table A.5: **Predicted probability of exporting - Random effects logit model with initial conditions correction a la Wooldridge**

		Export History E_{t-1} E_{t-2} E_{t-3}							
Industry	**All**	**111**	**110**	**101**	**011**	**100**	**010**	**001**	**000**
3	0.279	0.799	0.685	0.678	0.320	0.563	0.242	0.218	0.065
311	0.261	0.800	0.681	0.668	0.668	0.569	0.234	0.198	0.063
312	0.163	0.779	0.651	0.641	0.641	0.533	0.205	0.182	0.055
313	0.307	0.844	0.735	0.763	0.763	0.654	0.300	0.265	0.084
321	0.309	0.827	0.722	0.701	0.701	0.610	0.271	0.232	0.075
322	0.342	0.806	0.695	0.669	0.669	0.573	0.242	0.207	0.066
323	0.322	0.846	0.746	0.729	0.729	0.643	0.297	0.262	0.084
324	0.240	0.781	0.665	0.637	0.637	0.533	0.208	0.187	0.057
331	0.171	0.756	0.621	0.629	0.629	0.510	0.185	0.165	0.049
332	0.171	0.765	0.627	0.636	0.636	0.520	0.216	0.168	0.052
341	0.262	0.821	0.707	0.703	0.703	0.609	0.246	0.219	0.071
342	0.114	0.746	0.599	0.607	0.607	0.503	0.178	0.154	0.047
351	0.417	0.841	0.742	0.728	0.728	0.630	0.290	0.251	0.083
352	0.321	0.833	0.728	0.717	0.717	0.619	0.278	0.239	0.077
354	0.171	0.786	0.671	na	na	0.543	0.233	0.207	0.057
355	0.266	0.816	0.711	0.672	0.672	0.600	0.257	0.223	0.069
356	0.329	0.842	0.747	0.724	0.724	0.634	0.290	0.248	0.083
361	0.458	0.871	0.778	0.775	0.775	0.695	0.361	0.289	0.103
362	0.443	0.839	0.752	0.709	0.709	0.645	0.287	0.241	0.082
369	0.093	0.691	0.537	0.495	0.495	0.414	0.144	0.119	0.035
371	0.309	0.818	0.711	0.696	0.696	0.591	0.263	0.212	0.070
372	0.269	0.841	0.724	0.686	0.686	0.608	0.286	0.238	0.079
381	0.250	0.811	0.703	0.669	0.669	0.580	0.250	0.209	0.067
382	0.290	0.827	0.718	0.704	0.704	0.609	0.265	0.230	0.075
383	0.326	0.844	0.744	0.741	0.741	0.635	0.297	0.252	0.083
384	0.343	0.841	0.746	0.718	0.718	0.634	0.285	0.248	0.082
385	0.318	0.821	0.719	0.693	0.693	0.602	0.262	0.232	0.072
min	0.093	0.691	0.537	0.495	0.495	0.414	0.144	0.119	0.035
max	0.458	0.871	0.778	0.775	0.775	0.695	0.361	0.289	0.103

Table A.6: **Predicted probability of exporting over time (Wooldridge)**

	Export History E_{t-1} E_{t-2} E_{t-3}							
Year	**111**	**110**	**101**	**011**	**100**	**010**	**001**	**000**
1993	0.829	0.748	0.674	0.305	0.595	0.228	0.185	0.058
1994	0.841	0.712	0.680	0.367	0.570	0.278	0.214	0.064
1995	0.855	0.727	0.737	0.381	0.607	0.265	0.287	0.074
1996	0.767	0.611	0.628	0.279	0.488	0.194	0.179	0.048
1997	0.771	0.637	0.633	0.269	0.540	0.210	0.187	0.053
1998	0.820	0.722	0.734	0.335	0.635	0.292	0.238	0.078
1999	0.755	0.669	–	0.310	0.535	0.246	0.199	0.060
2000	0.791	0.680	0.691	0.334	0.587	0.248	0.262	0.074
2001	0.781	0.670	0.675	0.305	0.557	0.257	0.224	0.073