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Does Innovativeness Matter for International Competitiveness in Developing Countries? The Case of Turkish Manufacturing Industries

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I. Introduction

The accumulation of the studies that have tried to link the export performance of economic units (be they countries, industries or firms) with their technological orientation has basically generated a wide-spread emphasis on the role of technology in developed countries. As a matter of course, being developed and technological superiority have for long been the two sides of the same coin. Relative fewness of the studies, in this regard, which deal with the less-developed economies must not be surprising. Nevertheless, construction of a rationale for investigating the interactions between exporta and technology in technologically backward countries may also be fruitful in terms of a better determination of relevant strategies. Indeed, a perspective directed towards the differences among the successful and unsuccessful country-specific strategies for improving international competitivenes may help one to distinguish between the correct and ill-adsvised policy options. It is the contention of this paper to show, in the context of the Turkish experience, that neither less-developedness nor inadequacy in international competitiveness can be escaped from via mere recourse to ready-made policies of export subsidies or real devaluations. From this viewpoint, searching for alternative strategies seems inevitable. Technology, as a genuine lever required to raise living standards, may well be the key to improving international competitiveness. Subject-matter of this study is, thus, an inquiry into the seemingly closed doors that could be opened by this key.

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The following section II not only elaborates on the course of the alternative treatments of the technology factor by the variants of the theory of international trade, but also sets forth industrial organizational bases for firm-level studies in this context. It is in section III where the empirical literature that investigates the role of technology in inter-firm variations of export performance is concisely surveyed. Turkey's initially successful yet eventually retrogressive export-led growth strategy during the 1980s is discussed in part IV.1 to pave the way for drawing attention to substantially neglected formation of gross fixed capital and lack of a political conscience as to the significance of a national technology policy. Part IV.2 describes the data set, the model and the method to be utilized for empirical analysis. Firm-level and sectoral descriptive statistics are summed up in part IV.3. Determinants of the export intensity of Turkish firms with an emphasis on the technology factor are interpreted in part V.1. Innovator and non-innovator firms are compared and contrasted in part V.2. The paper runs its course with a set of concluding remarks in section VI, which also embodies a few bits of policy recommendation.

II. Evolution of the Theory of International Trade: Attitudes towards the Technology Factor and the Schumpeterian Viewpoint as a Rationale for Firm-Level Studies

That the traditional theory of international trade has basically two variants is quite a common knowledge. The Ricardian (classical) and the Heckscher-Ohlin (neoclassical) approaches are indeed indispensable overtures to be found in any standard text-book on international economics. Interestingly, the most salient difference between the text-book versions of these traditional trade theories lies in their respective treatments of the technology factor in the context of international specialization and trade patterns. In the Ricardian approach, relative (labor) productivity differentials (and thus "technological differences" in a sense) are alone able to generate a basis for trade across countries. On the contrary, the Heckscher-Ohlin approach assumes identical production functions for the same commodities over the world (and thus rules out the possibility of technological differences across countries), and explains the basis for trade solely in terms of differences in relative factor endowments. In this respect, it is no surprise to detect a kind of bifurcation within the early empirical trade studies: Either a classical or a neoclassical model was assumed to be the correct theoretical framework, and accordingly either relative labor productivities or relative capital-to-employee ratios served as relevant explanatory variables (Kellman and Spiegel, 1980: 27).

Despite their difference as such, both the classical and neoclassical trade theories are, in fact, in tune with each other on the motto that it is the *comparative cost advantages* that determine the trade patterns across countries. In other words, even though they part company with each other on the issue of what generates competitiveness differentials, both approaches, in the final analysis, rely on the notion of *cost-* or *price-competitiveness* in explaining trade patterns. Nevertheless, with their rigorously specified yet fictitious assumptions, and basically due to their reductionist flavor and *static* framework, the classical approach *mistreats* the technology factor, whereas the neoclassical theory simply *distreats* it.

Ricardian and Heckscher-Ohlin frameworks are essentially *static* in that the classical world is characterized by a *fixed* level of technology for each country (though it may be differential across countries), whereas the neoclassical world consists of countries with *fixed* levels of factors of production and *identical* technologies. Hence, neither of the theories deals with the *dynamics* of the creation of comparative advantages and the question of how comparative advantages may change over time. Namely, the classical approach has nothing to say as to what generates labor productivity differentials, whereas the neoclassical theory, by assumption and construction, pays attention to neither the potential differences in technological capabilities nor the possibility and determinants of changes in relative factor endowments. In both frameworks, every country, specializing in accordance with its comparative advantage (be it generated through differences in relative labor productivities or relative factor endowments), can easily be shown to be better off since trade makes it possible to consume at unattainable levels of *autarky*. Within these static contexts, international competitiveness ceases to be a point in question as every country can always find something that is worthwhile to produce and trade. Nevertheless:

> As is frequently observed, it matters a great deal today whether a country specializes in the production of potato chips or micro chips. According to conventional trade theory, however, this choice does not really matter (Haque, 1995: 22).

In this respect, apart from the classical and neoclassical approaches, the evolution of international trade theory has witnessed extensions as well as alternative expositions. The so-called neofactor and neotechnological trade theories are the two prominent cases.

The variants of the neofactor theory, which basically emerged as a reaction to the well-known Leontief paradox, had their basic contributions in distinguishing between qualified labor, i.e. human capital, and unskilled labor and in including " 'knowledge' as an endowment to the economy, which could be used as an input to the production process along with labor and capital, while maintaining the assumption of a common production function across countries" (Wakelin, 1997: 11-13). The fact that knowledge can be generated through R&D (the expected resultant of which is innovation) served as a source of inspiration for several studies, in which an emphasis on the importance of innovation was made in explaining trade patterns that were basically determined by comparative advantages in knowledge-intensive commodities. Such studies dealt primarily with US's trade patterns, and were, to a certain extent, successful in establishing significant causalities that ran from R&D expenditures (and human capital) to the composition of trade flows. For instance, Gruber et al. (1967), Keesing (1967), Baldwin (1971), Branson (1971), Lowinger (1975), Stern and Maskus (1981), and Sveikaukus (1983) revealed the significantly positive impact of R&D efforts on US's commodity trade. Similar results were obtained by Hughes (1986) for the UK and Vestal (1989) for Japan.

Despite the seeming success of the neofactor theory in explaining trade patterns through basically the inclusion of explanatory variables of human capital and innovation, its inappropriate treatments of physical and human capital and technological factors (knowledge creation and R&D activities in particular) as static endowments makes it vulnerable to criticisms relying on the dynamic nature of these factors. From this viewpoint, the neofactor theory is considered no more than an approach that merely increases the number of fixed endowments postulated to explain trade patterns. Getting rid of the static world, however, is a matter of constructing a dynamic theory of trade with an eye to the development and spread of technology as well as to the generation of resources. Indeed, the neotechnological theories of trade are different from the neo-endowment approaches in that, in the former, "it is the role of innovation in creating new markets and conferring cost advantages on the innovating nation, which is emphasized" (Wakelin, 1997: 15).

The neotechnological theories of international trade basically originates from Posner's (1961) technological-gap theory (TGT) and Vernon's (1966) product life cycle theory (PLCT), both of which rely on varying production functions for the same commodities across countries. In the TGT, a product innovation provides the innovating domestic firm(s) with a temporary monopoly power in home and export markets. Profits earned by the innovator above "normal" levels, however, lead to imitation on the part of foreign firms, which *eventually* develop comparative advantages in the new commodity. In this way, the imitation lag under consideration is suggestive of technological gaps across countries on the basis of the difference in innovative capabilities. The PLCT, on the other side, represents a step forward with respect to the TGT. The life cycle of a typical new product is divided into three consequent stages: i) *The new product stage* during which the need for qualified labor and intensive R&D activities reflect the dominat costs, ii) *The maturing product stage* characterized by dominant marketing and capital costs, and iii) *The standardized product stage* as distinguished by mass production that primarily uses raw materials and unqualified labor. In short, the PLCT predicts (in contrast to the strong factor intensity assumption of the factor-endowment theories) that a new product will have varying relative input requirements over its life cycle. "Accordingly, as the product matures and becomes standardized, comparative advantage may shift from a country relatively abundant in skilled labor to a country abundant in unskilled labor" (Chacoliades, 1990: 107-8). In this regard, the PLCT entails a static as well as a dynamic implication, both of which are consistent with the TGT. One the one (static) hand, "countries with a high technological capacity produce technology-intensive goods"; on the other (dynamic) hand, "technology intensity of goods decreases over time as they become standardized" (Wakelin, 1997: 17). As can be noticed, the dynamic component of these neotechnological theories of trade basically relies on the changing input requirements of *products* rather than on the changing levels of *technology* across countries. Hence, these theories may be interpreted in such a way that the dynamism referring to products may collapse into a still-static implication in terms of technical stability (Walker, 1979). Technologically capable and relatively innovative countries will continuously have a comparative advantage in new products, and a comparative disadvantage in standardized ones. Consequently, technologically advanced countries will constantly tend to export new products and import standardized ones over time, leaving no potential dynamics of catching-up through learning-by-innovating on the part of technologically-backward countries. In this respect, product dynamism, rather than truly technological dynamism, yields another case for "the insufficient treatment of technology", which can yet be tempered by the inclusion of the essentials of the Schumpeterian analysis on competitiveness (Wakelin, 1997: 19).

Schumpeter's seminal attitude, in this respect, may be regarded as a case of blending two crucial concepts: C*ompetitiveness* and *innovativeness.* His emphasis on a dynamic *competition for innovation* in lieu of the static price-competitiveness is worthwhile to copy-and-paste:

> The first thing to go is the traditional conception of the *modus operandi* of competition. Economists are at long last emerging from the stage in which price competition was all they saw. As soon as quality competition and sales effort are admitted into the sacred precincts of theory, the price variable is ousted from its dominant position. . . . [I]n capitalist reality as distinguished from its textbook picture, it is not that kind of competition which counts but the competition from *the new commodity, the new technology, the new source of supply, the new type of organization* . . . This kind of competition is as much more effective than the other as a bombardment is in comparison with forcing a door, and so much more important that it becomes a matter of comparative indifference whether competition in the ordinary sense functions more or less promptly; the powerful lever that in the long run expands output and brings down prices is in any case made of other stuff (Schumpeter, 1942: 84-85, emphases added).

In this connection, basic unit of analysis in the Schumpeterian view is the capitalist business enterprise since the innovation activity as the single most important determinant of competitiveness is basically carried out at the firm-level. Innovation requires substantial R&D layouts, which, in turn, necessitate the existence of relatively large firms in a particularly innovative industry. In other words, Schumpeter draws attention to the importance of monopolistic and oligopolistic market structures in creating innovative capabilities that yield competitive edges, which is in sharp contrast with the perfectly competitive and atomistic firms of the conventional theory. Indeed, in the context of the conventional theory, there is no reason to delve into the determinants of either domestic or international competitiveness at the firm-level:

> Its assumptions of perfect competition and perfect foresight - which imply, in turn, equal access to factors of production (including technology and skills), the lack of product differentiation and scale economies and the absence of risk (or equal capabilities of firms to bear risk) - ensure that all the productive units in an industry will exhibit identical competitive advantages abroad (Lall and Kumar, 1981: 453).

In contrast, however, the neo-Scumpeterian conception of competitiveness relies on the evolutionary aspects of innovation as a microeconomic process identified by "search for knowledge and techniques, and the cumulative nature of technological change", in which case "most innovations are incremental improvements on existing innovations based on past experience" and "are frequently specific to the firm, and based on firm-level skills and learning" (Wakelin, 1997: 20). Indeed, at the level of the firm, not only the allocation of resources to innovation and innovative strategies are decided upon, but also benefits of innovation are reaped in terms of cost reductions, new markets and potential monopoly rents (Wakelin, 1998: 830). Moreover, the market imperfections pertaining to the monopolistic or oligolopolistic structures, as also emphasized by the Schumpeterian accounts of competitiveness, provide another supplementary rationale for investigating into the inter-firm differences in export performance. This is basically because of the fact that "in an imperfect world (with differential access to factor markets, different technological capabilities, different rates of skill creation 'on the job', different information about final markets and different entrepreneurial and organizational capabilities), different firms from a given industry are apt to exhibit markedly varying success in international markets" (Lall and Kumar, 1981: 453).

III. A Survey of Firm-Level Studies on the Determinants of Export Performance with an Emphasis on Technology Factor

Relatively recent studies that try to link the export performance of firms with their technological orientation have adopted a number of measures and proxies for the degree of success in foreign trade and the inclination to innovative behavior. For instance, a variety of export performance measures has been regressed, via several econometric techniques, on such technology-related determinants as R&D-to-sales ratio, R&D dummies taking the value of one if the firm has proved to be an R&D performer, formal R&D expenditures, value of the royalty and licensing fees abroad, the percentage of equity held by foreign firms (as a measure of access to technology via direct foreign investment), dummies that distinguish between the producers of capital goods and of other goods, labor and capital productivities, skill- and capital-intensity of operations, imports of technology, number of innovations used or produced in the industries in which the firms-in-question are located, etc.

The causality postulated to run from technological factors to export performance has usually been verified. Indeed, the studies in general have been successful in demonstrating that there exist major exporters who relate their R&D activity more to exporting over time (Lall and Kumar, 1981), that the propensity-to-export of firms engaged in R&D tends to be higher than that of the entire branch to which they belong (Hirsch and Bijaoui, 1985), that the variation in export sales are well explained by the variations in R&D-to-sales ratio (Hirsch et al., 1988), that exporting firms have higher labor productivities (Abd-el-Rahman, 1991), that the technology factor is quite crucial in explaining the export behavior of firms in medium and low technology industries (and not in high-tech ones) especially in the case of developing countries (Kumar and Siddarthan, 1994), and that innovating and non-innovating firms behave differently both in terms of the probability of exporting and the level of exports implying that the capacity to innovate fundamentally affects the export performance of firms (Wakelin, 1998). In this respect, an interesting study on some Indian engineering and chemical firms reveals the significance of firm-specific determinants of export performance with the conclusion that product-centered R&D in engineering has a negative impact on international competitiveness, and that process-centered R&D in chemicals, while not taking India to world standards of efficiency, does not constitute a handicap in terms of product quality and design characteristics (Lall, 1986). Another study on Italian manufacturing firms not only reveals the important impact of R&D activities on export performance, but also yields that product innovations are more contributive in the case of small firms, whereas process innovations enhance the exports of medium-sized and large firms (Sterlacchini, 2001). On the other side, the cruciality of technical collaborations and indigeneous R&D efforts and yet the negative impact of capital intensity on the export performance of the firms (in the Indian automobile industry) have also been evidenced (Bhat and Sethuraman, 1995). In addition, it has also been shown that not only the influence of R&D on both export propensity and growth is significantly positive, but also there exist reciprocal relationships between R&D and exports (Zhao and Lin, 1997).

In this respect and as a matter of fact, an inquiry into the possibility of a causality in the opposite direction (i.e., from exporting behavior towards technological improvement) is a *desideratum* to be found in a study such as this. The so-called "learning-by-exporting" literature has indeed developed in this context. The idea that export-oriented policies may well expand technological frontiers (especially in the case of developing countries) provides a rationale for this domain of research. For instance, Dahlman and Westphal (1982) provide evidence that Korean firms were able to generate improvements in product quality and design as well as in productivity thanks to participating in exporting activity. Kırım (1990), in a case study of 659 largest Turkish manufacturing firms, argues that the attempt of export-led growth during the 1980s had significant impacts on the direction of in-house technological change, albeit not on the rate of R&D. All the same, while admitting the importance of the possibility of an opposite, or indeed a two-directional, causality, we would still rather confine the scope of this study to a framework of *exporting-by-learning*. Investigating, on the one hand, whether exporter firms are more efficient than their domestic non-exporter counterparts, Clerides *et al*. (1996), on the other, inquire into whether exporting generates efficiency gains. Relying on this firm-level panel-data study, which finds that more innovative firms become exporters and not *vice versa*, we are to be content with the present framework at least for the time being. Our cross-sectional data at hand comes from the only available innovation survey conducted for the first time at the end of 1998. In this regard, with the accumulation of new data through prospective surveys in the near future, a time-series dimension may also be available, in which case dealing with two-directional causalities as such may be feasible.

Finally, even though the inclusion of technology (as a potent determinant of export performance) into any model of international competitiveness is inevitable, it alone cannot account for the entirety of inter-firm variations. Indeed, any such model is to incorporate some other explanatory variables, whereby a theoretically wide comprehension can help improve the empirical results. This, in turn, necessitates an elaboration within the discipline of industrial organization with an eye to international economics. Therefore, one of the most inextricable tasks in front of an empirical researcher is to take into account such factors as *firm size, industrial concentration, product differentiation, unit labor costs, wages, markups, profitability, expenditures on advertising, etc.* as other possible determinants of export performance, which have usually shown up as significant regressors in the respective literature (Glejser et al., 1980; Lall and Kumar, 1981; Hirsch and Bijaoui, 1985; Lall, 1986; Hirsch et al., 1988; Abd-el-Rahman, 1991; Kumar and Siddarthan, 1994; Bhat and Sethuraman, 1995; Zhao and Li, 1997; Wakelin, 1998).

IV. Technological and International Competitiveness of the Turkish Manufacturing Industry

1. Background

In 1960s and 1970s, Turkey adopted an import substitution industrialization strategy, which was able to generate a process of rapid yet unsustainable economic growth. A balance-of-payments crisis towards the end of 1970s led the Turkish economy to implement a stabilization and structurtal adjustment program, the essence of which turned out to be an export-led growth strategy in the 1980s. The ready-made tools were plentiful export subsidies *cum* incessant real devaluations. In 1983, export incentives came up to 36 percent of the export revenue (Uygur, 1991), and from 1979 to 1984 Turkish lira was devalued agaist USD by 100 percent in real terms. The consequence was an export boom in the period under consideration. The boom-in-question, however, was achieved at the expense real wages. Indeed, the real wage rates (deflated by the consumer price index) could not catch up with their 1978 levels before the early 1990s (Taymaz, 1999).

The dramatic real wage deterioration created as such was accompanied by a non-increasing gross fixed capital formation (GFCF) in manufacturing during the 1980s. This was seemingly controversial a phenomenon since it was the manufacturing industry that led the others in the process of the export boom. Nevertheless, Dani Rodrik explains the situation within a comparative study on the differences between the export-led growth strategies of South Korea and Taiwan on the one hand and Turkey and Chile on the other:

> [M]odest export booms in Turkey and Chile in the 1980s have required cumulative exchange rate depreciations contemporaneously of the order of 100 percent, a change in relative prices vastly in excess of anything observed in East Asia (Rodrik, 1995: 2).

The two East Asian countries in question were indeed able to blend export-orientation with successful investment and technology strategies, whereas Turkey and Chile solely relied on devaluations and export incentives without any significant efforts to feed up the infrastructure.

In this regard, it is quite convincing a contention that "one way of differentiating competitively strong and weak countries is by the methods they adopt to gain the competitive edge - productivity increases or reduced wages" (Haque, 1995:23). While the former method, by and large, necessitates a search for technological development in the form of R&D activities (as implemented by South Korea and Taiwan, “Asian tigers” as of now); the latter may, for instance, be accomplished through a real devaluation of the currency (as ready-made a tool embraced by Turkey and Chile). So, it turns out that genuine international competitiveness is a matter of *innovativeness*, and has little to do with cost-reductions-via-devaluations (or by way of artificial incentives, like export subsidies, for that matter).

It is in the light of a few paragraphs above we intend to inquire into whether technological efforts of Turkish manufacturing firms are conducive to their export performance. With a weak “national system of innovation” and a neglibily small share of R&D expenditures in GNP, Turkey is an interesting case of analysis since she has a *relatively* dynamic and productive manufacturing industry, the significance of which in long-term growth and international competitiveness is indisputable. If individual technological efforts of manufacturing firms could be somewhat shown to play a role in enhancing export intensities, much higher benefits to be reaped under a well-established syetem of innovation would also be demonstrated to be rather likely. Perhaps, it is in this way that the conventional ready-made attitudes towards policy-making can be entirely replaced by a technology-centered public conscience.

2. The Data Set and the Model

The main data set of this study comes from the *Innovation Survey* that was conducted the first time by the State Institute of Statistics (SIS) in 1998. The survey covers the innovation activities of firms in the period 1995-97, adopts a questionnaire compatible with the Community Innovation Survey of the European Union, and uses the concept of "innovation" as defined in the *Oslo Manual*. A sample of about 4000 firms stratified by size and industry category was asked to complete the questionnaire. The response rate was about 55 percent. The SIS performed a non-response analysis and estimated sample weights for each respondent. The innovation database was matched with the 1995-97 data from the *Annual Survey of Manufacturing Industries* as a part of the *National System of Innovation Project* (for details, see Taymaz, 2001). The econometric analysis reported in this paper was conducted as a background study for this project.

Export intensity equations are estimated to find out the determinants of export performance. In this respect, it is obvious that the whole sample consists of many firms that do not export at all. Hence, the dependent variable assumes the value of zero for non-exporter firms, along with necessarily positive values for the exporters. Such being the case, the most appropriate way of obtaining unbiased and consistent estimators is the so-called Tobit estimation procedure, which is thus utilized to obtain the inferential results in section V. A list of explanatory variables and their definitions are below.

PRODUCT: A dummy variable that is equal to one if the firm reported to have materialized any product innovation, zero otherwise.

PROCESS: A dummy variable that is equal to one if the firm reported to have materialized any process innovation, zero otherwise.

RDINT: R&D intensity (R&D expenditures / sales).

SIZE: A measure of the size of the firm in terms of the number of employees.

SIZE X+: A dummy variable that is equal to one if the firm employs X or more employees, zero otherwise.

CAPINT: Capital intensity or capital-to-labor ratio proxied by log(depreciation allowances/number of employees).

TECHTRAN: A dummy variable that is equal to one if the firm acquired technology through license or know-how agreements, zero otherwise.

WAGE: Logarithm of the real wages.

PRIVATE: Share of private (national) ownership.

FOREIGN: Share of foreign ownership.

ADVERINT: Advertisement intensity (advertisement expenditures / sales).

SUBINPUT: Share of inputs subcontracted to suppliers.

SUBOUT: Share of output subcontracted by customers.

ADMINSH: Share of administrative personnel in all employees.

TECHSH: Share of technical personnel in all employees.

FEMALESH: Share of female personnel in all employees.

RDINTUS: R&D intensity of the US manufacturing industries at the ISIC 4-digit level (as a proxy for R&D intensity of the rest of the world).

REGINN: Sum of the average intensity of product and process innovations in the region (province) where the firm is located.

HI: The conventional Herfindahl index at the ISIC 4-digit level as a measure of concentration in the sector where the firm is operating.

LPDIFF: A measure of product differentiation at the ISIC 4-digit level.

LAGE: Logarithm of the age of the firm with respect to the year 1998.

HOLDING: A dummy variable for those firms which are members of a holding group.

Table 1: *Variable definitions and descriptive statistics for all firms, innovators and non-innovators - Weighted means*

Label	Description	All firms	Innovators	Non-innovators
EXPINT	Export/sales ratio	0.13	0.17	0.12
PRODUCT	Product innovator	0.15	0.64	0.00
PROCESS	Process innovator	0.18	0.80	0.00
RDINT/10^{-2}	RD expenditures/sales ratio	0. 17	0.70	0.007
SIZE	Number of employees	114	191	90
CAPINT	(ln) depreciation allowances/employees	-0.27	0.44	-0.51
TECHTRAN	Technology transfer dummy	0.04	0.07	0.02
WAGE	(ln) real wage rate	1.97	2.51	1.79
PRIVATE	Share of private ownership	0.92	0.93	0.92
FOREIGN	Share of foreign ownership	0.02	0.03	0.01
ADVERINT	Advertisement expenditures/sales ratio	0.01	0.01	0.00
SUBINPUT	Share of subcontracted inputs	0.04	0.03	0.04
SUBOUT	Share of subcontracted output	0.07	0.04	0.08
ADMINSH	Share of administrative employees	0.20	0.21	0.20
TECHSH	Share of technicians	0.06	0.07	0.06
FEMALESH	Share of female employees	0.22	0.16	0.23
REGINN	Regional innovation intensity	0.33	0.37	0.32
HI	Herfindahl index	0.05	0.06	0.05
LPDIFF	(ln) product differentiation	3.48	3.53	3.47
LAGE	(ln) age of the firm	0.89	0.96	0.87
HOLDING	Dummy variable for holding members	0.08	0.13	0.06

Source: SIS, *Innovation Survey, 1995-97*

3. Descriptive Statistics

Since our focus of attention is inter-firm variations, descriptive statistics at the firm-level are rather informative before the inferential analysis to be carried out in the next section. Means and standard deviations of the variables are provided in Table 1 for the whole sample (all firms), the firms that reported to have materialized product and/or process innovations (innovators), and the ones without innovations (non-innovators). All statistics are weighted by sample factor weights.

Export intensity at the firm level is slightly higher for innovators (17 percent) than for non-innovators (12 percent). The difference between innovators and non-innovators is quite obvious so far as their size is concerned (191 versus 90 employees on the average, respectively). The well-known Schumpeterian hypothesis, in this regard, seems to be descriptively supported. Interpretation of the capital intensity variable is also potentially interesting: Innovators use capital intensive production techniques, while non-innovators rely, by and large, on labor rather than capital. As expected, technology transfer is practised more commonly by the innovators than by non-innovators (7 percent versus 2 percent, respectively). This may indicate that technology transfer and innovativeness are complements. Logarithm of real wage is 2.51 in innovator firms, and 1.79 in non-innovators; a seemingly trivial difference. Yet, taking the antilogarithm of these values yields 12.3 and 5.99, respectively, as real wages on the average, which in turn is indicative of a discernible difference between the wages paid by the innovators and non-innovators. Private and foreign ownership of the firms, intensity of advertisements, subcontracted input and output shares, as well as the shares of administrative, technical and female personnels in total employment do not seem to differ between the innovators and non-innovators; yet, they may still play significant roles in the determination of the inter-firm variations in export intensity. Furthermore, neither the concentration levels of the firms in the respective industries nor their efforts to differentiate products exhibit a difference between innovators and non-innovators. Finally, on the one hand, innovator firms seem to be slightly older, and thus more resistant to competitive forces, than non-innovators. On the other hand, being a member of a business group (holding) is twice more commonly experienced by the innovators than by non-innovators (13 percent versus 6 percent). These two aspects are also supportive of the Schumpeterian view to some extent.

Table 2: Sample characteristics by industry - Weighted means

Variables	Industry (ISIC - Rev.2)								
	31	32	33	34	35	36	37	38	39
EXPINT	0.07	0.25	0.03	0.03	0.06	0.09	0.10	0.07	0.05
PRODUCT	0.08	0.10	0.20	0.18	0.35	0.17	0.15	0.21	0.16
PROCESS	0.15	0.14	0.09	0.19	0.25	0.29	0.31	0.25	0.22
RDINT/10^{-2}	0.04	0.10	0.02	0.002	0.25	0.80	0.08	0.30	0.03
SIZE	105	128	75	107	125	108	213	84	126
CAPINT	-0.36	-0.38	-0.91	0.53	0.31	0.01	0.04	-0.42	0.03
TECHTRAN	0.02	0.02	0.12	0.01	0.09	0.03	0.03	0.08	0.11
WAGE	2.38	1.42	1.73	2.78	3.10	1.94	2.48	2.13	2.75
HI	0.05	0.02	0.06	0.06	0.08	0.04	0.06	0.08	0.04
LAGE	0.95	0.82	0.87	1.00	0.97	0.93	0.97	0.89	0.85

Industry classification: 31 Food, 32 Textiles , 33 Wood, 34 Paper and printing , 35 Chemicals, 36 Non-metallic mineral products, 37 Metal, 38 Engineering, 39 Other

Insofar as our sample is concerned, some descriptive sectoral characteristics of the nine sub-sectors are to be found in Table 2. One of the most discernible difference is the relatively much higher average export intensity of the textile sector as compared to that of the rest. The average export intensity of the eight sectors, excluding the textiles, equals 6.25 percent, whereas the textile sector reports exports as 25 percent of its total sales. Interestingly however, the average of the percentage of firms that materialized product and process innovations is considerably low for textiles (12 percent); indeed, it is the second lowest value among the sub-sectors (11.5 percent in the food sector). Average percentage of innovators is the highest in the case of the manufacture of chemicals (30 percent), which in turn has a modest export intensity (6 percent). In the light of these facts, it is to be asserted that, *at the sectoral level*, innovativeness *per se* does not seem to necessarily contribute to the exports. Moreover, R&D intensities of all sectors are negligibly small. But it must be noted that the share of R&D in overall innovation expenditures is about 10-15 percent in Turkey. The average size of firms in the sectors is seemingly uncorrelated with export intensity. The capital intensity variable indicates that food, textiles, wood and engineering sectors are labor-intensive. The average export intensity of these labor intensive sectors equals 10.5 percent, whereas that comes up to only 6.6 percent for the remaining capital-intensive ones. This *sectoral* aspect, of course, is somewhat supportive of the factor-endowment theory since Turkey is most likely to be a labor-abundant country. Technology transfer dummy and export intensity seem to be independent from each other. When it comes to investigate the logarithm of real wages in the sectors, it is markedly the manufacture of chemicals (the leader in innovativeness) that pays the highest wages. The lowest wages, on the other side, are paid by textiles, the traditional export leader. These two descriptive aspects as to real wages somewhat confirm conventional *a priori* expectations. However, a firm-level analysis is required to understand important dynamics. The concentration, as measured by the Herfindahl index, does not seem to exhibit any significant difference across sectors; all the sectors do have considerably low levels of concentration. Similarly, the ages of the firms in the respective sectors are quite akin to each other.

Table 3: Determinants of export intensity, 1995-9
(Tobit estimation, weighted)

	All observations							
	Model 1		Model 2		Model 3		Model 4	
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
PRODUCT	0,042	1,134			0,044	1,180	0,147	3,510
PROCESS	0,076	2,240**			0,077	2,265**	0,157	4,083
RDINT			3,481	4,075**				
REGINN	0,175	1,806*	0,218	2,274**	0,179	1,838*		
SIZE 25+	0,145	2,529**	0,146	2,547**	0,144	2,509**		
SIZE 50+	0,190	6,245**	0,202	6,691**	0,190	6,295**		
SIZE 150+	0,053	1,248	0,058	1,346	0,059	1,388		
SIZE 250+	-0,036	-0,645	-0,032	-0,574	-0,038	-0,681		
SIZE 500+	0,084	1,470	0,090	1,576	0,087	1,518		
CAPINT	0,042	4,213**	0,045	4,569**	0,043	4,340**		
TECHTRAN	-0,013	-0,204	-0,018	-0,287	-0,004	-0,058		
WAGE	0,010	0,928	0,011	0,975	0,013	1,319		
PRIVATE	0,278	3,906**	0,293	4,143**	0,271	3,962**		
FOREIGN	0,806	6,125**	0,829	6,308**	0,794	6,335**		
ADVERINT	-2,007	-2,212**	-1,773	-1,973**	-2,019	-2,248**		
SUBINPUT	1,310	8,997**	1,300	8,944**	1,301	8,951**		
SUBOUT	-0,498	-5,506**	-0,506	-5,575**	-0,500	-5,522**		
ADMINSH	-0,188	-1,749*	-0,195	-1,825*	-0,191	-1,787*		
TECHSH	-0,531	-3,689**	-0,524	-3,676**	-0,532	-3,698**		
FEMALESH	0,398	6,023**	0,415	6,274**	0,395	5,978**		
RDINTUS	-0,463	-0,713	-0,511	-0,789	-0,277	-0,438		
HI	0,343	1,310	0,327	1,246				
LPDIFF	0,007	0,346	0,006	0,279				
LAGE	0,032	0,658	0,052	1,067				
HOLDING	0,019	0,435	0,023	0,515				
Marginal effect on export intensity conditional on being an exporter								
PRODUCT	0,019				0,019		0,065	
PROCESS	0,033				0,034		0,069	
RDINT			1,533					
Marginal effect on probability of being an exporter								
PRODUCT	0,040				0,042		0,118	
PROCESS	0,072				0,073		0,125	
RDINT			3,298					
Pseudo R^2	30,0		30,2		29,9		10,5	
log likelihood	-779,5		-776,4		-780,6		-995,5	
LR χ^2	666,5**		672,7**		664,2**		234,4**	
Df	32		31		28		10	
N observations	1512		1512		1512		1512	
N exporters	964		964		964		964	

** (*) means statistically significant at the 5% (10%) level, two-tailed test.
All models include sectoral dummy variables at the ISIC 2-digit level.

Table 3: Continued

	Innovators only				Non-innovators only	
	Model 5		Model 6		Model 7	
	Coeff	t-stat	Coeff	t-stat	Coeff	t-stat
PRODUCT	0,013	0,424				
PROCESS	0,051	1,676*				
RDINT			2,532	4,948**		
REGINN	-0,040	-0,488	0,001	0,010	0,221	1,306
SIZE 25+	0,213	2,051**	0,241	2,246**	0,129	1,605*
SIZE 50+	0,071	2,181**	0,094	2,908**	0,234	4,939**
SIZE 150+	0,072	1,817*	0,081	2,044**	0,062	0,894
SIZE 250+	0,019	0,400	0,015	0,315	-0,088	-0,922
SIZE 500+	-0,004	-0,096	-0,001	-0,033	0,169	1,663*
CAPINT	0,043	4,057**	0,045	4,223**	0,038	2,525**
TECHTRAN	0,036	0,714	0,025	0,498	0,031	0,276
WAGE	0,007	0,792	0,007	0,808	0,015	0,720
PRIVATE	0,167	2,164**	0,152	2,000**	0,322	2,891**
FOREIGN	0,165	1,320	0,152	1,230	1,297	5,860**
ADVERINT	-1,730	-2,557**	-1,735	-2,612**	-1,982	-1,133
SUBINPUT	1,003	5,776**	1,015	6,012**	1,304	5,965**
SUBOUT	-0,560	-5,111**	-0,542	-4,928**	-0,498	-3,744**
ADMINSH	-0,262	-2,372**	-0,257	-2,359**	-0,123	-0,738
TECHSH	0,243	1,571	0,247	1,627*	-0,813	-3,198**
FEMALESH	0,546	6,704**	0,615	7,551**	0,372	3,794**
RDINTUS	-0,688	-1,239	-0,923	-1,678*	-0,307	-0,271
HI	0,477	2,139**	0,434	1,956**	0,270	0,601
LPDIFF	-0,033	-1,529	-0,035	-1,658*	0,027	0,816
LAGE	0,100	1,840*	0,133	2,476**	0,001	0,010
HOLDING	-0,010	-0,256	-0,003	-0,067	0,056	0,752
Marginal effect on export intensity conditional on being an exporter						
PRODUCT	0,007					
PROCESS	0,027					
RDINT			1,346			
Marginal effect on probability of being an exporter						
PRODUCT	0,015					
PROCESS	0,059					
RDINT			2,951			
Pseudo R^2	49,1		51,8		28,8	
log likelihood	-202,0		-191,2		-448,4	
LR χ^2	389,3**		411,0**		361,8**	
Df	32		31		30	
N observations	679		679		833	
N exporters	512		512		452	

** (*) means statistically significant at the 5% (10%) level, two-tailed test.
All models include sectoral dummy variables at the ISIC 2-digit level.

V. Determinants of International Competitiveness: Estimation Results

It is in Table 3 where Tobit estimation results for firm-level determinants of export intensity are presented. The first four models involve "all firms"; that is, both innovators and non-innovators. Models 5 and 6 comprise "innovators only", whereas model 7 is for "non-innovators only". The data for the dependent variable (export intensity) belongs to the year 1997, whereas the explanatory variables are measured in terms of averages in the period 1995-97. In this regard, it is reasonable to expect to capture the *lagged* effect of explanatory variables on export performance. In the models considered, basic innovation variables (PRODUCT & PROCESS) and R&D intensity variable (RDINT) have been cautiously incorporated. Since "innovation" is the expected resultant of "R&D activities", they are very likely to exhibit high correlations with each other. Therefore, innovation and R&D variables have been separately utilized within the regressions. Furthermore, it is to be noted that RDINT data are available only for innovators. In what follows, estimation results are discussed for "all firms" in the first place. Then, "innovators" and "non-innovators" are contrasted and compared.

1. All Firms

So far as "all firms" in the sample are concerned, models 1 and 2 are the most comprehensive ones. One of the most outstanding results is that statistical significance of the explanatory variables remains intact irrespectively of the inclusion of basic innovation variables or the R&D intensity variable. In other words, the same explanatory variables show up as significant regressors in both of the models. Interestingly enough, the results in terms of the significance of the variables do not change even when some other variables are dropped (Model 3).

First of all, it is up to 150 employees that a larger firm size implies a significantly higher export performance. Beyond that size, export intensity seems to be independent of the number of employees. Besides, capital intensity (CAPINT) and wage (WAGE) variables may be interpreted together: The former is significantly conducive to export performance, whereas the latter seems to have no impact. This could be related to labor quality. In this regard, if Turkey is a labor-abundant country, then the positive influence of capital intensity on the export performance of Turkish firms turns out to be *reminiscent* of the well-known Leontief paradox, albeit on different grounds (that is, as compared with the capital-abundancy of the United States against the capital intensity of her import-competing sectors). It is further to be noted that WAGE turns out to be positively significant when CAPINT is dropped from the regressions. Moreover, increases in the share of private (national) and foreign ownerships (PRIVATE & FOREIGN) also imply higher export intensities. In this regard, state-owned enterprises can be said to be less export-oriented, whereas existence of foreign share-holders seems to be influential on exporting efforts. Negatively significant impact of advertisement intensity (ADVERINT) is another interesting result. A presumable interpretation is that advertising basically targets the home market. Hence, those firms with higher advertisement intensities are essentially preoccupied with meeting the domestic demand. On the other side, those firms which subcontract their inputs (SUBINPUT) to "other firms" (SUBOUT) tend to have higher export intensities, whereas those "other firms" scarcely export. Composition of labor force is also important: Share of female personnel in all employees (FEMALESH) is conducive to export performance, whereas shares of administrative and technical personnel (ADMINSH & TECHSH) have a negative influence. It is also worthwhile to note that such sectoral variables as the concentration ratio (HI) and numbers of products differentiated (LPDIFF) as well as such firm-specific variables the age of the firm (LAGE) and being a member of a business group (HOLDING) all show up as insignificant regressors.

Since it is the basic objective of this study to deal with the possible impacts of technological capabilities on the export performance of firms, technology-related variables must be discussed in detail. With respect to models 1 and 3, process innovations are conducive to exports, whereas product innovations do not have a significant influence. This may indicate that the priority of a "national system of innovation" in Turkey is to be put on process innovations. Of course, this does not imply that dealing with product innovations is meaningless. Indeed, model 4, though simple, suggests that both of the basic innovation variables are alone important determinants of export performance. Indeed, it is to be noted that PRODUCT turns out to be a significant determinant of export intensity, when PROCESS is dropped from Models 1 and 3. Positive significance of RDINT can be observed in model 2. Besides, one should also consider the facts that i) regional innovation intensity (REGINN) somewhat contributes to the export performance, and ii) technology transfers through license or know-how agreements (TECHTRAN) seem to have no significant impact.

Marginal effects of basic innovation variables as well as R&D intensity have also been calculated. In this respect, for an exporter firm, materializing a product innovation raises export intensity by 1.9 percentage point; and a process innovation does the same by 3.3 percentage point (Model 1). For instance, an average firm with an export intensity of 13 percent would be able to raise it up to 18.2 percent (a 5.2 percentage point increase), if it materialized a product innovation along with a process innovation. Similarly, a 1.0 percent increase in R&D intensity generates a 1.5 percent increase in export intensity (Model 2). On the other side, when a non-exporter firm materializes a product innovation, its probability of becoming an exporter increases by 4 percent; whereas the respective contribution of a process innovation is 7.2 percent (Model 1). These are quite substantial because the proportion of exporters is about 37 percent (weighted average). Consequently, a 1.0 percent increase in R&D intensity yields a 3.3 percent increase in the probability of becoming an exporter (Model 2). To be sure, implementation of a national technology policy is to seriously take into account such marginal effects as informational guide-lines.

In sum, it may be asserted that "new products" developed within the Turkish manufacturing industry are not so much able to catch up with foreign competitors in terms of quality and diversity. Indeed, "new products" may be primarily subject to domestic absorption. Main contribution towards exports seems to arise from "new processes" of production, which essentially improve the competitveness of the firms with respect to foreign competitors. To put it differently, price competitiveness can be said to be more dominant than other forms of competitiveness for Turkish manufacturing firms. One may further argue that R&D activities tend to generate more *process* than *product* innovations, the former having a clearer impact on exports.

2. Contrasting and Comparing Innovators and Non-innovators

One of the basic objectives of this study is to detect the differences between innovators (Models 5 and 6) and non-innovators (Model 7). Differences show up especially in the case of those variables that basically pertain to the domain of industrial organization: Intensity of advertisements (ADVERINT), sectoral concentration ratio (HI), degree of product differentiation (LPDIFF) and age of firms (LAGE) have *more-or-less* significant impacts on the export performance of innovators. However, same variables are insignificant in the case of non-innovators. Furthermore, innovators and non-innovators are also distinguishable in terms of the significance of their shares of foreign ownership (FOREIGN), administrative and technical personnel (ADMINSH & TECHSH). In this regard, determinants of exporting behavior can be said to vary depending on both firm-specific characteristics and sectoral aspects. Adverse impact of advertisement intensity on the exports of the innovators can be explained as in the case of the whole sample: Those innovators, which advertise, basically target the home market; whereas exporter innovators establish different ways of connections with their foreign customers. Insignificance of advertisements for non-innovators, which are relatively smaller in size, may be arising from insufficient financial resources allocated to advertising. On the other side, those innovator firms which operate in relatively more concentrated sectors are more likely to export, as the Herfindahl index (HI) indicates. Hence, for innovators, higher sectoral concentration is likely to be conducive to firm-level export performance, unlike in the case of non-innovators. Besides, the older the innovators are, the higher their export performance is. This may be indicative of the importance of learning processes. Interestingly enough, while the share of foreign ownership (FOREIGN) does not affect the export intensity of innovators, it is conducive to that of the non-innovators. Here, it is plausible to assert that the prior motive of foreign share-holders is export-orientation rather than innovativeness.

Innovators and non-innovators differ from each other also in terms of the impact of the firm size. For innovators, increases in firm size imply a significantly higher export performance up to 250 employees. Here, compared with the whole sample (up to 150 employees), the significant impact of firm size is clearer. However, the relationship between the size of the non-innovator firms and their export performance is quite ambigious. Unlike in the case of innovators, those non-innovator firms, which employ more than 500 personnel, tend to have higher export intensity. However, such large non-innovators are quite few in number, and they may be operating in relatively low-technology industries, while basically producing for export markets.

Like the results for the whole sample, share of private ownership (PRIVATE), share of female personnel (FEMALESH), subcontracting inputs (SUBINPUT), and subcontracting output (SUBOUT) all show up as significant regressors *irrespectively of being an innovator or not*. The first three are conducive to export performance, whereas those firms, which basically produce intermediate goods, tend to have poorer export performance. On the other side, technology transfers through license or know-how agreements (TECHTRAN) and being a member of a business group (HOLDING) influence the exports of neither innovators nor non-innovators. Moreover, probably the most noteworthy results have to do with the capital intensity (CAPINT) and wage (WAGE) variables. Positive significance of capital intensity along with the insignificance of wages for the whole sample keeps on validity also in the case of both innovators and non-innovators. To put it differently: i) a part of improvements in export performance depends definitely on intensive capital utilization, and ii) lower wages do not seem to generate a cost advantage on the part of Turkish manufacturing firms. Of course, these two aspects are of decisive importance for establishing the links between a rational technology policy and a national development strategy.

With respect to the technology-related variables, possibilities of comparison between innovators and non-innovators are rather limited. By definition, non-innovators are those firms which were not able to materialize any product or process innovations. Moreover, R&D data are applicable only for innovators. Hence, for comparison purposes, we are to be content with regional innovation intensity (REGINN) and R&D intensity of the US manufacturing industries (RDINTUS, as a proxy for the R&D intensity of the rest of world). As discussed earlier, REGINN is somewhat conducive to the export performance of the firms in the whole sample (Models 1, 2 and 3). However, when the sample is decomposed into innovators and non-innovators, the same variable turns out to be impotent. In other words, if "innovators only" and "non-innovators only" in a *province* are considered separately, export intensities do not seem to have to do with regional innovation intensities. And, when the mix of innovators and non-innovators in a province is considered, higher innovation intensities in the region imply a better export performance. In this respect, *regional* investments and technological incentives should be provided without discrimination; that is, investment schemes and incentive programs should be designed in such a way that innovators and non-innovators in a certain region can have equal possibilities of access. Besides, export intensity of innovators turns out to be slightly sensitive to the RDINTUS variable (Model 6). With an expectedly negative sign, foreign R&D activities somewhat erode the international competitiveness of innovator firms. Hence, an innovator exporter firm should be regularly supported in terms of its R&D efforts in order to keep on preserving its competitiveness. Indeed, the important role played by R&D intensity is well confirmed in Model 6. Finally, like in the case of the whole sample, priority should be put on process rather than product innovations for improving export performance (Model 5).

For innovator firms, marginal effects of basic innovation variables and R&D intensity are as follows. A product innovation raises the export intensity of an innovator by 0.7 percentage point, and a process innovation by 2.7 percentage point. A 1.0 percent increase in R&D intensity raises export intensity by 1.35 percent. On the other side, following a product innovation and a process innovation, the probability that a non-exporter innovator becomes an exporter increases by 1.5 and 5.9 percent, respectively. Consequently, a 1.0 percent increase in R&D intensity generates a 2.95 percent increase in the probability of becoming an exporter for innovator firms. It is quite obvious that marginal effects are lower for *innovator firms* as compared with the values for *the whole sample*. This has an important implication: In the initial phase of a national development strategy, which aims at establishing a strong link from technological infrastructure to international competitveness, *priority* should be put on *converting as many non-innovators as possible into innovators*. Technology diffusion policies, thus, seem to be of utmost importance.

VI. Concluding Remarks

That (process) innovations and R&D activities are crucial for the international competitiveness of Turkish manufacturing firms has been verified to a great extent. In contradistinction, technology transfers through license or know-how agreements and being a member of a business group do not show up as significant determinants of export performance. Therefore, a rational technology policy had better put priority on promoting in-house innovations. However, it seems also reasonable to consider technology transfers and own innovation activities as “complementary” processes. Namely, while technology transfers do not directly influence export intensities, they may be doing so through enhancing innovation possibilities.

The persistent insignificance of the real wage is also worthwhile considering. Turkey has conventionally implemented devaluations (basically to accomadate high inflation) with a hope to improve her international competitiveness via real cost reductions (e.g., the alleged advantage of "cheap labor"). Nevertheless, the real wage variable was able to significantly affect export intensity in none of the seven regressions we considered. Indeed, the invariably significant and positive impact of the capital intensity variable in the very same regressions is, in fact, a quite crucial warning to be obeyed by the policy-makers at all costs: Turkey as well as similar developing countries must escape from the illusion of temporary export booms achieved by such ready-made tools as devaluations and export subsidies, and construct a coherent technology policy *cum* a national development strategy that will generate permanent increases in gross fixed capital formation, and thus in productivity and international competitiveness.

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Abstract: Does Innovativeness Matter for International Competitiveness in Developing Countries? The Case of Turkish Manufacturing Industries. - The causality postulated to run from technology-related factors to export performance is investigated by Tobit models for Turkish manufacturing firms. Significantly positive role played by process innovations and R&D activities, invariably conducive capital intensity, and the persistent insignificance of the real wage are meaningful so far as a rational international competition policy is concerned. Discernible is the difference between innovator and non-innovator firms in terms of their firm-specific characteristics and sectoral aspects. In sum, the results are suggestive of the construction of a technology-oriented and capital-formative development path, if Turkey is to come up with the international competitive standards. JEL no. D21, F10, O31.