DETERMINANTS OF TECHNOLOGY TRANSFER IN DEVELOPING ECONOMIES: THE CASE OF TURKISH MANUFACTURING INDUSTRIES

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ABSTRACT

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IN DEVELOPING ECONOMIES:
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Approaches on transfer of technology to developing countries within the development discourse are discussed in historical perspective and determinants of disembodied technology transfer of Turkish manufacturing industries are analyzed via enterprise-level data and microeconometric methods. While firm size, general skill level, export behaviour, capital intensity have significant effect of technology transfer decision of the firm, foreign ownership does not. Sectoral characteristics' effects are also statistically significant.

Keywords: Technology transfer, developing countries, microeconometrics

ÖZ

GELİŞMEKTE OLAN EKONOMİLERDE
TEKNOLOJİ TRANSFERİNİN BELİRLEYİCİLERİ:
TÜRKİYE İMALAT SANAYİİ ÖRNEĞİ

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Gelişmekte olan ülkelere teknoloji transferi yaklaşımlarının kalkınma diskuru içindeki yeri tarihsel bir bakışla tartışılmış ve Türkiye imalat sanayi firmalarının içerilmemiş teknoloji transferi kararını belirleyen etmenler firma düzeyinde veriler ve mikroekonometrik yöntemlerle analiz edilmiştir. Firma büyüklüğü, işgücü niteliği, ihracat davranışı, sermaya yoğunluğu gibi etkenler istatistiki olarak anlamlı etkiler doğururken firmanın yabancı sahipliğinin teknoloji transferi kararına istatistiki olarak etkisi bulunmamıştır. sektörel yapıların da bu karara etkisi bulunduğu görülmüştür.

Anahtar sözcükler: Teknoloji transferi, gelişmekte olan ülkeler, mikroekonometri

to *Ana*

to *Doktor Dede*

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1. INTRODUCTION

Firms in developed economies allocate a great deal of resources to research and development (R&D) activities, aiming at producing profitable novel products (product innovations) and developing new production processes (process innovations). These firms are enabled to do so mainly by the market structure they perform within. In these economies, domestic markets are adequately large, exporting prospects are sufficient; firms have access to venture-capital and mechanisms through which risky innovative activities can be funded. Moreover, these firms have the opportunity to contact consultancy organizations specially established for guiding small and medium-size enterprises.

On the other hand, the structure of developing economies is another story. It lacks the ability to provide aforementioned opportunities to firms intending to perform innovative activities. Firms in these economies have to carry out their activities facing narrow domestic markets, limited export opportunities and either insufficiency or mostly complete lack of venture capital mechanisms.

However, according to neoclassical theory, technological knowledge is a public good; its consumption is not subject to competition (non-rival) and once produced every agent benefits from it (non-excludable). Once created transferring to another location is an almost costless effort via codifying. Hence, it is a free good; developing economies could and should acquire it and employ it domestically. Consequently, in orthodox approach, firms chose to transfer and adopt already produced and tested-in-market technologies via a number of methods, instead of carrying out risky, uncertain, innovative activities. Thus, what is assumed is that firms that have transferred technology will first assimilate and/or adapt the imported technologies to domestic market conditions, produce their own technologies and eventually, create new products or processes, hence innovate.

However, transfer and adoption processes certainly bear a considerable amount of

risk and cost. When a firm in a developing economy transfers technology, it will not be able to use it at its full potential instantaneously. Regardless of the chosen method for transfer, an adaptation period and cost will come out. In the relevant literature, there are a number of studies that deals with the risks and costs of technology transfer; both within developed economies and from developed economies to developing ones (for instance see, Radosevic, 1996; Lall 2001; Braga and Willmore 1991, Chatterji 1990). A great deal of these focuses on the supply-side of the process. That is they mostly concentrate on behaviors of technologically superior firms in developed economies, studying the factors affecting their technology transfer actions towards the firms in developing economies.

Moreover, when it comes to the analysis of determinants of technology transfer decision by using enterprise level data for developing economies is concerned, the number of studies decreases dramatically. Furthermore, none of them focus solely on the determinants of technology transfer but on its relation with some other factor, like research and development activities, export performance, productivity and so on.

The major motivation for this thesis is the mentioned insufficiency in the number of studies on technology transfer behaviour of firms in developing economies. As long as the conception of technology policy in developing countries is concerned, determinants of superior technology receiving firms' decisions are as much important as that of the source firms'. Thus, this study aims to examine the determinants of technology transfer decisions of firms in Turkish manufacturing industries.

For this aim, we employ a *probit* model using Turkish Statistical Institute's (TURKSTAT) Structural Business Statistics (*Yapısal İş İstatistikleri* in Turkish), cross-sectional, enterprise-level data, matched for the years 2003 and 2004. We expect to shed light on developing economy firms' technology transfer behaviour by analyzing determinants of Turkish manufacturing firms' technology transfer decisions. Therefore our main research question is, "What are the determinants of TT decision in manufacturing industries?", followed by whether major firm level

variables like size, foreign ownership or export behavior; as well as sector-specific structures play important roles.

In the second chapter, after the concept of technology transfer is defined and its modes are elaborated, a literature survey focused on the evolution of technology transfer approaches will be presented. Analyzing the determinants of technology transfer behaviour in Turkish manufacturing sectors will be the third chapter's content. The fourth chapter concludes.

2. TECHNOLOGY TRANSFER: CONCEPTUAL ISSUES

2.1 Definition and Forms of Technology Transfer

2.1.1 Definition of Technology Transfer

As stated by Bennett (2002) “in most cases, technology transfer implies a transaction or a longer-term collaboration in which two parties (the acquirer and the supplier of technology) are directly involved” and it suggests “a single transaction resulting in the acquirer gaining complete command of the technology” (Bennett, 2002: 6, 7).

Although this is a very convenient framework to begin, it is a fruitless effort to try to find a sole and simple definition for technology transfer. As Radosevic (1999) mentions,

> Technology and technology transfer are concepts with boundaries that we cannot clearly define. The generation and diffusion of technology are processes deeply embedded in the institutional fabric of economy and society. The forms which technology takes vary from the disembodied (patents, licenses) to those embodied in machines or persons (tacit knowledge). Forms of technology transfer vary furthermore as different forms of technology can be transferred through different channels. This multiplicity of forms in which technology is embodied and transferred poses severe limitations for quantifying it and for studying its effects (Radosevic, 1999: 14).

For instance, if technology is defined as “a set of knowledge contained in technical ideas, information or data; personal technical skills and expertise, and equipment, prototypes, designs or computer codes”, then technology transfer may take place in any of the above mentioned forms or their combinations, either embodied in the equipment supplied or in the forms of know-how, instruction and software (Bennett, 2002: 5).

On the other hand, there are views that reflect the discontentment even with the expression “transfer”. Reddy and Zhao (1989) mention that, “transfer connotes the free, noncommercial movement of something from one location or possessor to another. In fact, however, with technology, what is usually involved is a sale of such technology. For this reason the term "commercialization of technology" has been argued to be generally more appropriate (Reddy and Zhao, 1989: 295)”.

Another point we should mention is whether technology diffusion and transfer are the same or not. Rath (1994) emphasizes that the former should be distinguished then the later since transfer is a “purposive movement of established technology” however diffusion is almost an unplanned movement that might occur as a result of imitation or reverse engineering (Rath, 1994: 2).

2.1.2 Forms of Technology Transfer

Technology transfer can be classified in different dimensions. These different forms of transfer emanate from both the inherent features of technology and also from the nature of transfer.

Embodied Technology Transfer: Embodied technology transfer is defined as “the process whereby innovations spread in the economy through the purchase of technologically-intensive machinery, components and other equipment” by OECD (OECD, 1992: 48).

However embodiedness should not be restricted mere to machinery or machinery related equipment. Technology can also be embodied in the workers or in the production processes as well.

Disembodied Technology Transfer: OECD defines the disembodied technology transfer as “the process whereby technology and know-how spread through channels

other than embodiment in the machinery" (OECD, 1992: 48). Licensing and royalty payments are important examples of disembodied technology transfer.

Legal, Semi-legal and Illegal Transfer: According to Chang (2004), technology transfer can also be grouped as legal and illegal transfer as a result of the nature of transfer. Basically when market is mediating the technology transfer, it can be referred as legal; however in the illegal transfer, there is no market-mediation (Radosevic, 1999: 19). Chang (2003) gives technology licensing, joint venture and OEM production for TNCs as examples to legal transfer; reverse-engineering as a means of semi-legal transfer and "outright violation of intellectual property rights of the producers in the more advanced countries" is given as a case of illegal technology transfer (Chang, 2003: 2).

Vertical and Horizontal Transfer: As the transfer may be from a production unit to another one; it may also happen from a research laboratory to a production unit. The first form of transfer is called a "horizontal" transfer and the second is called a "vertical" transfer.

2.2 A Brief Examination of Evolution of Technology Transfer Approaches

Borrowing the ideas of Hardt and Negri (2001), it can be emphasized that the circumstances of the Cold War accelerated the collapse of the old colonial powers and gave rise to US leadership in constructing a new world order. In this manner, the cornerstones of the world were re-identified and US announced itself as the successor of the European countries as the new hegemonic power.

Development was also understood as something that had to be brought to the "backward" states by Western advanced metropolitan powers. These states could not achieve this on their own, they lacked knowledge and capital. It was claimed by the hegemonic powers that bringing development to the backward areas served both sides; both the developing and the developed benefited from it (the mutual benefits approach). Development represented a Western-influenced concept, and it was believed that exporting Western institutions to these countries would finally result in progress.

The earlier development theories had a few common points to focus on. First of all, growth was seen as the most effective tool for development in the post-war period. Per capita income growth was believed to create positive externalities to the other parts of the economy, such as eliminating poverty and income inequalities.[1] It was widely recommended by the mainstream development policies to increase capital accumulation as the key source of economic growth. As stated by Rath (1994), "this view meant an emphasis on the mobilization of domestic savings and increased external capital flows through concessional and market loans and through foreign direct investments by the newly active and rapidly growing category of multinational firms." (Rath, 1994: 6)

[1] The belief in *trickle down* theory was dominant in this era. Trickle down hypothesis basically claims that economic growth will eventually benefit the lower class of the society, which will help in solving the income disribution and poverty issues.

Keynesian economic thought had a significant influence over the etatist policies of the period. The popularity of Keynesianism merging with the success of Soviet central planning attracted the attention of many academics to etatism and planning in development. State was considered as a life buoy for the underdeveloped countries which lacked of entrepreneurship and burdened with immature capitalism. What is more, there were already imperfections in the market and in the global capitalism. Therefore, State was supported to take over the role of investor to accelerate capital formation and improve infrastructural facilities for that aim.

In such an environment, science and technology were regarded as public goods and would be transferred through foreign direct investments as a form of foreign capital flows (Rath, 1994: 6, 7). As Rath (1994) further states,

> Once created, everyone benefited; there were no losses to one individual because another acquired them, and the cost of diffusion and transfer of knowledge was close to zero compared with developing it in the first place. ... The increase in domestic capacity together with direct foreign investment would allow the developing countries to tap into this resource at negligible cost, allowing them to rapidly close the gap between themselves and the industrialized countries. (Rath, 1994: 6)

If we read between the lines, we encounter the naïve modernist hope merging with the fundamental statements of liberal economic theory. Since developing countries lack capital and developed countries have abundant capital, the returns of capital in developing countries would be higher, which would be the guaranty of continuing capital flow from developed to developing countries that will bring the new technology to the developing countries as well.

Coming to the environment of 1960s, there were important changes in the development discourse of the 1950s as described above. On the political context, developing countries started acting as a body and acquired political consciousness.

Many theories were developed by the economists of these countries, which had a profound influence on the development discourse of the new decade. In the beginning of 1970s, the pro-third worldist wave was still in the air. However the end of 1970s witnessed an important turnaround in development discourse.

One of the main tenets of economic policies of the time was import substitution policies. When technology transfer issue is in question, the key economic features of the period should be kept in mind. As Radosevic (1999) clearly explains,

> International technology transfer policy was an important issue in international relations between developed and developing countries during the 1960s and 1970s. Thirty-odd years' later significant changes have occurred in the world economy, which have altered not only the major issues in international technology transfer for developing countries but also the link between technology transfer and opportunities for their growth. […] developing countries' requirements for 'catching up' have changed since the 1960s/70s period in ways which have important consequences for the manner in which developing countries will use technology transfer as a mechanism for fostering growth." (Radosevic, 1999: 1)

In the shadow of import substitution industrialization (ISI), rising and gradually embraced protection, it was believed that technology would develop evenly in the developing world in such an environment and furthermore cost of technology was a far more important issue than the availability of or access to technology (Radosevic, 1999: 3). The priorities in technology transfer took shape in accordance with the dominant view of the era, such that, reducing the costs of technology imports, restricting the imports of technology to the techniques that could not be domestically supplied, making sure that the imported technology will be effectively transferred and adapted to local conditions appeared as central aims regarding technology transfer.

These concerns were highly perceptible since, as a result of the technology transfer policies followed in the past, "… in one small part the process of modernization, economic growth, and prosperity seemed to occur as predicted, but a much larger part of the economy appeared either to be unconnected and unchanged, or the connections were negative, leading to greater impoverishment unemployment and inequality" (Rath, 1994: 7). Therefore in this era, issues about the gains and losses of technology transfer from developed to developing countries attracted the greatest attention both the developed and developing country researchers and United Nations Conference on Trade and Development (UNCTAD) as well. [2]

By the 1980s the criticism of ISI had reached to such heights that it had few supporters in sight. As a strong opponent of ISI, Krueger (1985), by referring to the countries which adopted export-led growth strategies, supported the view that "outward-oriented policies had a dynamic effect on the domestic economy and helped accelerate growth rates" (Krueger, 1985:20). She also asserted that, import substitution in many developing countries were less successful than export-led policies in creating industrialization, even though its major aim was to achieve industrial growth. She argued further that ISI policies increased the dependence on imports, instead of reducing the dependence on the international economy, since "import substitution activities are import intensive and require both intermediate and capital goods from abroad to sustain production and growth. Thus, the economy becomes vulnerable to declines in availability of foreign exchange" (Krueger, 1985: 21). Export-led growth policies, in contrast, reduce such dependence by increasing foreign exchange earnings and thus the flexibility of the economy.[3]

In addition to these criticisms inspired by neo-classical economics, there were discontent within the discipline of development economics itself. Apart from the very low growth rates in some developing countries, the development policies by then were not satisfactory in solving inequality, employment and poverty problems

[2] Discontent of developing counrties with the technology transfer that occured so far was first discussed in detail in UNCTAD I meeting in 1964. See Rath (1994) for details.
[3] As mentioned earlier, Krueger was an ardent supporter of neo-liberal policies and was con-fronted with cogent criticisms of many heterodox economists.

(Bruton, 1984: 74). As Şenses (1984) emphasized, this underperformance of development economics "led to a growing realization that mass support could not be rallied behind the past record of development" (Şenses, 1984: 126).

Neo-classical resurgence materialized in the Washington Consensus. Saad-Filho (2005) defined this consensus as "… the convergence of three institutions based in Washington, D.C., the World Bank, the IMF and the US Treasury department, around neo-classical economic theory and neo-liberal policy prescriptions for poor countries (Saad-Filho, 2005: 113). Deregulation, fiscal discipline, reduced public expenditure; trade and financial liberalization were among the demands by these institutions from the developing world.

The globalization process gathered speed in the beginning of 1980s in tandem with the spread of neo-liberal policies. Globalization brought about the rise in international trade, FDI and financial flows; supported the multinational corporations and obligated affiliations to the international financial institutions (IFIs). Furthermore, globalization has been changing the relationship between finance, trade and production (Radosevic, 1999: 43). As stated in the quotation below, in this new setting, "developing countries are now much less in a position to control the interaction between finance, trade and production" compared to the way they could do in 1960s and 1970s (Radosevic, 199: 63). Developing countries do not necessarily get integrated into production and technology networks, by being integrated into the global economy as markets, since "the global economy and global political system by their very nature generate different degrees of political, financial, market, production and technological integration of national economies into the world economy (Radosevic, 1999: 2)".

In the surge of globalization, in developing countries' technology transfer process, the characteristics of new technologies, intellectual property rights and the domestic innovation capabilities acquire more importance. Following Radosevic (1999), the first argument that determines technology transfer opportunities of developing countries is whether the new technologies are based on implicit or explicit knowledge.

> The transferability of new technologies is an important element to be taken into account by technology transfer policy. Opinions differ regarding whether new technologies are becoming easier to appropriate or whether they are becoming a kind of "black box", difficult to "reverse engineer" and open. However, the tightening of intellectual property rights and the harmonization of this aspect of control over technology will undoubtedly reduce possibilities for technology import for developing countries. Whether the effects of that in the long term will be positive through stimulation of innovation in developing countries themselves is very much industry specific and generalizations are not possible." (Radosevic, 1999: 7)

Related to this subject, the second issue we should argue about is how the potential of developing countries changed in this new environment. Recipient country's indigenous technological capability plays a major role. As stated in Reddy and Zhao (1989) "because of the nature of technology, technology transfer is not as simple as the purchase of a capital good or the acquisition of its blueprint". Recipient firms should assign substantial resources to absorb, adapt and improve upon the original technology. Consequently, since "technical knowledge include imperfect understanding, incomplete availability, imperfect imitability, tacitness etc. its successful use tends to be dependent upon firms and countries developing their own technological capabilities. (Reddy and Zhao, 1989: 291)"

Compared with the earlier periods, we expect from the developing countries that they adopt the transferred technologies and create innovative processes after the transfer. In the earlier periods, this linkage was weaker mainly in ISI countries. As Radosevic (1999) mentions as well,

> The most controversial aspect of the 1960s and 1970s policies was in the very attempt to foster technological development by primarily relying on regulations in international technology transfer. Domestic technology policy was most often separate from technology import considerations or was practically very weak and undeveloped. It is no surprise that the objectives underlying technology transfer regulations were unrealistic.

> They are similar to the expectations that problems of growth can be solved by focusing mainly on the foreign trade area. (Radosevic, 1999: 40)

OECD emphasizes the same point by clearly putting forward the fact that "it often takes time to invent from a patent, to develop prototypes, to alter equipment, and to engage in the manufacturing activities required to introduce an imitative product or process." (OECD, 1992:50)

A third issue we should discuss in the same framework is the intellectual property rights regime. Chang (2004), attaches greater importance to the intellectual property rights (IPR), when discussing the history of technology transfer. He regards the emergence of IPRs as the main breakpoint in the development of technology transfer.

In the eighteenth century, controlling the migration of the skilled workers by the governments was the resorted measure of limiting or banning technology transfer. However, as Chang (2004) mentions:

> Subsequently, as increasing amounts of technologies got embodied in machines, machine exports came under control. Britain introduced a new Act in 1750 banning the export of “tools and utensils” in wool and silk industries, while strengthening the punishment for suborning. The ban was widened and strengthened in subsequent legislations. In 1774, another Act was introduced to control machine exports in cotton and linen industries. In 1781, the 1774 Act was revised and the wording “tools and utensils” changed to “any machine, engine, tool, press, paper, utensil or implement whatsoever”, indicating the increasing mechanization of the industries (Chang, 2004: 7).

Later with the development of IPRs, the form of transfer that occurred by licensing of patents emerged as an important means of transfer. As a result of Trade Related

Intellectual Property Rights (TRIPs), "an overwhelming majority of developing countries revised their intellectual property laws and extending the scope and duration of the protection" (Radosevic, 1999: 73), that gave way to the discussions about effects of IPRs on technology transfer.

TRIPS is generally discussed as one of the most detrimental agreements in WTO system in literature (to name some studies Siddharthan 1999, Wade 2003, Weiss 2005, Amsden 2005). It is an annex (Annex 1C) of the Marrakesh Agreement Establishing the World Trade Organization, on 15 April 1994, aimed at protecting and enforcing the intellectual property rights like trademarks, copyrights, designs and patents. According to Article 7, named "objectives" in the official text,

> The protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conducive to social and economic welfare, and to a balance of rights and obligations. (WTO Legal Texts website)

However, Siddharthan (1999) states that it is considered as one of the most arguable aspects of WTO regulations for its effects on developing and least developed economies. Since in most of the developed and developing countries there existed weaker protection on intellectual property before WTO accession, innovation through imitation and reverse engineering seemed viable ways but now, developing countries have lost this opportunity to a great extent.

According to Wade (2003), "[t]he new regulations are designed to expand the options of developed country firms to enter and exit markets more easily, with fewer restrictions and obligations, and to lock-in their appropriation of technological rents." In his analysis, TRIPS are hindering developing economies' development processes both through economic and political mechanisms.

Economic mechanism exists due to the imbalances among developed and developing world in terms of patented product demand and supply. The developed countries are

net exporters of patents, where the developing countries are net importers. One of World Bank's estimations clearly demonstrates this fact. World Bank estimates the net gains from patents, if TRIPS were fully put into practice. Figure 2.1 presents the results.

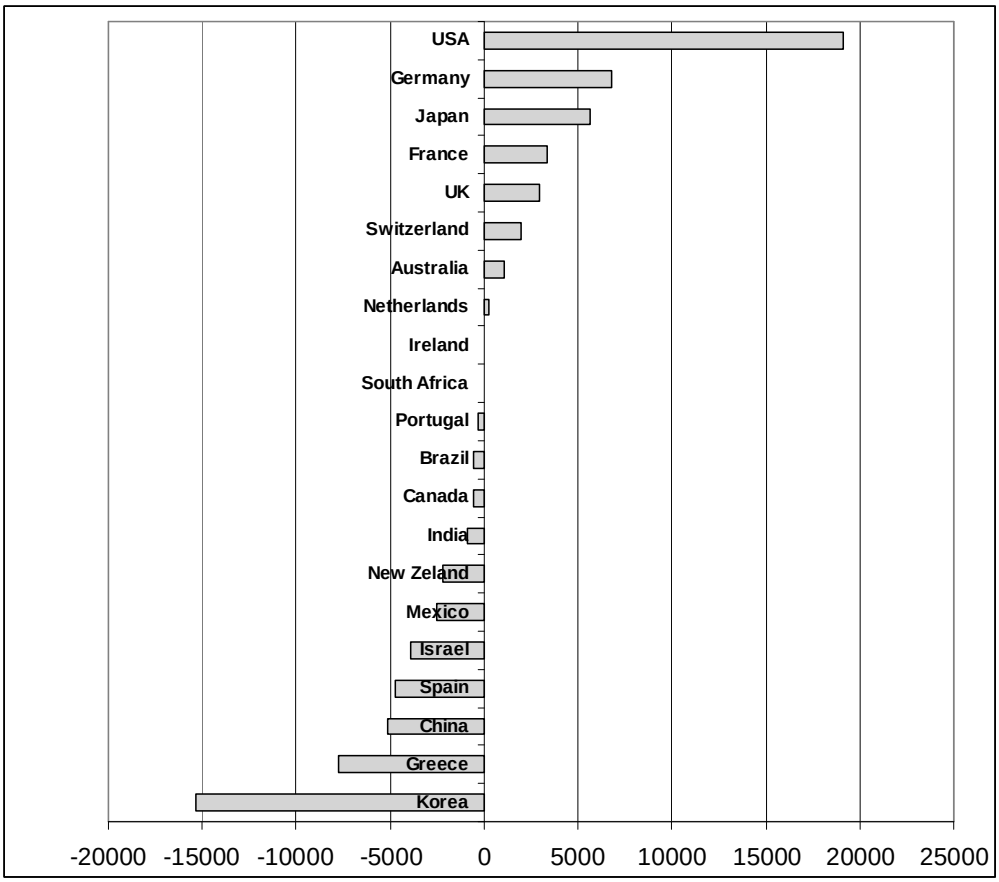

Figure 1: Scenario for net gains from patents if TRIPS were fully put into practice (millions of 2000 dollars)

Source: WB Global Economic Prospects, 2002, p133

According to this estimation, US gains $19 billion per year from patent incomes, more or less the sum of other 8 net gainers, which are all developed countries. Despite we see some countries that have relatively high per capita GDPs like Canada, Spain and Israel in net losers list, the picture is clear that the most developed countries benefits the most from protection of intellectual property rights.

2.3 Modes of Technology Transfer

There are many means of technology transfer. Technology transfer may be the result of reverse engineering by a firm on its rivals' products; descriptions of new products or processes can be found in publications, catalogues or patent applications; knowledge can be transmitted through conferences or seminars; research personnel may take knowledge with them when they change jobs; merger and acquisitions, joint ventures or other forms of inter-firm co-operation can lead to technology transfer. These different channels of transmission produce different diffusion patterns with diverse effects on productivity and competitiveness.

There are many ways of technology transfer examples above. However, we will refer to the more common forms of them.

Foreign Direct Investment and Joint Ventures: Foreign direct investment (FDI) refers to a form of investment that is done outside the home country of the investor. Through this investment, technology is transmitted as well.

Developing countries do not only hope to import new technologies, but to benefit from spillovers for the local firms. According to Saggi (2002), three channels of transfer come forward: demonstration effects, labor turnover and vertical linkages. The first refers to the situation, where local firms adopt the technologies transferred by the multinational firms by reverse engineering or imitation. Second refers to the experienced employer transfer between the multinational and the local firms. The third refers to the situation where there is a supplier or buyer relation between the investor and receiver firms.

For long TNCs have been the major source of FDI in the international economy; however there are many other forms of investment (and consequently technology transfer) occurring in the scope of TNCs, like joint ventures and subcontracting (Radosevic, 1999: 22). Reddy and Zhao (1989) emphasize the same point as in the following:

> Through the 1960s the establishment of a wholly-owned foreign subsidiary or a majority-owned foreign affiliate was the predominant method of foreign expansion by MNCs and a prime source of technology transfer. With the increased regulation of foreign investments in several countreis, joint ventures have become a far more important form of operation for the multinational enterprise. (Reddy and Zhao, 1989: 297)

Licensing: Licensing is the only mode of disembodied technology transfer that may be measured. By a license agreement the technology owner or rights holder grants a license, or a permission to use, the intellectual property, to the licensee. The licensee by the terms of the license is permitted to exploit the intellectual property.

Trade: Technology is mostly embedded in the goods. Trade is therefore an important means for the transfer of embodied technology. Particularly capital goods obtain the highest technology substance, since it contains learning processes and upward-downward linkages.

Human Capital Transfer/ Brain Drain/ Brain Gain: Economic history has witnessed the significance of the movement of people as a key means of technology transfer during the industrialization of Europe and the US. After the industrial revolution in Britain, when the technological superiority of the country was acknowledged, transferring skilled workers "in whom most technological knowledge was then embodied" became the major source of technology transfer (Chang, 2004: 5). Return of the brain drain, which may be called brain gain, is another important source of technology transfer embodied in people.

Reverse Engineering: Reverse engineering is the process of discovering the technological principles of a device, object or system through analysis of its structure, function and operation.

2.4 Cost of Technology Transfer

According to neoclassical perception, technological knowledge is a public good; its consumption is not subject to competition (non-rival; that is anyone willing to pay the price of a specific technology could benefit from it) and once produced every agent benefits from it (non-excludable). Moreover once the cost of creation of a new technology was incurred, its marginal cost of reproduction and transfer was close to zero. In addition technology could be assimilated to information easily, i.e. all the relevant aspects of a technology could be written down in a disembodied form as codified technical information. Once created transferring to another location is an almost costless effort via codifying. Hence, it is a free good; developing economies could and should acquire it and employ it domestically.

These assumptions are not valid for a number of reasons. First an information asymmetry exists between the provider and recipient of technology. Selection of appropriate technology requires at least a basic knowledge of that technology, which developing economies often lack. It is also not trivial to argue that technology can be assimilated into information easily. Technology has a tacit component which can not be codified. Thus this tacit component of technology can not be transferred automatically. Recipient of technology has to allocate resources to reveal the tacit component attached to the acquired technology.

Researchers have perceived the transfer costs that are beared by the developing countries through the technology transfer process differently. However they mostly agree on four types of transfer costs: cost related with pre-engineering technological transfer; costs associated with transferring the process/product design and engineering; costs of R&D personnel during transfer; costs due to low labor productivity and poor product quality during the learning process.

As mentioned above, technology is always to some extent implicit and location-specific. For example a typical imported capital good is adjusted to the quality standards of raw or intermediate materials of its origin country, or a specific

technology may have components that are designed so as to satisfy the user needs of its origin country. This means when technology is transferred, it should be adapted to local conditions. Although it may be considered as a simple progress to make necessary developments for adapting local conditions, generally it needs a major development operation. For instance, necessary adaptations should be made according to local materials, labour, market and environment.

Determinants of transfer costs are worth mentioning as well. Size and nature of demand, production costs and institutional differences that may exist between the host and home countries, labor intensity of the underlying technology, the number of transfers already executed for any product may be counted as determinants of TT costs (Reddy and Zhao, 1989: 296)[4]

[4] In determining the transfer costs in manufacturing projects: size of the supplier firm, age of the technology; degree of the technology diffusion, understanding of the transferred technology, recipient's R&D capacity, recipient's general manufacturing skills; and level of the host country's development play significant role.

3. DETERMINANTS OF TECHNOLOGY TRANSFER DECISION

In this chapter, we analyze the determinants of technology transfer decision firms in Turkish manufacturing industries. We mainly use Turkish Statistical Institute (TURKSTAT)'s *Structural Business Statistics and* employ a *probit* model to this end.

3.1 Data and Model

3.1.1 Data Sources

Our dataset mainly comes from annual *Structural Business Statistics*[5], an enterprise-level[6] survey conducted by TURKSTAT, and *Foreign Trade Statistics*[7], also published by TURKSTAT.

The questionnaire for *Structural Business Statistics* is composed of three sections for enterprise identity, one section for information on local units[8] and 10 sections dedicated to data at the enterprise-level. These are about employment, expenditure, income, stocks, imports and exports, investment, sales, structure of capital share, expenditure on research and development, taxes and profit-deficit (See Appendix B for full text of the questionnaire).

2003 and 2004 surveys for Structural Business Statistics are matched and merged for the purpose of the analysis. The total number of initial observations in this merged dataset was 33601, including all sectors. After an in-depth data-cleaning for missing and various error-bearing observations, and excluding non-manufacturing sectors,

[5] *Annual Survey of Manufacturing Industries* before 2002. For details on this dataset, see Appendix A. For full text of the questionnaires see Appendix B.
[6] An enterprise is defined as "an organizational unit that produces goods and services using decision autonomy concerning allocation of resources." See Appendix A.
[7] Annual, 4-digit NACE1.1 classification sectoral statistics for imports and export.
[8] A local unit is defined as "an enterprise or part thereof carrying out activities corresponding to goods and services situated in a geographically identified place." See Appendix A.

(sectors other than those between 16 and 39 NACE1.1, 4-digit level) this number is reduced to 11922.

Firms that employ less than 20 employees (3279 firms) were excluded from the dataset. The reason for this arises mainly from the data gathering method. The firms with more than 20 employees have a weight of 1 in the dataset; however the weight for firms with less then 20 employees is not 1. However, the main reason is that data is missing or bears various errors to a greater extent for these firms compared to those with more than 20 employees. As a result, the firms with less then 20 employees were dropped out from the dataset. Finally, the remaining number of firms in our regressions is 8643.

3.1.2 Descriptive Statistics

Table 1: Technology Importer Firms

NACE1.1 Classification Code (2 Digit)*	**Sectors**	**Number of firms**	**Number of Tech. Importers**	**Share of Tech. Importers** (%)
15	Food products and beverages	947	67	7.07
17	Textiles	1475	86	5.83
18	Wearing apparel	1395	78	5.59
19	Leather	235	13	5.53
20	Wood	125	2	1.60
21	Paper	181	9	4.97
22	Printing	175	7	4.00
24	Chemicals	310	42	13.55
25	Rubber and Plastic	467	22	4.71
26	Non-metallic	584	29	4.97
27	Metal	276	14	5.07
28	Fabricated metal	556	36	6.47
29	Machinery and equipment	693	53	7.65
31	Electrical machinery	252	22	8.73
32	Communication equipment	55	5	9.09
33	Medical-precision instruments	80	4	5.00
34	Motor vehicles	296	19	6.42
35	Other transport equipment	89	4	4.49
36	Furniture	452	36	7.96
Total		**8 643**	**548**	**6.34**

Source: Own calculations based TURKSTAT *Structural Business Statistics* 2003

* Sectors 16, 23, 30 and 37 are dropped out because of insufficient observations for regressions (13, 14, 4, 6 enterprises respectively)

As clearly seen in Table 1, food products-beverages, textiles, wearing apparel and machinery-equipment industries comprise more than 50% of these 8643 firms. Besides, these four industries hold 52% of the whole technology importer firms; total number of which is 548. However, when it comes to comparing share of firms that transfer technology, chemicals industry is the only one share of technology importer firms exceeds 10%. It is followed by communication equipment and electrical machinery with 9.09% and 8.07% in that order. Wood industry has the lowest share of technology importer firms with 1.60%. The share of technology importer 548 firms in total sample is 6.43%.

Table 2: Sectoral Figures

	SIZE, 2003		TECHNOLOGY TRANSFER EXPENDITURE, 2004		EXPORTS, 2003	
Sectors	**Total Number of Employees**	**Total Sales** (Quadrillion TL)	**Expenditure on Licenses, Patents and Trademarks** (Trillion TL)	**TT Exp./ Sales,** (‰)	**Total Value of Exports** (Quadrillion TL)	**Exports/Sales (**%)
Food products and beverages	126 080	22.05	3.01	0.14	3.06	13.86
Textiles	223 754	20.09	3.59	0.18	5.53	27.52
Wearing apparel	165 083	12.04	2.73	0.23	5.94	49.33
Leather	17 090	1.57	1.21	0.77	0.38	23.91
Wood	8 573	1.06	0.08	0.08	0.10	9.53
Paper	19 119	2.89	0.42	0.15	0.35	12.07
Printing	12 751	1.67	1.19	0.71	0.09	5.19
Chemicals	50 144	16.15	51.56	3.19	1.94	12.00
Rubber and Plastic	38 820	5.51	5.69	1.03	1.26	22.88
Non-metallic	68 374	8.24	1.83	0.22	2.10	25.47
Metal	53 499	14.75	1.97	0.13	4.33	29.38
Fabricated metal	44 967	3.99	1.27	0.32	0.78	19.46
Machinery and equipment	58 091	6.70	25.74	3.84	2.08	31.01
Electrical machinery	28 160	3.58	1.58	0.44	0.92	25.58
Communication equipment	12 863	4.23	0.97	0.23	2.05	48.31
Medical-precision instruments	6 116	0.53	1.86	3.51	0.07	12.40
Motor vehicles	58 624	16.06	4.13	0.26	7.53	46.88
Other transport equipment	13 488	1.11	0.35	0.32	0.40	35.94
Furniture	39 068	3.53	1.86	0.53	0.81	23.06
	1 044 664	**145.76**	**111.03**	**0.76**	**39.69**	**27.23**

Source: Own calculations based TURKSTAT *Structural Business Statistics* 2003

Table 2 shows that food products and beverages, textiles and wearing apparel industries employ nearly the half (49%) of the employees. However, their share in total expenditure on technology transfer is 8%. On the other hand, chemicals and machinery-equipment industries have allocated strikingly greater resources to technology transfer. The sum of value of these two industries' expenditure on technology transfer accounts for 76% of that for the entire sample.

When it comes to the share of technology transfer expenditure in sales, machinery-equipment, medical-precision instruments and chemicals outpace others with a share of greater than 3‰.

3.1.2 Model

We analyze determinants of technology transfer decisions of firms in Turkish manufacturing industries via a *probit* model.

The form of the model is as follows:

$$Y = \begin{cases} = 1, \; Y^* > 0 \\ = 0, \; \text{otherwise} \end{cases}$$

This is a *latent variable model* where

Y* is an unobserved variable for the econometrician but known by firms.

$$Yi = \beta_1 + \beta_2 X_{1i} + \beta_3 X_{2j} + \mu_j + \varepsilon_i$$

where;

Y denotes individual firms' technology transfer decision. Equals to 1 if the firm declared to have positive expenditure on transfer of technology.

X_1 is firm level variables' vector

X_2 is sectoral variables' vector

ε_i is the error term for firm level variables

μ_j is the sector-level dummy

Data on the dependent variable, firm's decision to transfer technology, comes from the 2004 survey and independent variables come from 2003. This approach is adopted due to two major reasons. First, we want to imply a lag structure for technology transfer decision. Second, we expect weaker correlations between the left and right hand variables, which will mitigate possible endogeneity issues to some degree. Dependent variable is a dummy variable that has the value of 1 if the firm declared to have expenditure on royalties, patents and/or licenses. This way we obtain a dependent variable focused on disembodied technology transfer.

In our attempts to analyze technology transfer behaviour of firms, we ran regressions also for the share of license expenditures in firm's total sales, via *tobit* and *Heckman* models with the same right hand variables (see Appendix C for the results). However, by definition, *tobit* method imposes the model that the decision and quantity of the regressed variable are affected from the same factors in the same way. To check whether this is the case, we ran Heckman regressions (both Maximum likelihood and two-stage methods). According to the regression results, the coefficients in the decision vector (selection equation) are statistically significant. However, the coefficients in the intensity vector (outcome equations) are not consistently insignificant in each regression. Consequently, we decided to run and present the results for *probit* model. Moreover, we prefer *probit* model's outcomes as far as the dataset characteristics are concerned; since any error reflected in response to "value of technology transfer expenditure" would be removed when the dependent variable is defined as a binary variable.

This is caused, to a great extent, by the difficulty in measuring expenditure of technology transfer agreements. As far as the nature of technology transfer agreements are concerned, firms sign these for the following, for instance, 5 years and each year, they declare to have spent 1/5 of the total fee. Thus, we suppose that, not the value or the share of license expenditure but the decision may be more accurate to measure for our purposes. Consequently, here we present the results for *probit* regressions.

In Table 3, we present definitions and descriptive statistics our dependent and independent variables.

Table 3: Descriptive statistics

Firm Level Variables	Description	Calculation	MEAN			MIN	MAX	St.D.
			All firms	Firms with TT	Firms without TT			
LICEXP	License expenditure (Million TL), 2004	Expenditure on license, trademarks, patents, etc , Million TL	12846	202605	0	0	3530000	474512
EMP	Number of employees, 2003	Average number of employees for four quarters	121	249	112	20	17229	347
WAGE	Average annual wage, 2003	Annual payments over the number of total paid and non-paid employees, Million TL	6108	8649	5936	306	145505	5416
CAPINT	Capital intensity, 2003	Average depreciation per worker	3428	6220	3239	0	258914	9397
EXP	Value of exports,2003	Value of firm's exports, Million TL	4592342	9960334	4228950	0	154000000	3820000
EXPINT	Export intensity, 2003	Ratio of firm's value of exports to its value of sales	0.17	0.23	0.16	0	1	0.28
EXPdum	Export dummy, 2003	1 if the firm exported	0.54	0.75	0.53	0	1	0.50
IMPSH	Share of imports, 2003	Ratio of firm's value of intermediary good imports to its total expenditures	1.52	2.34	1.46	0	161.65	5.96
IMPdum	Import dummy, 2003	1 if the firm's ratio of intermediary goods imports to its total expenditure is positive	0.38	0.64	0.37	0	1	0.49
FORSH	Share of foreign ownership, 2003	Share of foreign owned equity of the firm, %	3.09	7.50	2.79	0	100	15.78
FORdum	Foreign ownership dummy, 2003	1 if the share of foreign equities is ≥10%	0.04	0.09	0.04	0	1	0.20
RD	R&D Expenditure (Million TL), 2003	Firm's total expenditure on research and development (million TL)	36604	140599	29564	0	21900000	453663
Sectoral Variables								
IMPPEN	Import penetration rate, 2003	Ratio of sectoral imports to sectoral sales plus sectoral net imports NACE1.1 classification, 4 digit	0.39	0.53	0.38	-49	14.51	1.76
HERF	Herfindahl Index, 2003	Sum of market share of individual firms squared, NACE1.1 classification, 4 digit	0.08	0.10	0.08	0	1	0.10
LICSEC	Sektoral license expenditure (Million TL), 2003	Total expenditure of all the firms in the NACE1.1 classification, 3 digit sector on license, trademarks an patents	854490	1905991	783307	0	50100000	4291676
FDIQS	Share of foreign firms' sectoral output, 2003	Ratio of foreign firms' sectoral output to total NACE1.1 classification, 4 digit	0.12	0.16	0.12	0	1	0.18

Source: Own calculations based TURKSTAT *Structural Business Statistics* 2003, 2004, Foreign Trade Statistics 2003

3.1.2.2 Firm-level variables

Size

Size is measured as the average number of employees for four quarters in logarithm form[9]. Expected sign for this right hand variable is positive owing to the fact that technology transfer process is supposed to have high fixed costs, as discussed earlier, and larger firms are supposed to bear them more successfully.

Skilled labour

We used average annual wage as a proxy for skilled workforce. and measured as wage per worker, in logarithmic scale. Expected sign is positive since the firm is expected to adopt more easily transferred technology the higher its number of skilled workers.

Capital intensity: Depreciation per worker

As a proxy for use of factors, which may be suggested to have effect on technology transfer decision of the firm, we include this ratio as an explanatory variable with a positive expected sign. It is measured by depreciation per worker.

Total expenditure on research and development

As a firm's research and development (R&D) efforts may be rightfully argued to be an indicator of its capacity to learn and follow frontiers in its industry, we used total annual R&D expenditure of the firm as an explanatory variable, expecting a positive sign. Moreover, in developing economies as adaptation is required, R&D efforts are common in technology transferring firms. However, we are aware that including R&D expenditure in the explanatory variables vector may bear endogeneity problem; as the relation between R&D efforts and

[9] We measured size with both sales and number of employees in our analysis. The correlation between these two variables is calculated as 0.99 and no major difference is observed between the regression results. Hence, we present here the models that measure the firm size with number of employees. For the results of the models size is measured by sales, see Appendix D

technology transfer may be considered a two way interaction. Nevertheless, we expect that the imposed lag structure of our model may overcome this issue to some extent.

Export status

Exports: Measured as values, export intensity (as exports to sales ratio) and dummy variables. Whether a firm is an exporter is supposed to affect the technology transfer behavior of the firm for the fact that foreign markets are supposedly more competitive then the local markets. In order to compete with their foreign rivals effectively, local firms are expected to keep up with the most recent technology; which is, as far as the developing economies are concerned, produced within the superior capabilities of foreign economies and needed to be imported. In this context, we expect a positive sign for this variable.

Imported inputs

Measured as both the ratio of firm's value of intermediary good imports to its total expenditures and a dummy variable, which takes the value of 1 if this ratio is positive. Developing countries' customers' choice, may differ from the choice of developed countries' consumers, therefore an enterprise deciding to produce in a developing country may need to transfer technology to fit the needs and preferences of the demand in developing countries. This requirement on new technology may trigger a need for imported inputs. Therefore, we expect a positive sign.

Foreign ownership: Share, dummy

Measured as share of foreign-owned equities and a dummy variable that take the value of 1 if the foreign-owned equity share of the firm exceeds or is equal to 10%. We expect a positive sign or statistically insignificant coefficient. If it is positive, it would mean that as foreign firms would produce with superior technology which is not available domestically they transfer technology. If it is

insignificant, foreign ownership does not effect the decision to transfer technology.

3.1.2.2 Sectoral variables

These variables are calculated at 3 or 4-digit sectoral levels and take the same values for each firm within these sectors. These variables are included as proxies for competition and measurement for horizontal spillovers, both in terms of production costs and spread of knowledge.

Import penetration

Import penetration is a measure for competitions. It is a measure of overall quality and cost of the product that is produced by the sector. Domestic firms in the industry need to compete with those products' quality, which may eventually trigger transfer of better technology. Calculated at 4-digit sectoral level via *[(imports) / (sales+net imports)]* formula. Exchange rate is calculated as the average of monthly exchange rates for 2003, published by Central Bank of Turkey. We expect a positive sign as higher this ratio is, the more the sector is dominated by imports and competition for market share by domestic firms would be an incentive to improve their existing production methods.

Herfindahl Index

Herfindahl index is a measure for market concentration. Higher values of this index indicate a lesser competition in the sector. Calculated at 4-digit sectoral level. We expect a negative correlation between concentration and technology transfer decision of firms. Greater values for Herfindahl Index would reflect less competition and we assume that firms in the same sector would compete with each other in terms of production costs and quality; which could trigger transfer of technology.

Sectoral license expenditure

Total license expenditure of the sector, at 3-digit level. The sign of this variable may be both negative and positive, indicating different conditions. If the sign is positive; due to competition and demonstration effects within an industry, firms choose to transfer technology not to fall back in terms of costs and product quality or variety. If it is negative, it may be interpreted as an indication of weaker protection of intellectual property rights and opportunities for other firms than the contractor to access it.

Share of foreign-owned firms' output

Share of sales of firms with at least 10% foreign-owned equities in total sectoral sales of NACE 1.1 classification, 4-digit industry. Competition originating from foreign firms' production in the industry may trigger transfer of technology.

Sectors: Sector dummies, classification according to technology levels

We ran regressions both with sector dummies with respect to the technology intensity of the sub sector the firm perform within, following OECD's taxonomy[10] (regressions 1, 2 and 3 in Table 4) and with basic sector dummies (NACE 1.1 classification, 2-digit) (regressions 4, 5 and 6 in Table 4).

[10] See Appendix E for OECD technology taxonomy

3.2 Estimation Results

Table 4: Probit Estimations, Results for marginal effects[11]

	(1)	(2)	(3)	(4)	(5)	(6)
	TT DECISION					
SIZE	0.02028	0.02051	0.02405	0.02055	0.02096	0.02451
	(7.85)***	(7.65)***	(9.23)***	(7.88)***	(7.75)***	(9.37)***
(L)WAGE	0.01033	0.01082	0.01306	0.01122	0.01203	0.01411
	(2.09)**	(2.17)**	(2.59)***	(2.30)**	(2.43)**	(2.82)***
(L)CAPINT	0.00118	0.00141	0.00172	0.00122	0.00146	0.00176
	(2.43)**	(2.90)***	(3.48)***	(2.51)**	(3.00)***	(3.57)***
(L)RD	0.00132	0.00144	0.00169	0.00111	0.00123	0.00147
	(2.32)**	(2.50)**	(2.88)***	(1.98)**	(2.16)**	(2.54)**
EXPdum	0.01934			0.01873		
	(3.27)***			(3.17)***		
(L)EXP		0.00187			0.00185	
		(4.79)***			(4.75)***	
EXPINT			0.01565			0.01631
			(1.89)*			(1.92)*
IMPdum	0.02074			0.02227		
	(3.33)***			(3.56)***		
IMPSH		0.00035			0.00042	
		(1.10)			(1.39)	
FORdum	-0.00333			-0.00456		
	(0.33)			(0.47)		
FORSH		0.00004	0.00006		0.00002	0.00004
		(0.30)	(0.41)		(0.15)	(0.27)
IMPPEN	0.00363	0.00380	0.00408	0.00293	0.00306	0.00327
	(2.89)***	(3.05)***	(3.18)***	(2.34)**	(2.45)**	(2.56)**
HERF	0.03580	0.03671	0.03908	0.02465	0.02592	0.03078
	(1.66)*	(1.65)*	(1.73)*	(1.04)	(1.06)	(1.24)
LICSEC	0.000006	0.000006	0.000006	0.000006	0.000006	0.000006
	(2.33)**	(2.32)**	(2.27)**	(1.55)	(1.60)	(1.35)
FDIQS	0.00758	0.00597	0.00451	0.01158	0.01215	0.01074
	(0.53)	(0.41)	(0.30)	(0.72)	(0.74)	(0.64)
HITEK	-0.01345	-0.01088	-0.01164			
	(0.84)	(0.65)	(0.69)			
MEDHITEK	0.00258	0.00380	0.00600			
	(0.36)	(0.52)	(0.79)			
MEDLOWTEK	-0.01214	-0.01268	-0.01234			
	(2.04)**	(2.11)**	(2.02)**			
Pseudo R2	0.08	0.08	0.07	0.09	0.08	0.08
log likelihood	-1873.80	-1880.76	-1892.60	-1861.70	-1869.25	-1881.07
No. of obs.	8643.00	8643.00	8643.00	8643.00	8643.00	8643.00

Absolute value of z statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

[11] Marginal effects are calculated as follows: If the variable is continious, marginal effects are calculated at the variables' means. If the variable is discreete, marginal effect equals to the difference between the marginal effect when the variable is 0 and the marginal effect when the variable is 1.

Size is statistically significant and positively correlated with firm's probability of technology transfer in all models (also in models that measure size with sales, see Appendix D). As discussed before, this result is parallel with our pre-analysis expectations. Technology transfer process is costly and bears risks. Larger firms overcome these more easily. As suggested by our results, an increase of 1 percent in the number of workers would result in a 0.02 point of percentage increase in firm's probability to decide to transfer technology.

We also ran regressions with size dummies to obtain a better idea on the effect of firm size on its technology transfer behaviour (see Appendix F for the results). We created dummies for firms employing more than 25, 50, 150, 250 and 500 workers respectively. According to the results, in each model, each dummy other than DUMsize250 is statistically significant and positively correlated with the dependent variable.

Skill intensity, measured by average wage, is statistically significant and positively correlated with our dependent variable, as expected. %1 increase in average annual wages would result in a 0.01 point of percentage increase in firm's probability to decide to allocate resources to transfer technology.

The sign of capital intensity is also parallel with our expectations. 1% increase in capital intensity, as measured by depreciation per worker, would increase the probability of technology transfer by 0.001 point of percentage.

Firm's R&D expenditure is also a statistically significant determinant of its technology transfer decision. If the firm increases its R&D expenditures by 1%, according to our results, it will be more likely to transfer technology by a factor of slightly greater than 0.001 point of percentage.

Firm's exports play a significant role in its technology transfer decision, according to our findings. Whether it is measured as its value, a dummy

variable, or in ration to its sales, in each model, its coefficient is positive and statistically different from zero. International competition is, then, a major determinant of technology transfer decision of a firm.

Table 5: Foreign-owned firms, %

Sectors		Firms with TT	Firms without TT
15	Food products and beverages	8.64	2.60
17	Textiles	2.92	1.07
18	Wearing apparel	1.28	1.55
19	Leather	0.00	0.00
20	Wood	0.00	1.24
21	Paper	0.00	4.32
22	Printing	14.29	1.30
24	Chemicals	23.54	13.27
25	Rubber and Plastic	4.38	3.80
26	Non-metallic	9.28	2.24
27	Metal	16.93	1.23
28	Fabricated metal	8.28	2.58
29	Machinery and equipment	5.69	2.32
31	Electrical machinery	14.55	4.37
32	Communication equipment	0.00	4.08
33	Medical-precision instruments	0.00	6.59
34	Motor vehicles	15.79	10.91
35	Other transport equipment	0.00	4.87
36	Furniture	7.42	2.09

Source: TURKSTAT Structural Business Statistics 2003

Table 5 presents the shares of foreign-owned firms at two-digit sectoral level. For instance, technology transferring firms in the 15th sector comprise 8.64% of the technology transferring firms in the whole manufacturing sector. Chemicals, metal, motor vehicles, electrical machinery and printing industries are the top five industries with respect to share of foreign-owned firms in all the firms in the industry.

Contrary to our expectations, in none of the models we find a significant relationship between a firm's foreign ownership share and its probability to transfer technology. This may emanate from a number of causes. First, foreign ownership, *ceteris paribus*, may actually have negligible effect on firms' technology transfer decision. Second, foreign firms may not have declared their

expenditure on technology transfers completely. A final interpretation, and in our opinion more likely than the previous two, may be that foreign firms import technology not via means we are capable of capturing by our model. These may include bringing skilled human resources with them and investing in novel machinery (embodied technology transfer), so that their expenditure on technology transfer may not have been captured by TURKSAT's survey. Moreover, foreign firms may transfer technology directly from the headquarters; which may be completely identical to copying an internal document for the enterprise. If this is the case, our findings do not support one major claim of proponents of FDI that proposes positive spillovers from their production.

Table 6: Probit regressions solely with foreign ownership variables

	(1)	(2)	(3)	(4)
	TT Decision			
FORSH		0.00059		0.00058
		(4.39)***		(4.37)***
FORdum	0.05743		0.05747	
	(4.17)***		(4.17)***	
IMPPEN	0.00375	0.00375	0.00323	0.00324
	(2.74)***	(2.75)***	(2.32)**	(2.33)**
HERF	0.07575	0.07663	0.07330	0.07403
	(3.21)***	(3.25)***	(2.78)***	(2.81)***
SECLIC	0.00000	0.00000	0.00000	0.00000
	(3.05)***	(2.94)***	(2.58)***	(2.44)**
FDIQS	0.02532	0.02463	0.03180	0.03083
	(1.59)	(1.54)	(1.73)*	(1.68)*
HITEK	-0.00485	-0.00506		
	(0.26)	(0.28)		
MEDHITEK	0.00471	0.00491		
	(0.61)	(0.63)		
MEDLOWTEK	-0.01422	-0.01424		
	(2.20)**	(2.20)**		
Pseudo R2	0.02	0.02	0.02	0.02
log likelihood	-2005.77	-2004.70	-1997.17	-1996.13
No. of obs.	8643	8643	8643	8643

Nevertheless, we ran the regressions just with foreign ownership and sector-specific variables on the right-hand side and technology transfer decision on the left side. The results are presented in Table 6. Contrary to our model's suggestion, foreign ownership variables turn out to be significant. This may be resulting from relatively high correlations between size, export behaviour, skilled worker proxy, capital intensity and R&D expenditure variables and foreign ownership (see Appendix G for correlation matrix). In other words, compared to local firms foreign firms are larger, export more, more capital intensive, use relatively more skilled worker and finally conduct more R&D.

Among our 4 sector-level variables, the only one the coefficient of which is never significant is, supporting the above finding on foreign firms, ratio of foreign firms' sectoral output to total sectoral output. If any spillovers by competition or any other means had emerged, this sectoral variable should have captured it. Hence, according to our findings, foreign firm's presence does not have any statistically significant effects on domestic firms' technology transfer behaviour, directly or indirectly.

And finally being in medium-low tech sector, compared to low tech sector, has a significant negative effect on technology transfer decision.

CONCLUSION

Acquisition of technology by developing countries is not a trivial issue. It requires considerable planning and investment. Enterprises in developing economies have to spend a great amount of time and investment to fit imported technology to local conditions. Moreover, owing to tacitness, transferring it altogether is not possible. Even if it was, the task of the developing countries cannot be reduced to solely adapting imported technology to their local conditions. Even the technology supplying side unveils the technology completely, which does not seem very much like the case, developing countries would always inferior or *old* technology than the frontier.

As far as the orthodox approach on international technology transfer and foreign direct investment is concerned, foreign firms are supposed to bring novel technology and eventually, through spillovers, positive externalities originated from foreign firms' domestic production would spread to whole economy. However, our analysis is consistent with there is a vast amount of studies proving otherwise

In out thesis, we analyzed the determinants technology transfer of developing counties' firms through the sample of Turkish manufacturing industries. One major outcome of our study may be suggested that foreign ownership does not affect disembodied technology transfer decision of the firm. In other words, *ceteris paribus,* being foreign-owned has insignificant effect on firms' technology transfer decision. Moreover, our sectoral variable, foreign firms' share in total sectoral output, which proxies for vertical spillovers, is statistically equal to zero; which is consistent with our firm level variables for foreign ownership. As opposed to the proponents of technology transfer and FDI in any form, our study is one more contribution, however minor, to the

literature that suggests effects of FDI are not automatic and always beneficial to developing economies.

The governments of developing countries, since developing economies are mostly SME dominant structures, should form intermediary bodies which will act as agents to minimize these costs of the transfer and reinforce firms overcome the initial large costs of technology transfer agreements. To get the most out of technology transfer, the governments should increase the "absortbtive capacity" of local economy, which must be over a specific level to benefit from foreign investment (Blomstrom 1991). The term refers to the general technological capability of the host economy, the major component of which is a well educated workforce. In the absence of such workforce, the spillover effects of direct foreign investment would remain limited at best. This mentioned "education" includes not solely schooling but also inter-industry skills building and life long education. Therefore, what is meant in this respect is a well planned "human resource development" policy.

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APPENDIX A

EXPLANATION

1. Background

Beginning from 2002, Business Statistics were produced with regard to European Council decision No 58/97 accepted in 20/12/1996 (EC, Euratom)

2. Purpose

- To determine changes of the country's social and economic structure and to follow structure of enterprises in the industry and service sector which constitutes important part of national economy,
- To compile enterprise based data to determine structure of the sectors,
- To obtain guiding knowledge about economic and social measures that will be taken by decision maker and to produce data for various researches,
- To make available international statistical comparisons,
- To compile sector based data compatible with EU Structural Business Statistics regulations.

3. Coverage

3.1 Geographical Coverage

Regardless of the population size all province and district centers and municipalities are covered inside the border of the Turkey.

3.2 Sectoral Coverage

Sectors given below constitute coverage of 2006 Annual Industry and Service Statistics included in Statistical Classification of Economic Activities in the European Community NACE Rev.1.1.
(C) Mining and quarrying
(D) Manufacturing
(E) Electricity, gas and water supply

(F) Construction
(G) Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods
(H) Hotels and restaurants
(I) Transport, storage and communicatio
(K) Real estate, renting and business activities (M) Education
(N) Health and social work
(O) Other community, social and personal service activities

Agricultural sector mentioned in economy activity branches is not covered.
3.3 Statistical Unit
The statiscial unit of surveys on Annual Industry and Service Statistics is enterprise.
Enterprise: An enterprise is an organizational unit that produces goods and services using decision autonomy concerning allocation of resources. An enterprise is real or legal personality that produces goods and services on the market by carrying out one or more activities at one or more locations. The relation between enterprise and legal unit is directly stated by this definition:"An enterprise corresponds to a legal unit or combination of legal units." **Local Unit:** Local unit is an enterprise or part thereof carrying out activities corresponding to goods and services situated in a geographically identified place. Local unit is a part of enterprise that has a geographically defined address like center of the enterprise, office, store, canteen, factory, workshop, mine, construction site, hotel, restaurant, cafe, school, hospital, and depot. At or from this place economic activity is carried out for which one or more persons work full time or part time for one enterprise. The center of the enterprise is also a local unit.
3.4 Source of Address
Business Registers are used for Annual Industry and Service Statistics Survey as a frame.
4. Method
While compiling 2006 Annual Industry and Service Statistics both full enumeration and sampling methods are used. Since the aim is to produce information on the basis of local unit and enterprise, for the enterprises having more than 20 employees, full enumeration; for the enterprises having less than 20 employees, sampling method is used.
4.1 Sample Plan
Coverage: All the enterprises and their local units are covered by sectoral coverage.
Sampling framework: Business Registers are used as a frame for the 2006 Annual Industry and Service Statistics study.
Sampling unit: Sampling unit is enterprise. An enterprise can be constituted by either more than one local unit or only one local unit. In case of the enterprise constituted by only one local unit, this local unit is enterprise itself.
Observation unit: Enterprise
Analysis unit: Enterprise
Estimation dimension: The aim of Annual Industry and Service Statistics is to produce information based on enterprise and the local unit. For all sectors, in terms of enterprise NACE Rev. 1.1 (4-digit) class level and in terms of local units NACE Rev. 1.1 (2-digit) division level regional estimations are planned to be reached.
Full enumeration limits: After estimation dimensions and the structure of the sectors are taken into consideration during the studies of Annual Industry and Service Statistics, Full enumeration limits are determined as follows:

- All enterprises having more than 20 employees,
- In terms of sectors, some activities according to NACE Rev. 1.1 (4-digit) class level are covered by full enumeration.

Sampling method: Stratified simple random sampling method is used in the 2006 Annual Industry and Service Statistics study. The enterprises which have the activity mentioned in the coverage are taken from the Business Register and prepared a base for both for the sampling and full enurmeration part. As a size class number of persons employed has been used.

Sample space and selection of sample: Since the aim of Annual Industry and Service Statistics study is to produce estimations in terms of enterprise on the basis of NACE Rev. 1.1 (2-digit) division level for Turkey and at the level of Turkey while determining the volume of sample, these criteria are taken into consideration.

Sub framework constructed for all sectors are divided into the NACE Rev.1.1 (2-digit) division level stratum meeting the estimations and the distinction of sample space of NACE Rev.1.1 (4-digit) class level is realized with compromised allocation method. The aim of this allocation is to reach optimum distribution providing desirable level of estimations. Allocation to stratum by compromised allocation is done as follows:

$$n_h = \tilde{n} [K^2 + (1- K^2) M_h^2]^{1/2}$$

$\tilde{n}$ = Average sample space per section

$$M_h = N_h / (N / h) = h.W_h$$

K = Relative importance

$n_{min} = K.\tilde{n}$ Sample space per the smallest section

h = Number of stratum

The sample space in determined number also in the smallest stratum is guaranteed by this allocation method. Therefore, stratums in which very few the number of units i.e enterprises that identified as stuctural in system were taken full enumeration. In sector while considering cost and labour force, sample space is determined with $n_{min}= 3$ and sampling is done with a probability proportional to size of sample space. The level of estimation is formed from the total of the stratum so n_{min} is kept small.

Estimations and notations: Enterprises are sampled from the strata with systematic sampling method. The total n unit sampling from each stratum has a probability P_i is defined selection probability. The selection probability of sampling unit in any stratum is written as below:

$$P_{hi} = \frac{n_h}{N_h}$$

S = Sum of the sizes occurring in the data population

h = Number of stratum in the discussed size group (number of activity code)

i = Indice of enterprises

n_h = h. number of sampling unit in the stratum

N_h = h. number of total units in the stratum

The estimation ($\hat{Y}$) of any characteristic (y) provided by the sum of the products of the inverse of selection probabilities multiplied by the selected units.

$$\hat{Y}_h = \sum_i \left({}^{y_{hi}}\!/_{p_{hi}} \right) = \sum_i \frac{N_h}{n_h} y_{hi}$$

For the ($\hat{Y}$) total estimate variance in the stratum h formula is given below:

$$v\left(\hat{Y}_h\right) = N_h{}^2 v\left(\bar{y}_h\right) = N_h{}^2 \left[\sum \left(y_i - \bar{y}_h\right)^2 / \left(n_h - 1\right)\right]$$

The National Total is obtained from these estimations on the base of strata by using general rules of strata sampling. Sector total of any characteristic is:

$$\hat{Y} = \sum_h \hat{Y}_h$$

The variance about total estimation is

$$v\left(\hat{Y}\right) = \sum_h v\left(\hat{Y}_h\right)$$

4.2 Field Operation Period

The field operation of 2006 Annual Industry and Service Statistics Surveys were done by the methods of face to face, in September- December 2007.

5. Definitions and Concepts

Number of enterprises: The number of enterprises is count of all units that active at the sectors in coverage of Annual Industry and Service Statistics during the reference period.

Number of local units: The number of local units is count of units that get into the act depending on the active enterprises during the reference period. Local units must be included even if they have no paid employees. This statistic should include all units active during at least a part of the reference period.

Number of persons employed: This value is obtained by adding the annual average number of owners, partners and unpaid family workers and apprentices active in the enterprise to the annual average number of employees.

Number of employees: The number of employees is count of persons who work for an employer and who have a contract of employment and receive compensation in the form of wages, salaries, fees, gratuities, piecework pay or remuneration in kind.

In particular the following are considered as employees: • Paid working proprietors, • Students who have a formal commitment whereby they contribute to the unit's process of production in return for remuneration and/or education services, • Employees engaged under a contract specifically designed to encourage the recruitment of unemployed persons by public authorities or another organizations, • Homeworkers if there is an explicit agreement that the homeworker is remunerated on the basis of the work done and they are included on the pay-roll,
Number of part-time employees: Part-time workers are persons whose usual hours of work are less than the normal working hours. Part-time employees (duration of work less than the norm) and intermittent/seasonal employees (who may work full time but for a fixed short period, e.g. temporary workers, film crew etc.) should not be confused.
Number of apprentices : All employees who do not participate fully in the production process of the unit because they are working under an apprentice's contract or because the fact that they are undertaking vocational training impinges significantly on their productivity are included in this variable.
The number of employees converted into full time equivalents (FTE): Figures for the number of persons working less than the standard working time of a full-year full-time worker, should be converted into full time equivalents, with regard to the working time of a full-time full-year employee in the unit.
Number of hours worked by employees: The number of hours worked by employees represents the aggregate number of hours actually worked for the output of the observation unit during the reference period.
Personel cost: This value is obtained by adding the gross payments made to personel and social security costs.
Wages and salaries: Wages and salaries are defined as 'the total remuneration, in cash or in kind, payable to all persons counted on the payroll (including homeworkers), in return for work done during the accounting period'.

Social security costs: Employers' social security costs is the value of social contributions undertaken by employers in order to provide social security for their employees.
Turnover: Turnover is the total of the sales of goods and services invoiced by the observation unit during the reference period.
Production value: The production value is monetary value of the amount actually produced by the unit, based on sales, including changes in stocks and the resale of goods and services.
Value-added at factor cost: Value-added at factor cost is the gross income from operating activities after adjusting for operating subsidies and indirect taxes.
Total purchases of goods and services: Purchases of goods and services include the value of all goods and services purchased during the accounting period for resale or consumption in the production process, excluding capital goods the consumption of which is registered as consumption of fixed capital.
Change in stocks of goods and services: Change in stocks (positive or negative) is the difference between the value of the stocks at the end and the beginning of the reference period. Change in stocks may be measured by the value of entries into stocks less the value of withdrawals and the value of any recurrent losses of goods held in stocks. Stocks are recorded at purchaser's prices exclusive of VAT if they are purchased from another unit, otherwise at production cost.
Change in stocks of goods and services purchased for resale in the same condition as received: This variable is defined as the change in stocks at purchaser's prices exclusive of VAT between the end and the beginning of the reference period. The change in stocks may be measured by the value of entries into stocks of products purchased for resale less the value of withdrawals and the value of any recurrent losses of goods held in stocks.
Change in stocks of finished products and work in progress manufactured by the unit: This variable is defined as the change in the value of the stocks of finished products or in the course of production, which have been produced by the unit and which have not yet been sold, between the first and last days of the reference period.
Gross investment in tangible goods: Investment during the reference period in all tangible goods. **Gross investment in land:** Included under this variable, in addition to land, are underground deposits, forests and inland waters. Where land is purchased with existing buildings and the value of the two components is not separable, the total is recorded under this heading if it is estimated

that the value of the land exceeds the value of the existing buildings. If the existing buildings are estimated to be of greater value than the land, the total is recorded under gross investment in existing buildings and structures.

Gross investment in existing buildings and structures: The investment includes the cost of the existing buildings and structures which have been acquired during the reference period. Where land is purchased with existing buildings and the value of the two components is not separable, the total is recorded under this heading if it is estimated that the value of the existing buildings exceeds the value of the land. If the land is estimated to be of greater value than the existing buildings, the total is recorded under gross investment in land.

Gross investment in construction and alteration of buildings: This variable covers expenditure during the reference period on the construction or conversion of buildings. Purchases of new buildings that have never been used are included. Also included are all additions, alterations, improvements and renovations which prolong the service life or increase the productive capacity of buildings.

Included are permanent installations such as water supply, central heating, air conditioning, lighting etc. as well as construction expenditure related to oil wells (drilling), operational mines, pipe lines, power transmission lines, gas-pipes, railway lines, port installations, roads, bridges, viaducts, drains and other site improvements. Current maintenance costs are excluded.

Gross investment in machinery and equipment: This variable covers machinery (office machines, etc.), special vehicles used on the premises, other machinery and equipment, all vehicles and boats used off the premises, i.e. motor cars, commercial vehicles and lorries as well as special vehicles of all types, boats, railway wagons, etc. acquired new or second hand during the reference period.

6. Classifications

The classification of esterprises by type of activity is determined in accordance with the Statistical Classification of Economic Activities in the European Community. (NACE Rev.1.1)

APPENDIX B

TURKISH REPUPLIC
PRIME MINISTRY
NATIONAL INSTITUTE
OF STATISTICS

2003
STRUCTURAL BUSINESS STATISTICS
ENTERPRISE
QUESTIONNAIRE FORM

Confidentiality

Data collected in this questionnaire is for statistical purposes only and is entirely CONFIDENTIAL. Disclosure of individual information is prohibited by Law No. 59 and decree law No. 219.

Aim

Statistics produced by this questionnnaire will be used in; preparation of development plans and national programme, estimation of national income, observation of changes in the economic and social structure of Turkey, responding international data requests, enabling international comparisons and providing a source for various studies.

Coverage

The questionnaire will be filled out for all sectors. If there is more than one local unit belonging to the enterprise, information requested seperately for each local unit will be recorded under Section 14.

Methodology

This questionnaire should be filled exhaustively, covering all the requested information, a copy should be kept for own records, and the original should be submitted to an official of The National Institute of Statistics. The questionnaire should be filled, at head office of the enterprise, so that all of the units of the enterprise that have the same tax register number are covered.

In case of incompleteness, incorrectness or non response, adequate legal proceedings will urgently get under way regarding the owners and responsibles of the enterprise.

I request that the needed action be taken according to our guidelines, and wish for our good relations to continue, in hope of success in your business.

With respects,

Doç. Dr. Ömer DEMİR
Head of Institute

FOR INFORMATION CALL:

PROVINCE	AREA CODE	TELEPHONE	FAX	PROVINCE	AREA CODE	TELEPHONE	FAX
ADANA	322	457 65 56	457 64 19	KARS	474	223 26 02	223 58 41
ANKARA	312	425 38 43	425 34 18	KASTAMONU	366	215 50 92	215 50 89
ANTALYA	242	243 45 61	243 45 62	KAYSERİ	352	221 31 22	221 31 25
BALIKESİR	266	244 99 45	244 90 23	KOCAELİ	262	321 52 86	322 44 25
BURSA	224	361 75 25	361 84 88	KONYA	332	353 25 60	350 16 40
DENİZLİ	258	265 54 43	265 54 40	MALATYA	422	323 06 64	323 07 84
DİYARBAKIR	412	223 80 24	223 87 14	MANİSA	236	236 21 70	236 21 72
EDİRNE	284	225 31 47	212 03 51	NEVŞEHİR	384	212 82 23	212 82 24
ERZURUM	442	235 20 15	234 40 32	SAMSUN	362	431 25 08	432 50 88
GAZİANTEP	342	336 94 00	336 16 22	SİİRT	484	223 49 00	223 28 77
HATAY	326	216 70 40	216 70 78	TRABZON	462	321 57 49	322 57 44
İSTANBUL	212	258 66 26	258 36 76	VAN	432	214 25 11	216 30 06
İZMİR	232	483 14 54	483 70 81	ZONGULDAK	372	253 79 70	253 71 28

Turkish Prime Ministry State Institute of Statistics
Department of Agricultural and Industrial Statistics (312) 410 04 01, 410 04 08

web site : http://www.yapisal.die.gov.tr **e-mail : yapisal@die.gov.tr**

ADDRESS STICKER

SAMPLE NO:

SECTION 1 : NAME, ADDRESS AND LEGAL STATUS OF THE ENTERPRISE

1. Legal name _____

2. Signboard name _____

Is the address printed on the cover page correct? ☐ **Yes (go to question 4)** ☐ **No (correct below)**

3.Address of the head office of the enterprise :

3.1 Province

3.2. County

3.3. Subdistrict

3.4. Village

3.5. Quarter

3.6. District

3.7. Mark type and print name

Type Square ☐ Bolivard ☐ Avenue ☐ Street ☐ Group ☐

Name

3.8. If the place printed above cannot be identified by its own, print the related place below

Type Square ☐ Bolivard ☐ Avenue ☐ Street ☐ Group ☐

Name

3.9. Street number

3.10. Door number

3.11. Postal code

3.12. Phone

3.13. Fax

3.14. E-mail

4. Mark the option that defines the legal status of your enterprise for the end of year 2003

Individual proprietorship	Ordinary partnership	General partnership	Joint stock	Limited	Incorporated	Cooperative	Other	Please explain
☐	☐	☐	☐	☐	☐	☐	☐	

SECTION 2 : MAIN ACTIVITY AND SECONDARY ACTIVITIES OF ENTERPRISE

Mark the sectors which can be considered as the activity of the enterprise.

1 ☐ **Mining and Quarrying**
Example: Hardcoal mining, sand and gravel mining, chemical mineral mining

2 ☐ **Manufacturing Industry**
Example: Cotton woving manufacturing, grain manufacturing, aluminum production, isolated wire and cable production

3 ☐ **Production and distribution of electricity, gas and water**
Example: **Production of electricity**, purification and distribution of water, production and distribution of gas.

4 ☐ **Construction**
Example: Demolition of buildings; excavation, roof covering and building frames, sanitary installation, paint and glass works

5 ☐ **Wholesale Trade**
Example: Wholesale of cleaning agents, wholesale of textile products, wholesale of glass and paint.

6 ☐ **Retail Trade,Repair of Personal and Home Appliances**
Example: Retail trade of meat products, retail trade of medical products, repair of electrical home appliances, watches and shoes.

7 ☐ **Transportation, Storage, Communication**
Example: Passenger transportation by road, transportation by sea, cargo and delivery activities, storage and silo services.

8 ☐ **Financial Intermediation Activities**
Example: Activities regarding insurance and pension funds, leasing services, exchange office

9 ☐ **Renting of property and Business Activities**
Example: **Real estate**, rent a car, jurisprudence, accounting, advertising, business and management advisory services, translation services

10 ☐ **Education**
Example: Driving lessons, technical and professional education services

11 ☐ **Health and Social Services**
Example: Hospital services, Social services for homeless, veterinarian, dentist

12 ☐ **Other Social and Personal Services**
Example: Movie theaters, fairs and themepark activities, management of sports fields and stadiums, barber shops, turkish baths, saunas

13 ☐ **Hotels, Restaurants, Cafés and Pastries**
Example: **Hotels with restaurants**, pastries, pubs and cafés, canteens

14 ☐ **Sale, Repair and Maintenance of motor vehicles and motorcycles; retail trade of motor vehicle fuels**
Example: Gas stations, sale of spare car parts

Print in detail the main activity conducted in the sector in which the enterprise has the highest turnover amongst the sectors marked above, similar to the examples under the sector names.

* **Main Activitiy** :If the enterprise conducts more than one activity, the main activity is the one that generates the highest portion of the gross sales revenues. If more than one activity generates the same portion of the gross sales revenues, the main activity is the one in which more people are employed.

SECTION 3 : EMPLOYMENT, HOURS WORKED AND PAYMENTS

3.1. Employees, Owners and Shareholders in 2003

Months		Employees	Owners, shareholders and unpaid family workers (Exclude shareholders not working actively)
1. February			
2. May			
3. August			
4. November			
5. **TOTAL** (Sum of the 4 months above)			
6. **AVERAGE** = TOTAL / 4 (Round to nearest integer.)			
7. Annual average number of male and female employees	Fmale		
	Male		

Employees : The number of employees is defined as those persons who work for an employer and who have a contract of employment and receive compensation in the form of wages, salaries, fees, quantities, piecework pay or renumaration in kind. The number of employees includes part time workers, seasonal workers, persons on strike or a short term leave, but persons on long-term leave are excluded. Meanwhile voluntary workers are not included.

Owners and Shareholders: It consists of owners and partners who spend most of the working time in an individual proprietorship, simple partnership, general partnership or limited liability company. If owners and partners receive wages and salaries for their labour, they are included in the employee category.

Unpaid family workers: It includes persons who live with the owner of unit or regularly work for the unit but who have not a contract and not receive wages and salaries in kind. Persons who work as a permanent staff in other place of employment are excluded.

8. Average number of employees in manufacturing if manufacturing activity is conducted within the enterprise	
9. Annual average number of employees of the subcontractor if the enterprise employs other enterprises' personnel as subcontractors	

3.2. Average number of employees with the qualities listed below in 2003

Qualities	Average Number of Employees
1. Number of R&D personnel	
2. Number of paid apprentices and trainees	
3. Number of part-time employees	
3.1. Weekly work period of part-time employees	..... Hours
4. Number of paid homeworkers listed in the payroll	

R&D Personnel: Persons directly employed in R&D and managers, administrators, secretaries and like that directly providing service to R&D.

Paid trainees and apprentices: Persons that are inexperienced and are learning a profession or work under supervision of an expert.

Part-time employees: Persons with total working hours less than 70% of the normal monthly or weekly working hours within the unit. This definition covers all of the part-time work types (half-day, once a week etc.)

3.3. Paid hours worked in 2003

If total paid hours worked **can** be calculated :

1. Total paid hours worked in the year	

If total paid hours worked **cannot** be calculated :

2. Working hours of one paid employee per week	

Total paid hours worked in the year: Total number of hours worked by paid employees indicates the actual hours worked for the output of the observation unit during the reference period.

3.4. Gross payments to employees in 2003

1. Gross payments to personnel. (Employers contributions to social security and compensations excluded)	**000 000 TL**
2. Social security contribution of employer: SSK, Bağkur, Emekli Sandığı, unemployment insurance and other social security expenditure. **(Only employers share)**	**000 000 TL**
3. Denunciation compensation	**000 000 TL**
4. Seniority compensation	**000 000 TL**
5. Total personnel cost	**000 000 TL**

Gross payments to personnel: Payments such as gross wages, salaries, allowances, overtime payments, social contributions, bonuses, premiums, compensations etc in cash or in kind. (Excludes employers contributions to social security and denunciation and seniority compensations).

Social security cost : Employers' social security costs equals to the social contributions undertaken by the employer to secure the employees' rights to social benefits.

Denunciation Compensation: Amount paid to personnel by the employer for not conforming to articles regarding informing of annulment in the agreement.

Seniority Compensation: Amount paid by the employer to the personnel who has worked for the enterprise for a certain period of time and whose service agreement has ended with conditions laid out in law of business.

SECTION 4 : EXPENDITURE IN 2003 *(EXCLUDING VAT)*

Total annual expenditure of the enterprise, excluding personnel costs	**000 000 TL**

Details of total expenditure

1. Expenditure on equipment, raw and auxiliary materials purchased to be used in production of goods and services.*	000 000 TL
2. Expenditure on goods purchased to be sold without further processing (trading goods)	000 000 TL
3. Purchase of electricity	000 000 TL
4. Expenditure on fuels(heat, steam and hot water expenditure included, electricity excluded)	000 000 TL
5. Payments made to employment agencies and similar organizations	000 000 TL
6. Rent expenditure of the enterprise	000 000 TL
7. Rent expenditure of machinery and equipment	000 000 TL
8. Payments made to subcontracted firms	000 000 TL
9. Payments made for production subcontracted to third parties	000 000 TL
10. Financial expenditure (interest, exchange rate and credit commissions)	000 000 TL
11. Expenditure not covered by items 1-10 (Communication, transportation, water, advertisement, marketing, small repairs, insurance etc. all other expenditure	000 000 TL

(*) Fuel costs of vehicles belonging to enterprises whose main activity is transportation will be recorded here.

SECTION 5 : INCOME IN 2003 *(EXCLUDING VAT, SCT AND DISCOUNTS AND REFUNDS)*

Annual total income of enterprise (Turnover) (Discounts and refunds deducted, subsidies and end of year stocks excluded.)	**000 000 TL**

Details of total income (turnover)(Income from subcontracts included)

1. Income from sales of manufacturing industry's production	000 000 TL
2. Income from building constuction activities (installation work included)	000 000 TL
3. Income from civil engineering activities (installation work included)	000 000 TL
4. Income from mining and quarrying activities	000 000 TL
5. Income from electricity, gas and water activities	000 000 TL
6. Income from repair and maintenance of motor vehicles and motorcycles; repair of personal and home appliances	000 000 TL
7. Income form wholesale trade (sale of trading goods)	000 000 TL
8. Income from retail trade (sale of trading goods), and sales of motor vehicles, motorcycles and their fuel	000 000 TL
9. Income from intermediation activities (Agency-car commissioners, commissions obtained by Fruit and Vegetable Commissioners etc)	000 000 TL
10. Income from educational service activities	000 000 TL
11. Income from health and social service activities	000 000 TL
12. Income from service activities (excluding health and education)	000 000 TL
13. Income from transportation and storage activities (agency and commission income in transportation sector will be included here)	000 000 TL
14. Income from activities of hotels-restaurants-cafés etc.	000 000 TL
15. Income from mail and telecommunication activities	000 000 TL
16. Income from agricultural activities	000 000 TL
17. Rent income of the enterprise	000 000 TL
18. Financial income (interest, exchange rate and credit commissions)	000 000 TL
19. Income not covered by items 1-18 (Subsidies excluded)	000 000 TL

Subsidies and subcontractor activities

20. Subsidies received	000 000 TL
21. Part of above income obtained from work subcontracted to your enterprise	000 000 TL
22. Part of income obtained from work subcontracted to third parties	000 000 TL

SECTION 6 : STOCKS IN 2003 *(EXCLUDING VAT)*

	BEGINNING OF YEAR	END OF YEAR
1. Value of raw materials, auxiliary materials and fuel stocks	000 000 TL	000 000 TL
2. Value of semi-finished product stocks. (Value of goods still in production and not ready for sale)	000 000 TL	000 000 TL
3. Value of product stocks	000 000 TL	000 000 TL
4. Value of stocks of goods purchased to be sold without further porcessing (Trading goods)	000 000 TL	000 000 TL

SECTION 7. IMPORTS AND EXPORTS IN 2003 *(EXCLUDING VAT)*

	EXPORTS	IMPORTS
1. Import/export value of goods	000 000 TL	000 000 TL
2. Import/export value of services	000 000 TL	000 000 TL

SECTION 8: INVESTMENT IN FIXED CAPITAL, SALES AND DEPRECIATION IN 2003 *(EXCLUDING VAT)*

SECTION 8: FIXED CAPITAL INVESTMENT, SALE AND FIXED CAPITAL EXPENDITURE IN 2003 (EXCLUDING VAT)	Purchase value (million TL)	Billed amount in 2003 resulting from leasing (million TL)	Value of new fixed asset production, large scale repair and changes done by own personnel (million TL)	Total (million TL)
1. Investment in tangible goods				
1.1 Land and estate, land and estate improvement				
1.2 Building and civil engineering structures.				
1.3 Large scale repair and changes in existing building and civil engineering structures				
1.4 Transportation vehicle, machinery and equipment, computers				
1.5 Office equipment and furniture as office stock				
1.6 Large scale repair, maintenance and restoratrion (excluding ones in building and civil engineering structures)				
1.7 Pollution control installations, equipment and special pollution preventing accessories				
1.8 Technological cleaning equipment				
1.9 Investment in other tangible goods not included in lines 1.1- 1.8				
1.10 Total investment in tangible goods				
2. Investment in intangible goods				
2.1 Computer software				
2.2 Licence, trademark, patent right etc.				
2.3 Intangible investments not included in lines 2.1 and 2.2				
2.4 Total intangible investments				
3. Total investments (1.10 + 2.4).				

4. VAT paid for fixed capital purchases in 2003	000 000 TL		
5. Value of fixed capital sales in 2003	000 000 TL	**6. Depreciations allocated in 2003**	000 000 TL

SECTION 9: INSTALLED MOTORS, IF THE ENTERPRISE HAS ACTIVITIES IN MANUFACTURING INDUSTRY OR MINING SECTORS

	COUNT	TOTAL POWER
1.Electricity motors		HP (*)
2. Generators		Kw
3. Others (excluding ones linked to generators; steam machinery, diesel engines, gasogen engines, water turbines and wheels)		HP (*)

(*) 1 KW = 1.34 HP

SECTION 10: CAPITAL SHARES OF ENTERPRISE AT THE END OF 2003

	Shares (%)
1. Share of domestic real or judicial persons subject to special laws	
2. Share of public institutions and establishments	
3. Share of foreign capital	
TOTAL	100

If foreign share exists go to question 3.1.

3.1 Country of foreign shareholder	Share (%)
1.	
2.	
3.	

3.2. Country of origin of the partner with largest share that makes up the base capital of the foreign company with the largest share.

SECTION 11: RESEARCH AND DEVELOPMENT EXPENDITURE OF ENTERPRISE

1. Cost of R&D personnel in 2003 (all payments such as gross wages, insurance etc.)	000 000 TL

2. R&D investment expenditure in 2003	000 000 TL
3. In-house R&D expenditure (excluding personnel costs)	000 000 TL
4. External R&D expenditure	000 000 TL

SECTION 12 : VALUE ADDED AND OTHER INDIRECT TAXES REALIZED IN 2003	
1. Paid value added tax for activities of enterprise (the VAT amount calculated to be paid being greater than VAT amount to be deducted **[calculated amount-amount to be deducted]**)	000 000 TL
2. Value added tax refunded for activities of enterprise (VAT amount to be deducted being greater than calculated VAT amount **[amount to be deducted - calculated amount]**)	000 000 TL
3. Indirect taxes realised linked to production, goods and services (VAT and SCT excluded, real estate tax, other fees etc.	000 000 TL

SECTION 13: TAX REGISTRATION NUMBER AND NAME OF TAX OFFICE OF ENTERPRISE	
1. Tax registration number of enterprise	
2. Name of tax office	

SECTION 14: INFORMATION REGARDING LOCAL UNITS IN 2003 (*Branches, shops etc.)*

How many units in different addresses, including the head office, does the enterprise have?

- If no unit exists apart from the head office do not fill in this part.

- If units exist in more than one address, print the information regarding the head office in line 1.

No	Province in which the local unit is active	What is the main activity of the local unit? (Fill in according to guidelines in Section 2)	Annual average number of persons employed*	Share of local unit in total gross payments to employees (%)	Share of local unit in total annual turnover (%)	Production value of the local unit in 2003 if it was active in manufacturing, construction, mining, electricity, gas or water sectors (million TL)	Share of local unit in investments to tangible goods (Section 8, line 1.10) (%)	Type of local unit: office, shop, kiosk, factory, workshop, construction yard, hotel, café, mine, school etc.
1								
2								
3								
4								
5								
6								
7								
..								
..								
14								
15								
16								
17								
18								
19								
20								
	TOTAL		*	100	100		100	

* Should be equal to total number of persons employed in Section 3 question 3.1.

NOTE: If the number of local units of enterprise is higher than 20, this table should be copied and filled in the same format.

	RESPONDENT	INQUIRER	CONTROLLER
Name			
Date			
Signature			
Title			
Phone no			

Data entry staff

APPENDIX C

Results for Tobit Regression

	(1)	(2)	(3)	(4)	(5)	(6)
SIZE	0.00012	0.00012	0.00015	0.00012	0.00013	0.00015
	(6.27)***	(6.11)***	(7.50)***	(6.41)***	(6.33)***	(7.68)***
(L)WAGE	0.00008	0.00008	0.00010	0.00009	0.00009	0.00011
	(2.29)**	(2.24)**	(2.71)***	(2.44)**	(2.42)**	(2.85)***
(L)CAPINT	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
	(1.83)*	(2.25)**	(2.82)***	(1.98)**	(2.42)**	(2.98)***
(L)RD	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
	(1.91)*	(2.11)**	(2.48)**	(1.63)	(1.81)*	(2.17)**
(L)EXP		0.00001			0.00001	
		(4.78)***			(4.54)***	
IMPSH		0.00000			0.00000	
		(0.36)			(0.47)	
FORSH		0.00000	0.00000		0.00000	0.00000
		(0.86)	(0.95)		(0.69)	(0.79)
EXPINT			0.00009			0.00009
			(1.47)			(1.35)
EXPdum	0.00015			0.00013		
	(3.37)***			(3.13)***		
IMPdum	0.00014			0.00014		
	(3.07)***			(3.20)***		
FORdum	0.00001			-0.00001		
	(0.07)			(0.09)		
IMPPEN1	0.00003	0.00003	0.00003	0.00003	0.00003	0.00003
	(3.05)***	(3.12)***	(3.30)***	(2.65)***	(2.70)***	(2.85)***
HERF	0.00020	0.00021	0.00022	0.00019	0.00021	0.00024
	(1.15)	(1.24)	(1.24)	(1.08)	(1.18)	(1.30)
LICSEC	0.000006	0.000006	0.000006	0.000006	0.000006	0.000006
	(1.02)	(1.04)	(0.91)	(1.03)	(1.09)	(0.84)
FDIQS	0.00010	0.00009	0.00008	0.00012	0.00012	0.00011
	(0.94)	(0.82)	(0.71)	(1.04)	(1.03)	(0.94)
HITEK	0.00006	0.00009	0.00009			
	(0.43)	(0.60)	(0.61)			
MEDHITEK	0.00001	0.00001	0.00003			
	(0.11)	(0.25)	(0.51)			
MEDLOWTEK	-0.00007	-0.00007	-0.00007			
	(1.60)	(1.65)*	(1.61)			
Constant	-0.00271	-0.00271	-0.00294	-0.00278	-0.00276	-0.00297
	(8.99)***	(8.91)***	(9.45)***	(7.83)***	(7.68)***	(8.09)***
Pseudo R2	-0.70	-0.67	-0.61	-0.75	-0.72	-0.67
log likelihood	327.11	321.84	310.33	337.61	331.96	321.36
No. of obs.	8643	8643	8643	8643	8643	8643

APPENDIX D

Probit estimations (marginal effects), firms size measured with sales

	(1)	(2)	(3)	(4)	(5)	(6)
	TT Decision					
Lsales	0.01599	0.01694	0.01899	0.01645	0.01745	0.01972
	(7.95)***	(7.96)***	(9.77)***	(8.11)***	(8.13)***	(10.05)***
Lwage	0.00244	0.00112	0.00268	0.00394	0.00298	0.00426
	(0.48)	(0.21)	(0.51)	(0.79)	(0.58)	(0.83)
Lcapint1	0.00079	0.00101	0.00114	0.00084	0.00106	0.00120
	(1.67)*	(2.12)**	(2.39)**	(1.79)*	(2.25)**	(2.52)**
LARGE	0.00146	0.00153	0.00178	0.00126	0.00134	0.00154
	(2.62)***	(2.72)***	(3.11)***	(2.29)**	(2.41)**	(2.74)***
LIHRACAT		0.00178			0.00165	
		(4.65)***			(4.26)***	
ithgidpay		-0.00047			-0.00034	
		(1.27)			(1.00)	
yabanci		0.00002	0.00002		-0.00000	-0.00001
		(0.17)	(0.13)		(0.01)	(0.05)
expint			0.01709			0.01391
			(2.13)**			(1.65)*
DUMexp	0.01873			0.01702		
	(3.22)***			(2.93)***		
DUMith	0.01733			0.01846		
	(2.81)***			(3.01)***		
DUMfor	-0.00527			-0.00658		
	(0.54)			(0.69)		
IMPPEN1	0.00354	0.00365	0.00389	0.00271	0.00279	0.00295
	(2.83)***	(2.92)***	(3.07)***	(2.20)**	(2.25)**	(2.34)**
HERFINDAHL	0.03139	0.03562	0.03411	0.02987	0.03412	0.03613
	(1.46)	(1.63)	(1.53)	(1.29)	(1.44)	(1.50)
lisans3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	(2.36)**	(2.34)**	(2.33)**	(1.97)**	(1.94)*	(1.85)*
fdiqs	0.00623	0.00445	0.00296	0.01459	0.01465	0.01387
	(0.43)	(0.30)	(0.20)	(0.91)	(0.90)	(0.84)
DUMHITEK	-0.01071	-0.00753	-0.00815			
	(0.65)	(0.44)	(0.47)			
MEDHITEK	0.00383	0.00547	0.00778			
	(0.53)	(0.74)	(1.03)			
MEDLOWTEK	-0.01184	-0.01166	-0.01146			
	(2.01)**	(1.96)*	(1.90)*			
Pseudo R2	0.08	0.08	0.08	0.09	0.09	0.08
log likelihood	-1872.00	-1877.38	-1886.80	-1859.33	-1865.66	-1873.91
No. of obs.	8643.00	8643.00	8643.00	8643.00	8643.00	8643.00

APPENDIX E

Classification according to technology densities

High-technology manufacturing industries	**NACE rev. 1**
Manufacture of pharmaceuticals, medicinalchemicals and botanical products	244
Manufacture of office machinery and computers	30
Manufacture of radio, television and communication equipment and apparatus	32
Manufacture of medical, precision and optical instruments, watches and clocks	33
Manufacture of aircraft and spacecraft	353
Medium-high-technology manufacturing industries	
Manufacture of chemicals and chemical products (excl. Manufacture of pharmaceuticals, medicinal chemicals and botanical products)	24 excl. 244
Manufacture of machinery and equipment n.e.c.	29
Manufacture of electrical machinery and apparatus n.e.c.	31
Manufacture of motor vehicles, trailers and semi-trailers	34
Manufacture of railway and tramway locomotives and rolling stock	352
Manufacture of motorcycles and bicycles	354
Manufacture of other transport equipment n.e.c.	355
Medium-low-technology manufacturing industries	
Manufacture of coke, refined petroleum products and nuclear fuel	23
Manufacture of rubber and plastic products	25
Manufacture of other non-metallic mineral products	26
Manufacture of basic metals	27
Manufacture of fabricated metal products except machinery and equipment	28
Building and repairing of ships and boats	351
Low-technology manufacturing industries	
Manufacture of food products and beverages	15
Manufacture of tobacco products	16
Manufacture of textiles	17
Manufacture of wearing apparel; dressing and dyeing of fur	18
Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	19

Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	20
Manufacture of pulp, paper and paper products	21
Publishing, printing and reproduction of recorded media	22
Manufacture of furniture; manufacturing n.e.c.	36
Recycling	37

APPENDIX F

Probit estimation for marginal effects with size dummies

	(1)	(2)	(3)	(4)	(5)	(6)
	TT Decision					
DUMsize25	0.01526	0.01580	0.01847	0.01530	0.01593	0.01857
	(1.75)*	(1.80)*	(2.11)**	(1.78)*	(1.84)*	(2.15)**
DUMsize50	0.01216	0.01353	0.01699	0.01235	0.01386	0.01730
	(2.03)**	(2.25)**	(2.80)***	(2.09)**	(2.33)**	(2.88)***
DUMsize150	0.01909	0.01945	0.02361	0.01909	0.01979	0.02395
	(2.08)**	(2.09)**	(2.47)**	(2.10)**	(2.14)**	(2.53)**
DUMsize250	0.01773	0.01855	0.01865	0.01855	0.01944	0.01956
	(1.53)	(1.58)	(1.57)	(1.61)	(1.66)*	(1.65)*
DUMsize500	0.02730	0.02278	0.02769	0.02638	0.02190	0.02701
	(2.04)**	(1.72)*	(2.02)**	(2.01)**	(1.68)*	(2.00)**
LIHRACAT		0.00188			0.00187	
		(4.83)***			(4.80)***	
IMPSH		0.00035			0.00042	
		(1.13)			(1.41)	
FORSH		0.00005	0.00006		0.00003	0.00004
		(0.35)	(0.47)		(0.20)	(0.33)
EXPINT			0.01535			0.01615
			(1.85)*			(1.90)*
(L)WAGE	0.01054	0.01103	0.01345	0.01150	0.01231	0.01458
	(2.14)**	(2.23)**	(2.69)***	(2.36)**	(2.50)**	(2.93)***
(L)CAPINT	0.00118	0.00141	0.00171	0.00122	0.00145	0.00176
	(2.41)**	(2.89)***	(3.48)***	(2.50)**	(2.98)***	(3.57)***
(L)RD	0.00132	0.00146	0.00173	0.00112	0.00125	0.00152
	(2.32)**	(2.53)**	(2.95)***	(2.00)**	(2.21)**	(2.64)***
EXPdum	0.01936			0.01881		
	(3.28)***			(3.18)***		
IMPdum	0.02124			0.02273		
	(3.39)***			(3.61)***		
FORdum	-0.00273			-0.00402		
	(0.27)			(0.41)		
IMPPEN	0.00365	0.00381	0.00410	0.00294	0.00306	0.00329
	(2.92)***	(3.07)***	(3.22)***	(2.36)**	(2.47)**	(2.59)***
HERF	0.03550	0.03698	0.03972	0.02515	0.02706	0.03239
	(1.64)	(1.67)*	(1.77)*	(1.06)	(1.11)	(1.31)
LICSEC	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
	(2.21)**	(2.21)**	(2.15)**	(1.50)	(1.56)	(1.31)
FDIQS	0.00793	0.00650	0.00515	0.01133	0.01220	0.01088
	(0.55)	(0.44)	(0.34)	(0.70)	(0.74)	(0.65)
HITEK	-0.01258	-0.00997	-0.01076			
	(0.78)	(0.60)	(0.64)			
MEDHITEK	0.00247	0.00365	0.00571			
	(0.34)	(0.50)	(0.75)			
MEDLOWTEK	-0.01224	-0.01283	-0.01260			
	(2.06)**	(2.14)**	(2.07)**			
Pseudo R2	0.08	0.08	0.07	0.09	0.09	0.08
log lik.	-1871.60	-1878.63	-1890.75	-1859.90	-1867.45	-1879.60
No.obs.	8643.00	8643.00	8643.00	8643.00	8643.00	8643.00

APPENDIX G

Correlation matrix

	SIZE	LEXP	IMPSH	FORSH	EXPINT	LWAGE	LCAPINT	LRDEXP	IMPPEN1	HERF	LICSEC	FDIQS	DUMexp	DUMith
LEXP	0.3922	1.0000												
IMPSH	0.0669	0.1831	1.0000											
FORSH	0.1935	0.1536	0.0608	1.0000										
EXPINT	0.2396	0.6750	0.0620	0.0980	1.0000									
LWAGE	0.3638	0.2654	0.0436	0.3820	0.0860	1.0000								
LCAPINT	0.1913	0.2298	0.0931	0.1055	0.1209	0.2573	1.0000							
LRDEXP	0.2592	0.1861	0.0451	0.1027	0.0452	0.2517	0.1303	1.0000						
IMPPEN1	-0.0231	0.0291	0.0017	0.0021	0.0111	-0.0095	-0.0115	-0.0082	1.0000					
HERF	0.0404	0.0210	0.0680	0.0802	-0.0718	0.1859	0.0490	0.1103	-0.0502	1.0000				
LICSEC	0.0739	0.0270	-0.0062	0.1355	-0.0048	0.1540	0.0280	0.0708	-0.0466	-0.0958	1.0000			
FDIQS	0.0731	0.0693	0.0209	0.1906	-0.0238	0.2248	0.0722	0.1641	0.0369	0.1869	0.2531	1.0000		
EXPdum	0.2877	0.9668	0.1561	0.1121	0.5591	0.2085	0.2051	0.1574	0.0348	0.0211	0.0262	0.0657	1.0000	
IMPdum	0.3667	0.5374	0.3222	0.1737	0.2557	0.3248	0.2820	0.2133	0.0329	0.0693	0.0508	0.0960	0.5050	1.0000
FORdum	0.2125	0.1688	0.0626	0.9219	0.1051	0.3840	0.1088	0.1161	0.0043	0.0907	0.1120	0.1867	0.1237	0.1870