Düsseldorf Institute
for Competition Economics

DISCUSSION PAPER

No 21

A Spatial Approach to Measure Productivity Spillovers of Foreign Affiliated Firms in Turkish Manufacturing Industries

Mehmet Karaçuka
A. Nazif Catik

May 2011

HEINRICH HEINE
UNIVERSITÄT DÜSSELDORF

IMPRINT

DICE DISCUSSION PAPER

Published by
Heinrich-Heine-Universität Düsseldorf, Department of Economics, Düsseldorf Institute for Competition Economics (DICE), Universitätsstraße 1, 40225 Düsseldorf, Germany

Editor:

Prof. Dr. Hans-Theo Normann
Düsseldorf Institute for Competition Economics (DICE)
Phone: +49(0) 211-81-15125, e-mail: normann@dice.uni-duesseldorf.de

DICE DISCUSSION PAPER

ISSN 2190-9938 (online) – ISBN 978-3-86304-020-8

A SPATIAL APPROACH TO MEASURE PRODUCTIVITY SPILLOVERS OF FOREIGN AFFILIATED FIRMS IN TURKISH MANUFACTURING INDUSTRIES

Mehmet Karaçuka*
(Corresponding Author)
Department of Economics
Ege University
35040 Bornova / Izmir
mehmet.karacuka@ege.edu.tr

A.Nazif Catik
Department of Economics
Ege University
35040 Bornova / Izmir
a.nazif.catik@ege.edu.tr

May 2011

ABSTRACT

In this paper we aim to analyze the productivity spillovers of foreign affiliated and domestic firms in Turkish manufacturing industries. As a novelty inter-sectoral linkages are modeled through the use of spatial models. Our results indicate the existence of positive and significant productivity spillovers among the neighborhood firms. We also find that an increase in the share of foreign affiliated firms in a given industry has positive impact on the productivity level of vertically related industries. However, our results do not provide any clear evidence that domestic firms benefit from the foreign affiliated firms either operating in the same industry or in the neighborhood industries. The findings suggest that unlike the effects of foreign affiliated firms, research and development expenditures significantly contribute to the productivity levels of domestic firms.

JEL Classifications: JEL C31, J24, O14, O33.

Keywords: Productivity, foreign direct investment, research and development, spatial econometrics.

* This paper has been completed during a stay of the author as a Guest Scholar at Heinrich Heine Universität Düsseldorf, Düsseldorf Institute for Competition Economics (DICE), with a scholarship from the Turkish Council of Higher Education. The author thanks both institutions for providing the opportunity to benefit from the inspiring academic surrounding at DICE. We are also grateful for comments and suggestions of two anonymous referees. A revised version of this paper will be published in: *The Journal of Developing Areas.*

INTRODUCTION

Foreign direct investment (FDI) by definition (OECD, 2008: 40), reflects "the objective of establishing a lasting interest" between an investor in one country and a firm/enterprise in another country. In this definition, the lasting interest implies "a significant degree of influence on the management of the enterprise". The effects of FDI on both recipient and receiving countries have long been in debate and although there is some level of consensus in theoretical expectations that FDI should encourage economic performance, the empirical evidence is controversial. FDI theories argue that the main contributions on the host countries occur via productivity spillovers from foreign affiliates to domestic firms within this long lasting interest (Lall, 1978, 1997).

The main channels of such spillovers are labor turnovers, imitation of the superior technology by the local firms; increasing competition, and commercial ties between foreign and domestic firms (Blomström and Kokko, 1998). The first two channels, which are also called as demonstration effects, allow domestic firms to learn superior production technologies through simply observing the activities of the transnational corporations (TNCs) affiliates (Teece, 1977; Blomström and Kokko, 1998; Fosfuri, Motta, and Ronde, 2001). The effect of increasing competition occurs through the efficiency gains of domestic firms that are forced to compete with the TNCs. However, foreign entry into an industry may also lead to a fall in the number of firms when less efficient domestic firms cannot compete and shut down. The last channel, commercial ties, defined as backward and forward linkages among foreign affiliates and domestic firms, is considered to be most crucial channel both for the magnitude and the direction of productivity spillovers (see, Blomstörm and Kokko, 1998; Barkley and McNamara, 1994). Despite these arguments favoring the role of FDI on the host economies, TNCs, like all the firms, may be tended to keep information and technology within the firm and prevent the knowledge leakages to the competing firms (Alfaro, Chanda, Kalemli-Ozcan and Sayek, 2010). In this case, the expected spillovers can be limited to vertical interactions, mainly by knowledge transfer to the suppliers.

Even though theoretical expectations on the positive effects of FDI dominate the literature, empirics are controversial. Blomstrom and Kokko (2003), in their survey, point out the fact that spillovers are not automatic, and local conditions influence firms' adoption of foreign technologies and skills, as the diverse findings propose in the literature. However, there might be growth effects without spillovers just from the operation of foreign firms, which can be analyzed in terms of the impact of FDI on a country's output or growth. For example, Ramírez, M. D. (2006) finds that FDI has a positive and significant effect on private capital formation for Latin America countries the years 1981-2000, and argues that FDI is an important factor to increase the marginal productivity of private capital via the transfer of more advanced technology and managerial know-how. However, the macro empirical literature testing the growth effects of aggregate FDI flows for a broad cross-section of countries, emphasize on the absorptive capacity of the host economies. Borensztein, De Gregorio, and Lee (1998) show that FDI promotes higher growth only when the host country has a minimum threshold of stock of human capital. Alfaro, Chanda, Kalemli-Ozcan and Sayek (2004) provide evidence that financial development of a country is closely related to the growth effect of FDI on host countries. Blomstrom, Lipsey, and Zejan (1994) argue that FDI affects growth when the country is above some income level threshold. In a recent study covering 45 countries, Wijweera, Villano and Dollery (2010) find that FDI inflows exert a positive impact on economic growth only in the presence of a highly skilled labor. Balasubramanyam, Salisu, and Dapsoford (1996) find that openness is essential to benefit from the growth effects of FDI. However, Carkovic and Levine (2002) find that FDI does not exert a reliable, positive impact on economic growth in their panel study after controlling the endogeneity problem that might have arisen in macro level analysis. Görg and Strobl (2001) also show that the results differ according to data and estimation method employed in various studies.

Along with the methodological concerns such as omitted variables and simultaneity bias; the nature of the production linkages have led an increase in micro level studies to obtain more robust results on the effects of FDI as the data become available. However, the empirical literature presents the same diversity for the spillover effects of foreign affiliated firms on domestic firms in the host countries. Girma and Görg (2007) show that foreign firms are more productive than domestic firms in the U.K. and this leaves a space for spillovers even in developed countries. Haskel, Pereira and Slaughter (200†), also find that increases in foreign shares of the industries have positive effects on total factor productivity of domestic plants in U.K. Blomström and Sjöholm also (1999) find positive spillovers for Indonesia. Although their results support a previous study on Mexico (Blomström and Persson,1983), Aitken and Harrison (1999) criticise these studies for ignoring the fixed effects and they show that FDI can cause negative spillovers as they find for Venezuelan manufacturing firms, through competition effect. Barrios and Strobl (2002) support the importance of firm-industry fixed effects and find positive spillovers of foreign presence on domestic ones.

The diversity of the results in the empirical literature can be attributed to the usage of different levels of aggregation in the data, however, another important factor is the country and firm specific characteristics that limit the spillover effects. The main factors that limit these effects are accentuated as the technological gap between the foreign and domestic firms, absorptive capacity of domestic firms, degree of complementarity and ownership and entry mode of the FDI (Barrios and Strobl, 2002; Lipsey and Sjöholm, 2005). For instance, Smarzynska and Spatareanu (2008) find that the projects with joint domestic and foreign ownership are associated with positive productivity spillovers but no such effect is found for wholly owned foreign subsidiaries in Romanian case. This finding is explained by the less sophisticated technology of the TNCs in their joint projects that in turn may reduce the knowledge gap between foreign affiliates and domestic firms.

Based on the literature briefly discussed above, we aim to analyze the spillover effects of foreign affiliated firms on domestic firms in Turkish manufacturing industries. These spillovers, if any, are expected to occur through the interactions of domestic and foreign firms via sectoral and inter-sectoral linkages. So far limited number of studies is conducted on the empirical investigation of inter-sectoral linkages generated by FDI, mainly due to the lack of appropriate data. The most cited studies; Blalock (2001) on

Indonesia and Smarzynska-Javorcik (2004) on Lithuania empirically show that backward linkages are important channels that lead to productivity spillovers on domestic firms. For Turkey, Lenger and Taymaz (2006) find that foreign firms induce innovativeness of domestic suppliers in medium and high technology sectors, whereas they find a negative impact on the upstream sectors.

In this paper we extend the recent empirical literature on backward linkages of FDI, by employing spatial estimation methods. Following the recent improvements on spatial empirical techniques; intersectoral backward linkages are modeled through the use of Spatial Autoregressive (SAR) and Spatial Error (SEM) models. The main advantage of spatial techniques is that they allow us to introduce interdependencies of productivity levels among the sectors, which have not been systematically analyzed by the previous studies. In order to establish relationship among the sectors, we used a weight matrix obtained from the input-output table. Considering simultaneity bias arising from the models with weighted dependent variables, we employ maximum likelihood estimation techniques proposed by Elhorst (2003).

This paper is organized as follows. In the following section we briefly summarize the recent developments on foreign direct investment and R&D expenditures in Turkish manufacturing industries. Empirical models are presented in the third section. Section four contains description of the data and estimation results. Finally given the empirical findings, some conclusions are put forward in the last section.

THE EVOLUTION OF FOREIGN DIRECT INVESTMENT AND R&D EXPENDITURES IN TURKEY

Foreign direct investment inflows are considered as a crucial factor to increase employment, capital accumulation and technology for developing countries. Turkey, like many others has been increasingly adopting pro-investment measures in order to attract more multinational companies. Turkey has long been considered as under-performing in attracting FDI, despite its regional competitive advantages (Loewendhal and Ertugal-

Loewendhal, 2001). The efforts has been accelarated especially within the recovery packages as a response to the destruction of economic crisis of 2001, and increased the pace after the privatization programme of the new government, which also endured a certain amount of political stabilization.

As Figure 1 shows, FDI inflows and the number of foreign affiliated firms (FAFs) increased substantially after 2004, due to the political stability and the new FDI regime along with the privatization efforts by the recent government. Annual FDI inflows reached to 11 billion $ on average that put Turkey in top 20 in the ranking of countries that attract largest FDI after 2004.

[Insert Figure 1 about here]

Although Turkey has started to get greater shares of international investment and more transnational firms have been investing in Turkey, the essential benefit of these investments depend on the increases in productivity and technological development in the local economy. Acquiring technology via international investments of TNCs requires some level absorptive capacity in the domestic economy, but it is also critical that TNCs, as the main actors of innovation and knowledge, should also be engaging in technological activities in the host countries. TNCs account for the vast majority of private expenditures on R&D, however the bulk is undertaken by the parent firms and, when located abroad, mostly in developed countries (UNCTAD, 1999, 11; UNCTAD, 2005, 120). Although there is a trend towards the internationalization of R&D into the developing countries, R&D is still among the least internationalized segments of the TNCs' value chain. For instance R&D expenditure abroad by foreign affiliates of United States parent companies constituted only 13.5 % for developing countries, and concentrated mostly in five countries (China, Singapore, Brazil, Mexico and the Republic of Korea) accounting for 70% of the total R&D expenditure of United States TNCs in developing countries in 2002 (UNCTAD, 2005, 130).

As an indicator of the role of foreign institutions on technological innovation in the host countries, the number of U.S. Patent and Trademark Office patents granted to foreign institutions in selected developing countries between 2001 and 2003 are presented in Figure 2. The number of patents given to foreign institutions in Turkey is relatively small and reflects the limited amount of technological capacity of foreign firms in Turkey.

[Insert Figure 2 about here]

The main indicators of domestic and foreign affiliated firms in Turkish manufacturing industries in 2001 are presented in Table 1 with the ISIC Rev 2 codes (see Appendix Table A1 for the list of the industries). Gross investment and total output values are given in Turkish Lira (TL). Although in terms of the number of firms, the highest share of foreign affiliated firms (FAFs) is in other manufacturing industry (39), the share of this industry group (less than 1%) is negligible in total. The second highest ratio is manufacture of chemical and petroleum products (35) where FAFs constitutes 8.3 % of the industry. Manufacture of fabricated metal products, machinery and equipment (38) has the highest shares of foreign affiliated firms in sectoral output (70 %) and employment (21 %). The manufacture of chemical and petroleum products (35) follows closely (38). However the ratio of gross investment in output of FFAs is highest (6.34 %) for manufacture food beverages and tobacco (31), excluding other manufacturing industries (39). FFAs have the lowest gross investment ratio (0.1 %) in the manufacture of wood products (33), in which the domestic firms have the highest (21.09 %). FFAs have higher ratios than the domestic firms in industry groups, (31), (32), (35) and (39) in terms of investments per output.

[Insert Table 1 about here]

Evolution of total R&D expenditures of domestic and foreign affiliated firms between 1992 and 2001 is depicted in Figure 3. In general R&D expenditures in manufacturing industries show an increasing trend until 1999, but nearly decreased by half in 2001 due to the contractionary effects of November 2000-February 2001 financial crises. When the shares of domestic and foreign affiliated firms are compared, one can see that except for 1998 domestic firms allocated more resources on R&D.

[Insert Figure 3 about here]

R&D expenditures of foreign affiliated firms are mainly concentrated on medium-high-technology industries (see OECD (2003) for technological classification of the industries). The manufacturing of transport equipment and electrical machinery constitutes the highest foreign share in terms of R&D (see Figure 4). When domestic firms are considered, except for the manufacture of industrial chemicals, R&D expenditures are mainly intensified on low-technology industries. Manufacture of textile wearing apparel and leather, classified as one of the low-technology industries by OECD, is the most attractive industry in terms of R&D investments. R&D attractiveness of other low-technology industries, such as industrial chemicals and food manufacturing sectors are also remarkable.

[Insert Figure 4 about here]

It can be seen that R&D expenditures of both domestic and foreign affiliated firms cluster in specific industries. Although these figures do not directly provide any information on the technological superiority, based on the theoretical explanations on FDI, foreign affiliated firms are assumed to be employing superior technologies in order to penetrate into the domestic markets. If this is the case, we expect that spillover effects occur via inter and intra sectoral linkages among domestic and foreign firms. In the next section we introduce our model to measure the spillover effects of R&D expenditures and foreign affiliated firms in Turkish manufacturing industries through inter-sectoral linkages.

MODEL

In order to analyze the spillover effects in Turkish manufacturing industries we start from the following form of Cobb-Douglas production function, in line with the previous literature.

$$q_{it} = \alpha_i + \beta k_{it} + \delta rd_{it} + \gamma\, fshare_{it} + u_{it} \qquad (1)$$

Where q_{it} represents average labor productivity (*Q/L*), where *Q* represents value added in given sectors. k_{it} and rd_{it} denote capital (*K/L*) and research and development expenditure per labor (*RD/L*) respectively. $fshare_{it}$ is the share of value added of foreign affiliated firms in industry *i*, and u_{it} is *i.i.d.* error term. All variables are in natural log form.

Serious weakness of the model in (1) is that it ignores possible existence of neighborhood effects (inter-sectoral linkages) among the sectors in the estimation process. Exclusion of such kind of interactions may lead to biased estimation results, therefore those relations have to be incorporated to eliminate specification bias resulting from the omission of relevant variables. Anselin (1988) has proposed two different spatial econometric models, Spatial Autoregressive (SAR) and Spatial Error (SEM), to take the effects of spatial heterogeneity into account. In SAR models spatial interactions are reflected by the inclusion of spatially weighted dependent variable as an explanatory variable. In our model, sectors are treated in a spatial context, and hence neighborhood relationships are defined by the degree of inter-sectoral linkages. In this case equation (1) can be reformulated as follows:

$$q_{it} = \alpha_i + \beta k_{it} + \delta rd_{it} + \gamma\, fshare_{it} + \rho W q_{it} + u_{it} \qquad (2)$$

where Wq_{it} refers to the spatial lagged productivity levels obtained through multiplying the sectoral productivities with spatial weight matrix (W). ρ measures existence and strength of spatial interaction, in our case positive and significant ρ can be interpreted as an evidence for positive productivity spillover among the firms. Another way to incorporate spatial interaction is the use of SEM models, where spatial dependence is reflected through the spatially weighted error terms.

$$q_{it} = \alpha_i + \beta k_{it} + \delta rd_{it} + \gamma\, fshare_{it} + u_{it} \qquad (3)$$

$$u_{it} = \lambda W u_{it} + \varepsilon_{it} \qquad \text{where } \varepsilon_{it} \sim N(0, \sigma^2 I_n)$$

In the above model interactions among the sectors are mirrored by the off-diagonal elements of variance covariance matrix of residuals. Spillover effects measured by means of spatially weighted dependent variable in SAR models implies that change in productivity level of a given sector depends on the productivity of the contiguity sectors. Although SEM models are able to detect existence of such spatial interactions, it fails to identify the possible sources of spillovers. Therefore in order to determine what kind of factors, R&D or foreign share, play significant roles, spatial models are also estimated with the spatial lags of explanatory variables. This model is referred as a Spatial Durbin Model (SDM) by Anselin (1988) since its similarity with the one suggested by Durbin used to obtain a model corrected for residual autocorrelation in time series analysis. In this case SAR model can be rewritten as follows

$$q_{it} = \alpha_i + \beta\varphi k_{it} + \phi Wrd_{it} + \psi Wfshare_{it} + \rho Wq_{it} + u_{it} \qquad (4)$$

and the SEM Model is given by

$$q_{it} = \alpha_i + \beta k_{it} + \phi Wrd_{it} + \psi Wfshare_{it} + u_{it} \qquad (5)$$

$$u_{it} = \lambda Wu_{it} + \varepsilon_{it} \qquad \text{where } \varepsilon_{it} \sim N(0,\sigma^2 I_n)$$

Estimation of spatial models using OLS method may lead inconsistent results with the spatial models. For instance in a SAR model inclusion of spatial lag term may lead to simultaneity problem and OLS would fail to give unbiased and consistent parameter estimations. Likewise classical assumptions of OLS do not hold for variance covariance matrix of residuals of the SEM models; since off-diagonal elements of that matrix are used as a tool for the detection of spatial dependence. In contrast, maximum likelihood provides consistent estimates for those models (Lee, 2004). Anselin (1988) proposed some estimation techniques based on maximum likelihood, but since that time much of the spatial econometric studies have avoided the use of this estimation method due to its computational difficulties. However Elhorst (2003) has introduced several maximum likelihood techniques in the estimation of spatial panel data models. In this paper we will estimate our models by employing these techniques (1).

DATA AND ESTIMATION RESULTS

DATA

We use annual panel data of Turkish manufacturing industries including 20 sectors covering the period from 1992 to 2001. All data are obtained from Turkish State Institute of Statistics. Estimation sample is determined by the availability of number of the data on sectors attracting foreign direct investment and research and development expenditures. *q* and *rd* are real values deflated by GNP deflator; labor is measured by total working hours whereas capital is horse power of engines at sectoral level. Table 2 presents the correlation coefficients between the variables.

[Insert Table 2 about here]

The construction of weight matrix has great importance in the estimation of spatial econometric models. In order to illustrate spillover effects among the sectors, a weight matrix is obtained from the input output table of 1998. Since the weight matrix has always zeros on the main diagonal by definition, those elements of the matrix is restricted to zero, hence only the effects of neighborhood sectors are taken into consideration. We use sectoral correspondents obtained from OECD (2003) to make comparable sectors of input output table with the data on manufacturing industry. Weight matrix obtained from this procedure is normalized with respect rows to define inter-sectoral neighborhood.

4.2 Estimation Results

Our estimation procedure consists of two steps. First, to detect spillovers within the same industry we estimated the variants of equation (1) using the data of whole manufacturing industries, foreign affiliated and domestic firms. In the second step spatial effects are introduced to measure whether sectoral linkages play any role in explaining productivity differences by SAR and SEM models.

[Insert Table 3 about here]

Conventional panel data estimates [(2)] are given in Table 3. The signs of all parameters are in line with the theoretical predictions except for *fshare* in the regressions regarding the domestic firms presented in the columns from (5) to (8).. The coefficient of this variable is negative and insignificant for domestic firms. This finding suggests that there are no significant horizontal spillovers of foreign affiliated firms on domestic firms.

On the other hand, the significant and positive sign obtained for the whole manufacturing industry suggests that an increase in the share of foreign affiliates effects productivity level of the whole industry in a positive manner.

[Insert Table 4 about here]

The results obtained from spatial models for the whole manufacturing firms are shown in Table 4. First we note that inclusion of spatial contiguity among the sectors improves the fit of the model, as observed by the decrease in the standard errors of regressions and also rise in log-likehood statistics. Second,, spatial coefficient for the SAR (ρ) and SEM models (λ), are positive and significant, suggesting the positive productivity spillovers among the neighborhood sectors. Conventional panel data models neglect that kind of productivity dependencies which may cause misleading results in the estimations.

[Insert Table 5 about here]

Spatial estimates for domestic and foreign affiliated firms are presented in Table 5. The results support the finding that domestic firms do not benefit from the increase of foreign share in the same industry. We find that the share of foreign affiliates has little explanatory power for domestic firms. The sign of this coefficient is negative and insignificant for all spatial models (see columns from (1) to (8)). The evidence on the significant positive effect of foreign share on the whole industries can be explained by the interaction among the foreign firms, as observed by the significant and positive spatial lag and spatial autocorrelation parameters in the columns (9) to (12) in Table 5.

[Insert Table 6 about here]

Table 6 illustrates the estimation results for the whole manufacturing industries when the spatially lagged R&D expenditures and foreign share variables are included within the SDM model. The parameter of the spatially weighted R&D and foreign share variables are both positive and significant, suggesting the existence of spillovers when the whole domestic and foreign firms are taken together. However when the firms are analyzed separately in Table 7, the effects of foreign share both in the own and neighborhood industries is still insignificant for domestic firms.

[Insert Table 7 about here]

Unlike the effects of foreign share, R&D expenditures create positive spillovers for domestic firms both in the same and neighborhood industries. On the other hand the results do not provide any significant effect of R&D expenditures on the productivity levels of foreign affiliated firms. This finding can be attributed to the fact that foreign affiliated firms have smaller R&D shares compared to the domestic firms for the period under analysis. It can be also argued that even though foreign firms may bring along superior technologies, this is not revealed to the domestic firms significantly to create significant spillovers.

CONCLUSION

In this paper we aim to analyze productivity spillover effects of foreign affiliated firms and R&D expenditures in Turkish manufacturing industries. Spatial models are employed to construct the neighborhood relations among the sectors. Our estimates indicate the existence of positive and significant productivity spillovers among the neighborhood industries. In other words, productivity levels of the neighborhood industries are interdependent.

Even though an increase in the share of foreign affiliated firms contributes positively to the productivity levels of the whole manufacturing industries, it has no significant effect on the productivity of the domestic firms operating in the same industry. These results confirm the previous findings that there is no horizontal FDI spillover to the domestic firms in Turkey (see Lenger and Taymaz, 2006). In terms of vertical spillovers which are measured by the spatially lagged share of foreign affiliated firms, we obtain qualitatively the same results. We also find that R&D expenditures significantly contribute to the productivity levels of domestic firms, when spatially lagged R&D expenditures are included. This finding means that an increase in the R&D expenditures affects positively the productivity levels of domestic firms both in the same and the neighborhood industries.

The absence of R&D spillovers for foreign affiliated firms can be attributed to low level of R&D expenditures. UNCTAD (2005) reports that Turkey is ranked as one of the least attractive countries in terms of R&D expenditures of TNCs, and the amount of R&D expenditures of foreign affiliated firms has been declining in the recent years.

The first policy implication of the study is that more incentives should be given to boost innovative capabilities of the domestic firms. Secondly, policy measures should be taken to increase R&D activities of foreign affiliated firms and to attract more R&D oriented foreign firms. Due to the spillover effects these policies will not only affect the supported firms but also the firms in the same and neighborhood industries. The interaction possibilities between the domestic and foreign affiliated firms should be also encouraged, which in turn may give incentives to the foreign firms to share their firm specific capabilities.

ENDNOTES

1. Detailed information on the estimation of spatial econometric models by maximum likelihood is provided by Elhorst (2003). In spatial estimates we have utilised Spatial

Econometrics Toolbox developed by Le Sage, it's available on http://www.spatial-econometrics.com/ .

2. We followed the conventional steps in panel data estimations. First the model is estimated in both pooled and fixed effect form, and then to make a decision between those models Breush-Pagan test is conducted. In case of selection of fixed effects model over pooled model, we estimate the model using random effect. Decision between fixed and random effect is determined by Haussman specification test.

APPENDIX

TABLE A1. ISIC REV 2 MANUFACTURING INDUSTRY CLASSIFICATION

31 - Food, beverages and tobacco	353- Petroleum refineries
311- Food manufacturing	354- Miscellaneous products of petroleum and coal
312- Foot products n.e.c.	355- Rubber products
313 - Beverage industries	356- Plastic products n.e.c.
314- Tobacco manufactures	36- Non-metallic mineral products except products of petroleum and cool
32- Textile, wearing apparel and leather industries	361-Pottery, china and earthenware
321- Textiles	362 – Glass and glass products
322 - Wearing apparel, except footwear	369 – Other non-metallic mineral products
323 - Leather and products of leather, leather substitutes and fur, except footwear and wearing apparel	37 - Basic metal industries
324 - Footwear, except vulcanize or moulded rubber of plastic footwear	371 - Iron and steel basic industries
33 - Wood and wood, products including furnish	372 - Non-ferrous metal basic industries
331 - Wood and wood cork products, except furniture	38 - Fabricated metal products, machinery and equipment, transport equipment, professional and scientific and measuring and controlling equipment
332 - Furniture and fixtures, except primarily of metal	381 - Fabricated metal products except machinery and equipment
34 - Paper products, printing and publishing	382 - Machinery (except electrical)
341 - Paper and paper products	383 - Electrical machinery, apparatus, repairing , appliances and supplies
342 - Printing, publishing and allied industries	384 - Transport equipment
35 - Chemicals and of chemical petroleum, coal, rubber and plastic products	385 - Professional, scientific measuring and controlling equipment n.e.c. and photographic and optical goods
351 - Industrial chemicals	39 - Other manufacturing industries
352 - Other chemical products	

REFERENCES

Aitken, B., and Harrison, A. E. (1999), Do Domestic Firms Benefit from Direct Foreign Investment? Evidence from Venezuela, *American Economic Review*, 89 (3), 605-618.

Alfaro, L., Chanda A., Kalemli-Ozcan, S. and Sayek, S. (2004) FDI and economic growth: the role of local financial markets, *Journal of International Economics*, 64(1), 89-112.

Alfaro, L., Chanda A., Kalemli-Ozcan, S. and Sayek, S. (2010), Does Foreign Direct Investment Promote Growth? Exploring the Role of Financial Markets on Linkages, *Journal of Development Economics*, 91 (2), 242-256.

Anselin, L. (1988) *Spatial Econometrics: Methods and Models*, Dordrect, The Netherlands: Kluwer.

Balasubramanyam, V. N., Salisu, M., and Dapsoford, D. (1996) Foreign Direct Investment and Growth in EP and IS Countries, *Economic Journal*, 106, 92-105.

Barrios, S. and Strobl E. (2002), Foreign Direct Investment and Productivity Spillovers: Evidence from the Spanish Experience, *Weltwirtschaftliches Archiv*, 138 (3), 459-481.

Barkley, D.L. and McNamara K.T. (1994) Local input linkages: A comparison of foreign-owned and domestic manufacturers in Georgia and South Carolina, *Regional Studies*, 28, 725-737.

Blalock, G. and Gertler P. (2001) *Technology from Foreign Direct Investment: Strategic Transfer through Supply Chains*, Haas School of Business, University of California, Berkeley.

Blomström M. and Kokko A. (1998), Multinational Corporations and Spillovers, *Journal of Economic Surveys*, 12, 247-277.

Blomström M. and Kokko A. (2003), *The Economics of Foreign Direct Investment Incentives*, NBER Working Paper Series No. w9489.

Blomstörm, M., R.E. Lipsey, and Zejan, M. (1992) *What explains developing country growth?* , NBER Working Paper Series No. 4132.

Blomstrom, M. and Persson, H. (1983), Foreign investment and spillover efficiency in an underdeveloped economy: Evidence from the Mexican manufacturing industry, *World Development*, 11(6), 493-501.

Borensztein E., Gregorio, D. and Lee, J-W. (1998), How does foreign direct investment affect economic growth?, *Journal of International Economics*, 45, 115-135.

Carkovic, M. and Levine, R. (2002) *Does Foreign Direct Investment Accelerate EconomicGrowth?*. University of Minnesota Department of Finance Working Paper (available at: www//ssrn.com/abstract=314924)

Elhorst, J. P. (2003), Specification and Estimation Panel Data Models, *International Regional Review*, 26 (3), 244-268.

Fosfuri, A., Motta, M. and Ronde, T. (2001), Foreign Direct Investment and Spillovers through Workers Mobility, *Journal of International-Economics,* 53(1), 205-22.

Girma, S., and Görg, H. (2007), Multinationals' Productivity Advantage: Scale or Technology?. *Economic Inquiry,* 45, 350-362.

Görg, H., and E. Strobl (2001), Multinational Companies and Productivity Spillovers: A Meta-analysis, *Economic Journal*,111 (475), 723-739.

Haskel , J. E. , Pereira, S. C. and Slaughter, M. J. (2007), Does Inward Foreign Direct Investment Boost the Productivity of Domestic Firms?, *The Review of Economics and Statistics*, 89(3), 482-496.

Lall, S. (1978), Transnational, Domestic Enterprises and Industrial Structure in Host LDCs: A Survey, *Oxford Economic Papers*, 30 (2), 217-248.

Lall, S. (1997), "Investment, Technology and International Competitiveness" in John H. Dunning and Khalel A. Hamdani (ed.) *The New Globalism and Developing Countries*, Tokyo: UNU Press.

Lee, L. F. (2004), Asymptotic Distributions of Quasi-Maximum Likelihood Estimators for Spatial Autoregressive Models, *Econometrica*, 72, 1899-1925.

Lenger, A. and Taymaz, E. (2006), To Innovate or to Transfer? A Study on Spillovers and Foreign Firms in Turkey, *Journal of Evolutionary Economics*, 16, 137-153.

Lipsey, R.E. and Sjöholm, F. (2005), "Host Country Impacts of Inward FDI: Why Such Different Answers", in Blomström, M., E. Graham and T. Moran (ed.) *The Impact of Foreign Direct Investment on Development*, Washington: Institute for International Economics.

OECD (2008) *OECD Benchmark Definition of Foreign Direct Investment*, OECD, Paris.

OECD (2003) *OECD STAN Database*, www.oecd.org/sti/stan.

Ramírez, M. D. (2006) Does Foreign Direct Investment Enhance Private Capital Formation in Latin America? A Pooled Analysis for the 1981-2000 Period, *The Journal of Developing Areas*, 40 (1), 81-97.

Smarzynska-Javorcik, B. (2004), Does Foreign Direct Investment Increase the Productivity of Domestic Firms? In Search of Spillovers through Backward Linkages, *American Economic Review* 94(3), 605-627.

Smarzynska-Javorcik, B. and Spatareanu, M. (2008), To Share or Not to Share: Does Local Participation Matter for Spillovers from Foreign Direct Investment?, *Journal of Development Economics*, 85, (1-2), 194-217.

Teece, D. J. (1977), Technology Transfer by Multinational Firms: The Resource Cost of Transferring Technological Know-How, *Economic Journal*, 87, 242-261.

UNCTAD (1999) *World Investment Report 1999*, United Nations Publication, New York and Geneva.

UNCTAD (2005) *World Investment Report 2005*, United Nations Publication, New York and Geneva.

Wijweera, A., Villano R. and Dollery B. (2010), Economic Growth and FDI Inflows: A Stochastic Frontier Analysis, *The Journal of Developing Areas*, 43 (2), 143-158.

FIGURE 1. FDI INFLOWS AND THE NUMBER OF FOREIGN AFFILIATED FIRMS IN TURKEY: 1980-2009

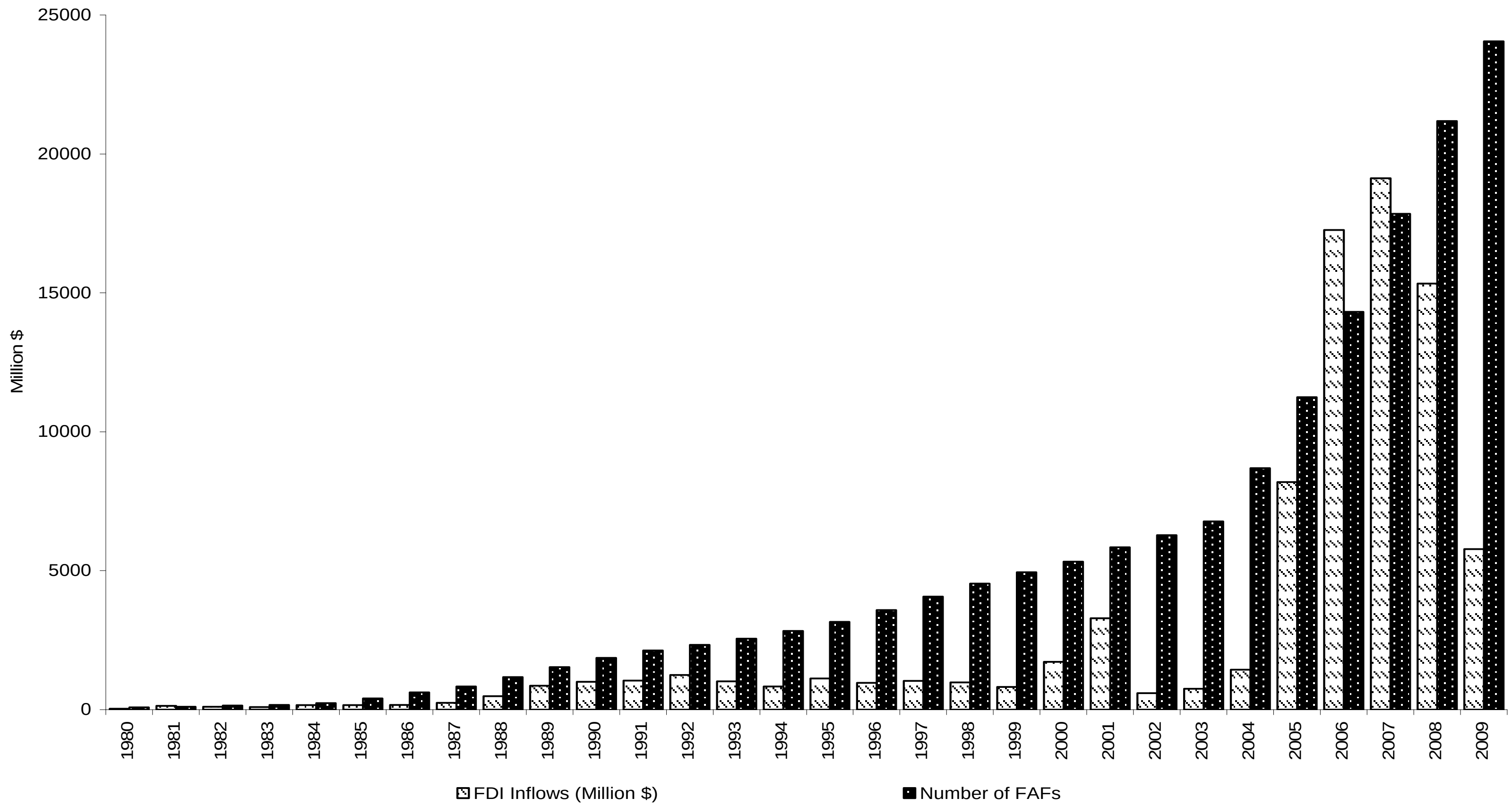
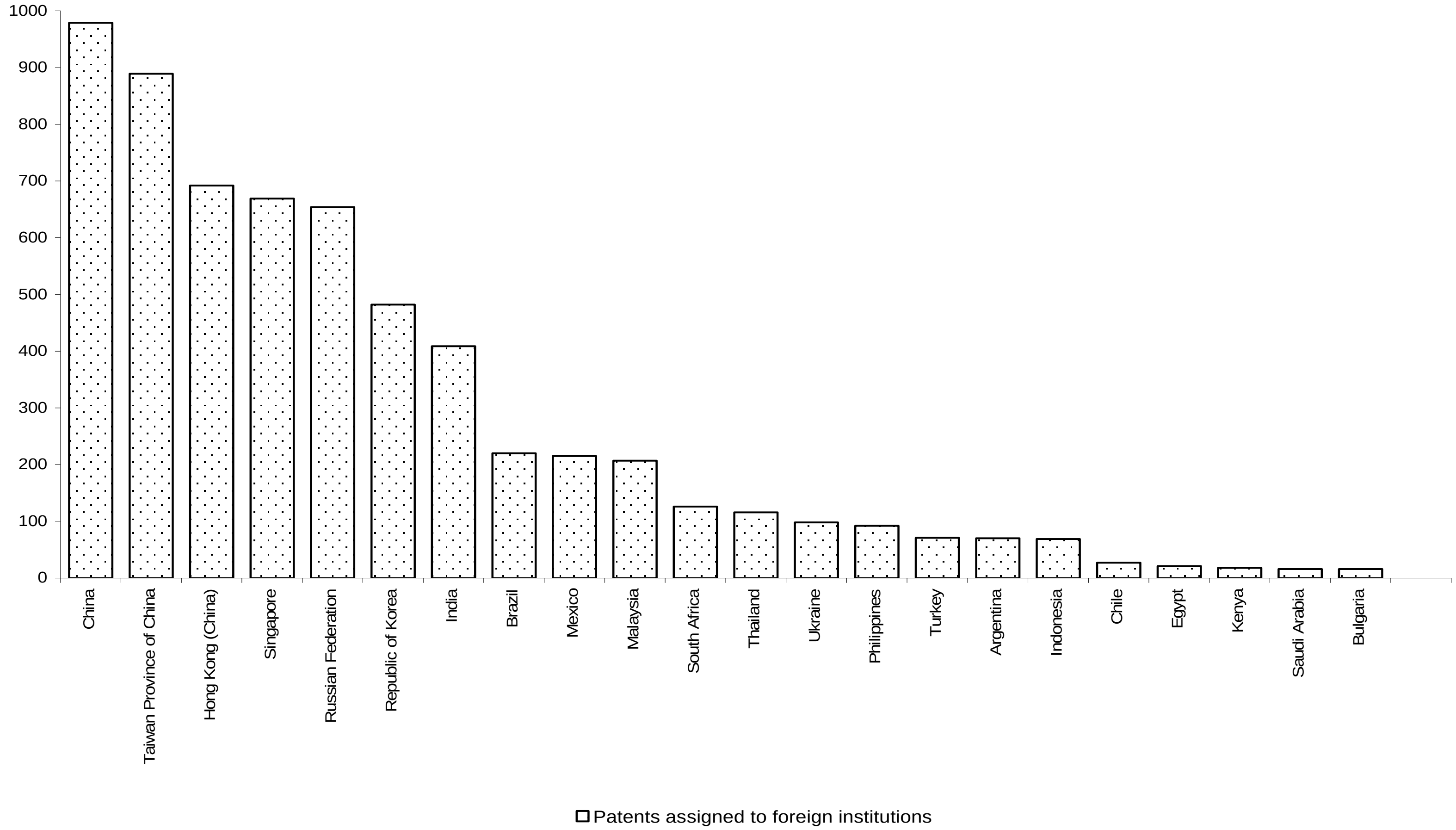
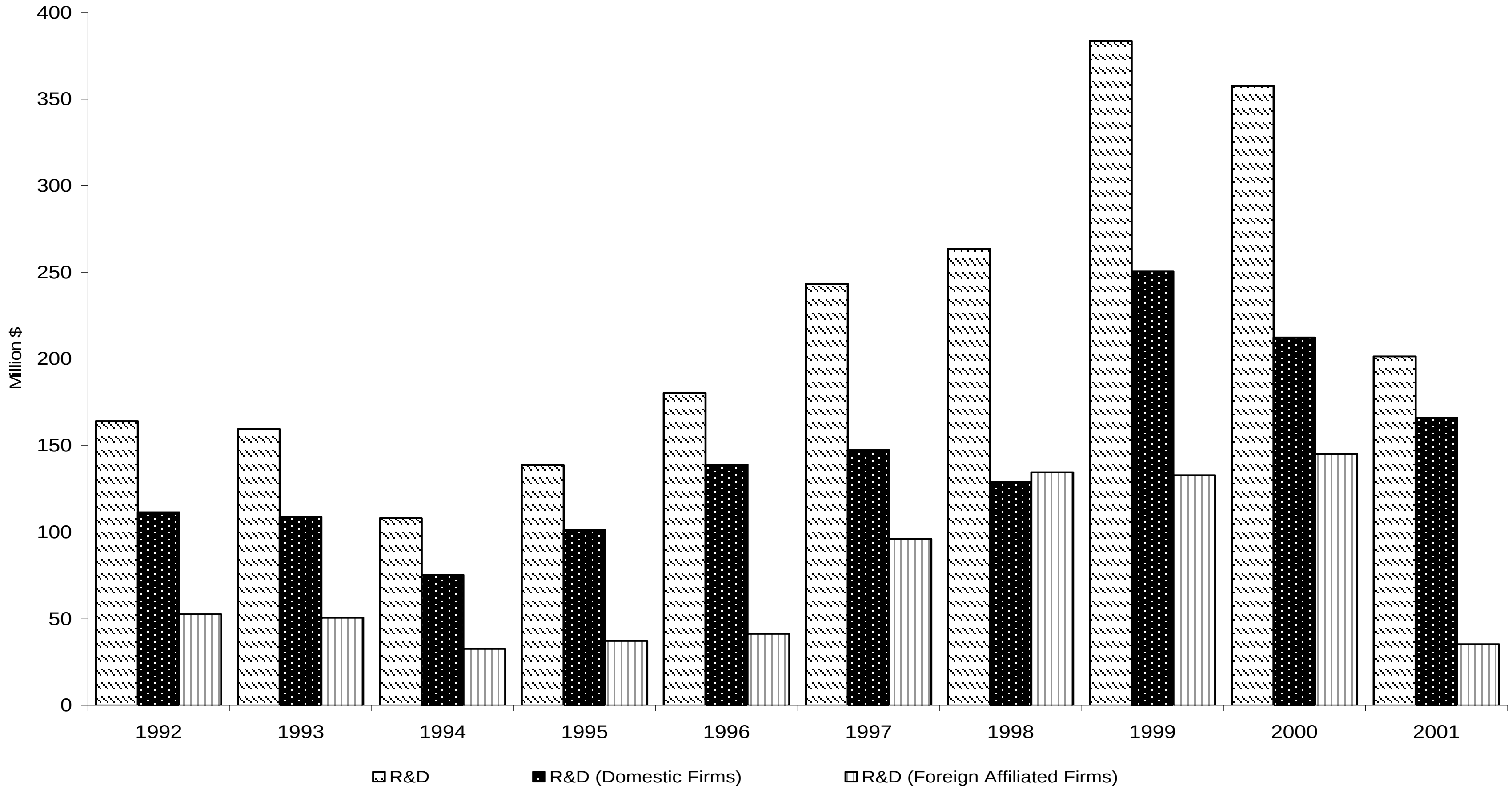


FIGURE 2. PATENTS ASSIGNED TO FOREIGN INSTITUTIONS



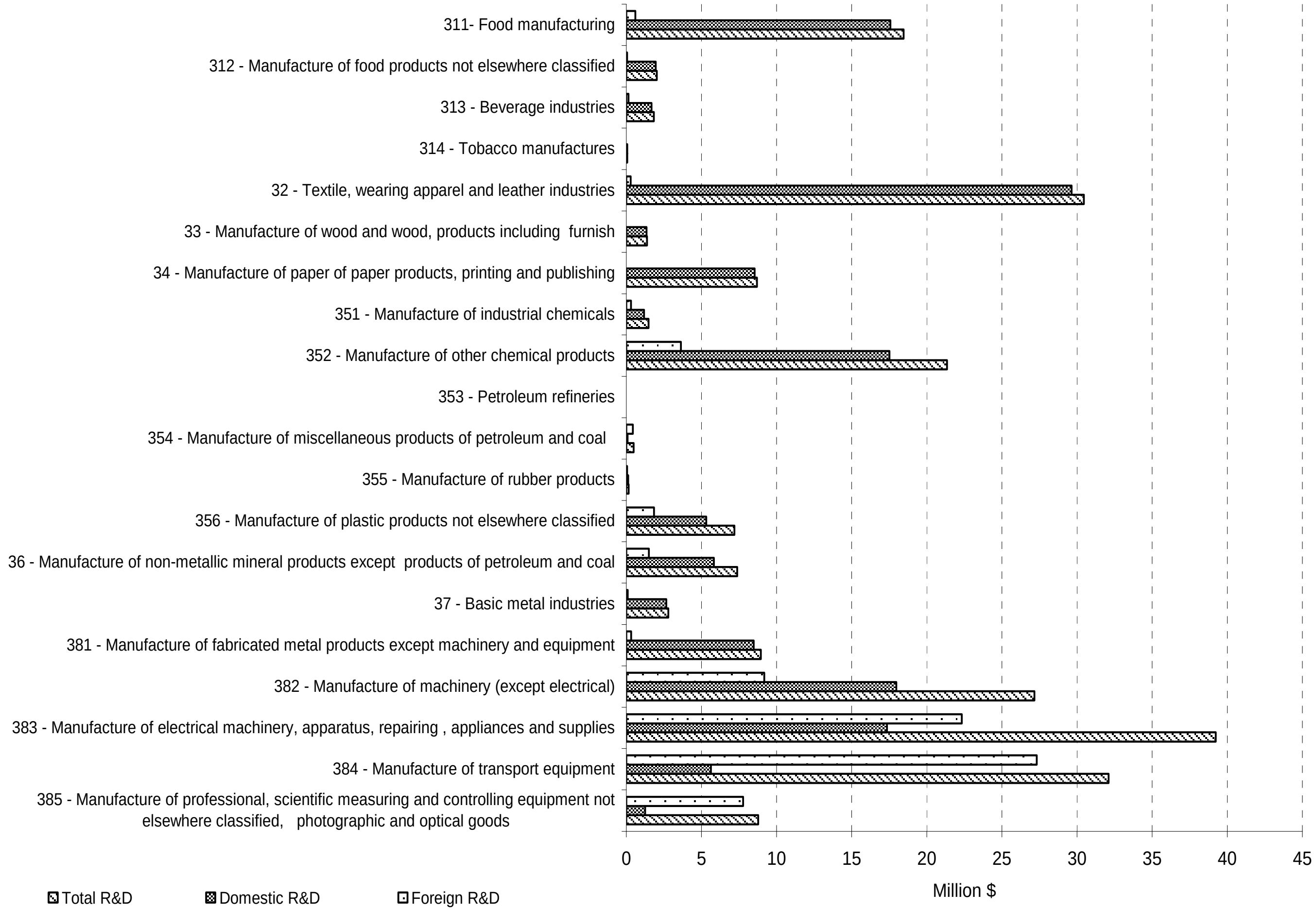
Source: UNCTAD, 2005.

FIGURE 3. R&D EXPENDITURES OF DOMESTIC AND FOREIGN AFFILIATED FIRMS



Source: TURKSTAT.

FIGURE 4. ANNUAL AVERAGE R&D EXPENDITURES BY DOMESTIC AND FOREIGN AFFILIATED FIRMS: 1992-2001



Source: TURKSTAT.

TABLE 1. MAIN INDICATORS FOR TURKISH MANUFACTURING INDUSTRIES: 2001

Industry Group		Number of Firms	Number of Employees	Gross Investment (TL)	Total Output (TL)	Gross Investment/ Total Output (%)
31	Domestic	1718	166225	747.38	19459.55	3.84
	Foreign	67	24220	321.08	5064.48	6.34
32	Domestic	3517	388101	1035.20	21304.24	4.86
	Foreign	51	14925	45.03	918.16	4.90
33	Domestic	462	24656	242.13	1148.24	21.09
	Foreign	5	566	0.08	80.21	0.10
34	Domestic	407	32361	292.15	2831.11	10.32
	Foreign	15	1629	13.49	352.19	3.83
35	Domestic	1072	107865	1031.05	33101.68	3.11
	Foreign	97	24723	240.11	7607.15	3.16
36	Domestic	805	67994	342.65	4914.11	6.97
	Foreign	34	5881	43.35	877.88	4.94
37	Domestic	391	55310	433.85	8144.82	5.33
	Foreign	11	2476	34.93	659.91	5.29
38	Domestic	2804	243924	1525.99	9711.93	15.71
	Foreign	152	64808	935.28	20573.45	4.55
39	Domestic	7	597	17.21	886.27	1.94
	Foreign	135	9329	29.20	86.81	33.64
Total		11750	1235590	7330.12	137722.21	5.32

Source: TURKSTAT.

TABLE 2. THE CORRELATION MATRIX

	Total Value Added	Value Added (Domestic Firms)	Value Added (FAFs)	Total R&D	R&D (Domestic Firms)	R&D (FAFs)
Total Value Added	1.000					
Value Added (Domestic Firms)	0.952	1.000				
Value Added (FAFs)	0.703	0.475	1.000			
Total R&D	0.201	0.153	0.194	1.000		
R&D (Domestic Firms)	0.323	0.320	0.177	0.954	1.000	
R&D (FAFs)	0.016	-0.132	0.358	0.795	0.629	1.000

TABLE 3. PANEL DATA ESTIMATION RESULTS

	Whole Manufacturing				Domestic Firms				Foreign Affiliated Firms	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
β	0.531	0.520	0.635	0.613	0.592	0.539	0.605	0.516	0.575	0.567
	(3.05)	(2.83)	(2.14)	(3.72)	(2.97)	(3.61)	(3.79)	(3.29)	(3.31)	(3.26)
δ		0.196		0.138		0.293		0.296		0.056
		(2.32)		(1.77)		(3.54)		(3.56)		(0.901)
γ			0.417	0.388			-0.025	-0.063		
			(2.80)	(3.06)			(-0.188)	(-0.49)		
S.E.	1.795	1.763	1.763	1.754	1.690	1.732	1.786	1.735	1.940	1.941
Log- Lik.	-387.6	-399.20	-395.73	-393.95	-398.3	-392.1	-398.24	-391.97	-398.03	-398.38

Note: Asymtotic t-values are given in parentheses.

TABLE 4. SPATIAL ESTIMATIONS: WHOLE MANUFACTURING INDUSTRIES

	SAR Model				SEM Model			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
β	0.444	0.443	0.527	0.530	0.741	0.752	0.908	0.905
	(5.041)	(5.070)	(6.271)	(6.423)	(6.226)	(6.239)	(8.399	(8.239)
δ		-0.002		-0.033		0.023		-0.011
		(-0.052)		(-0.866)		(0.386)		(-0.214)
γ			0.327	0.332			0.483	0.485
			(5.184)	(5.310)			(6.674)	(6.707)
ρ	0.731	0.740	0.746	0.760				
	(19.754)	(20.509)	(21.918)	(23.197)				
λ					0.736	0.750	0.780	0.786
					(21.378)	(22.979)	(27.092)	(28.059)
S.E.	0.875	0.862	0.750	0.730	0.824	0.804	0.626	0.619
Log-Lik.	-343.068	-343.092	-330.189	-329.874	-337.928	-337.818	-318.275	-318.209

Note: Asymtotic t-values are given in parentheses.

TABLE 5. SPATIAL ESTIMATIONS: DOMESTIC AND FOREIGN AFFILIATED FIRMS

	Domestic Firms								Foreign Affiliated Firms			
	SAR Model				SEM Model				SAR Model		SEM Model	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
β	0.508	0.489	0.505	0.482	0.863	0.883	0.915	0.935	0.511	0.505	0.444	0.469
	(7.397)	(7.118)	(7.019)	(6.666)	(10.066)	(10.655)	(10.184)	(10.732)	(3.903)	(3.859)	(3.168)	(3.520)
δ		0.073		0.076		0.170		0.167		0.043		0.018
		(1.953)		(2.021)		(3.633)		(3.619)		(0.922)		(0.413)
γ			-0.011	-0.021			0.112	0.107				
			(-0.193)	(-0.369)			(1.712)	(1.694)				
ρ	0.798	0.800	0.795	0.792					0.666	0.663		
	(29.801)	(30.557)	(29.229)	(29.117)					(12.304)	(12.163)		
λ					0.830	0.833	0.836	0.840			0.653	0.641
					(37.229)	(38.033)	(38.876)	(40.030)			(8.965)	(12.522)
S.E.	0.585	0.571	0.588	0.5793	0.480	0.447	0.466	0.434	2.129	2.122	2.129	2.174
Log-Lik.	-314.95	-312.92	-314.95	-312.82	-301.89	-295.54	-300.45	-294.15	-367.93	-367.50	-367.50	-369.21

Note: Asymtotic t-values are given in parentheses.

TABLE 6. SPATIAL DURBIN MODEL ESTIMATIONS: WHOLE MANUFACTURING INDUSTRIES

	SEM Model			SAR Model		
	(1)	(2)	(3)	(4)	(5)	(6)
β	0.775	0.634	0.710	0.467	0.506	0.444
	(6.504)	(5.926)	(6.154)	(5.258)	(6.174)	(4.979)
δ	0.019			-0.007		
	(0.333)			(-0.169)		
γ		0.545			0.343	
		(6.998)			(5.523)	
ϕ		0.339	0.305		0.209	0.211
		(3.827)	(3.332)		(3.791)	(3.480)
ψ	0.342		0.655	0.213		0.222
	(3.416)		(2.738)	(1.829)		(1.896)
ρ				0.723	0.731	0.681
				(18.846)	(20.802)	(15.875)
λ	0.746	0.755	0.739			
	(22.504	(23.591)	(21.708)			
S.E.	0.787	0.679	0.755	0.872	0.715	0.879
Log-Lik.	-334.987	-321.809	-329.671	-341.414	-322.894	-335.791

Note: Asymtotic t-values are given in parentheses.

TABLE 7. SPATIAL DURBIN MODEL ESTIMATIONS: DOMESTIC AND FOREIGN FIRMS

	Domestic Firms						Foreign Affiliated Firms	
	SAR Model			SEM Model			SAR	SEM Model
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)
β	0.421	0.472	0.458	0.863	0.806	0.735	0.502	0.656
	(6.939)	(6.798)	(7.053)	(10.414)	(9.226)	(8.740)	(3.927)	(4.192)
δ	0.108			0.172				
	(5.469)			(3.715)				
γ		0.002			0.139			
		(0.037)			(2.253)			
ϕ		0.209	0.197		0.417	0.393	0.060	0.034
		(3.957)	(3.881)		(5.257)	(4.897)	(0.736)	(0.319)
ψ	-0.077		-0.101	-0.385		-0.245		
	(-0.907)		(-1.135)	(-1.831)		(-1.170)		
ρ	0.848	0.788	0.821				0.510	
	(40.543)	(28.524)	(35.329)				(7.638)	
λ				0.834	0.833	0.833		0.511
				(38.316)	(38.037)	(38.040)		(8.193)
S.E.	0.458	0.552	0.515	0.439	0.412	0.420	1.981	1.968
Log-Lik.	-301.595	-307.189	-307.021	-293.878	-287.417	-289.203	-395.369	-394.789

Note: Asymtotic t-values are given in parentheses.

PREVIOUS DISCUSSION PAPERS

21 Karaçuka, Mehmet and Catik, A. Nazif, A Spatial Approach to Measure Productivity Spillovers of Foreign Affiliated Firms in Turkish Manufacturing Industries, May 2011.
Forthcoming in: The Journal of Developing Areas.

20 Catik, A. Nazif and Karaçuka, Mehmet, A Comparative Analysis of Alternative Univariate Time Series Models in Forecasting Turkish Inflation, May 2011.
Forthcoming in: Journal of Business Economics.

19 Normann, Hans-Theo and Wallace, Brian, The Impact of the Termination Rule on Cooperation in a Prisoner's Dilemma Experiment, May 2011.
Forthcoming in: International Journal of Game Theory.

18 Baake, Pio and von Schlippenbach, Vanessa, Distortions in Vertical Relations, April 2011.
Forthcoming in: Journal of Economics.

17 Haucap, Justus and Schwalbe, Ulrich, Economic Principles of State Aid Control, April 2011.

16 Haucap, Justus and Heimeshoff, Ulrich, Consumer Behavior towards On-net/Off-net Price Differentiation, January 2011.
Published in: Telecommunication Policy 35 (2011), pp. 325-332.

15 Duso, Tomaso, Gugler, Klaus, Yurtoglu, Burcin B., How Effective is European Merger Control? January 2011.
Forthcoming in: European Economic Review.

14 Haigner, Stefan D., Jenewein, Stefan, Müller, Hans Christian and Wakolbinger, Florian, The First shall be Last: Serial Position Effects in the Case Contestants evaluate Each Other, December 2010.
Published in: Economics Bulletin (2010), Volume 30, Issue 4, pp. 3170-3176.

13 Suleymanova, Irina and Wey, Christian, On the Role of Consumer Expectations in Markets with Network Effects, November 2010 (first version July 2010).

12 Haucap, Justus, Heimeshoff, Ulrich and Karacuka, Mehmet, Competition in the Turkish Mobile Telecommunications Market: Price Elasticities and Network Substitution, November 2010.
Published in: Telecommunications Policy 35 (2011), pp. 202-210.

11 Dewenter, Ralf, Haucap, Justus and Wenzel, Tobias, Semi-Collusion in Media Markets, November 2010.
Forthcoming in: International Review of Law and Economics.

10 Dewenter, Ralf and Kruse, Jörn, Calling Party Pays or Receiving Party Pays? The Diffusion of Mobile Telephony with Endogenous Regulation, October 2010.
Published in: Information Economics and Policy 23 (2011), pp. 107-117.

09 Hauck, Achim and Neyer, Ulrike, The Euro Area Interbank Market and the Liquidity Management of the Eurosystem in the Financial Crisis, September 2010.

08 Haucap, Justus, Heimeshoff, Ulrich and Luis Manuel Schultz, Legal and Illegal Cartels in Germany between 1958 and 2004, September 2010.
Published in: H. J. Ramser & M. Stadler (eds.), Marktmacht. Wirtschaftswissenschaftliches Seminar Ottobeuren, Volume 39, Mohr Siebeck: Tübingen 2010, pp. 71-94.

07 Herr, Annika, Quality and Welfare in a Mixed Duopoly with Regulated Prices: The Case of a Public and a Private Hospital, September 2010.
Forthcoming in: German Economic Review.

06 Blanco, Mariana, Engelmann, Dirk and Normann, Hans-Theo, A Within-Subject Analysis of Other-Regarding Preferences, September 2010.
Forthcoming in: Games and Economic Behavior.

05 Normann, Hans-Theo, Vertical Mergers, Foreclosure and Raising Rivals' Costs – Experimental Evidence, September 2010.
Forthcoming in: The Journal of Industrial Economics.

04 Gu, Yiquan and Wenzel, Tobias, Transparency, Price-Dependent Demand and Product Variety, September 2010.
Published in: Economics Letters 110 (2011), pp. 216-219.

03 Wenzel, Tobias, Deregulation of Shopping Hours: The Impact on Independent Retailers and Chain Stores, September 2010.
Published in: Scandinavian Journal of Economics 113 (2011), pp. 145-166.

02 Stühmeier, Torben and Wenzel, Tobias, Getting Beer During Commercials: Adverse Effects of Ad-Avoidance, September 2010.
Published in: Information Economics and Policy 23 (2011), pp. 98-106.

01 Inderst, Roman and Wey, Christian, Countervailing Power and Dynamic Efficiency, September 2010.
Forthcoming in: Journal of the European Economic Association, August 2011.

Heinrich-Heine-University of Düsseldorf

Düsseldorf Institute for Competition Economics (DICE)

Universitätsstraße 1 _ 40225 Düsseldorf
www.dice.uni-duesseldorf.de

ISSN 2190-9938 (online)
ISBN 978-3-86304-020-8