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"Spatial proximity and firm performances: how can location-based economies help the transition process in the Mediterranean region? Empirical evidence from Turkey, Italy and Tunisia "

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RESEARCH PROJECT FEM 41-09

Spatial proximity and firm performances: how can location-based economies help the transition process in the Mediterranean region? Empirical evidence from Turkey, Italy and Tunisia.

Draft Technical Report[1]

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The purpose of this agreement is to provide an original research work in the fields of social and economic analysis by the Team Leader Anna M. Ferragina. Members of the team: Erol Taymaz, Ünal Töngür, Sofiane Ghali, Habib Zitouna, Giulia Nunziante, Fernanda Mazzotta, Anna Ferragina.

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INDEX

EXECUTIVE SUMMARY RESEARCH PROJECT FEM 41-09

EXECUTIVE SUMMARY

The aim of this project is to investigate the productivity impact on firm's performance stemming from location-based economies due to agglomeration of firms, clustering of innovation and localisation of FDI in three Mediterranean countries, Turkey, Italy and Tunisia. More specifically the research addresses three main questions: 1) the relationships between agglomeration economies and firms' productivity; 2) the role of innovation spillovers at spatial level taking into account geographical and sector clustering of firms; 3) the spillovers from foreign MNEs at regional and sector level. In this framework the effect of other variables in shaping the agglomeration-output nexus are also explored including the role of size, ownership and firm innovation, the distance from the main town, infrastructures, economic crisis, regional level of development. Besides, we also control for the role of the firm's absorptive capacity and check how size and technology performance interact with agglomeration and innovation spillovers.

The choice of Turkey, Italy and Tunisia as case studies is based on the relevance that economies of agglomeration play in their economy. Italy provides an important benchmarking and is the most critical observatory among North Mediterranean countries for analysing the positive and negative impact of regional agglomeration of activities due to the traditional relevance of regional clusters of development (Industrial Districts) and big regional divides. Turkey and Tunisia are two very interesting case studies due to the emerging innovation clusters over the last years, marked by a large diffusion of science parks, innovation clusters, incubators, special economic zones (SEZs), Centre business districts (CBDs) (in Tunisia) and by an increasing role of multinational corporations (MNC).

Clustering of economic activities has been traditionally seen as a crucial mechanism for employment, firm growth and resilience. The clustering of industries in specific areas has improved industrial productivity in a number of countries. There are both specialisation (also named localisation) and urbanisation economies at work in industrial clusters. Within the specialization hypothesis, firm agglomeration in the same sector produces positive externalities and facilitates the growth of all manufacturing units within the sector. It is also recognized that clustering can also be an important driver of R&D via a broad range of processes like learning-by doing, externalities on inputs, labour markets pooling and R&D cooperation between firms (Baltagi et al., 2012). Porter (1998) also emphasized cluster's significant role in a firm's ongoing ability to innovate as concentration generates dynamic processes of knowledge creation, learning, innovation and knowledge transfer (diffusion and synergies). As a result, the cluster becomes a center of accumulated competence across a range of related industries and across various stages of production

Following this background literature, the role of spatial externalities is explored by considering agglomeration economies and external knowledge spillovers. Analysis of micro and macro factors which affect the efficiency conditions of firms are crucial in this context. The questions are: do firms localised in clusters of production exhibit a higher productivity? How far concentration of innovation of co-located firms is able to increase productivity? We also explore the complementarity between domestic and foreign firms. Firms should benefit from the experience of other firms in the vicinity, especially from the one of large foreign multinational firms. Hence, the analysis for each economy aims to provide a measure of spillovers from geographical and sectorial clustering of firms and from their innovation. We build specific indexes of agglomeration and innovation activity at territorial level (regions for Turkey, governorates for Tunisia, provinces for Italy). We also use indicators of innovation performed by domestic and by foreign multinationals at the spatial level of analysis adopted.

In all the three studies we try to include explicit regional variables and to capture regional spillovers due to agglomeration economies and to innovation spillovers. In this way, we directly contribute to the wide literature on productivity spillovers from agglomeration economies, as well as to the literature on localized knowledge spillovers from innovation.

Since the main goal of our study is to analyze the effects of agglomeration and spillovers, especially from foreign firms, we use a number of proxy variables that are expected to capture the effects of these factors. Agglomeration is measured by the density of firms (the number of firms), or by the density of production activities (output). We also split this into the (log) numbers of domestic and foreign firms in the same sector (defined at the NACE 4 or 2-digit level) and region/province (defined at NUTS 2 or 3 level). We use the number of domestic and foreign firms separately because the extent of spillovers could differ between domestic and foreign firms. Hence, the first most important channel we try to catch are the spillovers between firms in the same industry (horizontal spillovers). Three variables are adopted to this purpose: the output share of the region in the sectors output, the number and the output of firms by sector-region.

Then, we look at the R&D/innovation performed by domestic and by foreign firms which can be considered as an innovation spillover channel. The share of output of R&D performing domestic and foreign firms in the region/sector and the number of R&D performing domestic and foreign firms in the region/sector are the two proxies considered for Turkey and for Tunisia, while for Italy we consider the share of innovation proxied by intangible assets of domestic and foreign firms in the province and sector.

The third important issue is related to the presence of spillovers by foreign firms. We consider to this purpose the shares of foreign firms in the region and in the sector.

As not all firms are able to benefit from spillovers and enjoy agglomeration effects it is important to also control for the role of the absorptive capacity. Hence, we interact agglomeration and spillover variables with firm size (measured by the number of employees) and innovation. These interaction variables reveal if large firms and innovation performers benefit more from agglomeration effects and spillovers.

The specific additional insights of this project are the focus on agglomeration economies and innovation spillovers by a multidimensional approach, at spatial and firm level, in the effort to catch at the same time regional characteristics of the economic systems and firm heterogeneity. The analysis at firm level is crucial to detect agglomeration economies as some factors are firm-specific because they are driven by factors relating to the different sizes, specific approaches to production and different innovation strategies (Bloom and Van Reenen, 2010). The research, by focusing on the agglomeration economies in the local context within which firms operate, and at the same time concentrating on firm-specific determinants of productivity, fills a gap in the literature.

We use similar estimation strategies, and estimate production functions by using firm level panel data. Simultaneity and endogeneity is hence addressed using system Generalized Method of Moments (GMM) dynamic panel estimation techniques. This methodology allows us to distinguish the direction of the nexus clustering and productivity and to focus on whether more regional clustering lead to higher productivity, ruling out the other direction of causality, i.e. that higher productivity leads to more regional clustering. The estimated coefficients of the variables used as a proxy for clustering show the effect of clustering on output after controlling for inputs (capital, labor and materials), i.e., total factor productivity (TFP). Moreover, the GMM-system method allows for unobserved firm level effects (the so-called “fixed effects”).

Results for Turkey

Agglomerations externalities measured by different proxies show a strong positive effect on output and productivity. The proxy of agglomeration of activities confirm the presence of positive externalities due to specialisation economies and intra-industry spillovers. Two other agglomeration indicators, number and output of foreign firms and domestic firms in the region at sector level are both significant but while there are positive externalities from foreign firms’ agglomeration, conversely the externalities from agglomeration of domestic firms are negative suggesting congestion effects. Concerning the innovation spillovers from the number and the ouput of domestic and foreign firms which carry out R&D we also find positive and highly significant returns. The third finding concerns the presence of spillovers related to the presence of foreign firms share in the sector and in the region. The evidence is in favour of high FDI spillovers at local level. The estimation results for Turkey also suggest that spillovers emanating from foreign firms are stronger than those from domestic firms. Besides, there seems to be no spillovers specific to large firms but there are spillovers specific to technologically more sophisticated firms.

Results for Italy

For Italy we also find evidence in favour of agglomeration and innovation spillovers at local level on firm productivity. However, horizontal spillovers from agglomeration at local level are mainly stemming from non multinational firms rather than from the localisation of foreign multinationals. Firms also benefit from innovation of neighbouring domestic in the province in the same sector. Hence, spillovers spread positively within geographical and sectoral-based neighbourhoods which suggests that firms operate in a cooperative environment. Higher output share of foreign firms in the province also produce positive returns on output. Overall, the estimation results for Italy suggest that there are significant enhancing agglomeration effects between firms operating in the same sector and province, spillovers from innovation at local level are strong, but these spillovers are not emanating from multinational firms. Besides, in this specific case, unlike for the Turkish firms, agglomeration economies and innovation spillovers are more beneficial to small firms than to large ones. Hence, clustering is a way for small firms to overcome problem of smallness, and allowing a complementarity between innovative large and small firms to get better opportunities. Finally, there seems to be innovation spillovers from domestic firms specific to more technologically advanced firms. Hence, more innovative firms have a higher absorptive capacity.

Results for Tunisia

The analysis for Tunisia is conducive to quite similar results. Overall, there is evidence in favour of a positive impact of specialisation economies as suggested by the positive impact of the concentration of domestic firms and domestic RD performers and also by the positive impact of higher shares of a sector in a region. It seems that specialisation is a strong pushing factor of output at regional level. However, like in the case of Italy, innovation spillovers from foreign firms localisation in the region are not found. The analysis allows us to conclude that output is higher where there is regional clustering of activity and conclude that there is positive evidence of regional spillovers from agglomeration and from innovation although there is only a weak evidence of a positive impact of foreign firms.

In policy terms there is evidence on the outcome often found that firms in the same industry benefit more from each other as they are more technologically similar and the sector distance matters as this may facilitate the flow and absorption of knowledge among firms. We also found that FDI impact may be limited, the territorial and social redistribution depending on quality and distribution by sectors. This might also occur because the firms opened to the foreign market are in general a subcontractor which don’t have the autonomy to conduct neither technological nor non-technological innovation. Generally, it is argued that in an open economy agglomeration leads to higher efficiency. We find support to such conclusion in our three country cases. However, technology play a critical role and policies should pay specific effort to enhance the absorptive capacity of less technology sophisticated firms.

Besides, even if our result support agglomeration economies, a model of development based on strong polarization although enhancing firm performance and growth may produce important downside effects. Recent decades witnessed an increasing unbalanced process of regional growth in most Mediterranean countries which led to large income and employment gaps across regions, consequent massive migration, concentration of population in large cities and along the coast, degradation and isolation of internal areas, environmental impoverishment and abandonment. Regional inequality in Turkey have become more persistent after the 1980 liberalization and the east-west duality is an ongoing problem to the Turkish economy. In the region there are large spatial income disparities and spatial inequalities remain particularly high, with a 25% gap. In Tunisia industries have increasingly concentrated along the coast, while the interior regions are isolated from these hubs of economic activity. In 2006, 16 governorates out of a total of 24 had less than 3 per cent of total firms, not only disadvantaged by distance but mainly by a lack of infrastructure, transportation and information. In contrast, more than 83 per cent of industrial firms are located on the country’s coast (Sfax, Tunis, Sousse, Monastir, Ben Arous, Nabeul Bizerte, Ariana).

In this setting, while a reallocation of resources to less developed regions could be costly and counterproductive and regional tax incentives to poor regions might shift jobs away from territories that do not receive the subsidy, rather than create new ones, the government should rather invest in transportation infrastructure and develop regional complementarities. Such policies would expand job opportunities for the people outside the core regions and lead in the long term to a more sustainable convergence of standards of living among regions.

Abstract

In this paper we explore how firms' productivity is affected by agglomeration of firms, clustering of innovation and localisation of FDI in Turkey, Italy and Tunisia. We also control for the impact of firm characteristics on firm productivity (specifically the role of size, ownership and firm innovation) and of spatial features (the higher output of foreign firms, the distance from the main town, the regional infrastructures and the regional attractiveness). The firm's absorptive capacity is also taken into account by interacting the main variables of agglomeration and innovation at region-sector level with size and technology level of the firm. We use three separate unbalanced panels for different periods based on national data bases. For the three case studies our analysis builds upon similar specifications of panel estimates for output by GMM system methodology to address simultaneity and endogeneity on inputs and also the possible endogeneity between agglomeration and productivity. Overall, the estimation results suggest some common findings for the three case studies: there are significant productivity enhancing agglomeration effects, in particular there are significant spillovers between firms operating in the same sector and region, spillovers from innovation at local level are also strong, and higher output of foreign firms produce positive spillovers on productivity in the province. However, spillovers are specific to technologically more sophisticated firms.

Keywords Multifactor Productivity; Size and Spatial Distributions of Regional Economic Activity; Innovation; Multinational firms.

JEL - Codes: D24 (Multifactor Productivity); R12 (Size and Spatial Distributions of Regional Economic Activity); O3 (Innovation); F23 (Multinational firms).

1. Introduction

The aim of the proposed research is to investigate how firms' productivity is affected by agglomeration of firms, clustering of innovation and localisation of FDI in three Mediterranean countries, Turkey, Italy and Tunisia. More specifically the research addresses three questions: 1) the relationships between firms' agglomeration and output to check whether firms benefit from agglomeration economies; 2) the role of innovation spillovers at spatial level taking into account geographical and sector clustering of firms; 3) the spillovers from foreign MNEs at regional and sector level.

The choice of Turkey, Italy and Tunisia as case studies is based on the relevance that economies of agglomeration play in these economies. Italy provides an important benchmarking and is the most critical observatory among the North Mediterranean countries for analysing the positive and negative impact of regional agglomeration of activities. In this country important regional clusters of development (Industrial Districts) combine with big regional divides, and with structural and cohesion funds within an active regional policy to correct regional gaps. Turkey and Tunisia are two very interesting case studies due to the emerging innovation clusters. The last years were marked by a large diffusion of science parks, innovation clusters, incubators, special economic zones (SEZs), Centre Business Districts (CBDs) and by an increasing role of multinational corporations (MNC). Besides, Turkey and Tunisia are among the few countries of the South Mediterranean region well integrated to the global manufacturing markets, with a strong human capital base, a large number of engineers and skilled workers but at the same time a very high level of regional unemployment mainly for the educated and skilled. In Turkey, there are strong provincial inequalities. In Tunisia inequalities between regions (governatorates) is accentuated by the concentration of economic activities in Central Business Districts in coastal areas. The presence of agglomeration economies is hence causing strong regional disparities.

Clustering of economic activities has been traditionally seen as a crucial mechanism for employment, firm growth and resilience. The clustering of industries in specific areas has improved industrial productivity in a number of countries. There are both specialisation (also named localisation) and urbanisation economies at work. Within the specialization hypothesis, firm agglomeration in the same sector produces positive externalities and facilitates the growth of all manufacturing units within the sector. These advantages, which are inter-firms and intra-sector, measured by specialization index, are based mainly on information sharing, a skilled labour market and intra-industry communication. According to the Marshall theory, specialization increases the interaction between firms and workers, and speeds up the process of innovation and growth. On the other hand, according to the Jacobs (1969) theory knowledge externalities are associated with the diversity of neighbour industries. It is recognized that clustering can also be an important driver of R&D via a broad range of processes like learning-by doing, externalities on inputs, labour markets pooling and R&D cooperation between firms (Baltagi et al., 2012). Porter (1998) also emphasized cluster’s significant role in a firm’s ongoing ability to innovate as some of the same characteristics that enhance the firm productivity have even more effect on innovation. An extensive literature also shows that firms' behaviour depends on the spatial availability of territorial resources devoted to innovation and to growth (Henderson et al., 2002).

Following this background literature, the role of spatial externalities is explored by considering agglomeration economies and external knowledge spillovers. Analysis of micro and macro factors which affect the efficiency conditions of firms are crucial in this context and they entail the consideration of proximity between firms, agglomeration economies and innovation spillovers. The questions investigated are the following. Do firms localised in clusters of production exhibit a higher productivity? How far concentration of innovation of co-located firms in the same cluster is likely to increase productivity? We also explore the complementarity between domestic and foreign firms. Firms should benefit from the experience of other firms in the vicinity, especially from the one of large foreign multinational firms. The firm’s absorptive capacity is also taken into account by interacting the main variables of agglomeration and innovation at region-sector level with size and technology level of the firm. Hence, the analysis for each economy aims to provide a measure of spillovers on productivity from geographical and sectorial clustering of firms and from their innovation. We build specific indexes of agglomeration and innovation activity at territorial level (regions for Turkey, governorates for Tunisia, provinces for Italy). We also use indicators of innovation performed by domestic and by foreign multinationals at the spatial level of analysis adopted.

The specific additional insights are the focus on agglomeration economies and innovation spillovers taking into account a multidimensional approach, both at spatial and firm level, in the effort to catch at the same time regional characteristics of the economic systems and firm heterogeneity. The analysis at firm level is crucial to detect agglomeration economies as some factors are firm-specific because they are driven by factors relating to the individual skills of owners, workers and managers, to different sizes, specific approaches to production and different innovation strategies (Bloom and Van Reenen, 2010). Hence, we control for the impact of firm characteristics (specifically the role of size, ownership and firm innovation). Furthermore, we also check whether the regional endowment of territories where firms are located and in particular location of foreign multinationals and their R&D exerts a positive effect on firms' producti. The research, by focusing on the agglomeration economies in the local context within which firms operate and at the same time concentrating on firm-specific determinants of productivity, fills a gap in the literature.

There is quite a large literature on the impact of agglomeration economies on productivity in Italy, however only recent studies use firm level data and try to catch the underlying microeconomic determinants (Aiello, et al. 2014; Buccellato and Santoni, 2012; Cardamone, 2017; Di Giacinto et al, 2012; Ferragina and Mazzotta, 2015; Lamieri and Sangalli, 2013). There is an almost complete lack of studies addressing such issues for Turkey at micro level: most of the studies are carried out at industry level (Coulibaly et al., 2007; Önder et al., 2003; Öztürk and Kılıç, 2015) and only a recent analysis exploit firm level information on R&D spillovers in Turkey using spatial econometrics in a cross section frame (Çetin and Kalayci, 2016). There is a relatively recent literature on Tunisia built on firm level data, but it is especially based on surveys or on interviews carried out on specific innovation clusters (Achy, 2015; Ayadi and Mattoussi, 2014; Amara and Ayadi, 2011, 2013; El Elj, 2010; Mokaddem, 2015; Unu-wider, 2015)

For Turkey we use an unbalanced panel data including all private establishments employing 25 or more people for 2006-2013. Spatial unit of analyses in this case are the regions. For Italy we use an unbalanced panel of Italian manufacturing firms for 2005-2010 merging AIDA data with Capitalia survey Xth wave (manufacturing only) and adopting as spatial unit of analysis the provinces. The study on Tunisia adopts an unbalanced sample 1997-2006 provided by the Tunisian National Institute of Statistics using as spatial unit of analyses the governorates.

We adopt the same estimation strategies and similar specifications for the three case studies: panel estimates for output by GMM system methodology controlling for time fixed effects. Using system GMM dynamic panel estimation techniques we try to address simultaneity and endogeneity on inputs and also the possible endogeneity between agglomeration and productivity. We also adopt other methodologies (OLS, Fixed Effects, Levinshon and Petrin, Olley and Pakes) to check the robustness of our results,

There are many empirical studies aiming to investigate the relationship between productivity and agglomeration. Most commonly used agglomeration variable in these studies seems to be the employment and/or population density (see, for example, Brülhart and Mathys, 2008; Ciccone and Hall, 1996; Ciccone, 2002; Combes, Duranton, Gobillon and Roux, 2008). However, such proxies cannot be regarded as powerful ones since agglomeration is a complex phenomenon, which should be proxied by taking into account both industrial and geographical concentration. Therefore, it can be argued that choosing a proper proxy reflecting agglomeration economies at sector/region level plays an important role in avoiding unbiased and misleading results.

In the existing literature, productivity has been analysed in many different ways. First of all, the distinction among various studies in the literature is based on the definition and use of productivity. Some studies choose to use labour productivity (see, for example, Bradley and Gans, 1998; Ciccone, 2002) as a dependent variable while some choose firm productivity (see, for example, Graham, 2006; Lall, Shalizi and Deichman, 2004). The definition of firm productivity also varies: some researchers employ TFP (see, for example, Cingano and Schivardi, 2004; Önder, Deliktaş and Lenger, 2003), while some use more direct approaches and employ output or value added (see, for example, Combes, 2000; Glaeser, Kallal, Scheinkman and Shleifer, 1992). On the other hand, most of the previous studies do not employ GMM method to deal with endogeneity problem although they point out possible path dependence. Firms tend to locate in a specific area in order to take advantage of positive externalities. These externalities might result from firms experiencing high productivity levels. On the other hand, firms might want to locate close to each other since firms in a specific region are experiencing high levels of productivity.

To give a preview of our results, for Turkey we get strong evidence on agglomerations externalities measured by different proxies. The proxy of agglomeration of activities given by the regional output share confirms the presence of positive externalities due to specialisation economies and intra-industry spillovers. There are significant productivity enhancing spillovers between firms operating in the same sector, and these spillovers are stronger if firms operate in the same region.
Two other agglomeration indicators, number and output of foreign firms and domestic firms in the region at sector level, are both significant but while there are positive externalities from foreign firms' agglomeration, conversely the externalities from agglomeration of domestic firms are negative suggesting congestion effects. As for the answer to the second research question concerning the innovation spillovers we find that innovation spillovers from the number and the ouput of domestic and foreign firms which carry out R&D have both a positive and highly significant returns. The third finding concerns the presence of spillovers related to the presence of foreign firms share in the sector and in the region. The evidence is in favour of high FDI spillovers at local level. The estimation results for Turkey also suggest that spillovers emanating from foreign firms are stronger than those from domestic firms. Besides, there seems to be no spillovers specific to large firms but there seem to be some spillovers specific to technologically sophisticated firms.

For Italy we also find evidence in favour of agglomeration spillovers at local level and a relevant impact of our innovation indicators on firm output. Horizontal spillovers from agglomeration at local level are stemming from non multinational firms but not from multinational firms. Firms located in the province get local premiums in presence of higher innovation in the province in the same sector, confirming the crucial role played by intra-sectoral innovation spillovers due to closeness in space and in technology in enhancing productivity. Hence, innovation spillovers spread positively within geographical and sectoral-based neighborhoods which suggests that firms operate in a cooperative environment. Higher output of foreign firms produce positive spillovers on productivity in the province but not in the sector. Overall, the estimation results for Italy suggest that there are significant productivity enhancing agglomeration effects; there are significant productivity spillovers between firms operating in the same sector and region, spillovers emanating from multinational firms are weaker than those from non multinational domestic firms, spillovers from innovation at local level are strong, there seems to be spillovers specific to smaller firms, and there are innovation spillovers from domestic firms specific to more technologically sophisticated firms.

The analysis for Tunisia is conducive to similar results: productivity is higher where there is regional clustering of activity, and there is also positive evidence of innovation spillovers. Overall, there is a strong evidence in favour of a positive impact of specialisation economies as suggested by the positive impact of the concentration of domestic firms and domestic RD performers in a sector and also by the positive impact of higher shares of a sector in a region. It seems that the specialisation is the strong pushing factor of output at regional level. However, what comes out from the results is that spillovers from foreign firms localisation in the region are weaker as no evidence is found of spatial innovation spillovers due to the number of foreign firms, the number of foreign R&D performers, the output of foreign firms. The analysis allows us to conclude that output is higher where there is regional clustering of activity and conclude that there is positive evidence of regional spillovers from agglomeration and from innovation although there is no evidence of a positive impact of foreign firms.

The following report is organised as follows. After a literature review of the main strands of analysis and on the specific studies carried out for each country case on the topics of interest, we describe in section 3 the data and in section 4 the features of the three countries in terms of spatial concentration of firm, employment, FDI, innovation and the relationships between these variables.

In section 5 and 6 we develop the country specific analysis and describe our results by considering in each case the specific empirical methodology and econometric specification carried out to catch regional innovation and productivity spillovers deriving from the geographical and sector clustering of firms.

The results from the overall empirical analysis emphasises what are the policy recommendations in this context regarding promotion of agglomeration, localised innovation and foreign investment which may support the structural transformation of the economy.

2. Literature review[2]

2.1. Spatial agglomeration, innovation and firm performance

The literature on agglomeration economies effects is extensive and dates back to some seminal papers (Marshall, 1920; Glaeser et al. 1992; Porter, 1998; Jacobs, 1969; Audretsch and Feldman, 1996) which describe the positive effects related to technology transfers and to pro competitive effects (increased competition, reallocation of resources towards more productive firms, productivity improvements of incumbent firms). However, agglomeration may also trigger stronger competition, which may prompt the reallocation of resources towards more productive firms and to have negative effects in the short term as some firms can lose the race.

The theory surrounding agglomeration economies and spillover effects mainly identifies two types of externalities: localization (or specialization) economies and diversification economies. The localization economies may rise from industry specialization available to the local firms within the same sector (the Marshall- Arrow-Romer or MAR externalities) and by the emergence of the intra-industry transmission of knowledge (Glaeser et al. 1992) as firms learn from other firms in the same industry (Porter 1998). These economies explain the development of industrial districts (ID). Unlike localization economies, however, Jacobs (1969) economies indicate that the diversity of industries and knowledge spillovers across geographically close industries promote innovation and growth via inter-industry knowledge spillovers (Acs et al., 2007). The latter reflects external economies passed to enterprises as a result of the large-scale operation of the agglomeration, independent of the industry structure. For instance, relatively more densely populated areas are more likely to house universities, industry research laboratories and other knowledge generating facilities.

It is recognized that clustering is especially important as a driver of R&D via a broad range of processes like learning-by doing, externalities on inputs, labour market and knowledge, R&D cooperation between firms (Rosenthal and Strange; 2001; Ellison et al., 2010; Baltagi et al., 2012). The theory on agglomeration economies also argues that positive knowledge spillovers are more likely to occur if firms are located in the same area, as geographical proximity encourages the diffusion of ideas and technology due to the concentration of customers and suppliers, labour market pooling, worker mobility, and informal contacts (Greenstone et al. 2010). Technology transfers (intra and inter industry knowledge spillovers) may occur via vertical linkages (along the supply chain and the creation of specialized suppliers) and horizontal linkages (collaboration among firms, imitation, concentration of customers and suppliers; labour market pooling and workers mobility; informal contacts).

The nexus between spatial agglomeration and knowledge spillovers has been largely emphasized within the "geography of innovation" literature, which concentrates on measuring localized spillovers from R&D spending (Griliches, 1979; Jaffe, 1986; Breschi and Malerba, 2001; Bottazzi and Peri, 2003; Audretsch and Feldman, 2004). Within this literature, the private technology of individual firms spills over to other firms and becomes public knowledge increasing the

[2] * Authored by Anna Maria Ferragina.

productivity of all firms. Rosenthal and Strange (2001) and Ellison et al. (2010) consider the importance of input sharing, matching, and knowledge spillovers for manufacturing firms at various levels of geographic disaggregation, and other studies have found that knowledge spillovers tend to vanish rapidly as distance increases (Audretsch and Feldman, 1996; Keller, 2002). The concentration generates dynamic processes of knowledge creation, learning, innovation and knowledge transfer (diffusion and synergies). As a result, the cluster becomes a center of accumulated competence across a range of related industries and across various stages of production (De Propris and Driffield, 2006).
Another important strand of research related to these issue is the large literature which has focused on detecting spillovers from the presence of multinational enterprises, where horizontal and vertical spillovers can be inferred indirectly, though the estimation of their effects on firms’ total factor productivity The location choice of foreign Multinational Enterprises (MNEs) as source of potential spillovers from FDI is stressed by a large amount of research through a range of different channels including the creation of forward and backward linkages, competitive and demonstration effects, transfer of skilled workforce, transfer of (pecuniary and non-pecuniary) externalities to local firms (Aitken and Harrison, 1999; Gorg and Greenaway, 2004; Haskel et al., 2002; Javorick, 2004 among the seminal papers). These spillover effects from MNEs, either intra- or inter-industry ones, are more likely to materialize when firms are geographically closer.

2.2. Studies on localisation economies in Turkey, Italy and Tunisia.

i. Turkey

Turkey is a good case for assessing the impact of agglomeration economies on productivity. A majority of studies focuses on the regional distribution of income during the 1980–2000 period and on the regional inequality in Turkey which has become more persistent after the 1980 liberalization. Filiztekin (1998), Dogruel and Dogruel (2003), Karaca (2004), Gezici and Hewings (2004, 2007), Yıldırım and Öcal (2006), Kılıçaslan and Özatagan (2007), and Filiztekin and Çelik (2010) all focus on the way regional income gaps evolved concluding that even though there are small signs of convergence, they are far from successful and the east-west duality is an ongoing problem to the Turkish economy.

There is a limited number of studies on productivity for Turkish manufacturing which generally focus on the relationships productivity and export, FDI, trade, or technical efficiency (see Aslanoğlu, 2000; Taymaz and Saatçi, 1997; Taymaz and Yılmaz, 2007; Lenger and Taymaz, 2007). FDI is found to be an important channel for transfer of technology. It is suggested that modern, advanced technologies introduced by multinational firms can diffuse to domestic firms through spillovers.

Taymaz and Saatçi (1997) is among the first attempt to identify the effects of regional agglomeration. They estimated stochastic production frontiers with efficiency effects and found that regional agglomeration of firms enhance technical efficiency.

Önder et al. (2003) analyzed spatial characteristics of TFP in Turkish manufacturing. They investigate technical efficiency, technical change and TFP changes by estimating a trans-log Cobb-Douglas production function employing stochastic frontier analysis (SFA) methodology using regions’ share in production, population density and a specialization index based on the value added to represent regional characteristics. Their findings suggest that average firm size and regional characteristics are the main determinants of technical efficiency. They also indicate that firms operating with a larger scale are more efficient than small scale ones, and that industries located in metropolitan areas are more technically efficient than their peers in the peripheries.

Coulibaly et al. (2007) attempt to capture the relationship between productivity and agglomeration using two-digit Turkish manufacturing data for 1980-2000 period and several proxies such as accessibility, localization and urbanization. The estimation results suggest that both localization and urbanization economies, as well as market accessibility, are productivity-enhancing factors in Turkey.

Karacuka and Catik (2011) examine productivity spillovers from foreign and domestic companies based in Turkey and report spillover effects from neighbouring companies. However, these results are not confirmed by Öztürk and Kılıç (2015) analysis of the link between productivity and agglomeration employing Ellison and Glaeser index and Total Factor Productivity to represent agglomeration economies and productivity levels in Turkish manufacturing industries on 1980-2001 data. TFP is measured using SFA and then regressed along agglomeration and other control variables using a dynamic system GMM estimation method. This estimation method allows to account for the dynamic nature of TFP and also the possible endogeneity between productivity and agglomeration. The results indicate that Turkish manufacturing industries stand as an example of negative externalities.

Çetin (2016) employ spatial econometric methods in analyzing intra and inter industry knowledge spillovers in industrial zones and concluded that there are spillover effects in the industrial zone of Ankara, and that more than half of the spillovers are due to the geographical factors.

According to the study of Çetin and Kalayci (2016), which investigates the effects of R&D spillovers at provincial level also using spatial econometric, research and development (R&D) activities are of great significance in the long term development of firms. The determinants of R&D activities employed in the study are the number of qualified labor employees and the number of R&D employees, technology transfer represented by expenses for licensing, foreign ownership, Pavitt sector dummies, location dummies by the sea, border or airport. The results of the analyses suggest the presence of R&D knowledge spillovers at provincial level in Turkey, shown by spatial spillover effects in nearly one third of the total effects.

From our survey of papers on Turkey we may conclude that the literature is only based on regional, industrial or provincial analyses whereas the novelty we propose is the investigation of the impact of the localisation economies on co-located firm performances carried out at firm level and based on the emphasis on two mechanisms of analysis: micro and macro level combined together, firm heterogeneity, complementarity between micro and macro policy issues.

ii. Italy

A robust strand of the literature on Italy focus on the so called “district effect”, trying to quantify the Marshallian advantages (in terms of output premiums, growth performances or financial solidity) due to the location of firms into industrial districts with respect to the impact due to the role of “urban effects”, i.e. premia to firms located in urban areas associated to externalities of the Jacobian type. Quite mixed results are achieved in the literature on these issues.

Di Giacinto et al. (2012) detect stable productivity advantages of firms located in urban areas (the reference period spans from 1995 to 2006), while observing a weakening of the advantages traditionally associated to Italian industrial districts. The weakening of the local advantages associated to industrial districts is indeed confirmed by a wide stream of research (CENSIS, 2010; Bugamelli et al., 2009; 2012; Iuzzolino and Micucci, 2011; Cainelli et al., 2012; Alampi et al., 2012).

However, Buccellato and Santoni (2012), for the 2001-2010 period, carry out a more detailed analysis of productivity externalities in the Italian manufacturing industry, both within and between sectors, by aggregating the productivity levels of neighboring firms in a regression of firm level productivity over a set of territorial characteristics (including the degree of urbanization of the territory where the firm is located). The result is that the productivity premiums arising from increased productivity of neighboring firms are higher if compared to the premiums originating from an increased degree of urbanization of the territory. Moreover, the paper from Accetturo et al. (2013) confirms that agglomeration effects still play the major role in explaining local productivity premiums of Italian firms located in urban areas, with respect to firms’ selection effects.

These analyses have prompted further recent studies on Italy focusing on innovation spillovers effects both at regional and at firm level exploiting spatial econometric analysis. Antonelli et al. (2011), Dettori et al. (2012), Marrocu et al. (2011), Moreno et al. (2005), apply spatial econometrics techniques and find important innovation spillovers at the regional level. Lamieri and Sangalli (2013) found a relevant impact of patents on total factor productivity (TFP) of Italian manufacturing firms using a spatial autoregressive model (SARAR), which allows for spatial dependence in both TFP and error terms across firms, with the purpose of checking for the spatial diffusion of productivity.

Cardamone (2017), adopting a SAR specification, shows that the productivity of each firm is affected by the productivity of nearby firms. Besides, R&D play an important role on Italian firm productivity. This, in turn, determines an indirect effect of R&D on firm productivity because of the effect of a firm’s productivity on productivity of all nearby firms. Results also show that firm TFP is positively affected by R&D spillovers due to knowledge flows across firms within the same sector, i.e. intrasectoral spillovers, while there is no significant effect of intersectoral spillovers due to knowledge flows across firms in different sectors. Carboni (2013a and 2013b) recently used spatial econometric techniques to investigate the importance of sectoral proximity in promoting R&D investment and R&D collaboration among Italian manufacturing firms. The paper employs individual firm data in order to check the existence of industry spatial effects alongside other microeconomic determinants of R&D investment.

iii. Tunisia

The Tunisian structural adjustment programme has increased firm performance and their technological capabilities, but it has created a growing inequality in economic performance and employment opportunities between coastal and interior regions. This regional disparity has affected the spatial structure of economic activity. As well as a geographic concentration of firms in general, there is also a concentration of sectors in certain regions. For example, textile firms are mainly located in Monastir provinces, while chemical firms are located in Ben Arous provinces and most of agrofood firms are rather located in Sfax and Nabeul governorates. Since the mid-1990s, policies have focused on improving the productivity of firms by creating clusters of industries. Evidence from Tunisia indicates that firms choose to cluster in areas where there is high local demand to save on transport costs. Within individual clusters, the transmission of innovative ideas is encouraged, thus creating commercial relationship between competing firms. However, this patterns created inequalities in economic performance and employment opportunities, particularly between coastal and interior regions. The spatial structure of economic activity is currently based on strong disparities and the outcome is that industries have increasingly concentrated along Tunisia's coast, while the interior regions are isolated from these hubs of economic activity (Amara and Ayadi, 2011, 2013). In 2006, 16 governorates out of a total of 24 had less than 3 per cent of total firms, not only disadvantaged by distance but mainly by a lack of infrastructure, transportation and information. In contrast, more than 83 per cent of industrial firms are located on the country's coast (Sfax, Tunis, Sousse, Monastir, Ben Arous, Nabeul Bizerte, Ariana), where there are superior infrastructures and transportation networks. The three most privileged regions, Greater Tunis, the Center, and the North-East, are home to 60 percent of the population and almost 90 percent of formal enterprises. Conversely, the three deprived western regions, the North-West, Center-West, and South-West, accommodate 30 percent of the Tunisian population and less than 8 percent of enterprises.

This regional disparity grew significantly between 1996 and 2011. At the same time the advantages derived from industrial agglomerations in Tunisia highlight the importance of Central Business Districts (CBDs) for productivity and information sharing. More than 40 per cent of the firms located on the coastal area are concentrated in two CBDs, Tunis and Sfax. CBDs facilitate information-sharing and access to transportation and infrastructure. Researches clearly indicates that firms in agglomerations in Tunisia benefit from the proximity of other firms. Clustering allow firms to take advantage of the innovative ideas of other firms within the cluster (UNU-Wider, 2015).

Some recent studies for Tunisia find that regional concentration of economic activities improves competitiveness and efficiency. El Elj (2010) analyses the effects of factors external and internal to the firms on innovation in Tunisia, focusing on the opening of capital to foreign companies. The results indicate that the firm's technological competences, derived from in-house R&D effort and cooperation are the main determinants of innovation performance of Tunisian firms. However, the important firms with high export intensity and significant foreign capital participation are found to be less innovating than partially exporting firms with low foreign capital share.[3]

Ayadi and Mattoussi (2014) examine the geographic concentration of industry in Tunisia and identify the main factors driving the observed pattern of spatial concentration and the relationship between total factor productivity and the determinants of technological diffusion. The empirical analysis is based on three surveys on Tunisian manufacturing firms from 2004-06 conducted annually by the INS (Institut National de la Statistique) of Tunisia on all Tunisian manufacturing firms, with data to the sector-governorate level. The finding is that Centre business districts (CBDs) offered the best economic incentives. However, the results also suggest that openness to foreign companies in spite of a significant role in the use of technology was a vehicle for technology diffusion to the Tunisian manufacturing sector only in medium-high tech sectors. This reveals that the diffusion of technology requires certain conditions such as the importance of research and development and improvement in the firms' absorption capacity. Mokaddem (2015) analyses regional efficiency and spatial dependence in Tunisia applying data envelopment analysis (DEA) for the evaluation of efficiency across Tunisian firms with particular emphasis on the role played by spatial interactions and geographical location. Spatial externalities are found to enhance regional efficiency. Achy (2015) depicts how inequalities among the country's regions played a key role in fuelling social unrest. Thus, the hardest-hit cities of Sidi Bouzid, Kasserine, and Thala in the country's Center-West led the uprising against the regime. Statistics show that large parts of the country have been neglected and regional inequality has been exacerbated. For example, the gap in poverty rates between the capital and the rest of the country shows that the regional variation in terms of living standards increased between 2000 and 2004. The gap with respect to Tunis increased

[3] Ghali and Rezgui (2011) noted that foreign owned firms which are technically more efficient are concentrated in sectors where the domestic firms develop the best efficiency scores (machinery and non-electrical equipment, electrical and electronic equipment, and transport equipment).

in all regions. The North-West and Center-East, which benefited from public investments as well as private-sector projects in tourism and offshore manufacturing, are much closer to the capital city. The South and Center-West, conversely, are lagging behind. In the Center-West, the poverty rate was 14 times higher than in Tunis in 2004, compared with 8.5 times higher in 2000. Other indicators confirm the persistence of large disparities between the country's costal and interior regions in access to basic infrastructure, education, health services, and job opportunities. The poorest regions lack adequate economic and social infrastructure and suffer from higher unemployment rates. Regional inequality was not only the result of differences in natural endowments among the regions but also a result of the public policy.

3. Data description

For Turkey we use an unbalanced panel data of all enterprises[4] that either employ at least 20 people or have at least 3 local units during the 2006-2013. Although the data for 2003-2005 are also available, is seems that there are problems with some of the variables used in the analysis. Spatial unit of analysis is the "region" defined at the NUTS 2 level (a typical NUTS 2 region covers 3-4 provinces). The data source is the Turkish Statistics Institutes (TurkStat) Longitudinal Database. The database is unbalanced because of exit from and entry into the industry and/or the database.

Table 1 contains the number of all firms, domestic firms and foreign firms[5] from 2003 to 2013 and the share and the number of R&D performers among all these three groups. Foreign firms are more likely to conduct R&D. About 4-5% of domestic firms perform R&D whereas about 18-19% of foreign firms perform R&D. However, there is a decline in the share of domestic R&D performers after the 2009 crisis in spite of an increase in the number of firms doing R&D.

Table 2 shows the share of foreign firms in total number of firms, employment and value added, and their relative size and labor productivity. The share of foreign firms both as number and as employment and value added decreased after the 2009 crisis mainly because of the increase in the number of domestic firms (entry rate for domestic firms is higher than foreign firms after 2009). Foreign firms are about 4 times larger than domestic firms (in terms of the number of employees per firm) and 2 times more productive (in terms of value added per employee). However, the sectoral distribution highly explains this asymmetry.

In table 3, where the sectoral distribution of foreign firms is described for the 2011-2013 average, it appears that foreign firms have larger share in Tobacco products, Chemicals, Pharmaceuticals and Motor vehicles. Foreign firms are two to five times larger, on average, than domestic firms. Foreign firms' labor productivity is almost equal to that of domestic firms in pharmaceuticals, basic metals, computers, and other transportation equipment industries. The productivity differential (the productivity of foreign firms relative to the productivity of domestic firms) is higher than two in non-metallic mineral and fabricated metal industries. There is a weak positive correlation between relative size and productivity of foreign firms across industries, i.e., productivity differential between domestic and foreign firms is explained partly by differences in firm size.

We use for Italy an unbalanced panel of manufacturing firms for 2005-2010 merging AIDA with Capitalia survey Xth wave (manufacturing only). We focus on firm location in industrial districts,

4 We use the terms "firm" and "enterprise" interchangeably.

5 A firm is "foreign" if at least 10% of its shares is held by foreign agents. Note that the most of the foreign firms are majority owned, i.e., foreign agents own more than 50% of shares.

and urban areas and on several measures of innovation. Spatial unit of analysis are provinces. Our sample is stratified by size, sectors and region and representative of the Italian firm population. In tab. 8 the distribution by size classes testify the key role of SMEs in our sample (67%), the role of supplier dominated sectors (41%), the concentration of firms in the North (72.75%), the diffusion of local districts (44%) and the lack of internationalisation as testify the restricted presence of foreign multinationals (1.55%).

In tab. 9 we focus on describing the average firm behavior in terms of TFP and of innovative activities measured by intangible assets investment, aggregating firms according to size, localization in a district, Pavitt sectors, ownership (domestic or foreign). We observe that higher size, foreign ownership, belonging to sector more intensive in technology correspond to more intense innovation activities and output performance relative to the other dummies. Conversely, the firms localized in a district are less innovative and productive but this can easily be explained by the sectors of specialization which are typical of the Italian industrial district (the *made in Italy* sectors such as textile, clothing, and other traditional sectors).

The data used for Tunisia is an unbalanced panel of 3117 (in 2006) Tunisian manufacturing companies observed over 10 years, 1997-2006 (a long time series of micro data available in Tunisia provided by the Tunisian National Institute of Statistics). Spatial unit of analyses are governorates. This sample is representative of the Tunisian manufacturing sector with regards to control variables such as employment, gross fixed capital formation and output. The variables provide firm-level information on foreign ownership and production characteristics, such as labor, gross revenue, physical capital, materials, profits, and R&D performer, among any others.

In table 14, we can see that over the period 1997-2006, in the sample the number of domestic firms decreased by 61.6%, while the number of foreign firms has increased by 88.84%. Moreover, the table shows that the share of R&D performers is on average 6% for the domestic firms, and a slight increase of 15.5% could be noticed for the share of domestic R&D performers over the period 1997-2006. The share of foreign firms increased by 89%, with an Average Annual Growth Rate of 6.5%. The share of foreign firms in the employment grew with an average annual rate of 5.16%. The share of foreign firms in the value added increased by 16.27%, with an Average Annual Growth Rate of 1.5%.

The analysis of the sample show that 60% of the firms are concentrated on the costal regions. 92.5% of the companies are producing for the local market and 7.5% are exporting. The majority of foreign owned firms (FDI) are located on the coast: 30% are located in the greater Tunis (Tunis, Ariana, Ben Arous), 26% in Monastir, 11% in Sousse, 9% in Bizerte, Nabeul and 6% in Sfax. 54% of employment is located in the greater Tunis (Tunis, Ariana, Ben Arous), and nearly 90% in the coastal regions. The skilled workers are concentrated at 62% in Tunis, and 93% in coastal regions and 80% in local enterprises. Foreign firms dominate the R&D performers, moving from 79% of the total in 1997 to 94% in 2006 (maps 14-18).

4. Stylised facts on firm clustering, spatial productivity, and innovation in Turkey, Italy and Tunisia[6]

We provide a preliminary descriptive part as a background for our econometric analysis. For each country we use crucial indicators of performances at province level: value added share, foreign

[6] * Authored by Anna Maria Ferragina and Giulia Nunziante.

firms production share, innovation of domestic and foreign firms, relative labour productivity, TFP, employment growth, TFP growth.

Maps 1-8 show the unique nature of Turkish economy in terms of strong regional imbalances. We illustrate the pattern of clustering using maps that exploit information on the exact location of firms (also considering foreign firms location). They picture at province level the concentration of value added, the relative labour and TFP productivity, which is a way to answer the question: do firms cluster? TFP growth and employment growth maps give us a preview of the potential benefits of clustering while the number of foreign and domestic R&D performers give us a hint on spatial innovation spillover. Furthermore, figures 1-3 help investigating in a preliminary unconditional way the benefits of regional agglomeration using the correlations between some of the variables mapped above. In particular, fig. 1 shows the positive correlation between regional agglomeration (log regional share of value added) and regional relative productivity. The picture suggests that more concentrated regions are more productive. In fig. 2 regional agglomeration (log regional share of value added) is instead put in correlation with employment growth: here quite surprisingly more developed regions achieve lower employment growth from 2006-7 to 2011-12. This could be explained mainly with the less developed regions have higher population growth but it could also be due to the fact that concentration enhances productivity but not employment. In fig. 3 regional agglomeration is compared with the share of foreign firms in regional output: it appears evident that more concentrated regions attract more foreign firms.

For Italy, we concentrate upon some key indicators by province: a) the firm distribution (map 9); b) indicators of performances like production share, average TFP, and firm employment growth (map 10-12); c) indicators of innovation measured by intangible asset shares (map 13); d) some correlations between indicators of benefits from clustering. First of all we look at the relationship between the province agglomeration (log province share of value added) and TFP (fig. 7). As one would expect more concentrated provinces are more productive. In fig. 8, innovation and agglomeration at province level are also positively correlated and there is also a strong correlation between spatial TFP and spatial innovation (fig. 9). However, Italy, in spite of being a country marked by strong regional divides in terms of these spatial indicators at province level, is far from the extreme divides which are observed in Turkey and in Tunisia.

As for Tunisia, the maps 14-18 show the strong disparities in the concentration of resources between provinces measured by their share of production, by the firms concentration, by the share of foreign firms, by the labour share and by the qualified labour share. Besides no significant change appears confronting two years, 1997 and 2006. In particular, while the production and firm localisation show a less marked gap between the more developed coastal area and the eastern and southern parts of the country in 2006, the localisation of foreign firms in 2006 is ever more concentrated in close regions belonging to the western coast and to the central part of the country and the south does host a very small number of foreign firms. The employment share both in 1997 and 2006 show important gaps with the southern part of the country particularly disadvantaged. In addition to this, the analysis of the sample shows that 60% of the firms are concentrated on the coastal regions. 92.5% of the companies are producing for the local market and 7.5% are exporting. The majority of foreign owned firms (FDI) are located on the coast: 30% are located in the greater Tunis (Tunis, Ariana, Ben Arous), 26% in Monastir, 11% in Sousse, 9% in Bizerte, Nabeul and 6% in Sfax. 54% of employment is located in the greater Tunis (Tunis, Ariana, Ben Arous), and nearly 90% in the coastal regions. The skilled workers are 62% in Tunis, 93% in coastal regions and 80% in local enterprises. Foreign firms dominate the R&D performers, moving from 79% of the total in 1997 to 94% in 2006.

5. Empirical methodology: geographical and sectorial clustering of firms, innovation spillovers and productivity

The first issue we want to analyse is the relationship between agglomeration, innovation and firms' productivity. Analysis of micro and macro factors which affect the efficiency conditions of firms are crucial in this context and they entail the consideration of proximity between firms, agglomeration indicators and R&D spillovers. The questions are: do firms localised in clusters of production exhibit a higher productivity? How far concentration of innovation of co-located firms in the same cluster are able to increase it? We also explore the complementarity between domestic and foreign firms. Firms should benefit from the experience of other firms in the vicinity, especially from the one of large foreign multinational firms. So we ask how localisation of firms nearby multinationals operating in the same localised cluster would contribute to develop their productivity and would allow innovation to circulate.

Hence, the analysis for each economy aims to provide a measure of spillovers on productivity from geographical and sectorial clustering of firms and from their innovation. In addition to considering innovation measures at firm level, we build specific indexes of innovation activity at territorial level (regions for Turkey, governorates for Tunisia, provinces for Italy). We also use indicators of innovation performed by domestic and by foreign multinationals at the spatial level of analysis adopted.

To sum up, we try to capture regional and sectoral spillovers from agglomeration of activities, from foreign firms and from innovation performers (both domestic and foreign) in the sector and in the spatial unit under analysis.

In all the three studies we try to include explicit regional variables and to capture regional spillovers due to agglomeration economies and to innovation spillovers. In this way, we directly contribute to the wide literature on productivity spillovers from agglomeration economies, as well as to the literature on localized knowledge spillovers from innovation also checking for spillovers between firms taking place within regions, controlling for certain regions being more conducive to generating productivity growth. In order to distinguish between the two effects we also have as a control measures of base levels of regional attractiveness, e.g. value added per head. This controls for initial regional factors. We do also include time dummies. However, we do not include regional dummies as controlling on average across the years for regional effects might absorb some of the regional and sector externalities we are trying to estimate.

In spite of different spatial unit of analysis and different proxies for innovation we use the same estimation strategies: panel estimates for output (by GMM-system), controlling for time fixed effects. Simultaneity and endogeneity is hence addressed using system Generalized Method of Moments (GMM) dynamic panel estimation techniques. This methodology allows us to distinguish the direction of the nexus clustering and productivity and to focus on whether more regional clustering lead to higher productivity, ruling out the other direction of causality, i.e. that higher productivity leads to more regional clustering. It also allows to understand whether there are spillovers between firms taking place within regions, controlling for regional attractiveness to avoid to catch a different relationship i.e. that certain regions more developed are more conducive to generating productivity growth. The methodology we use, GMM (or GMM system), takes care of endogeneity of input by creating instrumental variables from existing variables. In the case of GMM-system, two equations are estimated jointly, the differenced equation and the level equation where first differences are used as instruments (the methodology for GMM is explained in Appendix 2).

We also compare as robustness check other estimations methods (OLS, Fixed effects, Levinshon and Petrin, Olley and Pakes). The latter two methods are described in the Appendix 3.

We consider different externality transmission channels, and consider which variable available in the data might best capture that. The first most important channel is to catch the spillovers between firms in the same industry (horizontal spillovers). Three variables are adopted to this purpose: the regional share variables by sector i.e. the output share of the region in the sectors output, the number and the output of firms by sector-region. Then, we look at the R&D/innovation performed by domestic and by foreign firms which can be considered as an innovation spillover channel. The share of output of R&D performing domestic and foreign firms in the region/sector and the number of R&D performing domestic and foreign firms in the region/sector are the two proxies considered for Turkey and for Tunisia, while for Italy we consider the share of innovation proxied by intangible assets of domestic and foreign firms in the province and sector.

As not all firms are able to benefit from spillovers and enjoy agglomeration effects it is important to also control for the role of the absorptive capacity. Hence, we interact agglomeration and spillover variables with firm size (measured by the number of employees) and with innovation variables. These interaction variables will reveal if large firms and innovation performers benefit more from agglomeration effects and spillovers. For example, if large firms benefit more, the coefficient of firm size-agglomeration effect interaction variable will be positive.

The third important issue is related to the presence of spillovers by foreign firms. We consider to this purpose the shares of foreign firms in the region and in the sector.

5.1. Turkey[7]

5.1.1. Model and descriptive statistics

In order to test the effects of agglomeration economies and spillovers, a Cobb-Douglas production function is estimated:

$$q_{i,t} = \alpha_i + \alpha_{Lq}q_{i,t-1} + \alpha_K K_{i,t} + \alpha_{LK}K_{i,t-1} + \alpha_L L_{i,t} + \alpha_{LL}L_{i,t-1} + \alpha_M M_{i,t} + \alpha_{Lm}M_{i,t-1} + D_t + \Sigma\beta_j X_{i,j,t} + e_{it} \qquad [1]$$

where q is real output, K capital, L labor, M inputs, D time dummies, and e the error term. Subscripts i and t denote firm and time, respectively. α_i's accounts for unobserved, time-invariant firm-specific effects. X is a vector of variables that explain total factor productivity, and it includes the variables that measure agglomeration effects and spillovers.

We use GMM-system method to estimate the production function that controls for the endogeneity of inputs, autocorrelation and heteroscedasticity. In order to check the robustness of estimation results, and to compare different methods, the same model was estimated by pooled ordinary least squares (OLS), fixed effects (FE), Olley-Pakes (OP), Levinshon-Petrin (LP) and GMM-system orthogonal deviations (GMM-O) methods.

[7] * Authored by Erol Taymaz and Ünal Töngür.

The *output variable* of the production function is the value of production (sales adjusted by changes in final product inventories). It is deflated by sectoral prices indices at NACE 4-digit level to find real output.

Inputs of the production function are capital, labor and inputs (raw materials, parts and components). Capital is measured by depreciation allowances, labor by the average number of employees, and inputs by the value of all inputs adjusted by changes in raw materials and work-in-process inventories. The Capital variable is deflated by investment price index whereas the input variable is deflated by sectoral price indices.

The GMM-system model is defined as a dynamic model: it includes the lagged values of the dependent variable (output) and all inputs. This specification allows for a flexible functional form and incorporates various adjustments.

The output and all input variables are used in log form. Therefore, the coefficients of input variables give us short-term factor elasticities. The long run factor elasticities are defined by

$$\varepsilon_i = (\alpha_i + \alpha_{Li}) / (1 - \alpha_{Lq}) \qquad [2]$$

where ε is the long-term elasticity of factor i, α_i the coefficient of factor i, α_{Li}) the coefficient of the lagged value of factor i, and α_{Lq} the coefficient of the lagged value of output.

The returns to scale parameter is defined by

$$\kappa = \varepsilon_K + \varepsilon_L + \varepsilon_M \qquad [3]$$

where κ is the returns to scale parameter, and the subscripts K, L and M denote capital, labor and inputs, respectively. There are constant returns to scale when $\kappa = 1$, increasing (decreasing) returns when $\kappa > 1$ ($\kappa < 1$).

In order to capture the effects of all shocks and exogenous technological change, all models include time dummies, i.e., a dummy variable for each year.

A dummy variable for foreign ownership is included into the model to capture the effects of foreign ownership on productivity. Foreign firms are, by definition, multinational firms, and are able to transfer technology from abroad, mainly from the parent firm. Therefore, foreign firms are likely to be more productive than domestic firms.

Technological activities of the firms is captured by a dummy variable that is equal to 1 if the firm performs R&D activities, and 0 otherwise. Since the firm can generate new products and/or processes as a result of R&D activities, the R&D dummy variable is expected to have a positive coefficient, i.e., R&D performers would be more productive.

Since the main of our study is to analyse the effects of agglomeration and spillovers, especially from foreign firms, we use a number of proxy variables that are expected to capture the effects of these factors. Note that there are a number of alternative proxy variables. For example, agglomeration can be measured by the density of firms (the number of firms), or by the density of production activities (output). Therefore, we experimented with a number of alternative variables, and replaced a set of explanatory variables by another set.

The first set of proxy variables for agglomeration effects includes the (log) numbers of domestic and foreign firms in the same sector (defined at the NACE 4-digit level) and region (defined at NUTS 2 level). These variable will have positive coefficients if agglomeration of firms leads to higher productivity. We use the number of domestic and foreign firms separately because the extent of spillovers could differ between domestic and foreign firms.

We use two additional variables, the number of domestic and foreign R&D performers in the same sector and region to test if R&D performers are more likely to spillover knowledge and technology to other firms that operate in the same sector and region.

The second set includes the (log) output of domestic and foreign R&D performers in a given sector and region. This set defines agglomeration in terms of output instead of the number of firms as defined in the first set. The number of firms variable would be meaningful if spillovers takes the form of imitation, whereas the output variable could reflect spillovers in the form of externalities and labor turnover.

The third set includes a number of variables about output shares. “Regional share (sector)” is the share of the region in total output of the sector in which the firm operates. The “Foreign share (sector)” and “Foreign share (region)” variables are defined similarly for foreign firms. If there are agglomeration economies in a sector, the firms located in a region where that sector is concentrated in would be more productive. If there are spillovers from foreign firms within a sector, then the “Foreign share (sector)” variable will have a positive coefficient. However, if spillovers from foreign firms have a geographical dimension, then the coefficient of the “Foreign share (region)” variable will be positive.

Benefiting from spillovers is not a passive process, and all firms cannot enjoy agglomeration effects to the same extent. To control for the role of the absorptive capacity, we interact agglomeration and spillover variables with firm size (measured by the number of employees) and R&D dummy variable. These interaction variables will reveal if large firms and R&D performers benefit more from agglomeration effects and spillovers. For example, if large firms benefit more, the coefficient of firm size-agglomeration effect interaction variable will be positive.

Finally, we also include into the model the output share of large firms in the same sector and region to test if spillovers originate only from large firms.

Descriptive statistics for all variables for the analysis period are presented in Table 4. Note that with the exception of dummy variables (FDI and R&D performer) and share variables (Regional output share, Foreign share (sector) and Foreign share (region)), all variables are in log form. As shown in the table, the share of foreign firms was 3.2% and the share of R&D performers 4.6%. The average number of domestic firms in the same sector and region is 36.9 ($e^{3.608}$). In the most concentrated case of the agglomeration of domestic firms, it reaches to 1663, i.e., 1663 firms operating in a sector are located in the same region.

The average number of foreign firms in the same sector-region is much smaller (only 2.1) and its maximum value becomes 33. The average number of R&D performing domestic (foreign) firms in the same region/sector is 2.01 and 1.16. Although the number of foreign firms is small, the average sectoral share of foreign firms is 11.4%, and the average regional share of foreign firms is 19.7%. The significant difference between the number and output of foreign firms shows that these two measures could reflect different aspects of agglomeration effects and spillovers emanating from foreign firms.

There could be similarities between the location choice of domestic and foreign firms. In such a case, the variables about the number of domestic and foreign firms will be highly correlated. In order to check it, we calculated the correlation coefficients of the variables about the number of firms (the number of domestic firms, foreign firms, domestic R&D performers, and foreign R&D performers in the same region/sector). As shown in Table 5, the correlations between all these variables are statistically significant at the 1% level, but the correlations are not perfect. This is due to the fact that foreign firms are more concentrated in certain regions of Turkey (see Maps 1-8).

5.1.2. Estimation results

Estimation results are presented in Table 6a (without interaction effects) and Table 6b (with interaction effects). We included agglomeration and spillover variables in blocks of variables to check the effects of correlations between explanatory variables.

Estimation results for production function are quite robust and sensible. The returns to scale parameter is around 1.05 for almost all models that indicates that there are mild increasing returns to scale in Turkish manufacturing. The (long run) elasticities of capital, labor and inputs are around 0.055, 0.356 and 0.635 which are reasonable. The coefficient of the lagged output variable is small (around 0.2), i.e., output adjusts quickly.

The coefficients of foreign ownership and R&D variables are statistically significant[8] in all models. Foreign firms in Turkish manufacturing are around 13% more productive than domestic firms. As may be expected, R&D performers are more productive than non-performers, and the average productivity differential between R&D performers and non-performers is around 5-6%.

Estimation results suggest that there are productivity spillovers from foreign firms operating in the same sector-region. The coefficient of the number of foreign firms operating in the same sector-region is positive and statistically significant. If the number of foreign firms increase by 1%, productivity of all firms operating in that sector and region increases by 0.04% (Model 4, Table 6a), i.e., these effects are economically significant, too.

The number of domestic firms operating in the same sector-region seems to have a negative effect on productivity when the model includes the variable on foreign firms (compare models 3 and 4, Table 6a). There could be congestion or negative competition effects due to agglomeration of domestic, and, most probably, technologically inferior firms.

In order to check if agglomeration and spillovers effects differ by firm characteristics, we use the number of R&D performing domestic and foreign firms in the same sector-region instead of total number of firms (Model 5, Table 6a). In that case, the coefficients of both domestic and foreign firms become positive and statistically significant. The coefficient of the number of R&D performing foreign firms is almost equal to the coefficient of the number of foreign firms (around 0.04), but the coefficient of the number of domestic R&D performers is somewhat smaller (0.008). These results reveal that the extent of spillovers from R&D performing and non-performing firms is quite similar. Domestic R&D performers generate positive spillovers, but they are weaker compared to those generated by foreign firms.

8 Unless otherwise noted, “statistically significant” means statistically significant at the 1% level.

In another group of regression, we used proxy variables defined in terms of total output instead of total number of firms produced by domestic and foreign firms in the same region. Model 7 shows that when the outputs of both domestic and foreign firms are higher in a sector-region, firms operating in that sector-region are likely to be more productive. These results, when compared to those of Model 4, support the congestion and competition arguments for domestic firms. If there are more domestic firms in a sector-region, it creates negative effects, but if total output produced by domestic firms increase in a sector-region, then firms become more productive. Note that, in this case too, the coefficient of output of foreign firms is higher that the coefficient for domestic firms, i.e., foreign firms’ output generate more spillovers.

When the output variables are replaced by the output of R&D performers, the results are the same: there are strong spillovers from the output of both domestic and foreign R&D performers, and the spillovers from foreign firms are stronger that those from domestic firms.

Finally, in order to check if regional spillovers are specific to those firms operating in the same sector, we redefined agglomeration and spillover variables separately at the sectoral and regional level instead of narrower sector-region level. In this case (Model 6) the “Regional share (sector)” variable shows the share of that region in the sectors’ total output, the “Foreign share (sector)” the share of foreign firms in the sectors’ total output, and the “Foreign share (region)” the share of foreign firms in the regions’ total output. Therefore, for example, the “Foreign share (region)” variable shows if there are regional spillovers from foreign firms that benefit to firms operating in the same region but in different sectors, whereas the “Foreign share (sector)” variable shows if there are spillovers from foreign firms that are beneficial to all firms operating in the same sector irrespective of its location.

Estimation results show that there are pure agglomeration effects (“Regional share (sector))”, i.e., if a regions share in a sectors’ total output is higher, the firms operating in that region and sector are more productive. Moreover, there are additional spillovers from foreign firms to all firms operating in the same sector, and to all firms operating in the same region, i.e., there are spillovers at the sectoral and regional level independent form each other.

In Models 9 and 10 (Table 6b), different variables used to capture agglomeration and spillover effects are included into the model to check the robustness of estimation results. There is no significant change in estimation results. The only exception is that the coefficient of the output of foreign R&D performers becomes insignificant when the model also includes other variables about spillovers from foreign firms.

Finally, Models 11-14 (Table 6b) include interaction variables that are used to understand if absorptive capacity is important in benefiting from agglomeration effects and spillovers. Most of the variables interacted with firm size have statistically insignificant coefficients at the 5% level, i.e., firm size does not matter in benefiting from spillovers. The only exception is the interaction with “Foreign share (sector)” variable that has a negative and statistically significant coefficient. It seems spillovers from foreign firms operating in the same sector are more important for small firms than large firms.

Regarding the interactions with R&D performer variables, the estimation results show that R&D does not matter much for benefiting from spillovers. It seems that R&D non-performers benefit more from spillovers from foreign firms operating in the same sector (Model 12), but when we look at spillovers from foreign R&D performing firms in the same sector-region, R&D activity enhances absorptive capacity, i.e., absorptive capacity created by R&D activity matters for spillovers from other (foreign) R&D performers. These results may indicate that there could be spillovers specific to technologically sophisticated firms.

Models 15 and 16 are estimated to check if only large firms generate spillovers. When the output share of large firms in the same sector-region is the only spillover variable (Model 15), the estimation results suggest that there are spillovers from large firms to others operating in the same sector-region. However, even when three aggregate spillover variables are included into the model (Model 16), the coefficient of the output of large firms in the same sector-region becomes insignificant, i.e., the existence of large firms does not create more spillovers.

The basic model was estimated by using different estimation methods (see Table A1). The returns to scale parameter is quite low for FE and LP methods. The parameter is almost equal to for OP method, and around 1.03-1.04 for OLS and GMM-O. However, with the exception of the FE method, all other methods lead to qualitatively similar results.

To summarize, the estimation results for Turkey suggest that:

- there are significant productivity enhancing agglomeration effects
- there are significant productivity enhancing spillovers between firms operating in the same sector, and these spillovers are stronger if firms operate in the same region
- spillovers emanating from foreign firms are stronger than those from domestic firms
- spillovers from R&D performers are stronger
- there could be some spillovers specific to technologically sophisticated firms
- there seems to be no spillovers specific to large firms.

5.1.3. Productivity dynamics and differentials

The previous section summarizes the results of production function estimates that reveal which factors contribute to total factor productivity. In this section, we will look at the dynamics of productivity by region and firm size, and productivity differentials by firm size at the regional level.

By using the estimated coefficients of the production function, the (log) level of total factor productivity for each firm-year is calculated as follows:

$$TFP_{i.t} = q_{i,t} - \alpha^*_{Lq}q_{i,t-1} + \alpha^*_{K}K_{i,t} + \alpha^*_{LK}K_{i,t-1} + \alpha^*_{L}L_{i,t} + \alpha^*_{LL}L_{i,t-1} + \alpha^*_{M}M_{i,t} + \alpha^*_{Lm}M_{i,t-1}$$

where $TFP_{i,t}$ is the (log) TFP level of firm i at time t. α^*’s are estimated values of production function coefficients.

We estimated TFP levels by coefficients estimated for all models, and checked if there are significant differences between TFP levels calculated for each model. The coefficients of correlation between TFP levels are above 0.99 for all models, i.e., all models give similar TFP estimates at the firm level. We use the coefficients of Model 9 (Table 6b) in the following analysis.

We ranked all regions by GDP per capita and formed 5 regions on the basis of their ranking. Region 1 has the highest and Region 5 the lowest GDP per capita. Figure 4 presents the mean TFP levels for those five regional groups for the period 2006-2013. It seems that regions 1 and 2 have similar TFP levels, whereas regions 3, 4 and 5 lag behind the more developed regions. It is interesting to observe that the economic crisis in 2009 had a stronger negative effect on less-developed regions (especially the least developed one) in terms of productivity level whereas the developed regions (1 and 2) were able to increase their productivity throughout the period. The less developed regions, after stagnation until 2011 achieved a rapid increase in productivity in 2012 and 2013.

Figure 5 presents similar data grouped by firm size. All firms are classified into three groups, large (employing 250 or more people), medium (50-249 employees) and small (20-49) categories. There are significant productivity differentials between large firms on the one hand, and small and medium-sized firms on the other. Small and medium-sized firms have, on average, similar productivity level. The effect of economic crisis on productivity across size categories is similar to that for regions. Less productive categories (small and medium-sized firms) felt the effect of economic crisis more than large firms did. Although the TFP level for small and medium-sized firms stagnated before and during the crisis, it increased almost continuously for large firms throughout the period.

Since there are similarities in the dynamics of productivity across regions and firm size categories, we calculated average TFP level by size-region categories for the post-2010 period (Figure 6). The data shows that although small firms in more developed regions are less productive than their large counterparts operating in the same region, they are more productive than large firms located in less developed regions. Moreover, the productivity differential between large and small firms is smaller in the most developed and the least developed regions: in the most developed regions, because even small firms are very productive; in the least developed regions, because even the large firms are not productive.

The data summarized in Figure 6 provides a strong evidence on the role of regional development, agglomeration effects and spillovers. Regions, because of agglomeration effects and spillovers, are at the core of productivity and, therefore, of economic development.

5.2. Italy[9]

5.2.1. Model and descriptive statistics

We follow for the Italian case a model similar to that adopted for Turkey.
In order to test the effects of agglomeration economies and spillovers, a Cobb-Douglas production function is estimated as in equation [4] :

$$q_{i,t} = \alpha_i + \alpha_{Lq}q_{i,t-1} + \alpha_K K_{i,t} + \alpha_{LK}K_{i,t-1} + \alpha_L L_{i,t} + \alpha_{LL}L_{i,t-1} + \alpha_M M_{i,t} + \alpha_{Lm}M_{i,t-1} + D_t + \Sigma\beta_j X_{i,j,t} + e_{it} \qquad [4]$$

where q is real output, K capital, L labor, M inputs, D_t a dummy for the crisis and e the error term. Subscripts i and t denote firm and time, respectively. α_i’s accounts for unobserved, time-invariant firm-specific effects. X is a vector of variables that explain total factor productivity, and it includes the variables that measure agglomeration effects and spillovers.

We use GMM-system method to estimate the production function that controls for the endogeneity of inputs, autocorrelation and heteroscedasticity. In order to check the robustness of the estimation results, and to compare different methods, the same model was estimated by pooled ordinary least squares (OLS), fixed effects (FE), Olley-Pakes (OP), Levinshon-Petrin (LP) methods.

The *output* variable of the production function is the value of production (sales adjusted by changes in final product inventories). Inputs of the production function are capital, labor and inputs. Capital

[9] Authored by Anna M. Ferragina

is measured by depreciation allowances, labor by the average number of employees, and inputs by the value of all inputs (raw materials, parts and components). These variables are deflated by sectoral prices indices at NACE 2-digit level to find real output, capital and input.

The GMM-system model is defined as a dynamic model: it includes the lagged values of the dependent variable (output) and all inputs. The output and all input variables are used in log form. Therefore, the coefficients of input variables give us short-term factor elasticities. We obtain the long run factor elasticities and the return to scale parameter by following the expression [2] and [3].

In order to capture the effects of shocks related to the global crisis, all models include a crisis dummie, i.e., a dummy variable for each year.

A dummy variable for foreign ownership is included in the model to capture the effects of foreign ownership on productivity. Foreign firms are multinational firms, and are able to transfer technology from abroad, mainly from the parent firm. Also domestic multinationals are included as like foreign firms they are more likely to be more productive than national firms.

Technological activities of the firms are captured by intangible assets. Since the firm can generate new products and/or processes as a result of R&D investment and patent activities, the intangible asset variable is expected to have a positive coefficient, i.e., innovating firms are likely to be more productive.

Since the focus of our study is to analyze the effects of agglomeration and spillovers we use a number of proxy variables that are expected to capture them. We introduce to this purpose variables able to capture regional and sectoral spillovers from agglomeration, innovation performed by domestic and by foreign firms in the province/sector and spillover from the presence of foreign firms at province and at sector level.

We build specific indexes of agglomeration and innovation activity at the territorial scale, where the spatial unit of analysis is the province where a firm is located. We try to consider different externality transmission channels. We first consider spillovers between firms in the same industry/province (horizontal spillovers) to investigate upon the agglomeration premia. The set of proxy variables for agglomeration effects includes the share of the province in the total sectorial output (*output_share_prov*). If there are agglomeration economies in a sector, the firms located in a region where that sector is concentrated in would be more productive. Secondly, we consider the (log) numbers of domestic and foreign multinationals and of non multinational domestic firms in the same sector (defined at the NACE 2-digit level) and region (defined at NUTS 2 level) (*nfirms_sect_prov_md, nfirms_sect_prov_mf, nfirms_sect_prov_nmn)*. These variables will have positive coefficients if agglomeration of firms leads to higher productivity.

An alternative set of proxy variables for firms' agglomeration includes the (log) of value added of domestic and foreign R&D performers in a given sector and region (*md_val_added, mf_val_added, nmn_val_added*). This set defines agglomeration in terms of output instead of the number of firms as defined in the first case.

Furthermore, we build indicators which allow to take into account innovation spillovers on productivity by considering the innovation performed by domestic, by foreign multinationals and by non multinational firms respectively in the different provinces (*linnov_prov_md, linnov_prov_mf, linnov_ prov_nmn)*. We use the number of domestic and foreign innovation in the same sector and region to test if innovation performers are more likely to spillover knowledge and technology to other firms that operate in the same sector and region.

The impact which foreign firms play in the sector and in the province is also considered (*foreign_share prov; foreign_share_sect*). If there are spillovers from foreign firms within a sector, then the "Foreign share (sector)" variable will have a positive coefficient. However, if spillovers from foreign firm have a geographical dimension, then the coefficient of the "Foreign share (region)" variable will be positive.

We also introduce as a control a measure of base levels of regional attractiveness using value added per capita in the province (*lva_pc*). This takes into account initial regional factors. Finally, spatial factors/distance i.e. the distance between the center where the firm is located and the economic center of the country (*dist_maintown*) is included as indicator of remoteness and the railways network is used as proxy for the regional infrastructure (*stations*).

At firm level we control for size, capital, ownership status, and innovation measured at firm level by intangible assets (*intangible_pro*). The estimates include a dummy for the crisis years (*crisis*). We do not include sectoral and regional dummies, as these would control on average across the years for regional and sector effects and might absorb some of the regional and industry externalities we are trying to estimate.

All these variables are listed and explained in tab. 10. Note that with the exception of dummy variables (FDI and domestic multinationals) and share variables (Regional output share, Foreign share (sector) and Foreign share (region)), all variables are in log form. In tab. 11 the descriptive statistics for these variables give an overview of the mean and the standard deviation for the firm characteristics and the regional indicators.

As shown in the table, the share of foreign firms was 2%. The average number of national firms in the same sector and region is 9.77 ($e^{2.28}$) while 1.6 ($e^{0.47}$) is the number of domestic multinationals. The average number of foreign firms in the same sector-region is only 1.18 ($e^{0.17}$). Although the number of foreign firms is small, the average sectoral share of foreign firms is 5%, and the average regional share of foreign firms is also 5%. There is also a significant difference between the number and the output of foreign firms this latter being 9.39. The average innovation of domestic (foreign) firms in the same province/sector is 3071 and 1480.

We also interact agglomeration and spillover variables with firm size (measured by the number of employees) and with the firm innovation variable. These interaction variables will reveal if large and more innovating firms benefit more from agglomeration effects and spillovers. For example, if large firms and more technology endowed ones benefit more, the coefficient of firm size-agglomeration effect interaction variables and of firm technology class-agglomeration variables will be positive.

5.2.2. Estimation results

In tab. 13 we present the results from the estimation of our models. We included agglomeration and innovation spillover variables in separate estimations to control for the effects of correlations between explanatory variables. In the first column we only consider the production function variables. Estimation results for production function are quite robust and sensible. The returns to scale parameter is around 0.8 for almost all models that indicates that there are mild decreasing returns to scale in Italian manufacturing. The coefficient of the lagged output variable is small (around 0.2), i.e., output adjusts quickly.

In column 2 in addition to the variables related to the production function (and the lagged labour, raw material, real capital input and dependent variable) the proxy for innovation (intangible asset investment) and the status of domestic or foreign multinational on the reference category of national firms are added. The expected signs and significance are obtained on all the variables. The coefficients of foreign ownership and innovation are statistically significant[10] in all models. Foreign firms in Italian manufacturing are around 23% more productive than domestic firms. As may be expected, the higher the intangible asset the more productive are firm.

In column 3 we focus on considering a proxy for firm agglomeration: the number of firms at sector/province level. We find evidence of spillovers from the concentration of non multinational firms in terms of enhancing output and we find a negative impact from foreign multinationals and from the concentration of domestic multinationals.

In column 4 we do find evidence that overall innovation in the province/sector has a positive impact. In column 5 the estimates focus on three key variables: a proxy for agglomeration at province level and the share of foreign firms in the province and in the sector output. The indicator of agglomeration of activities in the sector is positive and significant. I.e. the share of that region in the sectors’ total output, the share of foreign firms in the sectors’ total output, and the share of foreign firms in the regions’ total output. Therefore, for example, the “Foreign share (region)” variable shows if there are regional spillovers from foreign firms that benefit to firms operating in the same region but in different sectors, whereas the “Foreign share (sector)” variable shows if there are spillovers from foreign firms that are beneficial to all firms operating in the same sector irrespective of their location.

Estimation results show that there are pure agglomeration effects (“Regional share (sector))”, i.e., if a regions share in a sectors’ total output is higher, the firms operating in that region and sector are more productive. This is in line with what is asserted by some scholars. Laursen and Meliciani (2000) evaluate knowledge spillovers and innovation through an evolutionary economics approach and conclude that spillovers are often sector-specific. Moreover, there are additional spillovers from foreign firms to all firms operating in the same province but not to firms operating in the same region/sector, i.e., there are spillovers at the sectoral but not at regional level independent form each other.

As a robustness check for this result in the following estimate (column 6) we also adopt variables for agglomeration based on the concentration of the value added in the province/sector. The results indicate a positive impact but only as far as non multinational firms value added concentration is concerned.

Columns 7-12 include interaction variables that are used to understand if size (labour) and absorptive capacity (measured by technology intensity classes measured by splitting the sample in two classes according to firm intangible asset below and above the median) are important in benefiting from agglomeration effects and spillovers.

Some of the variables interacted with firm size have statistically and positive significant coefficients at the 5% level. It seems that the number of domestic multinationals operating in the same sector are more important for small firms than for large firms while agglomeration of national firms benefit the large firms more. The agglomeration of value added of foreign and domestic multinationals also

10 Unless otherwise noted, “statistically significant” means statistically significant at the 1% level.

favours the small firms more than the large ones and, the innovation of foreign multinationals favours small firms more.

Regarding the interactions with the class of technology to which the firm belong to (tech 1 class if lower than the average of intangible asset in the province and sector and tech 2 if higher), the estimation results show that innovation matter for benefiting from spillovers. It seems that less innovative firms benefit more from spillovers from foreign and domestic multinationals (Model 10), but technology activity enhances the absorptive capacity, i.e., absorptive capacity created by R&D activity do matter for spillovers from other domestic firms. These results may indicate that there could be spillovers specific to technologically more sophisticated firms.

As control variables we have in all the estimates the dummy for the crisis. In the estimates 2-12 a further control is the level of value added per capita to take into account the level of development and hence the attractiveness of the region, which might be the real factor pushing output and agglomeration at the same time. Furthermore, we consider the distance from the main town and the number of railway stations in the province. The signs of he coefficient are in line with our expectations.

To sum up, we find evidence in favour of agglomeration spillovers at local level but these effects are stemming from national firms not from foreign firms. Firms also get premiums in presence of higher innovation in the province in the same sector carried out by neighbouring domestic firms confirming the crucial role played by innovation spillovers due to closeness between domestic firms. Hence, innovation spillovers spread positively between domestic firms within geographical and sectoral-based neighborhoods which suggests that firms operate in a cooperative environment. However, foreign firms innovation has no significant impact.

In tab. A.2 we carry out a robustness exercise estimating our model with different methodologies. The baseline models were estimated by using different estimation methods (see Table A1). The returns to scale parameter is quite low for FE and LP methods. However, with the exception of the FE method, all other methods lead to qualitatively similar results.

The significance obtained is similar across the methods employed. The OLS and the fixed model return quite similar results with respect to GMM. However, OLS might lead to biased productivity estimates, caused by the endogeneity of input choices and selection bias and as noted by Wooldridge (2009), the fixed effects estimator imposes strict exogeneity of the inputs (Van Beveren, 2012). Hence, the Levinshon and Petrin and the Olley and Pakes estimations are our preferred models for our robustness checks, given that they address properly endogeneity and simultaneity in the input (but not for the endogeneity between agglomeration economies and firm output).

These models only in part confirm our previous GMM results: there is evidence of general agglomeration economies if we consider the concentration of output in the province at sector level i.e. there is evidence of specialisation economies. The number of national firms in the same sector and province improves firm output but the aggregation of foreign firms does not play a positive effect. The average innovation performed in the province performed by domestic firms is also highly significant. The remaining results confirm the key role of being located close to the core of the region and of having a well developed railway infrastructure.

To summarize, the estimation results for Italy suggest that:

- there are significant productivity enhancing agglomeration effects

- there are significant productivity enhancing spillovers between firms operating in the same sector and region
- spillovers emanating from multinational firms are weaker than those from non multinational domestic firms
- spillovers from innovation at local level are strong
- there are agglomeration and innovation spillovers specific towards more technologically sophisticated firms
- there seems to be evidence of spillovers specific to small firms

5.1.3. Productivity dynamics and differentials

The previous section summarizes the results of production function estimates that reveal which factors contribute to total factor productivity. In this section, we will look at the dynamics of productivity by region and firm size, and productivity differentials by firm size at the regional level.

By using the estimated coefficients of the production function, the (log) level of total factor productivity for each firm-year is calculated as follows:

$$TFP_{i.t} = q_{i,t} - \alpha^{*}_{Lq}q_{i,t-1} + \alpha^{*}_{K}K_{i,t} + \alpha^{*}_{LK}K_{i,t-1} + \alpha^{*}_{L}L_{i,t} + \alpha^{*}_{LL}L_{i,t-1} + \alpha^{*}_{M}M_{i,t} + \alpha^{*}_{Lm}M_{i,t-1} \qquad [5$$

where $TFP_{i,t}$ is the (log) TFP level of firm i at time t. α^{*}'s are estimated values of production function coefficients.

Figure 10 a presents the mean TFP levels for four macro areas groups for the period 2005-2010. It seems that regions 1 2 have similar TFP levels, whereas regions 3 lies above and 4 lags behind the more developed regions. The economic crisis in 2009 had a stronger negative effect on more-developed regions in terms of productivity level.

Figure 10 b presents similar data grouped by firm size. All firms are classified into three groups, large (employing 250 or more people), medium (50-249 employees) and small (20-49) categories. There are significant productivity differentials between large firms on the one hand, and small and medium-sized firms on the other. Small and medium-sized firms have, on average, similar productivity level.
Since there are similarities in the dynamics of productivity across regions and firm size categories, we calculated average TFP level by size-region categories for the same period (Figure 10 e). The data shows that small firms in more developed regions are less productive than their large counterparts operating in the same region. Moreover, the productivity differential between large and small firms is smaller in the most developed and the least developed regions.

5.3. Tunisia[11]

5.3.1. Model and descriptive statistics

In order to test the effects of agglomeration economies and spillovers, we follow for the Tunisian case a similar approach to that adopted for Italy and Turkey with some minor differences due to the lack of data.

[11] * Authored by Sofiane Ghali and Habib Zitouna.

The Cobb-Douglas production function is estimated to test the effects of agglomeration economies and spillovers:

$$q_{i,t} = \alpha_i + \alpha_{Lq}q_{i,t-1} + \alpha_K K_{i,t} + \alpha_{LK}K_{i,t-1} + \alpha_L L_{i,t} + \alpha_{LL}L_{i,t-1} + \Sigma\beta_j X_{i,j,t} + e_{it} \qquad [5]$$

where q is real output, K capital, L labor. Subscripts i and t denote firm and time, respectively. α_i's accounts for unobserved, time-invariant firm-specific effects. X is a vector of variables that explain total factor productivity, and it includes the variables that measure agglomeration effects and spillovers.

We first use GMM system as proposed by Arellano and Bond (1991). In this case we consider the production function in first differences:

$$\Delta q_{it} = \alpha\Delta K_{it} + \beta\Delta L_{it} + \Sigma\beta j\Delta X_{ijt}^{k} + \Delta\varepsilon_{it} \qquad [6]$$

and check for robustness of the estimation results through:

- OLS estimators :
- Fixed-Effects estimators : The Within-Groups estimator (WGE) or Fixed-effects estimator of the production function is just the OLS estimator in the Within-Groups transformed equation:

$$(q_{it} - \bar{q}_{it}) = \alpha(K_{it} + \bar{K}_{it}) + \beta(L_{it} - \bar{L}_{it}) + \Sigma\beta j\left(X_{ijt}^{k} - \bar{X}_{ijt}^{k}\right) + (\varepsilon_{it} - \bar{\epsilon}_{it}) \qquad [7]$$

- Olley and Pakes estimators (OP) : Olley and Pakes (1996) propose a control function approach to estimate production functions.

- Levinshon and Petrin estimators (LP) : Levinshon and Petrin (2003) have extended Olley-Pakes approach to contexts where data on capital investment presents significant censoring at zero investment

Levinshon and Petrin (2003) proposed the semi-parametric method to estimate the total factor productivity (TFP) in order to control for the unobserved firm-specific productivity shocks.

As in Olley and Pakes (1996), we assume that a unobsevables follow a first-order Markov process.

The estimation can be done in two steps (Thangavelu et al. 2010). We first carry out a third-order polynomial approximation to estimate the conditional moments. The second step pertains to solving the GMM minimization problem to identify the coefficients.

For the analysis of Tunisian case, roughly we use the same variables we have adopted for Turkey and Italy. More specifically, we use a number of proxy variables that are expected to capture the agglomeration and spillovers effects. We introduce to this purpose variables able to capture regional and sectoral spillovers from agglomeration, innovation performed by domestic and by foreign firms in the province/sector and spillovers from the presence of foreign firms at province and at sector level.

We build specific indexes of agglomeration and innovation activity at the territorial scale, where the spatial unit of analysis is the governorate where a firm is located. We try to consider different externality transmission channels. We first consider spillovers between firms in the same industry/governorate (horizontal spillovers) to investigate upon the agglomeration premia. The set of proxy variables for agglomeration effects includes the share of the governorate in the total sectorial output (Regionaloutputshare). If there are agglomeration economies in a sector, the firms located in a region where that sector is concentrated in would be more productive. Secondly, we consider the (log) numbers of domestic and foreign firms in the same sector and region (Tunisian governorate) (Nb domestic firms, Nb foreign firms*)*. These variables will have positive coefficients if agglomeration of firms leads to higher productivity.

An alternative set of proxy variables for firms' agglomeration includes the (log) of total output of domestic and foreign R&D performers in a given sector and governorate. This set defines agglomeration in terms of output instead of the number of firms as defined in the first case.

Furthermore, we build indicators which allow to take into account innovation spillovers on productivity by considering the innovation performed by domestic and foreign firms respectively in the different regions. We use the number of domestic and foreign innovation in the same sector and governorate to test if innovation performers are more likely to spillover knowledge and technology to other firms that operate in the same sector and region.

The impact which foreign firms play in the sector and in the governorate is also considered (*foreign_share region; foreign_share_sect*). If there are spillovers from foreign firms within a sector, then the "Foreign share (sector)" variable will have a positive coefficient. However, if spillovers from foreign firm have a geographical dimension, then the coefficient of the "Foreign share (region)" variable will be positive.

Some differences with variables used in the other chapters of the report are related to the proxy for R&D performers which is given by the firms with qualified labour on total labour above 25%, the distance variable considered is from the capital Tunis, the innovation spillovers are related to the share of domestic and foreign firms with qualified labour on total labour above 25%. The descriptions of the variables and different mean statistics and correlations among variables are presented in tab. 15-17.

5.3.2 Estimation Results

Table 18 reports estimates of the econometric specification (M1 and M2) where:
- M1 includes lLabor, lCapital, Foreign, R&D-performer, N-R&D-performing foreign firms (region/sector), R&D-performing domestic firms (region/sector), Regional output share, Foreign share (sector) and Foreign share (region).

- M2 includes also lLabor, lCapital, Foreign, R&D performer, Regional output share, Foreign share (sector), Foreign share (region), N –domestic firms (region/sector), N-foreign firms (region/sector).

The first column includes the OLS estimates with the heteroskedasticity-robust estimators. All coefficients, but thoses for foreign and RD performer, are significantly different from zero. As emphasized earlier, the OLS estimates tend to be biased because of the unobservable firm's heterogeneity. We address this econometric issue by using Fixed Effects (FE) estimation reported in the second column. The variables N R&D performing domestic firms, and N domestic firms are non significant and the Foreign variable is significantly equal to zero.

The use of OP estimation also gives the non-significance of Foreign share and the significance equal to zero of Foreign and R&D performer. The same result is also given by LP estimation.

The use of GMM estimations improves the results except for the variable “N foreign firms” which is not significant.

Table 19 summarizes the signs of the coefficients which were estimated using different methods (OLS, FE, OP, LP, and GMM). The variables that keep the same sign, whatever the methods are, Labor, Capital, Nb R&D performing domestic firms, and Foreign share. These variables have a positive sign, they affect positively the production. However, the variables we cannot affirm that they impact the production are R&D performer, Nb R&D performing foreign firms, Regional output share, and Nb domestic firms. Their sign differs depending on the estimation methods and vary between positive and negative impact.

Following these tests, we focus our study on the GMM method, where we defined the following models (M1 to M16):
- M1: L.output, L.capital, L.labor
- M2: L.output, L.capital, L.labor + foreign, RDperformer
- M3: L.output, L.capital, L.labor + foreign, RDperformer + Nb domestic firms
- M4: L.output, L.capital, L.labor + foreign, RDperformer + Nb domestic firms + Nb foreign firms
- M5: L.output, L.capital, L.labor + foreign, RDperformer + Nb domestic RD performer, Nb foreign RD performer
- M6: L.output, L.capital, L.labor + foreign, RDperformer + Regional share(sect), foreign share (sect+ region)
- M7: L.output, L.capital, L.labor + foreign, RDperformer + L.total output (foreign + domestic)
- M8: L.output, L.capital, L.labor + foreign, RDperformer + L.tot output RD performer (domestic + foreign)
- M9: M4 + M5 + M6
- M10: M4 + M6 + M8
- M11: M2 + M6 + Firms size*(regional output share + foreign share (sect+region))
- M12: M6 + RD performer*(regional output share+ foreign share (sect+region))
- M13: M8 + firm size*(L.tot output RD performer (domestic + foreign))
- M14: M8 + RD performer*(L.tot output RD performer (domestic + foreign))
- M15: M2 + L.tot output large firms
- M16: M6 + L.tot output large firms

Table 20, reports results of estimates of the econometric specification (M1 to M16). The main conclusions drawn from this table are the following:

The coefficients of labor and capital that are significant and different from zero in the sixteen models (except M4 and M5).

In the sixteenth model, the coefficients associated to the lagged output (equal to 0.9 in mean) are positive and significantly different from zero. These coefficients allow us to conclude that in the long period, the firms will be submitted to the divergence phenomena.

Table 21 summarizes the signs of the coefficients which were estimated using GMM method, for the sixteen models presented above. Some variables kept the same positive sign, whatever the models (lagged output, Labor, Capital, Foreign, N domestic R&D performers, Regional share, Q domestic firms, and the interaction variables Firm size * Foreign share, Firm size * Regional output share, R&D performer * Foreign share, Firm size * Q domestic R&D performers, and Firm size * Q foreign R&D performers). Other variables kept the same negative sign (N foreign R&D performers, Q foreign firms, Q share of large firms, and the interaction variables Firrm size * Foreign share). There are some remaining variables for which the signs differ depending on the estimation models ranging between positive, negative, and null impact. These are R&D performer, N domestic firms, N foreign firms, Foreign share, Q domestic R&D performers, and Q foreign R&D performers.

To sum up the main results:

- In our preferred GMM estimations, the signs of the variables Labor and Capital are as expected. The coefficients are always significant for Labour but not significant for the variable related to capital.

- The variable R&D performer is always positive and significant suggesting that innovation and R&D expenditures not surprisingly improve firms' productivity

- The coefficient of the foreign ownership dummy is positive and highly significant. So foreign firms are more productive than domestic firms.

- The agglomeration proxies measured by regional share of output, number of domestic firms and the variables measuring the innovation spillovers (number of domestic R&D performers, Output of domestic R&D performers) show quite stable signs and significance and do allow to support the hypothesis of the presence of important positive externalities from innovation at spatial level.

- Overall, there is strong evidence in favour of a positive impact of specialisation economies as suggested by the positive impact of the concentration of domestic firms and domestic RD performers in a sector and also by the positive impact of higher shares of a sector in a region.

- Output is higher where there is regional clustering of activity. Therefore there is a positive evidence of regional spillovers from agglomeration and from innovation while there is no evidence of a positive impact of foreign firms. It seems that specialisation is the strong pushing factor of output at regional level.
- However, spillovers from foreign firms localisation in the region are not found. There is no evidence of spatial innovation spillovers due to the number of foreign firms, the number of foreign R&D performers, the output of foreign firms since all have statistically not significant coefficients.

6. Conclusions and policy implications

We investigate what are the benefits of clustering estimating the effects of aggregation and other localisation variables on firms' productivity. First of all, we considered how far intense competition and polarisation in clusterised areas is able to promote higher productivity. Overall, our results emphasise the relevance of agglomeration economies in Turkey, Italy and Tunisia. However, there are a few important differences to emphasise among these three countries. While in Turkey there are positive externalities from foreign firms’ agglomeration, conversely the externalities from agglomeration of domestic firms are negative suggesting congestion effects. The estimation results for Turkey also suggest a crucial role for foreign firms in terms of high FDI spillovers at local level and that spillovers emanating from foreign firms are stronger than those from domestic firms. Conversely, in the case of Italy and Tunisia there are quite opposite results: no evidence of congestion effects due to agglomeration of domestic firms while innovation spillovers from foreign firms localisation in the region are not found.

Important localised innovation spillovers are indeed found in all of them. Besides, there is evidence on the outcome often found that firms in the same industry benefit more from each other as they are more technologically similar and the sector closeness also matters as this may facilitate the flow and absorption of knowledge among firms. We also found the territorial and social redistribution of spillovers may be limited in particular from foreign multinationals. This might also occur because the firms opened to the foreign market are in general a subcontractor which don’t have the total autonomy to conduct technological neither technological innovation. As not all firms are able to benefit from spillovers and enjoy agglomeration effects it is important to also control for the role of the absorptive capacity. Hence, we consider innovation spillovers by type of firms (SME/large, high/low innovating and hence with high/low absorptive capacity). Hence, we interact agglomeration and spillover variables with firm size (measured by the number of employees) and innovation variables. These interaction variables reveal that the innovation performers benefit more from agglomeration effects and spillovers, as in most of our estimations the coefficient of firm innovation-agglomeration effect interaction variable is positive. Another result specific to Italian firms is that agglomeration economies and innovation spillovers are more beneficial to small firms than to large ones.

In policy terms there is evidence on the outcome often found that firms in the same industry benefit more from each other as they are more technologically similar and the sector distance matters as this may facilitate the flow and absorption of knowledge among firms. We also found that FDI impact may be limited, the territorial and social redistribution depending on quality and distribution by sectors. This might also occur because the firms opened to the foreign market are in general a subcontractor which don’t have the autonomy to conduct neither technological nor non-technological innovation. Generally, it is argued that in an open economy agglomeration leads to higher efficiency. We find support to such conclusion in our three country cases. However, technology play a critical role and policies should pay specific effort to enhance the absorptive capacity of less technology sophisticated firms.

Some answers to crucial policy questions spur from this analysis. Generally, it is argued that, in an open economy, agglomeration leads to higher efficiency. Our result mostly support this conclusion with the due caveat and country and firm characteristics specificity. A model of development based on strong polarization, is confirmed to be enhancing in most cases firm performance and growth, However, recent decades witnessed an increasing unbalanced process of regional growth in most Mediterranean countries which led to large income and employment gaps across regions, consequent massive migration, concentration of population in large cities and along the coast, degradation and isolation of internal areas, environmental impoverishment and abandonment.

While a reallocation of resources to less developed regions could be costly and counterproductive giving that regional tax incentives to poor regions may shift jobs away from territories that do not receive the subsidy, rather than create new ones the policy target for the government should rather be investing in transportation infrastructure, ease access to housing, and develop regional complementarities. Such policies would expand job opportunities for the people outside the coastal region and lead in the long term to a more sustainable convergence of standards of living among regions.

The experience drawn by this analysis may give a support in identifying key drivers and patterns of localised production and to provide a benchmark to analyse the issue of efficiency of clusters of SMEs in South Mediterranean countries drawing some general directives and policy advices. In particular, results may be useful within the Euro-Med cluster cooperation on industry and innovation framework. The emerging innovation clusters based in Tunisia, Morocco and Lebanon, the CBDs in Tunisia, the Special Economic Zones and the role of MNCs are key elements in this context. These results may also represent the economic underpinning of policy analysis aimed at fostering innovation at regional level. In spite of the challenges of globalization, place still make the difference and can emerge as laboratories of new partnerships: local/global, private/public driven.

This report paves the way to a better experience drawn by this analysis may give a support in identifying key drivers and patterns of localised production and to provide a benchmark to analyse the issue of efficiency of clusters of SMEs in South Mediterranean countries drawing some general directives and policy advices. In particular, results may be useful within the Euro-Med cluster cooperation on industry and innovation framework. The emerging innovation clusters based in Tunisia, Morocco and Lebanon, the CBDs in Tunisia, the Special Economic Zones and the role of MNCs are key elements in this context. These results may also represent the economic underpinning of policy analysis aimed at fostering innovation at regional level. In spite of the challenges of globalization, place still make the difference and can emerge as laboratories of new partnerships: local/global, private/public driven.

An important shortcoming of our research is related to not have explored the role of science parks, innovation clusters, incubators, special economic zones (SEZs), Centre Business Districts (CBDs) in Turkey and Tunisia. Further development of this study should consider more specifically the role of these emerging innovation clusters. Besides private-public partnership and, in particular, university-firms relationships should also be explored.

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APPENDIX GRAPHS & TABLES

TURKEY

Maps 1-8

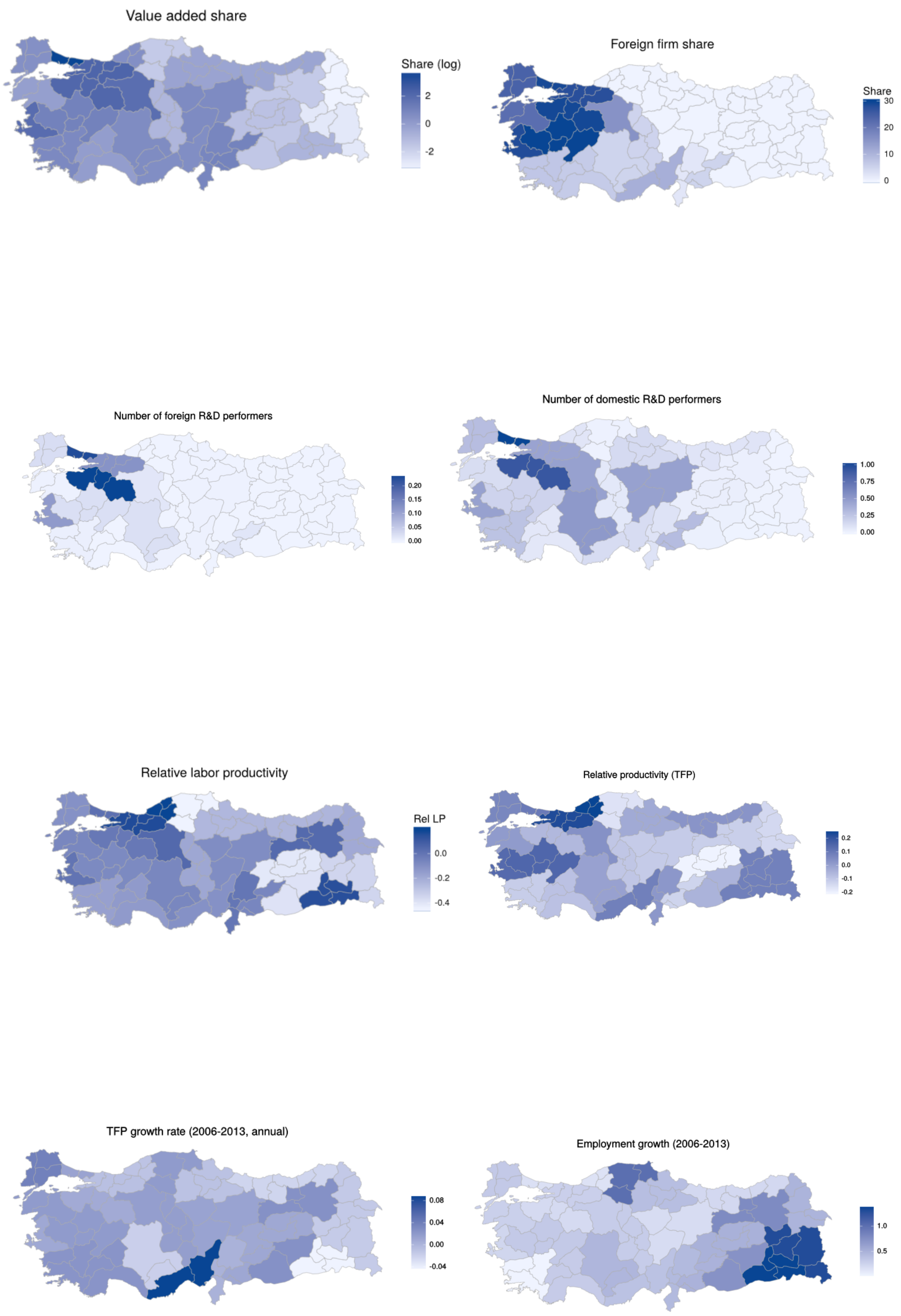
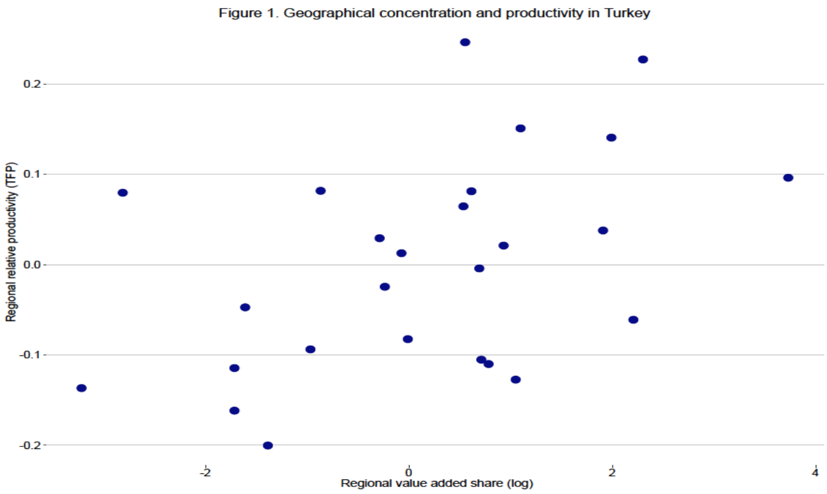


Figure 1:



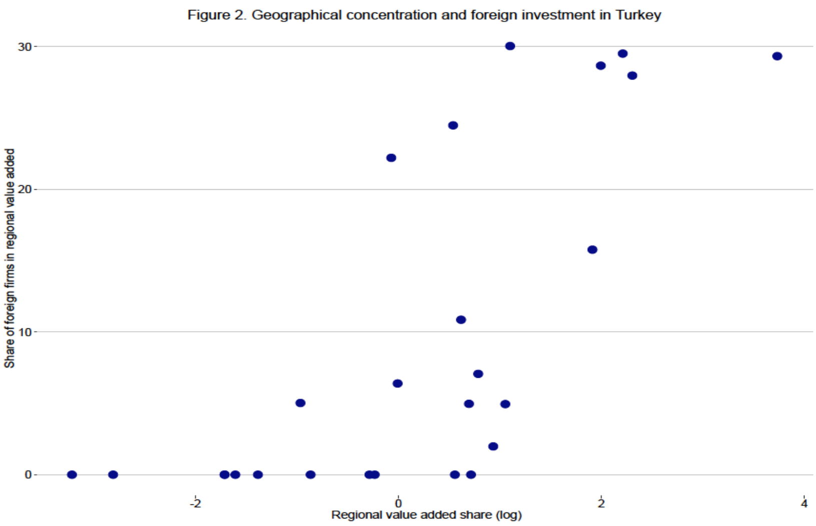


Figure 3:

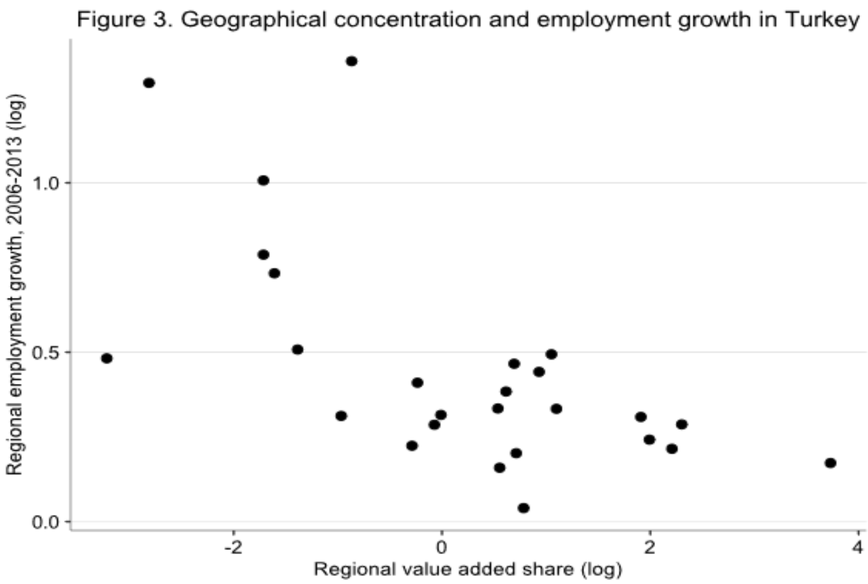


Figure 4. TFP dynamics by regions, Turkey (2006-2013)

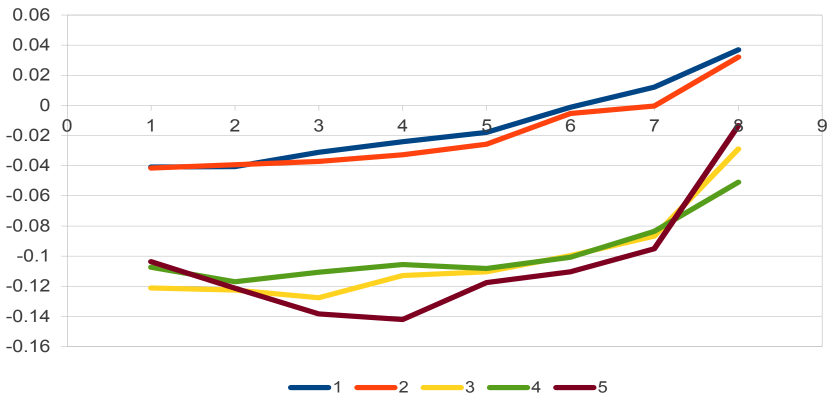


Figure 5. TFP dynamics by firm size, Turkey (2006-2013)

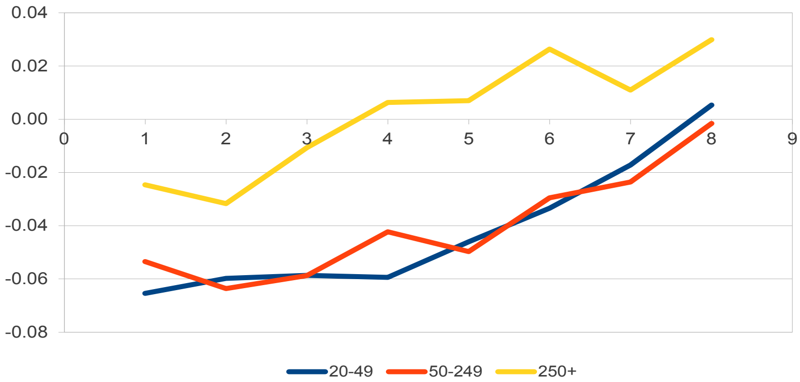


Figure 6. Productivity differential by region and firm size, Turkey

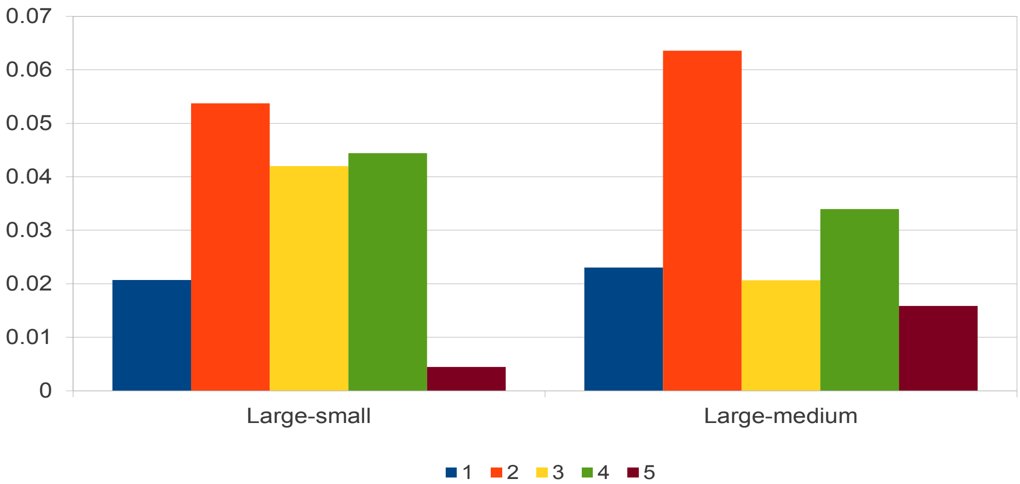


Table 1: Number of Firms

Table 1. Number of firms

	Number of firms			Share of R&D performers		
	All	Domestic	Foreign	All	Domestic	Foreign
2003	13936	13499	437	3.4	2.9	18.1
2004	16869	16318	551	3.1	2.7	15.1
2005	20060	19442	618	3.8	3.4	17.6
2006	21215	20428	787	3.3	2.9	14.9
2007	20556	19780	776	4.0	3.4	17.3
2008	22533	21772	761	4.2	3.7	17.5
2009	19526	18812	714	5.4	4.9	18.2
2010	23735	22896	839	5.4	5.0	16.9
2011	28657	27691	966	4.9	4.5	17.5
2012	30867	29927	940	5.0	4.5	19.3
2013	33630	32634	996	4.5	4.1	18.5

Table 2. Share of foreign firms, 2003-2013

	# of firms %	Employment %	Value added %	Relative size	Relative labor productivity
2003	3.1	11.7	24.1	3.7	2.1
2004	3.3	12.0	25.8	3.7	2.2
2005	3.1	11.2	24.1	3.6	2.2
2006	3.7	13.4	28.6	3.6	2.1
2007	3.8	13.5	28.5	3.6	2.1
2008	3.4	13.1	25.9	3.9	2.0
2009	3.7	13.1	27.0	3.6	2.1
2010	3.5	11.7	23.8	3.3	2.0
2011	3.4	12.2	23.4	3.6	1.9
2012	3.0	11.6	23.0	3.8	2.0
2013	3.0	11.1	22.2	3.8	2.0

Table 3

Table 3. Sectoral distribution of foreign firms, 2011-2013 average

		Firms %	Employment %	Value added %	Relative size	Relative labor productivity
10	Food	3.34	12.35	20.35	3.70	1.65
11	Beverages	6.57	30.86	48.98	4.70	1.59
12	Tobacco products	34.21	59.54	99.49	1.74	1.67
13	Textiles	1.77	3.02	3.62	1.71	1.20
14	Wearing apparel	0.85	4.36	7.82	5.13	1.79
15	Leather products	0.78	1.76	1.98	2.24	1.13
16	Wood products					
17	Paper products	5.69	15.13	23.52	2.66	1.55
18	Printing					
19	Coke and refined pet					
20	Chemicals	12.47	24.22	33.76	1.94	1.39
21	Pharmaceuticals	19.05	37.46	43.08	1.97	1.15
22	Rubber and plastics	4.08	13.41	25.94	3.29	1.93
23	Non-metallic mineral	2.31	8.39	22.22	3.63	2.65
24	Basic metals	3.16	10.09	10.49	3.19	1.04
25	Fabricated metal	2.65	6.69	14.32	2.52	2.14
26	Computers, electronics	5.65	17.73	15.89	3.14	0.90
27	Electrical equipment	4.97	17.39	28.34	3.50	1.63
28	Machinery	3.54	15.91	30.25	4.49	1.90
29	Motor vehicles	11.53	47.90	64.38	4.16	1.34
30	Other transport equipment	6.95	14.16	15.45	2.04	1.09
31	Furniture	0.76	1.83	3.32	2.42	1.81
32	Other manufacturing	3.62	9.51	17.60	2.62	1.85
33	Repair and installation	2.93	4.23	8.44	1.44	1.99
Total		3.12	11.61	22.80	3.73	1.96

Table 4. Descriptive statistics

Variable	Mean	Std dev	Min	Max
Output	14.634	1.790	-1.265	23.018
Number of employees	3.664	1.153	0.000	9.663
Capital stock	11.074	1.983	-0.604	20.111
Inputs	14.400	1.970	-1.295	22.968
FDI	0.032	0.175	0.000	1.000
R&D performer	0.046	0.210	0.000	1.000
Number of domestic firms (region/sector)	3.608	1.756	0.000	7.416
Number of foreign firms (region/sector)	0.740	0.869	0.000	3.497
Number of R&D performing domestic firms (region/sector)	0.700	0.784	0.000	3.332
Number of R&D performing foreign firms (region/sector)	0.148	0.372	0.000	2.398
Regional output share	0.291	0.281	0.000	1.000
Foreign share (sector)	0.114	0.156	0.000	1.000
Foreign share (region)	0.197	0.106	0.000	0.534
Output of domestic firms (region/sector)	16.385	4.848	0.000	21.364
Output of foreign firms (region/sector)	0.351	2.435	0.000	21.810
Output of R&D performing domestic firms (region/sector)	3.052	6.975	0.000	24.097
Output of R&D performing foreign firms (region/sector)	9.994	9.233	0.000	24.395

Notes: All variables are in log form.
FDI and R&D performer are dummy variables.
Regional output share, Foreign share (sector) and Foreign share (region) are in percentage.

Table 5. Correlations between the number of firms in a region-sector

	Domestic	Foreign	Domestic R&D performer	Foreign R&D performer
Domestic	1.000			
Foreign	0.687	1.000		
Domestic R&D performer	0.492	0.567	1.000	
Foreign R&D performer	0.251	0.528	0.500	1.000

Notes: Variables refer to the number of firms in a region-sector (4-digit). All variables are in log form.
All correlation coefficients are statistically significant at the 1% level.

Turkey

(2006-2013 period, GMM-System results)

Variables	GMM 1	GMM 2	GMM 3	GMM 4	GMM 5	GMM 6	GMM 7	GMM 8	GMM 9	GMM 10
Labor	0.485**	0.488**	0.479**	0.485**	0.501**	0.491**	0.500**	0.497**	0.497**	0.482**
	(0.0555)	(0.0556)	(0.0544)	(0.0546)	(0.0563)	(0.0555)	(0.0558)	(0.0559)	(0.0560)	(0.0549)
Capital	0.0370**	0.0374**	0.0369**	0.0370**	0.0380**	0.0373**	0.0378**	0.0379**	0.0379**	0.0366**
	(0.00439)	(0.00442)	(0.00436)	(0.00436)	(0.00445)	(0.00438)	(0.00444)	(0.00445)	(0.00444)	(0.00435)
Inputs	0.485**	0.479**	0.487**	0.482**	0.466**	0.475**	0.468**	0.472**	0.471**	0.485**
	(0.0556)	(0.0560)	(0.0551)	(0.0553)	(0.0567)	(0.0563)	(0.0563)	(0.0564)	(0.0564)	(0.0558)
FDI		0.133**	0.130**	0.115**	0.130**	0.115**	0.109**	0.138**	0.130**	0.0974**
		(0.0188)	(0.0182)	(0.0171)	(0.0186)	(0.0171)	(0.0173)	(0.0199)	(0.0187)	(0.0162)
R&D performer		0.0602**	0.0590**	0.0539**	0.0576**	0.0512**	0.0509**	0.0617**	0.0545**	0.0445**
		(0.00949)	(0.00919)	(0.00893)	(0.00934)	(0.00866)	(0.00907)	(0.00956)	(0.00906)	(0.00833)
N domestic firms (region/sector)			-0.00099	-0.0161**		-0.0169**				-0.0181**
			(0.00149)	(0.00263)		(0.00292)				(0.00358)
N foreign firms (region/sector)				0.0427**		0.0341**				0.0199**
				(0.00390)		(0.00321)				(0.00261)
N R&D performing domestic firms (region/sector)					0.00771**	0.00944**				0.00225
					(0.00184)	(0.00299)				(0.00258)
N R&D performing foreign firms (region/sector)					0.0416**	0.0197**				0.00702*
					(0.00395)	(0.00361)				(0.00350)
Regional output share							0.0663**			0.0906**
							(0.00811)			(0.0144)
Foreign share (sector)							0.198**			0.136**
							(0.0179)			(0.0126)
Foreign share (region)							0.0614**			0.0613**
							(0.0150)			(0.0146)
Q domestic firms (region/sector)								0.00255**		
								(0.000408)		
Q foreign firms (region/sector)								0.00359**		
								(0.000865)		
Q R&D performing domestic firms (region/sector)									0.00169**	
									(0.000181)	

Q R&D performing foreign firms (region/sector)									0.000750**	
									(0.000158)	
Lag labor	-0.208**	-0.211**	-0.207**	-0.209**	-0.218**	-0.212**	-0.215**	-0.216**	-0.215**	-0.207**
	(0.0331)	(0.0333)	(0.0327)	(0.0328)	(0.0336)	(0.0332)	(0.0333)	(0.0335)	(0.0335)	(0.0329)
Lag capital	0.00586**	0.00592**	0.00587**	0.00598**	0.00608**	0.00603**	0.00615**	0.00608**	0.00607**	0.00606**
	(0.00205)	(0.00205)	(0.00204)	(0.00204)	(0.00205)	(0.00204)	(0.00205)	(0.00206)	(0.00205)	(0.00203)
Lag inputs	0.0184	0.0198	0.0166	0.02	0.026	0.0229	0.0261	0.0229	0.024	0.0201
	(0.0278)	(0.0279)	(0.0276)	(0.0276)	(0.0282)	(0.0280)	(0.0280)	(0.0281)	(0.0281)	(0.0278)
Lag output	0.217**	0.217**	0.216**	0.214**	0.217**	0.214**	0.213**	0.218**	0.216**	0.210**
	(0.0207)	(0.0208)	(0.0207)	(0.0207)	(0.0207)	(0.0207)	(0.0208)	(0.0208)	(0.0207)	(0.0207)
Returns to scale (short run)	1.007	1.004	1.003	1.004	1.005	1.0033	1.006	1.007	1.006	1.0036
Long run coefficients										
Labor	0.354	0.354	0.347	0.351	0.361	0.355	0.362	0.359	0.360	0.348
Capital	0.055	0.055	0.055	0.055	0.056	0.055	0.056	0.056	0.056	0.054
Inputs	0.643	0.637	0.642	0.639	0.628	0.633	0.628	0.633	0.631	0.639
Returns to scale	1.051	1.046	1.044	1.045	1.046	1.044	1.046	1.048	1.047	1.041
AR(1)	-20.3**	-20.11**	-20.53**	-20.31**	-19.61**	-19.97**	-19.73**	-19.85**	-19.79**	-20.3**
AR(2)	2.96**	2.96**	2.95**	2.84**	2.92**	2.86**	2.83**	2.98**	2.94**	2.79**
AR(3)	2.02*	1.99*	1.98*	2.003	1.99*	2.00*	1.954	1.99*	2.00*	1.950
Hansen test (overidentification restr., chi2(22)	37.05*	35.75*	36.26*	35.78*	33.740	35.35*	34.74*	34.16*	34.13*	37.76*
Hansen tests of exogeneity										
GMM instruments, chi2(18)	32.11*	29.53*	30.22*	28.16	27.10	27.41	26.22	27.69	27.52	27.92
GMM instruments (difference) chi2(4)	4.93	6.22	6.04	7.62	6.64	7.94	8.52	6.47	6.60	9.85*
IV instruments, chi2(16)	23.09	15.10	13.75	13.62	13.70	13.60	13.18	12.90	12.92	11.53
IV instruments (difference), chi2(6)	13.96*	20.65**	22.51**	22.16*	20.04*	21.74*	21.56*	21.26*	21.20*	26.24*

Notes: Standard errors in parentheses (** $p<0.01$, * $p<0.05$)
All variables are in log form. There are 123,947 observations (32,739 firms) in the sample.
FDI and R&D performer are dummy variables.
Regional output share, Foreign share (sector) and Foreign share (region) are in percentage.
All model includes time dummies.
GMM instruments: From the 2nd lag for output, labor, and inputs, and from the 1st lag for capital.

Table 6b. Production function estimation results for Turkey
(2006-2013 period, GMM-System results)

	OLS	OLS	FE	FE	OP	OP	LP	LP	GMM-O	GMM-O
	1	2	3	4	5	6	7	8	9	10
Labor	0.262**	0.264**	0.274**	0.274**	0.192**	0.195**	0.241**	0.244**	0.494**	0.500**
	(0.00123)	(0.00124)	(0.00213)	(0.00213)	(0.00145)	(0.00238)	(0.00258)	(0.000447)	(0.0528)	(0.0528)
Capital	0.0277**	0.0272**	0.0233**	0.0232**	0.0264**	0.0259**	0.0218**	0.0187**	0.0348**	0.0351**
	(0.000653)	(0.000655)	(0.000877)	(0.000877)	(0.000437)	(0.000663)	(0.00192)	(0.000755)	(0.00383)	(0.00385)
Inputs	0.742**	0.741**	0.672**	0.672**	0.788**	0.787**	0.657**	0.665**	0.491**	0.486**
	(0.000852)	(0.000854)	(0.00146)	(0.00146)	(0.00204)	(0.00127)	(0.000711)	(0.0632)	(0.0510)	(0.0507)
FDI	0.0917**	0.0868**	-0.00529	-0.00582	0.0638**	0.0550**	0.0464**	0.0367**	0.115**	0.108**
	(0.00481)	(0.00482)	(0.0102)	(0.0102)	(0.00531)	(0.00304)	(0.000240)	(0.00749)	(0.0162)	(0.0163)
R&D performer	0.0702**	0.0663**	0.0197**	0.0194**	0.0540**	0.0474**	0.0359**	0.0295**	0.0553**	0.0547**
	(0.00405)	(0.00406)	(0.00467)	(0.00467)	(0.00403)	(0.00634)	(0.00358)	(0.00780)	(0.00897)	(0.00930)
N domestic firms (region/sector)		-0.0119**		-0.00204	-0.00473**		-0.00717**		-0.0168**	
		(0.000844)		(0.00160)	(0.00183)		(0.000663)		(0.00276)	
N foreign firms (region/sector)		0.0232**		-0.0012	0.0302**		0.0322**		0.0342**	
		(0.00155)		(0.00220)	(0.00313)		(0.00182)		(0.00307)	
N R&D performing domestic firms (region/sector)	-0.00393**		-0.00201		0.00192	-0.000498	0.00852**	0.00480**	0.00886**	-0.00285
	(0.00136)		(0.00178)		(0.00106)	(0.00101)	(0.000423)	(0.00151)	(0.00282)	(0.00175)
N R&D performing foreign firms (region/sector)	0.0225**		0.0160**		0.0192**	0.0197**	0.0172**	0.0168**	0.0197**	0.0147**
	(0.00279)		(0.00333)		(0.00369)	(0.00751)	(0.00127)	(0.00251)	(0.00353)	(0.00335)
Regional output share	0.0618**	0.0713**	-0.0011	0.0103		0.0491**		0.0345**		0.0614**
	(0.00363)	(0.00422)	(0.00649)	(0.00698)		(0.00720)		(0.0108)		(0.00765)
Foreign share (sector)	0.165**	0.137**	0.0109	0.0193		0.123**		0.136**		0.185**
	(0.00612)	(0.00628)	(0.0109)	(0.0110)		(0.00737)		(0.00338)		(0.0167)
Foreign share (region)	0.127**	0.121**	-0.00541	-0.00275		0.120**		0.167**		0.0665**
	(0.00934)	(0.00942)	(0.0142)	(0.0142)		(0.0146)		(0.0163)		(0.0151)
Lag labor									-0.216**	-0.217**
									(0.0323)	(0.0322)
Lag capital									0.00608**	0.00611**
									(0.00190)	(0.00190)
Lag inputs									0.0177	0.0201
									(0.0254)	(0.0254)

Lag output									0.207**	0.205**
									(0.0197)	(0.0198)
Returns to scale (long term)	1.032	1.032	0.969	0.969	1.006	1.008	0.920	0.928	1.044	1.044
Number of observations	172659	172659	172659	172659	144486	144486	172659	172659	123947	123947
Number of firms	44476	44476	44476	44476					32739	32739

Notes: Standard errors in parentheses (** p<0.01, * p<0.05)

OLS pooled ordinary least squares, FE fixed effects, OP Olley-Pakes, LP Levinshon-Petrin, GMM-O GMM-system orthogonal deviations estimates.

All variables are in log form

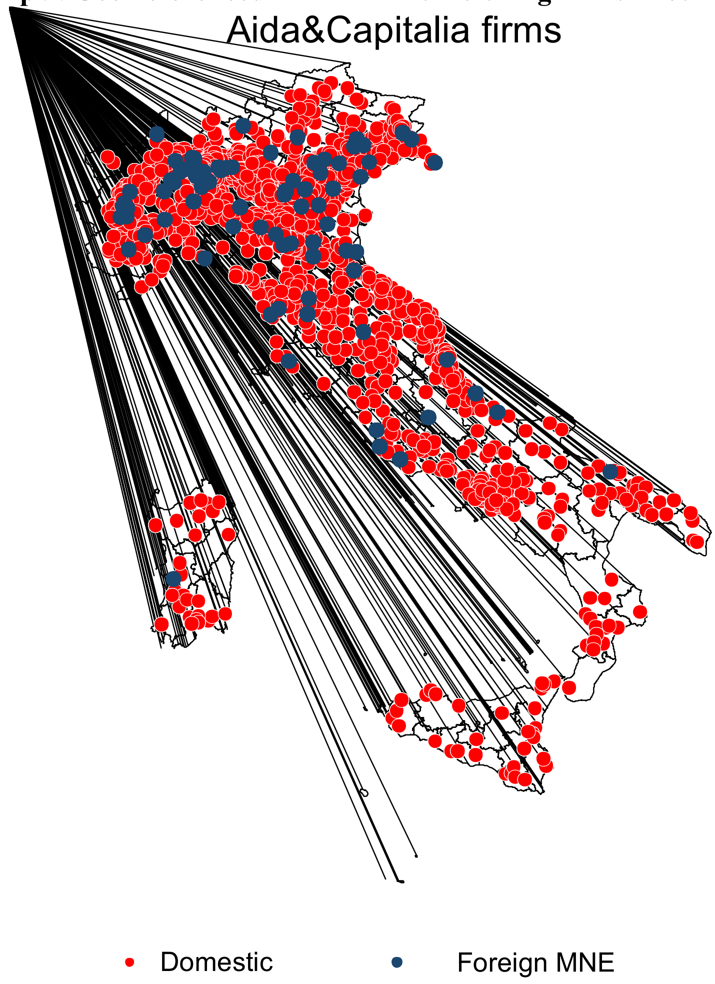
FDI and R&D performer are dummy variables

Regional output share, Foreign share (sector) and Foreign share (region) are in percentage

All model includes time dummies.

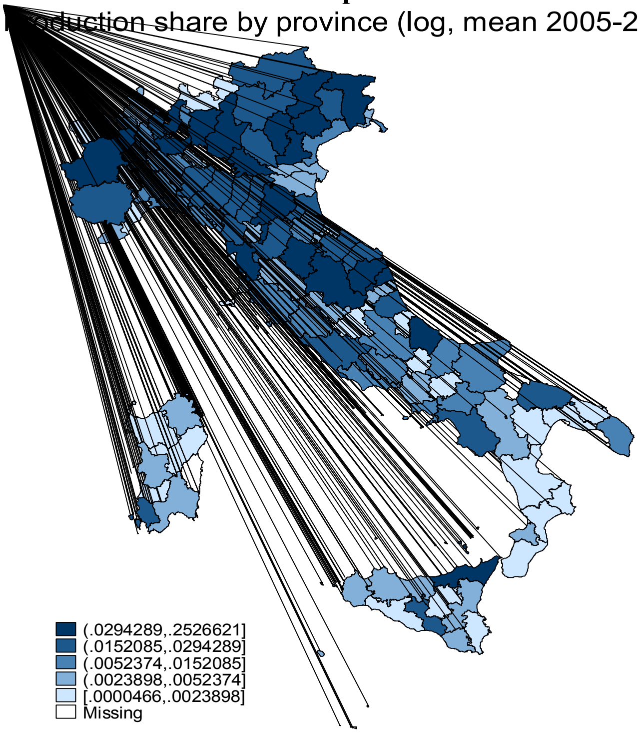
ITALY

Map 9. Geo-referenced Italian manufacturing firms in our sample



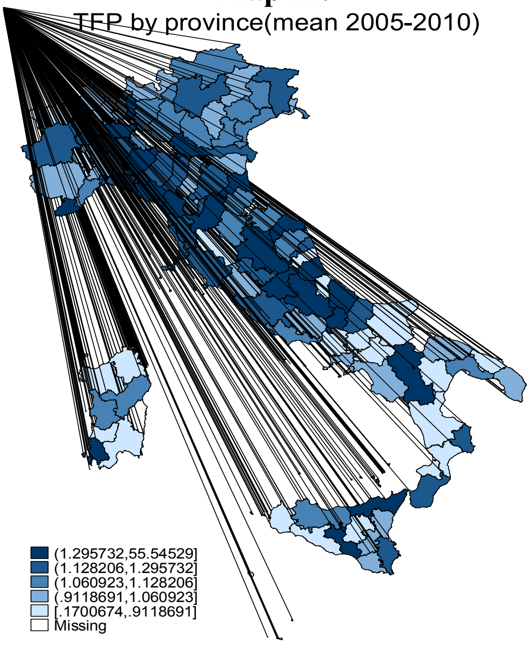
Map 10.

Production share by province (log, mean 2005-2010)

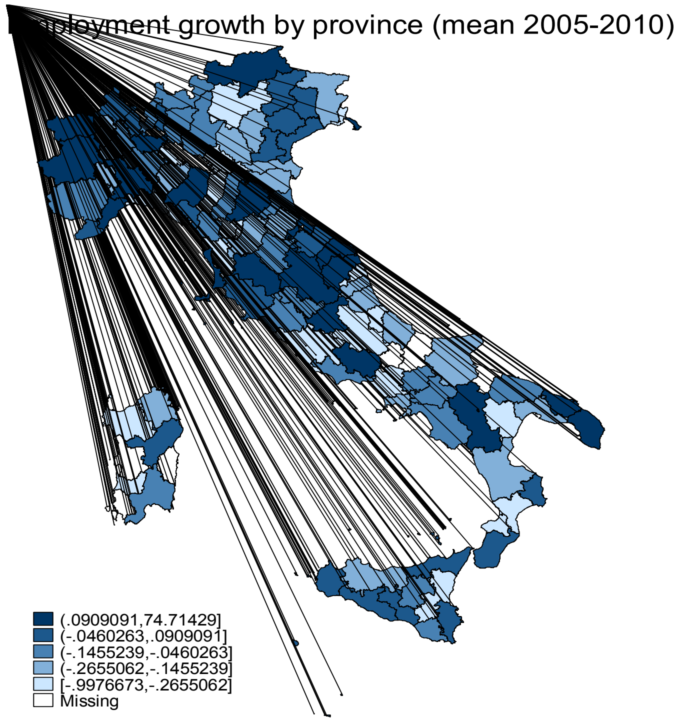


Map 11.

TFP by province(mean 2005-2010)



Map 12.


Employment growth by province (mean 2005-2010)
(.0909091,74.71429]
(-.0460263,.0909091]
(-.1455239,-.0460263]
(-.2655062,-.1455239]
[-.9976673,-.2655062]
Missing

Map 13.

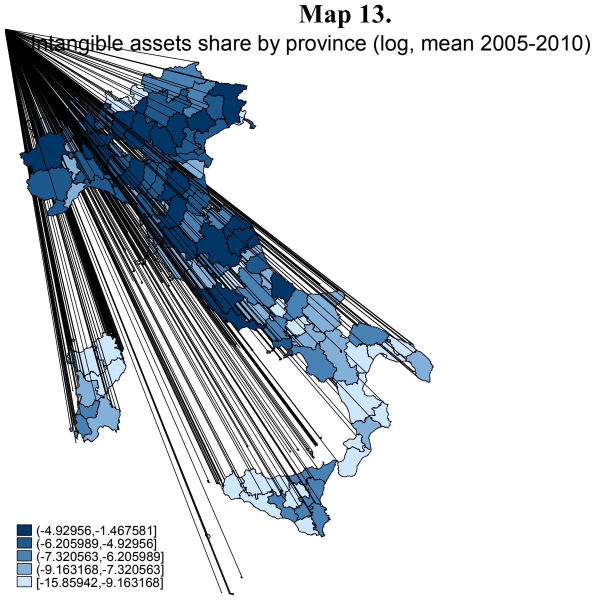

Intangible assets share by province (log, mean 2005-2010)
(-4.92956,-1.467581]
(-6.205989,-4.92956]
(-7.320563,-6.205989]
(-9.163168,-7.320563]
[-15.85942,-9.163168]

Fig. 7. Geographical concentration and productivity (TFP) in Italy at province level

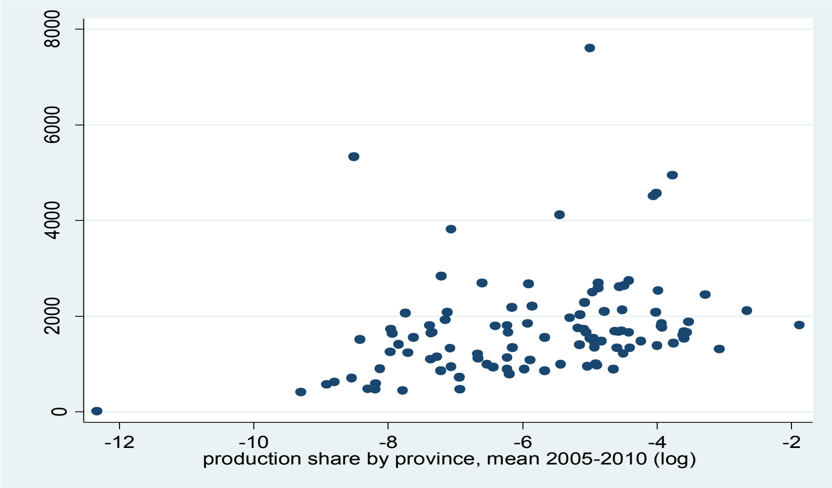


Fig. 8. Correlation between innovation (intangible assets) and geographical concentration of activities

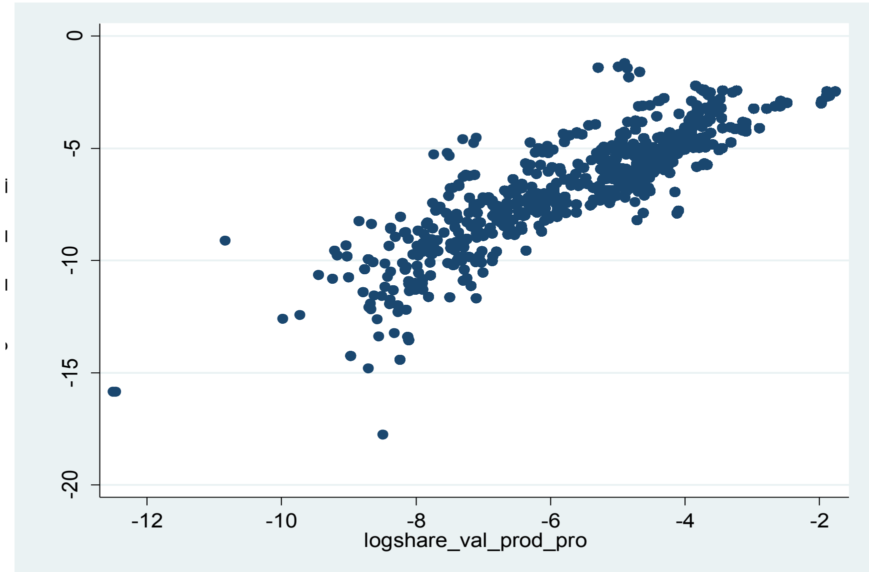


Fig. 9. Correlation between TFP and intangible assets

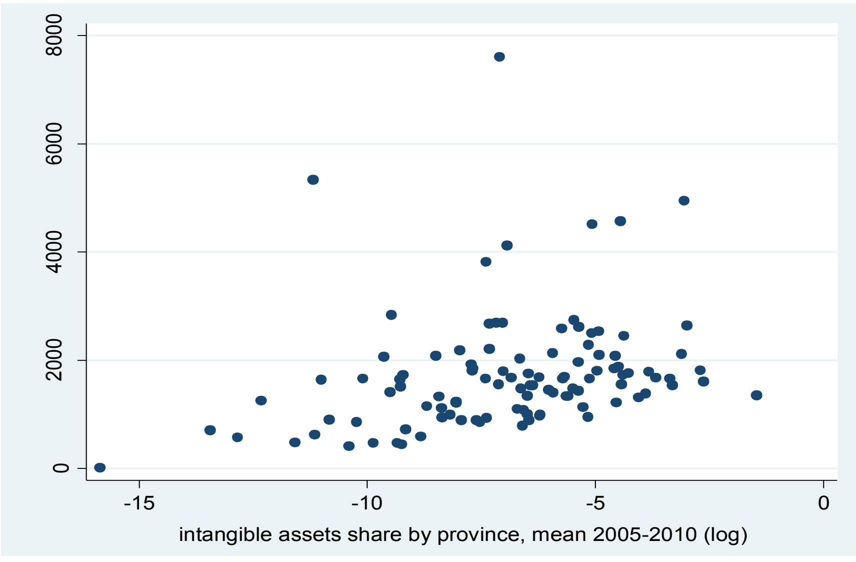


Fig. 10a. TFP by firm characteristics: localisation

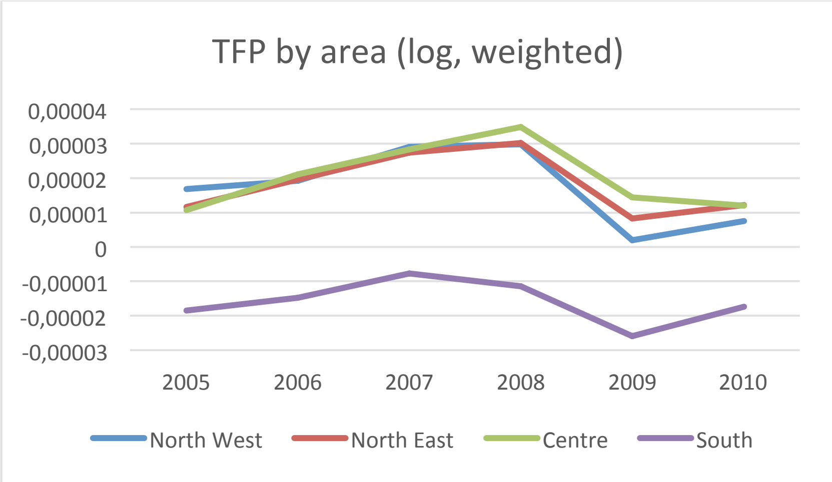


Fig. 10b. TFP by firm characteristics: size

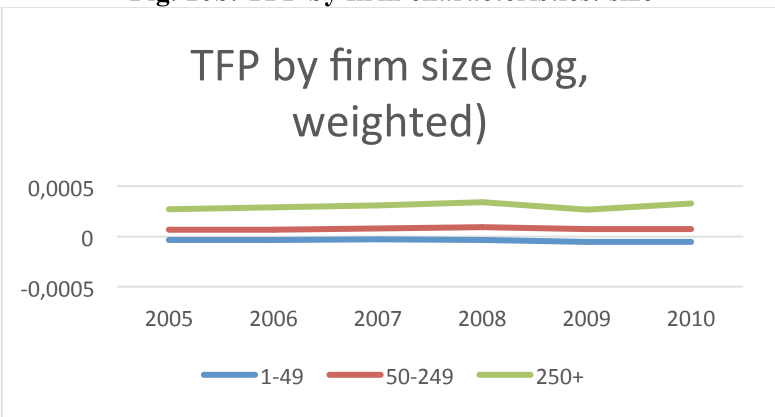


Fig. 10c. TFP by firm characteristics: technology intensity

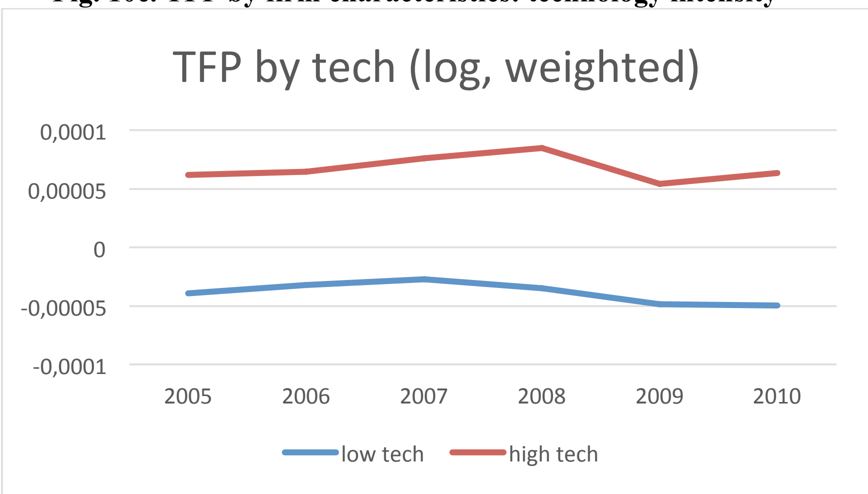


Fig. 10d. TFP by firm characteristics: ownership

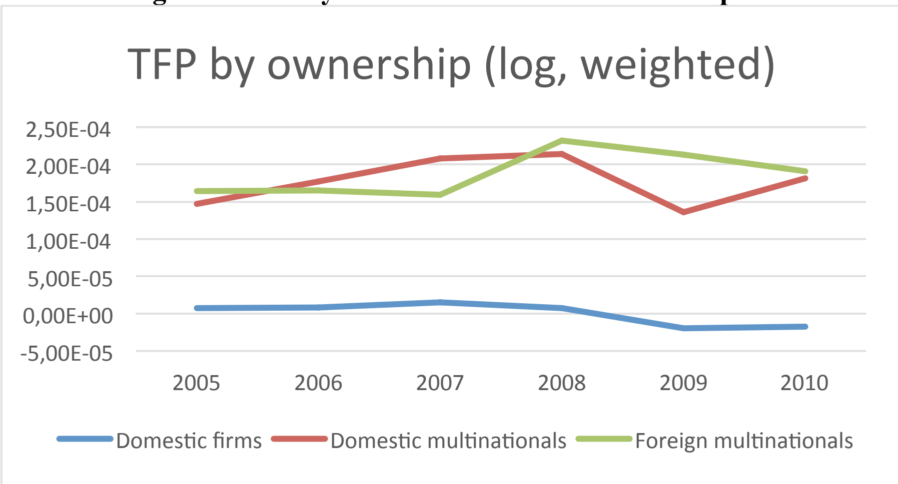


Fig. 10e. TFP by firm characteristics: size and localisation

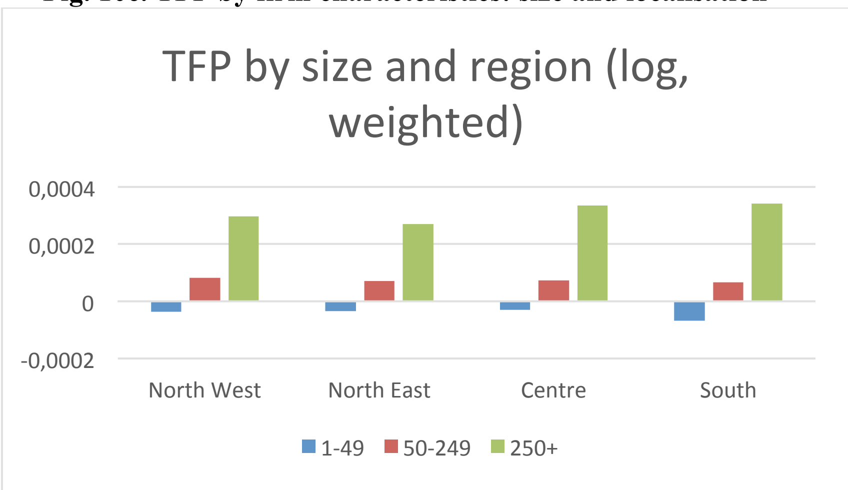
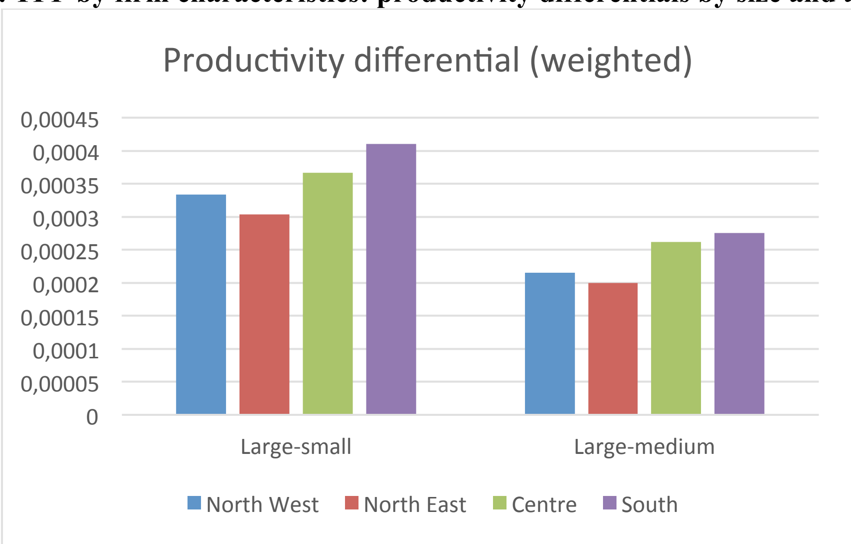


Fig. 10f. TFP by firm characteristics: productivity differentials by size and areas



Tab. 8. Firm distribution in our sample (2005-2010)

		Aida&Capitalia
Class Size	1-49	67.31
	50-249	25.70
	250 and more	6.99
Territorial Areas	North	72.75
	Centre	16.65
	South	10.60
Pavitt Classification	Supplier dominated	41.07
	Specialized suppliers	18.99
	Scale Intensive	34.39
	Science Based	5.55
Local district	Yes	44.65
	No	55.35
Ownership	Domestic Multinationals (2)	5.97
	Foreign Multinationals (3)	1.55
	Domestic firms (1)	92.49

Tab. 9. Innovation and TFP: firm behaviour (mean and SD in brackets)

		TFP_SETT	INTANGIBLE ASSETS	INTANGIBLE ASSETS /EMPLOYEES
Total	mean	2845.83	1159799.00	9909.23
	sd	13383.24	17500000.00	76639.24
1-49	mean	1872.73	117532.00	10497.94
	Sd	14211.20	402002.20	87662.32
40-249	mean	3161.53	782694.80	6672.24
	Sd	4116.33	5174656.00	28730.33
>=250	mean	11051.29	12600000.00	16146.96
	Sd	21889.66	64400000.00	83267.02
Local District (Not)	mean	3273.91	1489723.00	12081.55
	Sd	17685.89	22200000.00	100461.00
Local District (Yes)	mean	2314.95	750693.80	7215.55
	Sd	3583.49	8763883.00	25094.51
Supplier dominated	mean	2555.30	1323918.00	8789.79
	Sd	3557.81	25200000.00	42279.79
Specialized suppliers	mean	1599.00	932100.90	6661.13
	Sd	1496.59	7756216.00	23379.07
Scale intensive	mean	2450.02	834687.60	11171.16
	Sd	4983.60	6207019.00	107601.20
Science based	mean	11711.73	2736804.00	21496.51
	Sd	53739.77	19500000.00	137353.90
Domestic	mean	2419.39	934932.50	9724.09
	Sd	5448.17	17600000.00	79108.39
Domestic Multinational	mean	6050.19	4238017.00	11883.81
	Sd	11585.82	16700000.00	27564.54
Foreign Multinational	mean	15948.91	2728555.00	13356.38
	Sd	95295.04	10800000.00	50944.51

Tab. 10. Description of the variables used in the estimates

FIRM SPECIFIC VARIABLES	Variable	Definition	Level	Years	Source
Production function	Output	Real production value	Firm	2005-2010	Elaboration based on Aida statistics
	Labour	N. of employees	Firm	2005-2010	Elaboration based on Aida statistics
	Mpreal	Real value of raw materials	Firm	2005-2010	Elaboration based on Aida statistics
	Kreal	Real value of capital	Firm	2005-2010	Elaboration based on Aida statistics
Onwership	Domestic Multinational	Dummy= 1 if the firm is an Italian multinational	Firm	2005-2010	Elaboration based on Aida statistics
	Foreign Multinational	Dummy= 1 if the firm is a foreign multinational	Firm	2005-2010	Elaboration based on Aida statistics
	Non Multinational firm	Dummy= 1 if the firm is not a multinational firm	Firm	2005-2010	Elaboration based on Aida statistics
R&D	Intangible assets_real	Real value of intangible assets	Firm	2005-2010	Elaboration based on Aida statistics
	intangible_pro	Intangible assets per employee	Firm	2005-2010	Elaboration based on Aida statistics
Fixed assets	Imm_mat	Fixed tangible assets	Firm	2005-2010	Elaboration based on Aida statistics
Investment calculated by inventory method	Inv	It = Kt+1 - (1-delta)Kt Assuming delta = 0.05 for tangible assets and delta = 0.1 for intangible assets	Firm	2005-2010	Elaboration based on Aida statistics
PROVINCE/SECTOR VARIABLES:					
FDI:					
Foreign multinationals share (sector)	Foreign_share _sector	Share of foreign multinationals output of the sector on the total output of the sector	Sector	2005-2010	Elaboration based on Aida statistics
Foreign multinationals share (province)	Foreign_share _prov	Share of foreign multinationals output of the province on the total output of the province	Province	2005-2010	Elaboration based on Aida statistics
AGGLOMERATION:					
Province output share	Output_share _prov	Output share of the province in the sectoral output (sector refers to 2-digit NACE sector)	Province/sector	2005-2010	Elaboration based on Aida statistics
Number of firms (sector/province)	nfirms_sector __prov_md	Number of domestic multinationals in the sector by province	Sector/province	2005-2010	Elaboration based on Aida statistics
	nfirms_sector _prov_mf	Number of foreign multinationals in the sector by province	Sector/province	2005-2010	Elaboration based on Aida statistics
	nfirms_sector _prov_nmn	Number of non multinational firms in the sector by province	Sector/province	2005-2010	Elaboration based on Aida statistics
	nfirms_sector _prov	Number of firms in the sector by province	Sector/province	2005-2010	Elaboration based on Aida statistics
Value added (sector/province)	md_val_add_r eal	Real value added of domestic multinationals by sector and province	Sector/province	2005-2010	Elaboration based on Aida statistics
	mf_val_add_r eal	Real value added of foreign multinationals by sector and province	Sector/province	2005-2010	Elaboration based on Aida statistics

	nmn_val_add_real	Real value added of non multinational firms by sector and province	Sector/province	2005-2010	Elaboration based on Aida statistics
INNOVATION SPILLOVERS:					
Average intangible assets (province)	innovat_prov_mdb	Average value of domestic multinationals intangible assets in the province	Firm	2005-2010	Elaboration based on Aida statistics
	innovat_prov_mfb	Average value of foreign multinationals intangible assets in the province	Firm	2005-2010	Elaboration based on Aida statistics
	innovat_prov_nmn	Average value of non multinationals intangible assets in the province	Firm	2005-2010	Elaboration based on Aida statistics
OTHER VARIABLES					
Infrastructures (province)	Dist_maintown	Distance to the chief town (km)	firm	2005-2010	Elaboration based on Aida statistics
	Stations	Railway stations in the province (n.)	firm	2005-2010	Elaboration based on Aida statistics
	Highways	Highways length in the province (km)	firm	2005-2010	Elaboration based on Aida statistics
Value added per capita (province)	Va_pc	Value added per capita of the province	Province	2005-2010	Istat
Crisis	Crisis	Dummy=1 if year=2008, 2009, 2010	Firm	2005-2010	

Tab. 11. Descriptive statistics

	Mean	Std. Dev	Mean	Max
Output	11.13	1.37	6.32	16.67
Labor	3.47	1.29	0.69	9.38
Kreal	9.38	1.81	0.00	16.24
Mpreal	10.23	1.69	0.00	16.33
Foreign Multinational	0.02	0.12	0.00	1.00
Domestic Multinational	0.06	0.24	0.00	1.00
Intangible_pro	6.68	2.90	0.00	15.79
Output_share_prov	0.05	0.08	0.00	0.54
Foreign_share_sector	0.05	0.06	0.00	0.28
Foreign_share_prov	0.05	0.10	0.00	0.94
nfim_sector__prov_md	0.47	0.67	0.00	2.77
nfirms_sector_prov_mf	0.17	0.38	0.00	2.30
nfirms_sector_prov_nmn	2.28	1.07	0.00	4.51
md_val_add_real	4.96	6.16	0.00	15.64
mf_val_add_real	2.24	4.74	0.00	15.20
nmn_val_add_real	12.21	2.00	0.00	15.90
innovaz_imm_prov_mdb	7.30	4.25	0.00	14.21
innovaz_imm_prov_mfb	3.81	4.25	0.00	13.28
innovaz_imm_prov_nmn	8.03	1.19	0.00	13.41
Stations	31.44	19.76	0.00	96.00
Dist_maintown	14.91	13.05	0.00	129.21
Va_pc	10.05	0.18	9.35	10.44
Crisis	0.47	0.50	0.00	1.00

Table 12. Correlations between variables

	foreign multinational	domestic multinational	Intangible _pro	output_share_prov	foreign_share_sector	foreign_share_prov	nfirms_sect_prov_md	nfirms_sect_prov_mf	nfirms_sect_prov_nmn	md_val_add_real	mf_val_add_real	nmn_val_add_real	linnovat_prov_mdb	linnovat_prov_mfb	linnovat_prov_nmnb
foreign multinational	1														
domestic multinational	0.0183	1													
Intangible _pro	-0.0202	0.0837	1												
output_share_prov	0.0447	0.0802	0.066	1											
foreign_share_sector	0.1104	0.09	0.0423	0.066	1										
foreign_share_prov	0.1247	0.0332	0.011	0.08	0.1685	1									
nfirms_sect_prov_md	0.2342	0.0631	0.0347	0.4623	0.3799	0.3112	1								
nfirms_sect_prov_mf	0.0494	0.1428	0.0118	-0.0044	0.4415	0.1002	0.3061	1							
nfirms_sect_prov_nmn	-0.0279	-0.0198	0.0166	0.447	0.1713	0.0307	0.4684	0.3069	1						
md_val_add_real	0.0212	0.3018	0.0394	0.4141	0.2517	0.0664	0.3714	0.4906	0.4891	1					
mf_val_add_real	0.2519	0.05	0.0302	0.3933	0.3391	0.3037	0.9508	0.3052	0.4647	0.3315	1				
nmn_val_add_real	-0.0842	-0.0874	0.0551	0.4613	0.1218	-0.0209	0.351	0.2134	0.8272	0.3662	0.3473	1			
linnovat_prov_mdb	0.0303	0.1324	0.0483	0.2278	0.128	0.1203	0.2342	0.298	0.3336	0.4446	0.2316	0.2762	1		
linnovat_prov_mfb	0.1127	0.0394	0.0436	0.2749	0.1768	0.5492	0.5001	0.1315	0.2726	0.1872	0.5097	0.2129	0.3347	1	
linnovat_prov_nmn	0.0088	-0.0376	0.1072	0.1777	-0.0517	-0.0364	0.0639	-0.1337	0.1402	-0.0262	0.0839	0.2437	0.0645	0.098	1

Tab. 13. Production function estimation results for Italy (GMM-system)

		No interactions						Interactives with size			Interactives with tech dummy		
		GMM	GMM	GMM	GMM	GMM	GMM	GMM	GMM	GMM	GMM	GMM	GMM
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Production function	Returns to scale	0.84108	0.87887	0.7882	0.78029	0.78391	0.7613	0.87361	0.80765	0.81943	0.78626	0.77982	0.75636
	Lag output	0.177***	0.226***	0.212*	0.203***	0.229***	0.183***	0.208*	0.192***	0.183***	0.210*	0.204***	0.180***
		(0.0223)	(0.0246)	(0.116)	(0.0234)	(0.0241)	(0.0237)	(0.115)	(0.0247)	(0.0257)	(0.116)	(0.0235)	(0.0236)
	Labour	0.189***	0.265***	0.182	0.179***	0.162***	0.173***	0.312**	0.226***	0.255***	0.181	0.178***	0.166***
		(0.0187)	(0.0217)	(0.117)	(0.0205)	(0.0209)	(0.0206)	(0.151)	(0.0277)	(0.0290)	(0.116)	(0.0207)	(0.0205)
	Lag Labour	0.00085	0.00577	0.00931	0.00989*	0.00951*	0.00720	0.00531	0.00775	0.00373	0.00926	0.00972*	0.00716
		(0.0048)	(0.00537)	(0.0133)	(0.00537)	(0.00540)	(0.00529)	(0.0129)	(0.00554)	(0.00562)	(0.0132)	(0.00539)	(0.00526)
	Capital	0.164***	0.175***	0.267***	0.263***	0.274***	0.257***	0.275***	0.275***	0.274***	0.266***	0.266***	0.255***
		(0.0141)	(0.0155)	(0.0695)	(0.0162)	(0.0167)	(0.0160)	(0.0594)	(0.0168)	(0.0171)	(0.0697)	(0.0162)	(0.0159)
	Lag capital	-0.163***	-0.175***	-0.248***	-0.245***	-0.255***	-0.237***	-0.259***	-0.256***	-0.253***	-0.248***	-0.247***	-0.234***
		(0.0136)	(0.0149)	(0.0605)	(0.0151)	(0.0156)	(0.0149)	(0.0556)	(0.0158)	(0.0161)	(0.0606)	(0.0152)	(0.0149)
	Inputs	0.480***	0.479***	0.404***	0.404***	0.405***	0.403***	0.368***	0.391***	0.382***	0.405***	0.403***	0.407***
		(0.0083)	(0.0101)	(0.0622)	(0.0116)	(0.0117)	(0.0115)	(0.0652)	(0.0122)	(0.0125)	(0.0624)	(0.0116)	(0.0115)
	Lag inputs	-0.0677****	-0.0969***	-0.0378	-0.0336***	-0.0406***	-0.0249**	-0.0357	-0.0281**	-0.0253**	-0.037	-0.0339***	-0.0248**
		(0.0110)	(0.0119)	(0.0726)	(0.0115)	(0.0116)	(0.0115)	(0.0662)	(0.0122)	(0.0125)	(0.0728)	(0.0116)	(0.0115)
Onwership	Foreign owner (dummy)		0.236***	0.376***	0.385***	0.361***	0.481***	0.293***	0.366***	0.426***	0.377***	0.387***	0.485***
			(0.0252)	(0.0808)	(0.0250)	(0.0249)	(0.0283)	(0.0849)	(0.0266)	(0.0323)	(0.0811)	(0.0252)	(0.0281)
	Domestic multinationals (dummy)		0.133***	0.272***	0.274***	0.264***	0.341***	0.196***	0.244***	0.269***	0.273***	0.277***	0.349***
			(0.0225)	(0.0728)	(0.0223)	(0.0223)	(0.0243)	(0.063)	(0.0226)	(0.0233)	(0.0728)	(0.0225)	(0.0242)
R & D	Intangible assets		0.0229***	0.0200**	0.0197***	0.0181***	0.0204***	0.0248***	0.0214***	0.0228***	0.0312***	-0.00437	0.0255***
			(0.00142)	(0.00786)	(0.00144)	(0.00149)	(0.00144)	(0.009)	(0.00157)	(0.00169)	(0.011)	(0.00462)	(0.00432)
FDI variables	Foreign share sector					0.0107							
						(0.0348)							
	Foreign share province					0.0379*							
						(0.0211)							
	Output share province					0.546***							
						(0.0319)							
Agglomeration	nfirms_sector_prov_md			-0.00928				-0.0151			-0.0115		
				(0.0122)				(0.0126)			(0.0291)		
	nfirms_sector_prov_mf			0.00179				-0.00148			0.00922		
				(0.0165)				(0.0216)			(0.042)		
	nfirms_sector_prov_nmn			0.0108				0.0171			0.0437**		
				(0.00821)				(0.0121)			(0.0219)		
	md_val_add_sector_prov						-0.00172***			-0.00185***			-0.000774
							(0.000391)			(0.000434)			(0.000926)
	mf_val_add_sector_prov						-0.00267***			-0.00171***			0.00118
							(0.000477)			(0.000539)			(0.00112)
	nmn_val_add_sector_prov						0.0361***			0.0306***			0.0383***
							(0.00196)			(0.00175)			(0.00290)
Innovation	innovat_ prov_md				0.00338***				0.00277***			0.00711***	
					(0.000664)				(0.000738)			(0.00137)	
	innovat_ prov_mf				-0.000618				-7.36e-05			0.00124	
					(0.000496)				(0.000532)			(0.00120)	
	innovat_ prov_nmn				0.0156***				0.0139***			-0.00857**	
					(0.00212)				(0.00201)			(0.00394)	
Interatctive size	nfirms_ md* labour							-6.91E-05					
								(5.83E-05)					
	nfirms_ mf* labour							1.00E-05					
								(0.00013)					
	nfirms _nmn* labour							-1.72E-05					
								(7.47E-05)					
	md_val_add * labour									-2.10e-06**			
										(9.75e-07)			
	mf_val_add* labour									-8.12e-06***			
										(1.82e-06)			
	nmn_val_add* labour									2.90e-06			
										(3.32e-06)			
	innovat_ prov_md * labour								-3.76e-07				
									(1.90e-06)				
	innovat_ prov_mf * labour								-5.78e-06***				
									(1.30e-06)				
	innovat_ prov_nmn* labour								1.23e-06				
									(4.69e-06)				
Interattive tech	nfirms_ md* tech										0.000409		
											(0.00363)		
	nfirms_ mf* tech										-0.00085		
											(0.00521)		
	nfirms _nmn* tech										-0.00501*		
											(0.00286)		
	md_val_add * tech												-0.000141
													(0.000125)
	mf_val_add* tech												-0.000558***
													(0.000149)
	nmn_val_add* tech												-0.000276
													(0.000346)
	innovat_ prov_md * tech											-0.000518***	
												(0.000187)	
	innovat_ prov_mf * tech											-0.000270*	
												(0.000162)	
	innovat_ prov_nmn* tech											0.00365***	
												(0.000572)	
Other variables	dist_main town			-0.00124**	-0.00137***	-0.000919***	-0.00106***	-0.00147**	-0.00144***	-0.00123***	-0.00124**	-0.00135***	-0.00106***
				(0.00056)	(0.000137)	(0.000140)	(0.000136)	(0.00058)	(0.000148)	(0.000152)	(0.00056)	(0.000138)	(0.000135)
	Stations			0.000964***	0.000728***	0.000329***	0.000476***	0.000869**	0.000734***	0.000509***	0.000969***	0.000748***	0.000467**

												*
			(0.00037)	(9.59e-05)	(9.47e-05)	(9.29e-05)	(0.00034)	(0.000103)	(0.000100)	(0.00037)	(9.65e-05)	(9.23e-05)
va_pc			0.0976***	0.0698***	0.0680***	0.0400***	0.0824***	0.0718***	0.0448***	0.0970***	0.0679***	0.0394***
			(0.0293)	(0.0155)	(0.0145)	(0.0145)	(0.0293)	(0.0162)	(0.0155)	(0.0294)	(0.0156)	(0.0144)
Crisis			-0.0617***	-0.0672***	-0.0750***	-0.0565***	-0.0638***	-0.0690***	-0.0593***	-0.0619***	-0.0684***	-0.0559***
			(0.0142)	(0.00567)	(0.00573)	(0.00553)	(0.0146)	(0.00593)	(0.00596)	(0.0143)	(0.00569)	(0.00550)
Constant	4.274215***	3.598***	3.042***	3.279***	3.262***	3.438***	3.145***	3.306***	3.385***	2.986***	3.458***	3.413***
	(0.1309)	(0.137)	(0.622)	(0.191)	(0.190)	(0.185)	(0.647)	(0.200)	(0.199)	(0.609)	(0.199)	(0.185)
Observations	14,389	14,389	13,037	13,037	13,037	13,037	13,037	13,037	13,037	13,037	13,037	13,037
Number of firmid_op	3,228	3,228	2,951	2,951	2,951	2,951	2,951	2,951	2,951	2,951	2,951	2,951
Hansen J	96.86	77.09	93.14	94.61	95.97	94.85	93.95	94.43	94.05	93.68	94.83	95.63
Jdf	44	44	44	44	44	44	44	44	44	44	44	44
Jp	7.63e-06	0.00150	2.21E-05	1.46e-05	9.86e-06	1.36e-05	1.76E-05	1.54e-05	1.71e-05	1.90E-05	1.37e-05	1.09e-05
AR1	-4.108	-4.753	-4.936	-4.796	-5.010	-4.474	-4.914	-4.478	-4.236	-4.908	-4.861	-4.411
AR2	-0.344	-0.178	-0.692	-0.730	-0.641	-0.795	-0.962	-0.863	-1	-0.745	-0.671	-0.801
AR3	2.17	2.15	0.93	0.92	0.82	0.72	1.33	1.05	1.11	0.87	0.83	0.65

Standard errors in parentheses

*** p<0.01 **p<0.05 *p<0.10

All variables are in log form.

Province output share, Foreign share (sector) and Foreign share (region) are in percentage
GMM instruments: gmm(l.lval_prod ldipendenti lkreal2 lmpreal, lag (2 .))

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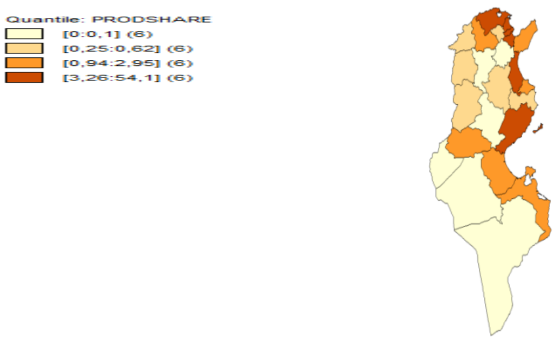
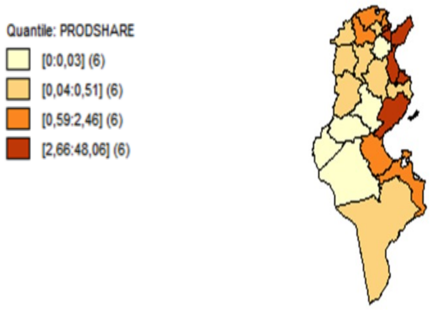
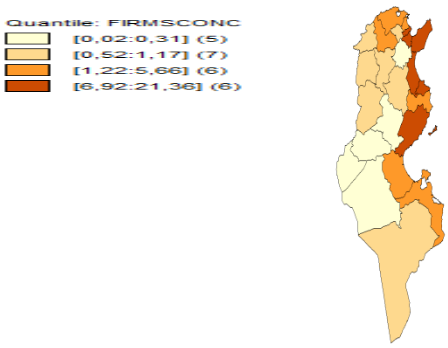
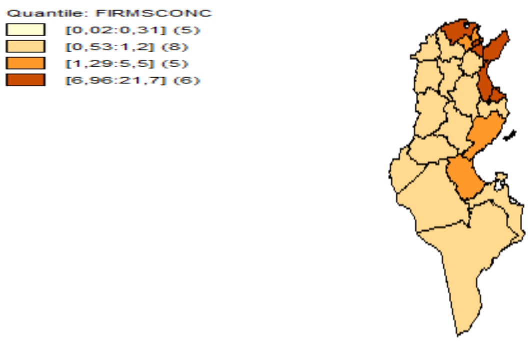
Map 14: **Production share (1997, 2006)**



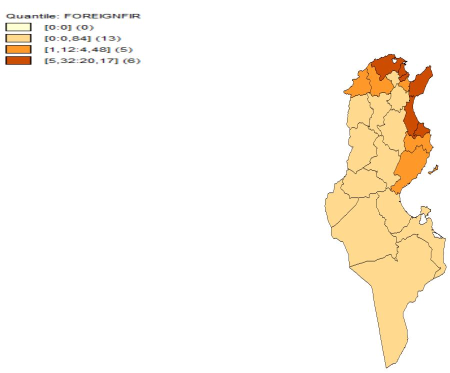


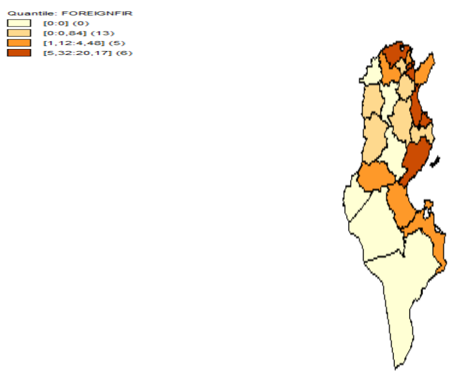
Map 15: **Firms concentration (1997, 2006)**



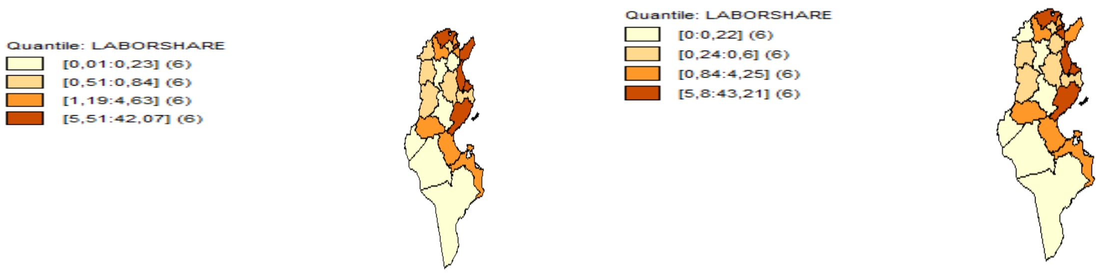


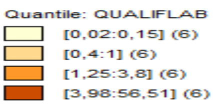
Map 16: **Foreign Firms Share (1997, 2006)**



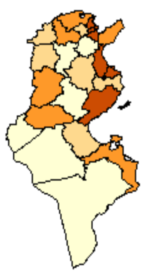


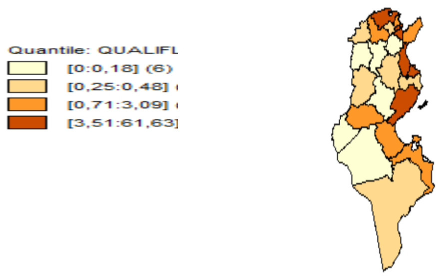
Map 17: **Labor Share (1997, 2006)**





Map 18: **Qualified Labor Share (1997, 2006)**





Tab. 14. Number of firms in the sample

	Number of firms			Share of R&D performers		
	All	**Domestic**	**Foreign**	**All**	**Domestic**	**Foreign**
1997	4268	2521	1747	36,4	6,1	80,1
1998	4268	2387	1881	37,9	5,1	79,6
1999	4268	2259	2009	40,7	5,2	80,7
2000	4268	2417	1851	33,5	5,3	70,3
2001	4268	2226	2042	39,4	5,9	75,9
2002	4268	1254	3014	64,1	5,1	88,6
2003	4268	865	3403	74,4	9,1	91,0
2004	4268	941	3327	72,5	6,9	91,1
2005	4268	494	3774	73,5	2,2	82,9
2006	4268	969	3299	73,0	6,7	92,5

Tab. 15. Description of the variables

FIRM LEVEL VARIABLES		
	Lagged Production	Output of the firm in t-1
	Labor	log (total employment)
	Capital	log (capital)
	Distance	Log (distance to Tunis city)
	Foreign	dummy for foreign vs local firm
	RD performer	(Qualified Labor / Total Labor) >25%
	Regional share	regional output/ total output
PROVINCE/SECTOR LEVEL VARIABLES		
Localisation economies	**Regional share of sector output**	Share of the region in sector output
Regional innovation spillovers	**Domestic R&D share in region**	Share of the domestic R&D performers in the output of the region
	Foreign R&D share in region	Share of the foreign R&D performers in the output of the region
Sector innovation spillovers	**Foreign R&D share in sector**	Share of the foreign R&D performers in the output of the sector
	Domestic R&D share in sector	Share of the domestic R&D performers in the output of the sector
FDI spillovers	**Foreign share in sector**	Output of foreign firms in the sector / Total output of the sector
	Foreign share in region	foreign output in the region/ Total output of the region
Other variables:	**Market share**	Output of the firm /output of the sector
	Sectoral share in Region	Share of the sector in the region ouput

Tab. 16. Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
lOutput	18,008	14.18186	1.747333	2.397895	21.55563
lLabor	20,478	4.015459	1.345667	0	9.205328
lCapital	14,639	13.97602	2.067789	4.289585	22.29278
lva	17,639	8.84828	1.703887	4.488471	16.85111
Foreign	4268	.6173149	.4860481	0	1
R&D performer	4268	.5455717	.4979247	0	1
N domestic firms	4268	7.265369	.5468743	6.202536	7.832411
N foreign firms	4268	7.83463	.2907959	7.465655	8.23589
N R&D performing domestic firms (region/sector)	4268	4.362814	.7285237	2.397895	5.043425
N R&D performing foreign firms (region/sector)	4268	7.647852	.3619972	7.170888	8.048149
Log tot output domestic	4268	3.750048	4.773578	0	10.27324
Log tot output foreign	4268	5.612032	4.422746	0	9.478128
Log tot output domestic R&D_performers	4268	.1509971	1.009467	0	7.331089
Log tot output foreign R&D_performers	4268	4.39933	4.206837	0	9.056006
Log tot output share of large firms	4268	5.178484	4.433053	0	9.429152

	Interaction variables				
Firm size * Regional output share	4268	.0913951	.1822525	0	.5966147
Fİrm size * Foreign share (sector)	26,229	.4028586	.3198452	0	1
Firm size * Foreign share (region)	26,303	.3208062	.2546593	0	1
R&D performer * Q domestic R&D performers	4268	.1509971	1.009467	0	7.331089
R&D performer * Q foreign R&D performers	4268	4.39933	4.206837	0	9.056006

Tab. 17. Coefficient of output, labour, capital and R&D performers for local and foreign firms

Foreign	**lOutput**	**lLabor**	**lCapital**	**RD performer**
Local Firms	14.15629	3.82124	13.91574	.1580236
Foreign Firms	14.22725	4.77364	14.19946	.8580863
Total	14.18186	4.015459	13.97602	.5901828

Tab. 18. OLS, FE, OP, LP and GMM estimations

	OLS	**OLS**	**FE**	**FE**	**OP**	**OP**	**LP**	**LP**	**GMM-O**	**GMM-O**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
lLabor	**0.355*** **	**0.359*** **	**0.315*** **	**0.319*** **	**0.328*** **	**0.331*** **	**0.319*** **	**0.322*** **	**0.081*** **	**0.107*** **
	(16.58)	(16.70)	(12.30)	(12.43)	(6.65)	(8.23)	(7.63)	(7.77)	(5.48)	(6.49)
lCapital	**0.504*** **	**0.495*** **	**0.521*** **	**0.523*** **	**0.540*** **	**0.358***	**0.786*** **	**0.777*** **	**0.104*** **	**0.088*** **
	(39.32)	(38.02)	(19.65)	(19.69)	(3.49)	(2.24)	(3.80)	(4.12)	(8.57)	(6.25)
Foreign	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	**1.865*** **
	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(.)	(15.89)
R&D performer	-0.021	-0.017	**0.189***	**0.196** **	-0.000	0.008	0.046	0.057	-0.071	**-0.188***
	(-0.21)	(-0.18)	(2.49)	(2.58)	(-0.00)	(0.05)	(0.26)	(0.33)	(-1.18)	(-2.36)
N R&D performing foreign firms (region/sector)	0.007		**0.084*** **		0.027		0.033		**-0.017** **	
	(0.51)		(3.76)		(1.05)		(1.36)		(-3.22)	
N R&D performing domestic firms (region/sector)	**0.213*** **		0.006		**0.289***		**0.285** **		**0.143*** **	
	(3.31)		(0.13)		(2.44)		(2.60)		(3.70)	
Regional output share	**0.618*** **	**0.716*** **	**-1.178** **	**-1.115***	**0.563*** **	**0.681*** **	**0.550** **	**0.668*** **	**0.131***	**0.329*** **
	(6.07)	(7.41)	(-2.60)	(-2.46)	(3.52)	(3.43)	(2.80)	(3.38)	(2.55)	(5.25)
Foreign share (sector)	**-0.661*** **	**-0.827*** **	**0.219***	**0.207***	**-0.644*** **	**-0.869*** **	**-0.608*** **	**-0.824*** **	**-0.149*** **	**-0.314*** **
	(-8.14)	(-9.26)	(2.29)	(2.06)	(-5.42)	(-6.62)	(-4.44)	(-5.73)	(-3.52)	(-5.90)
Foreign share (region)	**0.188***	0.109	**0.187***	**0.174***	0.176	0.065	0.189	0.082	**0.151*** **	**0.164*** **
	(2.38)	(1.35)	(2.51)	(2.28)	(1.61)	(0.45)	(1.59)	(0.59)	(5.45)	(4.84)
N domestic firms (region/sector)		**-0.058** **		0.006		**-0.080***		**-0.072***		**-0.021***
		(-2.86)		(0.22)		(-2.51)		(-2.49)		(-2.09)
N foreign firms (region/sector)		**0.053***		**0.144** **		**0.091***		**0.092** **		0.000
		(2.51)		(2.79)		(2.21)		(2.72)		(0.00)
L.lOutput									**0.772*** **	**0.766*** **
									(54.32)	(44.85)
_cons	**6.096*** **	**6.310*** **	**5.500*** **	**5.227*** **					**1.607*** **	0.000

	(39.34)	(39.16)	(14.89)	(12.52)					(14.93)	(.)
r2	0.643	0.642	0.283	0.281						
N	3072	3072	3072	3072	11775	11775	2650	2650	1930	1930

Table 19. The signs of the coefficient to be estimated with the OLS, FE, OP, LP and GMM estimators

	OLS	**OLS**	**FE**	**FE**	**OP**	**OP**	**LP**	**LP**	**GMM-O**	**GMM-O**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
lLabor	+	+	+	+	+	+	+	+	+	+
lCapital	+	+	+	+	+	+	+	+	+	+
Foreign	0	0	0	0	0	0	0	0	0	+
R&D performer	-	-	+	+	0	+	+	+	-	-
N R&D performing foreign firms (region/sector)	+		+		+		+		-	
N R&D performing domestic firms (region/sector)	+		+		+		+		+	
Regional output share	+	+	-	-	+	+	+	+	+	+
Foreign share (sector)	-	-	+	+	-	-	-	-	-	-
Foreign share (region)	+	+	+	+	+	+	+	+	+	+
N domestic firms (region/sector)		-		+		-		-		-
N foreign firms (region/sector)		+		+		+		+		0
L.lOutput		0		0		0		0	+	+
_cons	+	+	+	+	0	0	0	0	+	0

Table 20. Production function estimation results for Tunisia: output (1997-2006, GMM-System results)

	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16
L.loutput	**0.892*****	**0.891*****	**0.932*****	**0.965*****	**0.967*****	**0.812*****	**0.929*****	**0.918*****	**0.772*****	**0.763*****	**0.791*****	**0.770*****	**0.932*****	**0.918*****	**0.921*****	**0.837*****
	(32.84)	(40.43)	(48.29)	(66.52)	(71.09)	(41.68)	(54.59)	(53.33)	(57.97)	(48.38)	(47.36)	(64.12)	(72.65)	(53.33)	(47.12)	(48.57)
lLabor	**0.053*****	**0.053*****	**0.034*****	**0.022****	**0.022****	**0.072*****	**0.037*****	**0.038*****	**0.107*****	**0.100*****	**0.068*****	**0.073*****	**0.030*****	**0.038*****	**0.042*****	**0.162*****
	(4.15)	(4.74)	(3.41)	(2.82)	(2.83)	(4.68)	(3.85)	(4.06)	(8.26)	(6.87)	(4.29)	(5.43)	(3.89)	(4.06)	(4.18)	(6.05)
lCapital	**0.044*****	**0.044*****	**0.028****	0.012	0.010	**0.071*****	**0.027****	**0.033*****	**0.088*****	**0.093*****	**0.088*****	**0.106*****	**0.028*****	**0.033*****	**0.030****	**0.031***
	(3.32)	(3.91)	(2.76)	(1.43)	(1.28)	(4.99)	(2.98)	(3.65)	(8.49)	(7.57)	(7.95)	(14.04)	(3.96)	(3.65)	(2.99)	(2.20)
Foreign		0.004	0.004	0.007	0.012	0.000	**0.094***	0.011	**1.812*****	0.000	**1.668*****	**1.673*****	0.015	0.011	0.003	0.000
		(0.27)	(0.30)	(0.47)	(0.97)	(.)	(1.96)	(0.75)	(15.68)	(.)	(13.13)	(13.05)	(1.22)	(0.75)	(0.21)	(.)
R&D performer (dummy)		-0.036	-0.040	-0.050	-0.106	-0.094	-0.033	**-0.765***	-0.067	**0.654*****	-0.064	0.098	**-1.079*****	**-0.765***	-0.046	-0.007
		(-0.53)	(-0.67)	(-0.93)	(-1.83)	(-1.60)	(-0.57)	(-2.55)	(-1.49)	(6.36)	(-1.73)	(1.06)	(-4.54)	(-2.55)	(-0.78)	(-0.13)
N domestic firms (sector-region)			0.007	0.008					**-0.022***	-0.016						
			(1.83)	(1.57)					(-2.19)	(-1.91)						
N foreign firms (sector-region)				-0.003					0.017	0.003						
				(-0.73)					(0.68)	(0.36)						
N foreign R&D performers (sect-reg)					-0.002				-0.009							
					(-0.66)				(-0.47)							
N domestic R&D performers (sect-reg)					**0.049****				**0.076***							
					(2.60)				(2.42)							
Regional share						**0.151***			**0.155****	**0.218*****	**0.186****	**0.242*****				**0.187****
						(2.35)			(2.92)	(3.73)	(2.95)	(4.50)				(3.09)

Foreign share (sector)						**-0.276*****			**-0.323*****	**-0.340*****	**-0.240*****	**-0.236*****				**-0.350*****
						(-5.57)			(-7.82)	(-7.21)	(-6.89)	(-5.05)				(-7.46)
Foreign share (region)						0.061			**0.108*****	**0.083****	0.038	**0.079***				**0.074***
						(1.78)			(5.86)	(2.69)	(1.16)	(2.57)				(2.15)
Q domestic firms (sect-reg)							0.006									
							(1.22)									
Q foreign firms (sect-reg)							-0.012									
							(-1.52)									
Q domestic R&D performers (sect-reg)								**0.227****		0.000			**0.314*****	**0.227****		
								(2.58)		(.)			(4.50)	(2.58)		
Q foreign R&D performers (sect-reg)								**0.170***		**-0.199*****			**0.282*****	**0.170***		
								(2.24)		(-9.53)			(4.46)	(2.24)		
Fİrm size * Foreign share (sector)											-0.021					
											(-0.40)					
Firm size * Foreign share (region)											0.046					
											(0.81)					
Firm size * Regional output share											0.016					
											(0.27)					
R&D performer * Regional output share												**-0.509****				
												(-2.66)				
R&D performer * Foreign share (sector)												0.015				
												(0.29)				
R&D performer * Foreign share (region)												0.071				
												(1.55)				
Firm size * Q domestic R&D performers (sect-reg)													0.009			
													(0.40)			
Firm size * Q foeign R&D performers (sect-reg)													0.014			
													(0.62)			
Q share of large firms (sect-reg)															-0.002	**-0.022****
															(-0.31)	(-2.86)
Constant	**0.757*****	**0.761*****	**0.471*****	**0.278****	**0.287****	**1.599*****	**0.492*****	**0.583*****	0.000	**1.912*****	0.000	0.000	**0.499*****	**0.583*****	**0.570*****	**1.429*****
	(4.33)	(5.32)	(3.71)	(2.90)	(3.18)	(11.55)	(4.41)	(5.17)	(.)	(16.33)	(.)	(.)	(5.73)	(5.17)	(4.32)	(11.33)
N	10267	10267	10267	10267	10267	1930	10267	10267	1930	1930	1930	1930	10267	10267	10267	1932

Table 21. The signs of the coefficient to be estimated with the GMM estimators

	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13	M14	M15	M16
L.loutput	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
lLabor	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
lCapital	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Foreign		+	+	+	+	null	+	+	+	null	+	+	+	+	+	null
R&D performer (dummy)		-	-	-	-	-	-	-	-	+	-	+	-	-	-	-
N domestic firms (sector-region)			+	+					-	-						
N foreign firms (sector-region)				-					+	+						
N foreign R&D performers (sect-reg)					-				-							
N domestic R&D performers (sect-reg)					+				+							
Regional share						+			+	+	+	+	+	+	+	+
Foreign share (sector)						-			-	-	-	-	+	+	+	-
Foreign share (region)						+			+	+	+	+	+	+	+	+
Q domestic firms (sect-reg)							+									
Q foreign firms (sect-reg)							-									
Q domestic R&D performers (sect-reg)								+		null			+	+		
Q foreign R&D performers (sect-reg)								+		-			+	+		
Fİrm size * Foreign share (sector)											-					
Firm size * Foreign share (region)											+					
Firm size * Regional output share											+					
R&D performer * Regional output share												-				
R&D performer * Foreign share (sector)												+				
R&D performer * Foreign share (region)												+				
Firm size * Q domestic R&D performers (sect-reg)													+			
Firm size * Q foeign R&D performers (sect-reg)													+			
Q share of large firms (sect-reg)															-	-
Constant	+	+	+	+	+	+	+	+	null	+	null	null	+	+	+	+

Appendix A.

Tab. A.2. Production function estimation for Italy

	OLS	OLS	OLS	FE	FE	FE	LP	LP	LP	OP	OP	OP
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Returns to scale	0,896	0,894	0,891	0,507	0,5049	0,5049	0.206	0,613	0,627	0,8484	0,8442	0,497
Labour	0.284***	0.283***	0.281***	0.0321**	0.0319**	0.0317**	0.206**	0.205**	0.203**	0.254**	0.253**	0.251**
	(0.00383)	(0.00383)	(0.00382)	(0.00387)	(0.00386)	(0.00386)	(0.0101)	(0.0101)	(0.0108)	(0.0199)	(0.0161)	(0.0162)
Capital	0.109***	0.109***	0.109***	0.0679**	0.0680**	0.0682**		0	2.68e-10	0.0954*	0.0932*	0.0946**
	(0.00258)	(0.00257)	(0.00257)	(0.00317)	(0.00317)	(0.00316)		(0.0219)	(0.0202)	(0.0401)	(0.0445)	(0.0364)
Input	0.503***	0.502***	0.501***	0.407**	0.405**	0.405**		0.408**	0.424**	0.499**	0.498**	0.497**
	(0.00276)	(0.00276)	(0.00275)	(0.00293)	(0.00293)	(0.00292)		(0.0334)	(0.0354)	(0.0176)	(0.0164)	(0.0157)
Foreign owner	0.273***	0.258***	0.329***	0.00264	0.00487	0.0567*	0.146**	0.118*	0.183**	0.230**	0.215**	0.279**
	(0.0262)	(0.0253)	(0.0264)	(0.0259)	(0.0248)	(0.0259)	(0.0632)	(0.0572)	(0.0521)	(0.0689)	(0.0508)	(0.0667)
Domestic multinationals	0.145***	0.132***	0.175***	0.00989	0.00841	0.0349**	0.0523**	0.0359*	0.0704**	0.0980**	0.0850**	0.125**
	(0.0146)	(0.0141)	(0.0149)	(0.0105)	(0.00997)	(0.0107)	(0.0156)	(0.0165)	(0.0214)	(0.0259)	(0.021)	(0.0217)
Intangible asset per employee	0.0147***	0.0141***	0.0144***	0.00258*	0.00234*	0.00246*	0.0154**	0.0148**	0.0150**	0.0148**	0.0144**	0.0145**
	(0.00115)	(0.00116)	(0.00115)	(0.00114)	(0.00114)	(0.00114)	(0.00175)	(0.00189)	(0.00219)	(0.0023)	(0.00223)	(0.00264)
foreign_share_sector												
foreign_share_prov												
output_share_prov												
Nfirm sect_prov _md	-0.0142**			-0.00608			-0.0156			-0.0118		
	(0.00670)			(0.00523)			(0.00820)			(0.0106)		
Nfirm sect_prov _mf	-0.0123*			-0.0218*			-0.0319**			-0.011		
	(0.0106)			(0.00968)			(0.0162)			(0.0203)		
Nfirm sect_prov _nmn	0.0230***			-0.0232			0.0274**			0.0247**		
	(0.00413)			(0.0148)			(0.00565)			(0.00889)		
lmd_val_add			-0.00192***			0.00220**			-0.00115			-0.0015
			(0.000633)			(0.000485)			(0.000773)			(0.00097)
lmf_val_add			-0.00251***			-0.00273**			-0.00293*			-0.00188
			(0.000787)			(0.000865)			(0.00127)			(0.00146)
lnmn_val_add			0.0272***			0.0261**			0.0216**			0.0258**
			(0.00202)			(0.00256)			(0.00357)			(0.00416)
Linnovat_md		0.00341***			0.00365**			0.00416**			0.00408**	
		(0.000902)			(0.000588)			(0.00108)			(0.00091)	
Linnovat_mf		-0.000482			-0.00399**			-0.000733			-0.0002	
		(0.000830)			(0.000792)			(0.000878)			(0.00125)	
Linnovat_nmn		0.0121***			0.00813*			0.00710			0.00615	
		(0.00313)			(0.00318)			(0.00595)			(0.00683)	
dist_prov_main town	-0.00233***	-0.00249***	-0.00225***	-0.00525	0.00442	-0.0168	-0.00127**	-0.00141**	-0.00122**	-0.00185**	-0.00202**	-0.00179**
	(0.000245)	(0.000245)	(0.000244)	(0.173)	(0.173)	(0.173)	(0.000490)	(0.000426)	(0.000381)	(0.00048)	(4.43E-04)	(0.00034)
Stations	0.000744***	0.000574***	0.000497***	0.0110**	0.0102**	0.0118**	0.000704*	0.000523*	0.000502	0.000536	0.000479	0.000299
	(0.000177)	(0.000182)	(0.000177)	(0.00143)	(0.00144)	(0.00142)	(0.000323)	(0.000259)	(0.000325)	(0.00034)	(0.00033)	(0.00029)
lva_pc	0.179***	0.162***	0.143***	0.0723**	0.0525**	0.0736**	0.142**	0.127**	0.124**	0.199**	0.187**	0.168**
	(0.0226)	(0.0241)	(0.0225)	(0.0160)	(0.0157)	(0.0155)	(0.0264)	(0.0264)	(0.0265)	(0.0194)	(2.92E-02)	(0.0411)
Crisis	-0.0132	-0.0262***	-0.0100	-0.0383**	-0.0417**	-0.0305**	-0.00505	-0.0237**	-0.00554	-0.0214	-0.0370**	-0.0186*
	(0.00830)	(0.00869)	(0.00821)	(0.00515)	(0.00513)	(0.00500)	(0.00772)	(0.00572)	(0.00735)	(0.0127)	(1.09E-02)	(0.00927)
Constant	2.043***	2.168***	2.172***	5.276*	5.238*	5.040						
	(0.228)	(0.240)	(0.225)	(2.609)	(2.602)	(2.598)						
Observations	16,387	16,387	16,387	16,387	16,387	16,387	16,387	16,387	16,387	18136	18136	18136
R-squared	0.912	0.912	0.913	0.659	0.660	0.662						
Number of firmid_op				2,973	2,973	2,973						

OLS pooled ordinary least squares, FE fixed effects, OP Olley-Pakes, LP Levinshon-Petrin. All variables are in log form. Regional output share, Foreign share (sector) and Foreign share (region) are in percentage

Appendix B. Estimation methodologies based on the Levinshon and Petrin and on Olley and Pakes procedures.

In the first step we estimated the TFP. When this is estimated at firm-level simultaneity bias and selection bias may emerge (Van Beveren, 2012; Syverson, 2011). The firm-specific error term consists of two parts: firm productivity, ε_{it}, which are unpredictable zero-mean shocks to productivity after inputs are chosen, and ω_{it}, which is observed by the firm but not by the econometrician. The asymmetric information about ω_{it} causes two biases in the OLS estimates: a simultaneity bias and a selection bias. The “simultaneity bias” problem is due to endogeneity in the inputs, arising from the potential correlation between input choices and the unobserved productivity shock as firms may alter their mix of inputs in response to a productivity shock. Hence, the firm can choose the amount of inputs according to its prior knowledge about its productivity levels, which are not observable. This implies correlation between unobserved productivity and a plant’s input decisions. If more productive plants tend to hire more workers due to higher current and anticipated future profitability, OLS will tend to provide upwardly biased estimates on the input coefficients. This implies that the error and the inputs in the production might be correlated and that the coefficient estimates obtained with OLS might be biased. (Van Beveren, 2012).
The selection bias arises because firms with larger capital stocks can expect larger future returns for any given level of current productivity, and will therefore continue to operate for lower productivity levels, thereby leading to a negative bias in the OLS capital coefficient: firms with a higher capital supply will be able to survive with lower ω_{it}, relative to firms with a lower capital stock. The selection bias or ‘endogeneity of attrition’ problem will generate a negative correlation between ε_{it} and K_{it}, causing the capital coefficient to be biased downwards.
Over the last years, several methodologies have been developed in the literature to solve these problems. Firm-level fixed effects including time-invariant individual effects and instrumental variable strategies for input choices have been proposed in a first attempt. More recent methodologies include Olley and Pakes (1996), GMM by Blundell and Bond (1998) and Levinsohn and Petrin (2003).
Olley and Pakes (1996) developed a semiparametric approach in which the simultaneity problems are addressed by using investment to proxy for an unobserved time-varying productivity shock. This is based on the assumption that future productivity is strictly increasing with respect to productivity shock so firms that observe a positive productivity shock in a period will invest more in that period (Van Beveren 2012).[12] Olley and Pakes (1996) were also the first to take the selection bias explicitly into account by using survival probabilities. Hence, investment decisions at the firm level can be shown to depend on capital and productivity or i_{it} = it (k_{it}, ω_{it}), where lower-case notation refers to logarithmic transformation of variables, as earlier. Provided investment is strictly increasing in productivity, conditional on capital, this investment decision can be inverted, allowing us to express unobserved productivity as a function of observables: $\omega_{it} = h_t(k_{it}, i_{it})$ where ht (.) = i_t^{-1} (.).
Using this information, equation can be written as

[12] A number of assumptions are made. First, the model assumes there is only one unobserved state variable at the firm level, i.e. its productivity, and it evolves as a first-order Markov process. Second, the model imposes monotonicity on the investment variable, to ensure invertibility of the investment demand function. This implies that investment has to be increasing in productivity, conditional on the values of all state variables. As a consequence, only non-negative values of investment can be used in the analysis. Finally, industry-wide price indices are used to deflate inputs and output in value terms to proxy for their respective quantities, which entails assuming that all firms in the industry face common input and output prices (Ackerberg et al. 2007; Cainelli et al. 2015; Van Beveren 2012).

$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + h_t (k_{it}, i_{it}) + u^q_{it}$ (1)

Next, define the function $\phi(i_{it}, k_{it})$ as follows:

$$\phi(i_{it}, k_{it}) = \beta_0 + \beta_k k_{it} + h_t (i_{it}, k_{it})$$

Estimation of equation (2) proceeds in two steps (OP, 1996). In the first stage of the estimation algorithm, the following equation is estimated using OLS:

$$y_{it} = \beta_l l_{it} + \beta_m m_{it} + \phi(i_{it}, k_{it}) + u^q_{it} \quad (2)$$

where $\phi(i_{it}, k_{it})$ is approximated by a higher-order polynomial in i_{it} and k_{it} (including a constant term). Estimation of equation (2) results in a consistent estimate of the coefficients on labour and materials (the variable factors of production).

To recover the coefficient on the capital variable, it is necessary to exploit information on firm dynamics. Productivity is assumed to follow a first-order Markov process, i.e. $\omega_{it+1} = E(\omega_{it+1} | \omega_{it}) + \xi_{it+1}$, where ξ_{it+1} represents the news component and is assumed to be uncorrelated with productivity and capital in period t + 1. Firms will continue to operate provided their productivity level exceeds the lower bound, i.e. $\chi_{it+1} = 1$ if $\omega_{it+1} \geq \underline{\omega}_{it+1}$, where χ_{it+1} is a survival indicator variable. Because the news component ξ_{it+1} is correlated with the variable inputs, labour and material inputs are subtracted from the log of output.

Considering the expectation of $E(y_{it+1} - \beta_l l_{i\,t+1} - \beta_m m_{i\,t+1})$, conditional on the survival of the firm results in the following expression:

$$E [y_{it+1} - \beta_l l_{it+1} - \beta_m m_{it+1|} k_{it+1}, \chi_{it+1} = 1]$$
$$= \beta_0 + \beta_k k_{it+1} + E [\omega_{i\,t+1} | \omega_{it}, \chi_{it+1} = 1]$$

The second stage of the estimation algorithm can then be derived as follows:

$$y_{it+1} - \beta_l l_{it+1} - \beta_m m_{it+1}$$
$$= \beta_0 + \beta_k k_{it+1} + E(\omega_{i\,t+1} | \omega_{it}, \chi_{it+1}) + \xi_{it+1} + u^q_{it+1}$$
$$= \beta 0 + \beta_k k_{it+1} + g(P_{it}, \phi t - \beta_k k_{it}) + \xi_{it+1} + u^q_{it+1} \quad (3)$$

where $E(\omega_{it+1} | \omega_{it}, \chi_{it+1}) = g(P_{it}, \phi_{it} - \beta_k k_{it})$ follows from the law of motion for the productivity shocks and P_{it} is the probability of survival of firm i in the next period, i.e. $Pit = Pr\{\chi_{it+1} = 1\}$.

A consistent estimate of the coefficient on capital is obtained by substituting the estimated coefficients on labour and materials from the first stage, as well as the estimated survival probability in equation (2). As in the first stage of the estimation procedure, the function $g(P_{it}, \phi_{it} - \beta_k k_{it})$ is approximated using a higher-order polynomial expansion in P_{it} and $\phi_{it} - \beta_k k_{it}$. Finally, this results in the following estimating equation:

$$y_{it+1} - \beta_l l_{it+1} - \beta_m m_{it+1}$$
$$= \beta_0 + \beta_k k_{it+1} + g\ (P_{it}, \phi t - \beta_k k_{i\,t} + \xi_{it+1} + u^q_{it+1} \quad (4)$$

The coefficient on capital can then be obtained by applying non-linear least squares on equation (4). Standard errors can be calculated by bootstrapping.

However, because of indivisibility, investment is often zero, which prevents inverting the function. Levinsohn and Petrin (2003) suggested a modification of the Olley-Pakes approach by using intermediate inputs (raw materials, electricity, or fuels) instead of investment to proxy for unobservable productivity. Levinsohn and Petrin (2003) argue that using information on intermediate input choices, such as demand for raw materials or services, allows controlling for productivity shocks to obtain consistent and unbiased estimates of K and L. In their model, labour and materials are freely variable inputs, but capital is treated as a state variable that is affected by the distribution of the productivity shock.

The data coverage of the proxy for unobservable productivity is an important factor in deciding which approach to use, since plants with zero or missing observations on investment would be dropped from the estimation. As with our data we may follow both LP and OP approach, for the second stage we consider important to use both methodologies. On the one hand, plants with zero or missing observations on investment would be dropped from the OP estimation[13], but on the other hand, LP do not incorporate the survival probability which the OP method takes into account.[14]

In OP, investment decisions at firm level can be shown to depend on capital and productivity or $i_{it} = i_t\ (k_{it}, \omega_{it})$, where lower-case notation refers to logarithmic transformation of variables. Provided investment is strictly increasing in productivity, conditional on capital, this investment decision can be inverted, allowing us to express unobserved productivity as a function of observables and under the conditions of monotonicity and investment strictly increasing in productivity, the production function can be specified as follows:

$$ln\, y_{it} = \gamma + \alpha\, ln\, l_{it} + \beta ln\, k_{it} + \delta ln\, m_{it} + h_i(k_{it} i_{it}) + \eta_{it} \qquad [A.1]$$

The LP methodology is a two-step approach that allows the simultaneity problem between productivity shock and input choices to be solved by controlling for unobservable, using intermediate inputs as the proxy variable. Hence, intermediate inputs are expressed as a function of capital and productivity: $m_{it} = m_i(k_{it}\varpi_{it})$ and under the conditions of monotonicity and intermediate inputs strictly increasing in productivity, the production function can be specified as follows:

$$ln\, y_{it} = \gamma + \alpha\, ln\, l_{it} + \beta ln\, k_{it} + \delta ln\, m_{it} + \varpi_{it}(k_{it} i_{it}) + \eta_{it} \qquad [A.2]$$

where m_{it} denotes intermediate inputs of firm i at time t, the term $\varpi_{it} = s_t(k_{it} m_{it})$ expresses the unobserved productivity as a function of the observables and $s_t(k_{it} m_{it}) = m_t^{-1}(k_{it} m_{it})$ denotes the inversion of the intermediate inputs function.

Deflated balance sheet data on value added, total labour costs, intermediate inputs, and fixed capital are used to estimate industry specific production functions.

[13] In our case for OP as a proxy for investment we have built the ratio between the real operational result and the return on investment (which in turn depends on real operational results on total assets i.e. on the investment).

[14] Due to these differences the results between the OP and LP method may significantly differ.

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Appendix C. Estimation methodology based on system GMM

In all our regressions the dynamic panel data techniques are based on the system GMM estimator developed by Arellano and Bond (1991) and Blundell and Bond (1998), which enables us to control for the possible simultaneity and endogeneity problems in our models.[15]

Our estimator combines in a system the equation in first-differences with an equation in levels. We treat all the input in our equations as endogenous and instrument them using their lagged levels in the differenced and level equation and standard instruments of all the others variables also in levels equation. This estimation method allows us to assume that the firms’ characteristics are endogenous variables.

We adopt the system Generalized Method of Moments (GMM) method proposed by Blundell and Bond (1998) to deal with the endogeneity issue. They show that when the dependent variable follows a path close to a random walk, the differenced- GMM from Arellano and Bond (1991) has poor finite sample properties, and it is downwards biased, especially when T is small. Therefore, Blundell and Bond (1998) propose another estimator (the System-GMM) derived from the estimation of a system of two simultaneous equations, one in levels (with lagged levels as instruments) and the other in first differences (with lagged first differences as instruments). By adding the original equation in levels to the system and exploiting the additional moment conditions, Blundell and Bond (1998) found a consistent improvement in efficiency and a significant reduction in finite sample bias compared with the simple first-differenced GMM. In particular, in multivariate dynamic panel models, the System-GMM estimator is shown to perform better than the differenced-GMM when series are persistent and there is a dramatic reduction in the finite sample bias due to the exploitation of additional moment conditions (Blundell, Bond and Windmeijer, 2000).

A major problem with the use of GMM methods concerns the choice of the instruments. The instruments should be highly correlated with the variables to be instrumented to be strong in Murray (2006) terminology. They should also be uncorrelated with the disturbances of the equation of interest.[16] The validity of the instruments can instead be tested using the Hansen/Sargan statistics (or J statistics). The test of overidentifying restrictions implies that the estimator is valid if its P-value is above the chosen critical level (i.e. 1, 5 or 10 percent).[17]

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[15] The Arellano-Bond (1991) and Arellano-Bover (1995)/Blundell-Bond (1998) dynamic panel estimators are general estimators designed for situations with 1) small T, large N panels, meaning few time periods and many individuals; 2) a linear functional relationship; 3) a single left-hand-side variable that is dynamic, depending on its own past realizations; 4) independent variables that are not strictly exogenous, meaning correlated with past and possibly current realizations of the error; 5) fixed individual effects; and 6) heteroskedasticity and autocorrelation within individuals but not across them. Arellano-Bond estimation starts by transforming all regressors, usually by differencing, and uses the Generalized Method of Moments (Hansen 1982), and so is called Difference GMM. The Arellano-Bover/Blundell-Bond estimator augments Arellano-Bond by making an additional assumption, that first differences of instrument variables are uncorrelated with the fixed effects. This allows the introduction of more instruments, and can dramatically improve efficiency. It builds a system of two equations - the original equation as well as the transformed one - and is known as System GMM.

[16] Econometric tests are used to judge whether the chosen instruments are strong and valid. Following Staiger and Stock, the instruments can be considered as good if the first-stage F-statistic of the regression of the variable to be instrumented on the instrument is above 10 (Sekkat, 2011).

[17] The Sargan test regresses the residuals from the IV estimation of the equation of interest on the instruments and uses the R^2 to test the significance of this regression. The test statistic is the number of observations times the R2 and has a chi square distribution. Its degree of freedom is equal to the number of instrument minus the number of variable to be instrumented (Sekkat, 2011). However, the Monte Carlo evidence of Blundell et al. (2000) shows that when using system GMM on a large panel data to estimate a production function, the Sargan test tends to over-reject the null hypothesis of instrument validity.

Another test to be carried out is made to assess the presence of nth-order serial correlation in the differenced residuals using the m(n) test, which is asymptotically distributed as a standard normal under the null of no nth-order serial correlation of the differenced residuals. This test needs to be performed as the dynamic model specifications that we estimate can only be appropriate if they are exempt from serial correlation in the first-differenced residuals. In the presence of serial correlation of order n in the differenced residuals, the instrument set for the equation in first-differences needs to be restricted to lags n + 1 and deeper. We use indeed three and four lags. However, we report the the m1 and m2 tests for second order serial correlation of the differenced residuals in our tables.