

# Knowledge flows and networks in the ICT sector : the case of Pakistan

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# Summary

This thesis contributes to the literature in a number of ways. It primarily seeks to assess the role of FDI in a developing country context and its associated spillovers within a high-tech sector where the likelihood of knowledge flows and learning is the highest. Given the special nature of ICT – both in terms of attracting FDI and its potential for spillovers – it focuses on the ICT sector in Pakistan. However, in order to put the ICT sector into the broader context of development, it first seeks to understand the historical background of the economy as a whole. Therefore, taking a step back, we first study the initial conditions which have significantly shaped Pakistan’s growth and development trajectory. For this purpose chapter 3 gives an overview of long-term economic and political developments in Pakistan which provides a background for the subsequent analysis of Pakistan’s sectoral productivity and the performance of the ICT sector in Pakistan. Economic developments are discussed in the context of various civilian and military ruled periods. We established that Pakistan’s path to social and economic development has not been straightforward. Unfavorable initial conditions, having a rival country as a neighbor, lack of an adequate policy framework and the civil-military divide were all handicaps, many of which are still present today. Despite all odds, there were periods of robust growth but largely at the expense of social development as shown by the various indicators. Towards the end of the chapter some of the most important challenges faced by the country are highlighted together with a discussion of how they came into being.

While Chapter 3 concentrates mainly on the different periods and their salient policy features, Chapter 4 takes the discussion into inter and intra sectoral productivity with the aim to understand the trends in two particular sectors, manufacturing and services. The reasons why we were interested in understanding the evolution of these two sectors in particular are two-fold. Firstly, empirical evidence unequivocally advocates the role of manufacturing for development. Developing countries which have managed to converge towards a developed economy have mostly gone through a more or less similar process during their transition period. The second reason has to do with the more recent trend; developed countries transforming from manufacturing centric into services centric economies. Another recent development is the rapidly increasing role of information and communications technologies (ICTs) for growth. The chapter employs the shift and share analysis to account for productivity growth on a dataset of all industrial sectors spanning over 3 decades with the goal to observe if the economy has been shifting resources from an agrarian economy to a manufacturing one, and more recently in becoming a service-oriented economy. The special role which the service sector in general and ICT in particular has played in helping countries

catch up is one reason for the special attention which is given to the ICT sector. Another reason is its relevance to FDI; it being the sector with the most inflows by far. Last but not least, the sector is important because ICTs, by virtue of being general purpose technologies, are closely related with productivity growth in the wider economy. A shift-share analysis is performed in order to look at the broader structural change and thereby attempt to quantify the contribution of the ICT sector. However, the weakness of the underlying data on the ICT component of services prevented us from singling out the contribution of this sector to structural change. While assessing the impact of structural changes within the economy on productivity we found that for the whole economy structural changes do contribute positively to productivity growth, though within sector productivity increases are much more important. Productivity contributions of structural shifts within the manufacturing sector were negligible or even negative.

Chapter 5 provides an overview of the ICT sector of Pakistan and serves as a backdrop for our survey in this sector. It also presents a historical perspective highlighting some important events that led to the evolution (and later decline) of this sector. This chapter establishes that though the ground work for transitioning to a knowledge economy is laid, in order to be able to become competitive at the level of existing global players like India and China, a lot of hard work needs to be put in. These efforts cannot just be limited to the organizational domain but rather would need strong support from policy makers as well. The right set of policy instruments would not just focus on pushing from the outside e.g. encouraging more FDI, but also pulling from the inside i.e. to devise a framework which would help firms to absorb spillovers.

In our pursuit of spillovers from ICT and to understand the causes of such externalities we then empirically estimated the existence, channels and mechanisms of spillovers based on primary data gathered from our survey. Thus, chapter 6 undertakes an empirical examination of spillovers in the Pakistan ICT sector and its subsectors. ICT being an advanced technology sector makes it more likely for innovations resulting in knowledge spillovers. Our study contributed to the existing body of knowledge by exploring the effects of a set of variables on the innovative and productive performance of firms, while relating them to the established mechanisms of spillovers. Our results validated some of the established findings in literature. With regards to absorptive capacity and human capital our findings corroborated that CEOs' education is positively associated with Productivity, R&D intensity and the decision to perform R&D. Similarly the number of a CEO's previous jobs has a positive impact on Process Innovative Performance. We also found that more foreign qualified technical staff members in a firm increase the likelihood of it being more productive and foreign qualified (education) staff intensity positively affects labor productivity. Training for technical staff and Technical staff to employee ration positively predicts Product Innovative Performance. Firms doing R&D and those having more number of dedicated R&D staff are more likely to be involved in process innovations. As for labor mobility, we could confirm that CEOs foreign experience positively predicts productivity. More-

over, the finding that firms which point to MNCs as their primary source for technology are more productive validates the demonstration effect.

Some of our findings, with regard to the role of education and performance of multinationals were unexpected and went against established views in literature. This could be due to the specific conditions and challenges faced by both foreign and domestic firms in a developing country context or due to methodological issues pointed out, which need to be addressed in future research.

Chapter 7 looks at the spillover debate from a social capital perspective. Network data gathered through our extended questionnaire is analyzed for two distinct features of social capital. Firstly the network of contacts which grants individuals access to resources belonging to their contacts, and secondly the quality and quantity of those resources. Our methodology, in a way, combines both structural elements of a network and the resource dimension. We achieve this by using variables which represent structural information like constraint and centrality (degree, closeness and betweenness) but construct these variables using matrices which contain resource exchange weights and frequencies, both being dimensions which shed light on the strength of ties, not the structural characteristics as such. We started out by validating the importance of general embeddedness metrics in predicting innovative and economic performance. We got mixed results for general embeddedness. Innovative performance is unaffected by both centrality metrics used and productivity is positively and significantly predicted by out-degree centrality. We also tested Burt's hypothesis of structural holes and found it to be significantly positive meaning that firms with plenty of structural holes outperform firms with redundant ties. We also tested our data set for the impact of interaction frequency on innovativeness and productivity. Here too a positive and significant link between interaction frequency and both innovativeness and productivity was established corroborating the importance of information in high-tech sectors which is ensured through frequent interactions between firms.

The final chapter summarizes the conclusions emerging from our empirical analysis.