Summary and conclusions

This dissertation consists of five chapters on multinational firms, FDI policy, and R&D cooperation. This dissertation studies how host countries can best benefit from increasing inflows of FDI and it provides policy recommendations on optimal FDI policy strategies. An important focus of this dissertation is on FDI in resource-rich developing countries. Chapters 2 and 3 are based on a game-theoretical model in which multinational firms compete in the product market and strategically interact in technology transfer. The existing theoretical literature on technology transfer mainly considers the entry mode of a foreign firm into a market dominated by domestic companies (see e.g. Mattoo et al., 2004; Ethier and Markusen, 1996; Markusen, 2001; Saggi, 1996, 1999). However, numerous industries such as automobile, electronics, extractive and chemical industries, are dominated by foreign multinational companies and national firms play a less prominent role (see e.g. Markusen and Venables, 1998). Hence, this dissertation extends the existing models by taking into account strategic interaction among multinational firms in both technology transfer and the product market stage.

Chapters 4 and 5 are empirical studies based on the South African innovation survey. South Africa aims to move away from dependence on primary resource production. The country has taken different measures to increase public and private investment in R&D. It focuses on certain sectors such as the biotechnology and the mining sector in which it aims to develop centers
of excellence. Cooperative research agreements between firms, universities, and suppliers or customers play an important role in the country’s strategy to develop these centers of excellence.\textsuperscript{49} Hence, Chapter 4 studies which firm and industry characteristics will determine whether cooperative R&D agreements between firms and knowledge institutions take place. Chapter 5 studies which type of cooperative research agreements with foreign partners in the mining sector result in product and process innovations. Chapter 5 also shortly addresses the issue of mining automation which will likely become a major issue in the future due to its effects on employment and growth.

In Chapter 2 a game-theoretical model is developed with a host country government that either directly restricts the equity share of foreign firms or imposes mandatory joint ventures with a domestic firm. The goal of this model is to shed light on the relationships between foreign ownership restrictions, technology transfer, and market structure. Chapter 2 shows that the host country government can improve welfare by taking away the joint venture equity share of the domestic firm. A similar measure was taken in 1984 by the Norwegian government when it took away significant ownership shares from the national oil company Statoil and started to manage these equity shares through the Ministry of Oil and Energy. In Nigeria the Oil and Gas Reform Implementation Committee (OGIC) proposed a similar framework for Nigeria’s oil and gas industry but these policy recommendations have not (yet) been implemented (see Thurber and Istad, 2010). One reason may be that the Nigerian state-owned oil company has effectively prevented the implementation of this policy which would reduce its profits. In line with these findings international experience shows that the most successful national resources companies are those that have limited noncommercial objectives and are subject to competition from other companies (see Heller, Mahdavi, and Schreuder, 2014). Norway’s national oil company, Statoil, and Chile’s national mining company, Codelco, are two such examples. These companies have long been exposed to international competition, encouraged by governments expecting the efficiency of their state-owned companies to benefit from such competition (see McPherson, 2010).

\textsuperscript{49}The Innovation Policy Platform (IPP) South Africa STI Outlook 2016 Country Profile.
Chapter 2 also provides a possible rationale for why FDI crowding out effects are more often observed in more advanced countries than in less advanced countries. Due to a lower skill level in less advanced countries, transferring technology to these countries will be more costly (see Teece, 1977). As a result in more advanced countries, foreign multinational firms will transfer relatively more technology to their subsidiaries which weakens the competitive position of local firms. As a result of this higher level of technology transfer the crowding-out effects are stronger in more advanced countries than in less developed countries. The higher cost of technology transfer in less developed countries may also explain why these countries are often the preferred destination for outward FDI by emerging market firms. In case of higher cost of technology transfer, an emerging market firm may more easily compete with firms from advanced countries due to lower technology transfer by the latter.

The game-theoretical model is further developed in Chapter 3 in order to analyze the optimal mode of entry of a number of multinational firms into a host country and to analyze the optimal strategy for liberalization of the FDI regime. Strategic interaction among multinational firms in both technology transfer and in the product market stage is taken into account and this leads to a number of novel results. It is shown that higher local firm competition increases technology transfer by foreign firms in industries that typically use less sophisticated technologies (e.g. manufacturing industries). Hence, in such industries, policies that foster market entry by domestic firms may provide an alternative to formal technology transfer requirements.\(^\text{50}\)

Furthermore, acquisition as a mode of entry becomes more likely when there are multiple MNEs entering into a host market. When the number of foreign firms relative to the number of domestic firms increases, acquisition will be the preferred mode of entry in case of both low and intermediate levels of cost of technology transfer. This provides a possible rationale for the surge in the share of FDI taking place through mergers and acquisitions even in emerging market economies. Finally, it is shown that the level of the cost of technology transfer provides a possible rationale for the often

\(^{50}\) Kokko and Blomström (1995) show that formal technology transfer requirements are negatively related to technology transfer.
observed pattern of investment liberalization. Foreign firms are often first allowed to compete with local firms and in a later stage of development, foreign ownership restrictions are also removed. Chapter 3 shows that, when the cost of technology transfer goes down, it is welfare enhancing to first allow foreign firms to enter the market and compete with local companies. As the cost of technology transfer decreases even further it will be welfare enhancing to also remove foreign ownership restrictions. Hence, the results show that investment liberalization should go in tandem with host country policies that lower the cost of technology transfer such as, for example, human capital enhancement policies. One of the shortcomings of the theoretical model, however, is that it does not allow for analyzing asymmetric foreign firms. Analyzing asymmetric foreign firms is beyond the scope of this dissertation and should be addressed in further research.\(^{51}\)

Based on the South African innovation survey, Chapter 4 analyzes the firm and industry characteristics that determine R&D collaboration with knowledge institutions. Industry-science research partnerships play an important role in the process of technological catch-up (see e.g. UNIDO, 2005; Mazzoleni and Nelson, 2007). The results show that South African firms that established a subsidiary abroad will more likely collaborate in research with universities or public research institutes. This is in line with the asset-exploiting motive for FDI (see Dunning, 1979). Firms that internationalize their production, engage in (cooperative) R&D in order to develop technological assets which they can exploit by transferring these assets to their affiliates abroad. This technology transfer will then improve the competitive position of their affiliates (see Cantwell, 1989; Pearce, 1999; Narula and Marin, 2005). Hence, the government may foster industry-science research partnerships by liberalizing the foreign investment regime. Allowing more foreign firms to enter into the local market and stimulating domestic firms to enter into foreign markets will increase the competitive pressure on domestic firms and this may in turn induce local firms to engage in cooperative research agreements with scientific organizations in order to develop technological assets.

\(^{51}\)The model could be extended along the lines of the literature on firm heterogeneity and entry modes in foreign markets (see e.g. Nocke and Yeaple, 2007 and 2008; Bernard et al., 2003; and Helpman et al., 2004).
The results also show that foreign firms active in South Africa are less likely to engage in cooperative research agreements with scientific organizations compared to local firms. This is consistent with previous studies that show that basic R&D which relies on scientific organizations is mainly done at the headquarters and not in host countries. In line with studies done in more advanced countries, Chapter 4 shows that larger firms and firms active in the science-based industries are more likely to collaborate with knowledge institutions and these research agreements may be used in order to share the high cost of innovation. Furthermore, the results show that the use of publicly available information is an important complementary innovation strategy to R&D collaboration with scientific organizations. This implies that, besides the traditional subsidies that governments provide for collaborative research with science, governments may stimulate industry-science R&D collaboration by investing more directly in knowledge institutions which will enhance the ability of these organizations to generate publicly available information. Cooperation with customers or suppliers is also an important complementary innovation strategy to R&D collaboration with scientific organizations. R&D cooperation with suppliers and customers typically involves applied research, while scientific organizations are mainly active in basic research. Hence, the results show that by engaging in more applied R&D in collaboration with vertical partners, the marginal benefit of cooperation with knowledge institutions increases and this induces firms to combine the two types of research partnerships. Hence, when trying to induce firms to cooperate in R&D with scientific organizations, it will be beneficial to also support the involvement of suppliers and customers. R&D partnerships involving both vertical partners and scientific organizations actually played an important role in South Africa’s mining industry. Different mining equipment technologies were developed through research partnerships involving mining companies, suppliers, and scientific organizations (see Pogue, 2008).

Although only marginally significant, the results show that appropriability concerns may form a barrier preventing R&D collaboration with scientific organizations. This contrasts with findings from studies done in more advanced countries, where appropriability concerns do not prevent cooperative research agreements with knowledge institutions but only with competitors or
vertical partners. Hence, by improving the protection of intellectual property rights, governments in developing countries may foster industry-science R&D partnerships.\textsuperscript{52}

Based on the South African innovation survey, Chapter 5 aims to find the determinant factors of product and process innovations by firms that are active in the mining sector. Resource-rich countries are increasingly aiming to benefit from technology and knowledge spillovers in their extractive industries. In order to enhance knowledge spillovers, host country governments require natural resources companies to hire and train local workers, to engage in supplier development programs, and to be active in cooperative research agreements with local partners. Chapter 5 shows that companies active in the natural resources sector will more likely introduce product or process innovations if they engage in cooperative research agreements with foreign customers or suppliers. Compared to mining companies and downstream firms, mining suppliers are more likely to introduce product innovations that are new to the market and the absorptive capacity of firms, proxied by a firm’s own investment in R&D is an important determinant of both product and process innovations. Finally, firms with more skilled workers will more likely introduce new or significantly improved services. Hence, the results show that host country government policy should aim to improve local technical skills and stimulate local research initiatives by, for example, bringing mining companies, suppliers, and public research centers together in research consortia. This has proven to be an effective way to develop innovative solutions in mining. Besides host country governments, natural-resources firms play an important role in developing local skills, by training their local workforce and through supplier development programs. A shortcoming of the empirical analysis is that it only uses South African data which restricts the generalizability of the results. Further research in other developing countries (ideally using panel data) may provide further information on whether the determinants of cooperative research agreements and innovation differ in these countries from those in more advanced countries.

\textsuperscript{52}Kim and Aguilera (2015) indeed show that emerging market economies are characterized by ‘institutional voids’, which refer to the lack of market-supporting institutions such as property rights protection.
Finally, Chapter 5 addresses the issue of mining automation. In recent years, technological improvements in the mining industry have accelerated the process of mining automation. As a result, fewer workers are needed at minesites, and mining companies need high-technology equipment. In order to cope with mining automation resource-rich countries need to transform their policies and aim to attract mining operating and research centers. One way to do this is by refocusing towards upgrading local technological and information technology skills to levels that are needed for processing data and operating autonomous equipment.