Promoting and Financing Industrial Diversification in Resource-Dependent Developing Countries

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Abstract

This thesis studies the promotion and financing of industrial diversification in natural resource-dependent countries. After a brief introduction, the research contribution to the existing literature is discussed in Chapters 2, 3, and 4.

Chapter 2 attempts to answer the following question: Does financial development induce the diversification and complexity of exports in natural resource-dependent countries? Financial development and deregulation are standard recommendations in order to achieve greater industrial and economic development in these countries. However, using standard panel data econometrics, this chapter shows that financial development has no positive impact on export diversification or complexity. It argues that a general financial development policy recommendation is not expected to be a key for industrial and export diversification in these countries. This result provides an essential motivation for the following chapters.

Chapter 3 looks at the financing of industrial diversification in two specific countries, namely Chile and Malaysia, which were both natural resource-dependent, but managed to successfully diversify their respective economies. The two countries have followed different strategies. In Chile, diversification has been towards niche natural resource-based industries, while in Malaysia the strategy has been to defy comparative advantages, resulting in specialization in sophisticated and high value added products. This chapter examines the role of the state and the financial system in financing the industrial diversification. The main finding is that in both countries the state has always played a key role in directing finance to strategic sectors and in contributing to the emergence of new industrial activities. Diversification in Chile and Malaysia has not occurred through free market operations and liberalized financial systems settings.

Chapter 4 concentrates on promoting industrial diversification in oil dependent countries using Saudi Arabia as the case study. It starts by reviewing various strategies of economic diversification in the context of resource-dependent countries. In particular, it reviews the literature on resource-based industrialization (e.g. Perez, 2015), the literature on the Growth Identification and Facilitation Framework (i.e. Lin 2011) and the literature on the product space theory (i.e. Hidalgo and Hausmann 2009). This chapter, then, uses these frameworks to suggest possible diversification strategies in Saudi Arabia and to assess the

government's recently promoted diversification plan (Vision 2030). Furthermore, the potential role of the Saudi financial system is fully examined.

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Declaration

I declare that, except where explicit reference is made to the contribution of others, this dissertation is the result of my own work and has not been submitted for any other degree at the University of Glasgow or any other institution.

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1 Introduction

Diversification of economic and industrial activities is considered to be crucial to create employment opportunities, and to promote technological development and economic prosperity. In resource-dependent countries, the process of industrial diversification takes place by reducing the reliance on raw materials and traditional products towards technology intensive manufacturing (Reinert 2007). However, despite the windfall resource revenues, these countries have not been able to channel them in favour of productive and technologically intensive industrial activities[1].

The main aim of this research is to answer this question: how can resource-dependent developing countries promote and finance industrial diversification? This research is guided by three sub-questions that have been derived after examining the related literature:

A. Does financial deepening promote industrial diversification and upgrading in resource-dependent developing countries?
B. Can state-directed credit help to promote industrial diversification?
C. What type of industrial strategy should a resource-dependent country follow? What are the sectors that can be targeted?

Before addressing these questions, it is important to say that, in the literature on industrial development in resource-dependent developing countries, the emphasis has been mainly devoted to the overwhelming resource curse literature, i.e. a negative impact of natural resources on industrial and economic development. This resource curse has been explained through different theories such as the Dutch Disease, rent-seeking behaviour, volatility damage, and the curse in financial development.

The Dutch Disease terminology refers to the crowding-out effect of the Dutch natural gas discoveries, around 1959, on manufacturing sector activities, essentially through the real exchange rate appreciation. This theory demonstrates that the influx of resource revenues generates great demand for non-tradable goods and raises their prices. This results in a loss of tradable goods competitiveness, i.e. manufacturing, and real exchange rate appreciation (Corden 1984). An alternative explanation lies in the rent-seeking behaviour by societies in resource-rich countries. This theory argues that resource revenue discourages the

[1] For instance, high technology exports have accounted for 17.4 percent of the total developing world's exports in 1995; in 2016 their share increased to 22.3 percent. On the other hand, in resource dependent counties high technology products barely increased from 0.56 to 0.62 percent of their total export basket (High-technology exports data are according to Lall (2000) definition, and they are retrieved from the UNCTAD database).

entrepreneurial spirit in society. Because of the substantial wealth flowing around the government, entrepreneurs find it more profitable to participate in rent-seeking and unproductive activities to benefit from that wealth[2] (Beblawi 1987; Torvik 2002). The third explanation highlights the volatility in natural resource income. Volatility in commodity prices may cause output fluctuations and discourage human capital development, investment, and economic development[3] (Ramey and Ramey 1991; Van der Ploeg and Poelhekke 2009).

A fourth major explanation is the financial development curse. This theory suggests that resource-dependent countries have under-developed financial systems, which hinders the transformation of resource wealth into productive sectors. Therefore, financial development allows the absorption of commodity wealth (Beck and Poelhekke 2017) and the promotion of greater economic and industrial development (Beck 2011). Rather than suggesting the use of directed credit towards non-resource tradable sectors to mitigate the Dutch Disease, this theory recommends financial liberalization and a reduction in state-directed credit in order for the financial system to channel resources to more productive investment and, thus, mitigate the Disease (Beck and Poelhekke 2017). Recently, the IMF (2016) argued for the need to reduce state-directed lending in order to achieve greater economic diversification.

Despite theoretical and empirical challenges facing the resource curse theory (they will be discussed extensively in Chapters 2 and 4), its related literature typically highlights a negative perspective ('half-empty') of natural resource abundance and, more importantly, underestimates the role of economic policies in mitigating the resource curse. On the other hand, there is a relatively scarce amount of literature that looks at the positive perspective ('half-full') of natural resource abundance and the opportunities to develop the manufacturing sector around the natural resource sector (i.e. Hirschman 1981; Perez 2015; Ramos 1998).

This limited literature on industrial development in resource-dependent countries reveals a substantial research gap on the role of economic policies in promoting industrial development; not only towards manufacturing activities around the resource sector (resource based industrialization, (RBI)) but also towards the wider range of manufacturing sectors

[2] Alichi and Arezki (2009) provides support for the rent-seeking theory by showing adverse effect of government current spending financed by commodity revenues on the private investment in non-resource sectors.

[3] It is important to note that studies supporting this rent-seeking explanation have argued that government spending contributes to increasing output volatility and, therefore, further induce the resource curse (Ramey and Ramey, 1995; Van der Ploeg and Poelhekke, 2009).

and activities. This observation of the literature gap is also shared by Morris et al. (2012) in which the authors were "conscious of a major research and associated policy gap on the promotion of industrial development in the context of expanded commodities production" (p.vii). A major noteworthy limitation of this body of knowledge, which has not been considered carefully in previous research, is the role of the financial system in promoting industrial diversification in these countries; especially the role of public financial institutions and policies. The prominence of this issue can be seen in Kaplinsky et al. (2012) and Felipe and Rhee (2015) which show that financing is considered a major constrain facing resource-dependent countries in their industrial development and diversification[4].

Therefore, by considering the role of industrial and financial system policies as well as institutions in promoting manufacturing diversification, the researcher is confident that the research and its policy implications make original contributions to the literature on industrial development in resource-dependent developing countries. It does so by answering the three questions (A, B and C) stated at the outset of this chapter.

Chapter 2 studies question A on the impact of financial development on the diversification and complexity of exports[5]. Financial development and liberalization are standard recommendations for these countries by international institutions (such as the IMF and the World Bank). Based on its ability to allocate resources efficiently and to support sectors that depend heavily on external finance (i.e. manufacturing), Beck (2011) argues that financial deepening is an essential factor in escaping the resource curse by financing the manufacturing sector development and diversification. (Beck and Poelhekke 2017) and the IMF (2016) demonstrate that natural resource countries suffer from a financial development resource curse (underdeveloped financial sectors) and thus financial deepening and de-regulation (i.e. reducing the role of state in directing credit) are crucial measures in increasing the efficiency of the financial system in absorbing natural resource windfalls and in mitigating the resource curse. This chapter highlights that despite the significant growth in financial development indicators in these countries over the study period (1995-2013), export diversification and complexity have been deteriorating. Statistically, using different

[4] This constrain is being highlighted despite the significant increase in resource rents after 2003 that have resulted in substantial government revenues.

[5] Export diversification is measured through the widely cited Hirschman-Herfindahl Index (UNCTAD database). Export complexity refers to the Economic Complexity Index (ECI) developed by Hausmann et al. (2014), which measure the technological intensity of a country through the knowledge intensity in their exported products. Machineries, electronics and transportation products are considered the most complex products, while natural resource products are considered the least complex in this index.

sets of standard panel data econometrics, financial development does not have a positive impact on the diversification of exports. Furthermore, the results suggest that financial development may hinder industrial complexity; one explanation is that private banks may encourage firms in these countries to specialize on producing and exporting raw materials and traditional resource-based products and may support already established competitive sectors. This outcome provides an important motivation for the content of subsequent chapters.

Chapter 3 considers research questions B and C and examines the role of the financial system and the state in promoting and financing industrial diversification in two countries which were both natural resource-dependent but managed to diversify their economies following very different strategies: Chile and Malaysia. In Chile, industrialization has been based on natural resources, while in Malaysia industrialization has been directed towards high-tech and more sophisticated sectors. This chapter focuses more on the role of finance in the emergence of what have become major industrial sectors in these countries (i.e. farmed salmon in Chile and semiconductors in Malaysia). A key finding of this chapter is that the state, in both countries, has played a critical role in directing finance towards the emergence of targeted industries. In the form of industrial banks, public venture capital institutions or state-directed credit, both governments have supported new industries with long-term, developmental and risky finance. In short, the industrial diversification in both countries has not occurred through free market and liberalized financial system operations.

Chapter 4 is also concerned with research questions B and C on the role of the financial system and the state in promoting and financing industrial diversification but focuses on a resource-dependent country that has not successfully diversified its industrial basket yet: Saudi Arabia. This chapter begins by highlighting the role of industrial policies in mitigating the Dutch Disease and in achieving economic diversification. It, then, reviews three major industrial diversification approaches for resource-dependent countries: resource-based industrialization (RBI) (e.g. Perez 2015), the Growth Identification and Facilitation Framework (Lin 2011) and the Product Space Theory (Hidalgo and Hausmann 2009). These frameworks are used in two ways; firstly, to discuss possible diversification strategies in Saudi Arabia, and secondly, to assess the diversification strategy (Vision 2030) which was launched recently by the Saudi Government. Finally, the chapter examines the role of the Saudi financial system in achieving these industrial diversification plans. To evaluate the role of the financial sector, the researcher conducted semi-structured interviews with senior

officials in major public financial institutions, i.e. the Saudi Industrial Development Fund, the Saudi SMEs Authority, the Saudi Agriculture Development Fund and the Saudi Development Fund, in addition to executives in private financial institutions. Finally, the research contribution and its policy implications are discussed in Chapter 5 that concludes this thesis.

- **Research methodology**

This thesis uses a mixed methods approach that allows the researcher to consider the complexity of the research project and to undertake a structural analysis of the research question (Creswell et al. 2011; Hartley 2004; Hesse-Biber and Johnson 2013; Olsen 2004).

There are two major research methods in economics and management research: quantitative and qualitative (Bryman 2016). Generally, the quantitative method allows a researcher to analyze empirical facts regarding a certain phenomenon in the real world. "In the explanatory phase of an investigation, quantitative methods can identify patterns and associations that may otherwise be masked" (McEvoy and Richards 2006, p.71). However, quantitative methods on their own may not be capable of explaining the essence and roots of a certain phenomenon. In such a circumstance, qualitative methods can allow the researcher to observe what is hidden and to investigate the complex structure related to the main research problem. Qualitative methods "can help to illuminate complex concepts and relationships that are unlikely to be captured by predetermined response categories or standardised quantitative measures" (ibid., p.71).

Creswell et al. (2011) show that mixed methods help the researcher to overcome expected deficiencies in either a quantitative or a qualitative research approach. For instance, while quantitative approaches are useful in providing reliable patterns, associations and comparisons regarding certain social phenomena, they are less likely to explain why the phenomena take place; whereas mixed methods can bridge this limitation and provide a deeper explanation and understanding of the social reality (Bryman 2016; Creswell et al. 2011).

In this study, the purpose of employing mixed methods is not to validate the quantitative findings using qualitative methods, or vice versa, but to advance the understanding of the main research question: How can resource-dependent developing countries promote and finance industrial diversification? Chapter 2 employs quantitative

methods using panel econometrics techniques to investigate the following question: Does financial development have a positive impact on industrial upgrading? The analysis considers thirty-eight resource dependent developing countries and utilizes secondary data from different sources such as the World Bank, the IMF and UNCTAD.

The qualitative research method is employed as a main method for the two subsequent chapters. Chapters 3 and 4 use case studies that allow for qualitative, in-depth and contextual investigation of industrial diversification in Chile, Malaysia and Saudi Arabia. According to Stake (2008), case studies allow for flexible techniques and instruments of data collection. Furthermore, Hartley (2004) maintains that case studies are appropriate approaches when the research question requires a comprehensive understanding of a complex phenomenon, because focusing on a specific case allows the researcher to obtain context-rich data.

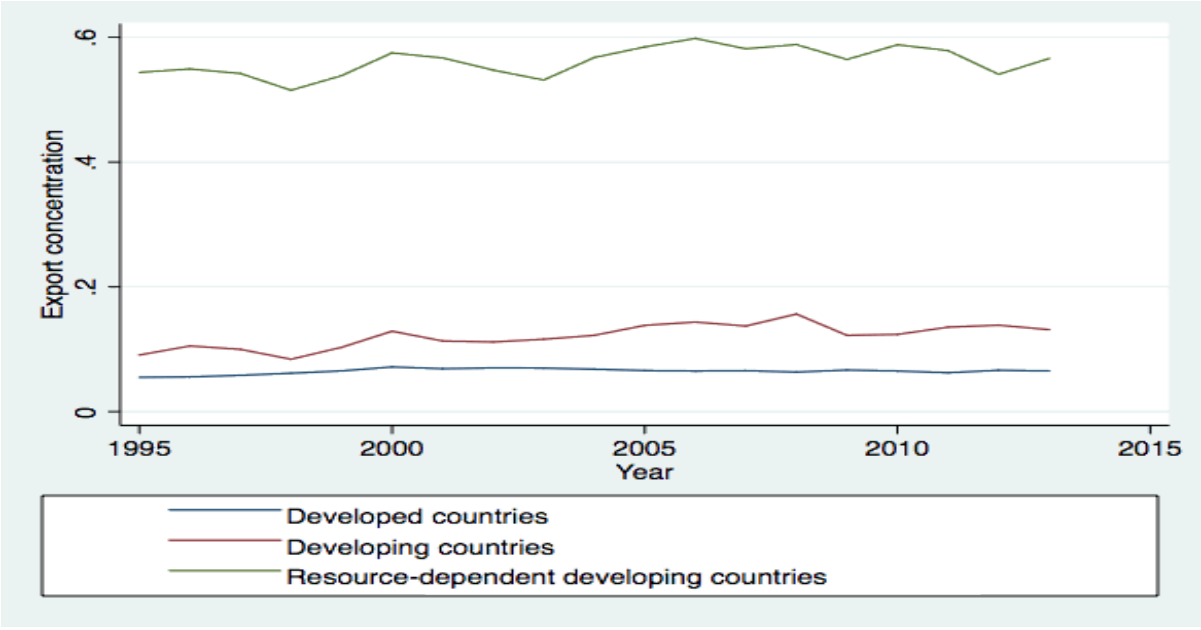
Chapters 3 and 4 have utilized three main data collection methods. First, industrial manufacturing added value and export data have been retrieved from the UNIDO database, COMTRADE database and relevant domestic public agencies (e.g. central banks' databases). Secondly, data on public financial institutions have been taken either from their published annual reports or from unpublished datasheets obtained after official contacts with specific agencies. Thirdly, semi-structured interviews with officials of certain institutions (e.g. public development banks) were used both to collect data when these were not available in published forms and, more importantly, to obtain insights about these institutions. These interviews took place after designing an interview guide, constructing interviews questions and identifying the interviewees to be targeted. The researcher has contacted these candidates through emails, by telephone and by personal visits to their official offices. However, in many cases reaching targeted candidates was difficult and not straightforward. For instance, in the case of Chile, the researcher was not able to contact targeted agencies and candidates until visiting the Chilean Embassy in London, which introduced him officially to appropriate officials. Appendix 1 presents further details on the semi-structured interview process, which includes the interviews guide, interviews questions, and interviewees' details.

2 The impact of financial development on export diversification and complexity in resource dependent countries

2.1 Introduction

Resource-dependent developing countries (RDDCs) have been experiencing a high concentration of exports and slow economic development[6]. Measured by the Herfandhal-Hirschman index, RDDCs had an average export concentration of 56.7 percent in 2013 compared to 13.0 and 6.5 percent in developing and developed countries respectively (see Figure *2.1*). This concentration has been explained by the resource curse theory, through the crowding out argument (Dutch Disease) (Corden 1984; Sachs and Warner 2001), rent seeking behaviour (Beblawi 1987; Torvik 2002) and resource volatility (Ramey and Ramey 1991; Van der Ploeg and Poelhekke 2009). A significantly growing strand of the literature argues that the lack of financial sector development, which is known as the "financial development curse", is a major contributor to slow economic development and poor industrial diversification (e.g. Beck 2011; Mlachila and Ouedraogo 2017; Nili and Rastad 2007).

Figure 2.1: Export concentration (1995-2013)



Source: author calculation based on UNCTAD data.

[6] According to Ghura and Pattillo (2012), a country is considered to be resource-dependent if it meets one of the two following criteria: (1) the share of its fiscal revenues from hydrocarbons or mineral resources is at least 25 percent of total fiscal revenue, or (2) the share of hydrocarbons or mineral resources exports is over 25 percent of the total exports. This research studies 38 developing countries that meet this definition: Algeria, Angola, Azerbaijan, Bahrain, Bolivia, Botswana, Brunei Darussalam, Cameroon, Chad, Chile, Congo Republic, Congo Democratic, Ecuador, Equatorial Guinea, Gabon, Guinea, Guyana, Iran, Kazakhstan, Kuwait, Libya, Mali, Malaysia, Mexico, Mongolia, Nigeria, Oman, Papua New Guinea, Qatar, Russia, Saudi Arabia, Sudan, Trinidad and Tobago, the UAE, Venezuela, Yemen and Zambia.

Financial development is expected to lead to economic and industrial diversification by promoting sectors that rely heavily on external finance (Rajan and Zingales 1996). With regard to RDDCs, Beck (2011) highlights that the resource sectors are less dependent on external finance, and financial development is expected to stimulate the development of other sectors (e.g. more sophisticated manufacturing). As a policy implication, Beck calls for "extra effort" in broadening and deepening the financial system in resource-dependent countries.

The lack of development in the financial sector in these countries is explained by the natural resource abundance[7] (Beck 2011; Kurronen 2015; Mlachila and Ouedraogo 2017). In an IMF publication, Mlachila and Ouedraogo (2017) explain the resource curse in financial development by the natural resource sector's enclave operation (i.e. isolated from the domestic economy). In the resource sector, multi-national companies usually finance their operations internally. Should they need external finance, they access it through international markets. Therefore, they have little reliance on local banks, which contributes to the under-development of financial systems. Furthermore, they argue that macro-economic fluctuations following commodity price shocks hinder the growth in financial systems.

Beck (2011) explains the financial sector curse by supply and demand factors. On the supply side, high investment in the natural resource sector hinders investment in the financial system and pushes skilled labour away from the financial system. Furthermore, Beck demonstrates that the financial system development requires sound institutional infrastructure, which is underdeveloped in most of these countries. On the demand side, he shows that there is low external finance demand from the main sector of the economy - the natural resource sector - which contributes to a lower financial development[8].

This view has been shared by Kurronen (2015) who argues that the small financial systems in RDDCs are mainly devoted to serve the resource sector's needs and might not serve the other emerging sectors. This underdeveloped financial system, she maintains, can hinder economic diversification and strengthen the resource curse's impact. By studying oil-exporting countries, Nili and Rastad (2007) also highlights a lower level of financial

[7] While the resource curse theory suggests a negative impact of natural resource dependence on economic development, this strand of the literature argues that resource-dependence also hinders the financial sector development, which has a further adverse impact on economic development.

[8] On the other hand, Beck (2011) shows that the natural resource revenues, which are expected to boost non-traded goods, can lead to higher demand for financial products.

development compared to the rest of the world. They argue that the weakness of the financial system is associated with the dominance of governments in total investments and the deterioration in private sector activity.

Principally, these studies claim that financial system growth will be channelled to more productive sectors, and will result in higher industrial development. This view is mainly motivated by the mainstream dogma that developed and liberalized financial markets are able to remove market frictions, to improve resource allocation and to promote productive sectors (Levine 2005; Levine et al. 2000). Market signals, in this framework, are considered the main determinant of financial resource allocation. In a seminal study that has inspired an extensive amount of literature relating finance to industry, Rajan and Zingales (1996) demonstrate that financial development promotes economic development by reducing firms' external finance costs. More precisely, sectors that depend more on external finance grow faster in countries that have developed their financial systems[9].

Nonetheless, if market signals were the main determinant of financial resource allocation, supply of finance might not match the demand in crucial sectors (e.g. new manufacturing activities). This is because of high investment risk or inadequate collateral even in the case of high social value. Indeed, unregulated financial institutions may direct their lending to stock markets, real estate markets and other profitable service sectors. Lending to these sectors can be at a significantly higher interest rate because the return can be extremely high. This makes it even more difficult for industrial entrepreneurs to borrow because their potential return from industrial projects is limited, despite their substantially higher social returns relative to real estate and stock markets (Ghosh 2008; Khan 2008). Furthermore, because of the prevailing market signals, financial markets may direct credit towards import-intensive sectors and traditional sectors because of their significantly lower risk (Ghosh 2008).

Some notable emerging literature that should be highlighted in this context shows no significant impact of the financial sectors' growth on productive investments in developing countries. That is to say that the substantial growth of credit to the private sector in developing countries did not favour the more productive sectors; instead financial

[9] The following section discusses Rajan and Zanales (1996) argument in some length and show criticism of their work.

institutions have been focusing on household consumption and mortgage loans (Bonizzi 2013; Dos Santos 2013; Karwowski and Stockhammer 2017; Van Waeyenberge and Bargawi 2015). This trend in developing countries can be explained by banks' profitability and risk aversion motives, in addition to neo-liberal policies[10] towards de-regulating and privatizing the education, healthcare and housing sectors (Dos Santos 2013).

Given the significant growth in financial sectors in RDDCs, this study examines the impact of this growth on their export diversity and complexity. Financial development and the export structure are analysed using descriptive statistics and cross-country panel econometrics techniques. This chapter starts in Section 2.2 with the study's motivation before Section 2.3 presents a review of the literature. Sections 2.4 present the empirical measures, before and Section 2.5 shows export and finance trends in resource-dependent countries. Section 2.6 presents the panel econometrics' methods and results. Finally, Section 2.7 presents conclusions.

2.2 Study motivation

The importance of studying the role of developing the financial systems in resource-dependent countries (RDDCs) is because international institutions, e.g. the IMF and World Bank[11], continue to advocate that these countries should implement policies towards more developed and liberalised financial markets. For instance, a recent IMF report, "Economic Diversification in Oil-Exporting Arab Countries" (2016), emphasizes the need to reform and expand the financial markets in order to achieve greater economic and industrial diversification. The report states that "further efforts to reform financial system, reduce directed lending, and develop domestic security markets will be important to support the financing of the private sector" (IMF 2016, p.12).

[10] Neoliberal policies, in general, refer to the set of policies promoted during the 1980s by the World Bank and the IMF. These policies, the so-called Washington Consensus, aim to achieve macro-economic stability, deregulate the financial market, liberalize trade, reduce the government's role in economic activity, reduce public expenditure, and privatize state owned assets (Williamson, 1990).

[11] The researcher refers here, mainly, to the IMF and World Bank's core programmes that are designed to help developing countries to achieve greater economic development and more efficient financial systems. However, the researcher acknowledges that IMF and World Bank' economists may have substantially different views than those promoted in the core programmes in this regard (i.e. the association between financial sector growth and economic development). For instance, in an IMF publication, Sahay et al. (2015) question the positive impact of financial deepening on long-term economic growth and stability. They stated that "the effect of financial development on economic growth is bell-shaped: it weakens at higher levels of financial development. This weakening effect stems from financial deepening, rather than from greater access or higher efficiency" (p.5). However, other economists such as Cihak and Demirguc-Kunt (2013) and Demirguc-Kunt et al. (2010), continue to maintain that financial development and liberalization are critical for economic development and prosperity.

This study investigates whether RDDCs are likely to have a more diversified export structure following financial development. The study contributes to the literature in two major ways. First, it contributes to the growing resource curse literature that relates slow economic growth to weak financial systems. It does so by looking at a fundamental channel through which finance development can spur growth in RDDCs, namely through export upgrading and diversification. Beck (2011), among others, shows that there is a natural resource curse in financial development, which hinders economic growth and industrial development in RDDCs. Thus, he argues for "intensified efforts in resource based economies to deepen and broaden financial systems" (p.1).

However, Beck also calls for more research in RDDCs. Rather than studying the finance and growth relationship, he suggests investigating the impact of finance on disaggregated GDP on the resource and non-resource sectors. In other words, he calls for research into the relationship between finance and development in non-natural resource sectors. This work is unique in this regard because of its careful consideration of the impact of finance on non-resource sectors through export concentration and complexity. In RDDCs, lower export concentration and higher economic complexity implies advancement in the non-natural resource industrial activity. However, there appears to be no existing empirical research that discusses the impact of finance on the industrial or export structure in RDDCs.

Secondly, it contributes to the limited amount of research and policy implication on the industrial and export diversification in RDDCs (Morris et al., 2012). Kaplinsky et al. (2012) and Felipe and Rhee (2015) consider financing to be a major constraint facing the industrial diversification plans in RDDCs. If it is established that financial development can promote industrial diversification and complexity, then policies to increase the depth of the financial system can be an appropriate recommendation for RDDCs as a means to finance their industrial upgrading.

2.3 Literature review

There are three different strands of the literature that deal with the impact of financial development on manufacturing and export development. The first strand shows financial development as a source of comparative advantage; the second shows the importance of financial markets by incorporating risk into trade markets; and the third strand investigates the impact of financial system development, liberalization and financialisation on the productive sectors of the economy.

The first strand of the literature presents financial development as a source of countries' comparative advantage. Kletzer and Bardhan (1987) argue that countries with an identical endowment structure and no economies of scale can face different costs of production because of credit imperfections. In particular, imperfect information and moral hazard considerations can lead some countries to face higher interest rates or scarcity of credit compared to other countries. This results in disparities in their comparative advantages for goods that require working capital, trade financing or marketing costs. Baldwin (1989) developed a model with two countries and two relevant goods. One good is subject to demand shocks, while the other is not. He shows that economies with a developed financial system are more capable of diversifying their risks resulting from demand shocks and this allows firms to produce risky goods with lower risk premiums and at lower cost. While Kletzer and Bardhan (1987) stress the role of financial development in channelling finance to industries that require it more, Baldwin (1989) focuses on the function of financial development in diversifying the risks faced by exporters. It is critical to note that the two studies assumed no technology differences across countries, i.e. technology transfer and acquisition is not considered in their analysis of the industry and trade development.

In the theoretical part of his work, Beck (2002) explains that countries with well-developed financial systems tend to specialise in increasing return sectors. He presents an open economy model of two production technologies: the first is manufacturing (increasing returns to scale) and the second is food (constant returns to scale). In his model, financial development is assumed to lower the search cost, increase external finance and encourage the production of goods with increasing returns to scale. The model predicts that economies with more developed financial systems are more likely to be net exporters of manufacturing products. In other words, he argues that trade patterns can be determined by financial intermediation. In his empirical section, Beck finds that countries with higher levels of financial development tend to have higher export shares in manufactured goods. In the context of resource rich countries, increasing the share of manufacturing relative to primary exports should result in greater export diversification and complexity.

It has been argued that industries that rely heavily on external finance profit from financial development more so than other industries. In their seminal study, Rajan and Zingales (1996) found that industrial sectors which require greater external finance grow faster in countries with higher financial development. They consider the dependence on external finance of firms in the US to be a proxy for that in all other countries. Their study

assumes the degree of dependence on external finance to be based on technological reasons that vary from industry to industry. Hence, the study assumes that the technological reasons that are valid for US industry also apply to all other countries.

According to Rajan and Zingales (1996) export diversification in RDDCs might benefit from financial development if the oil and mineral industries have relatively lower external finance dependence. Table 1 shows the external finance dependence for oil and mineral sectors according to their index; the higher ratio means greater external financial dependence. The oil and mineral sectors show relatively lower external finance dependence (compared to others such as the drugs and plastic sectors with 1.49 and 1.19 dependence respectively). This means that financial development might help the other manufacturing sectors to grow and to reduce export concentration in RDDCs.

Indeed, Beck (2011) shows that the non-natural resource sectors have a higher external finance dependence than the resource sectors. Beck also provides support for Rajan and Zingales (1996) with regard to RDDCs: financial development support sectors that rely heavily on external finance. However, in his finance-growth empirical work, Beck states that his results are inconclusive calling for more work on disaggregated GDP growth into resource and non-resource components. This statement clearly demonstrates the need for further research that considers the relationship between finance and growth using indicators other than GDP growth, which can emphasize the non-natural resource economic development.

Table 2.1: External finance dependence for oil and mineral sectors

Industrial sectors	**External finance dependence**
Non-ferrous metal	0.01
Petroleum refineries	0.04
Non-metal products	0.06
Iron and steel	0.09
Metal products	0.24
Petroleum and coal products	0.33

Source: Rajan and Zingales (1996).

It is important to note here that the measure of external finance proposed by Rajan and Zingales has been challenged for both theoretical and practical reasons. Kabango and Paloni (2011) raise doubts about the universality of the index by showing country-specific institutional differences that might affect their need for external finance. For example, some industries receive some subsidies for strategic reasons (e.g. food security), which may reduce

their reliance on external finance relative to other countries that do not consider them strategic. Empirically, Kabango and Paloni study the case of Malawi and construct an external finance index that ranks Malawian industrial sectors based on their actual need for external finance (rather than using the US industry as a proxy as in Rajan and Zingales). After ranking the Malawian industry, Kabango and Paloni demonstrate that their index is significantly different from Rajan and Zingales. This finding questions the applicability of the external finance dependence proxy proposed by Rajan and Zingales to other countries.

Moreover, Von Furstenberg and Von Kalckreuth (2006) also questions Rajan and Zingales' ranking for the US industrial sectors using the same methodology for external finance dependence but with more inclusive industrial dataset. The dataset used by Von Furstenberg and Von Kalckreuth is an industry-level dataset that is retrieved from the Bureau of Economic Analysis (U.S. Department of Commerce) which covers every establishment in each industrial sector. In the meantime, Rajan and Zingales utilizes data from the Compustat database which refers to the median of publicly exchanged firms. In short, Von Furstenberg and Von Kalckreuth doubt the applicability of Rajan and Zingales' ranking using different dataset for the same country (the US) and thus, invalidates its application in other countries.

In general, this dominant strand of the literature, which considers financial development to be a source of comparative advantage, utilizes abstract and simplified modelling that undervalues major industrial development factors. A central factor, that has been neglected, is technology transfer. Despite its vital role in industrial upgrading (Amsden 2001; Khan 2008; Lall 1992; Mansfield 1975), Lall (2000) demonstrates that neoclassical trade theories assume fixed and fully diffused technology across countries. Exporters, automatically, choose the most fitting technology relative to their endowment structure. They, then, start using technology efficiently with no adaptation, transfer or learning costs. In this framework, there is no distinction between technological capacity and capability[12]. Given a homogeneous and rational labour force, inefficiency occurs only when governments intervene to hinder trade liberalisation. However, in practice, technology transfer is a crucial factor in choosing production technology. For developing countries, the real technology transfer[13] should include a process of assimilation, adaptation, modification or further

[12] Technological capacity means equipment, physical plants, and blueprints, while capability means the producer's ability to use the technology efficiently (Lall, 1998).

[13] In some developing countries, the technology transfer takes place only as an input in the production stage and does not add to the existing stock of domestic technology, i.e. the impact on the human capital skills is very limited.

innovation so that it can upgrade the technology base of the domestic economy (Mansfield 1975).

Moreover, mainstream models relating finance to industry (or trade) assume perfect capital markets. However, this assumption has been challenged by the existence of imperfection problems. For example, Carpenter and Petersen (2002) study firms investing in new technologies and found that they face a large financing gap. This gap is explained by three main reasons. First, the borrower's investment returns are highly uncertain, which might result in negative expected returns to creditors. Secondly, new technological investments entail high information uncertainty between firms and lenders. Thirdly, new technology investments have small collateral value. In other words, there might be a large financing gap between the supply and demand for funds for new technology projects because of the problems of asymmetric expectation and limited collateral. Thus, Dymski (2003) and Khan (2008) argue for the importance of government selective intervention in fulfilling this financing gap and supporting innovation projects.

The second strand of the literature relating finance to industrial upgrading is built on the Heckscher-Ohlin-Samuelson (HOS) model of comparative advantage. It argues that the HOS model fails to address the problem of uncertainty about the global economic conditions faced by primary commodity exporters. Ruffin (1974) shows that the uncertainty in trade markets could be classified into two types: uncertainty about general prices and uncertainty about foreign trade. The first type refers to uncertainty about the production cost relative to the prevailing price when the product becomes available. The second type, foreign trade uncertainty, is a result of trading in global markets; through, payments, exchange rates and marketing costs uncertainties. After accounting for these types of uncertainty in his trade model, Ruffin maintains that risk-averse exporters of primary products will reduce their export specialisation according to their comparative advantage. In other words, uncertainty will push primary product producers to increase their export diversification.

DeRosa (1992) supports Ruffin's theory by incorporating uncertainty into the HOS model. DeRosa explains that uncertainty pushes risk-averse exporters away from specialising in producing primary products and highlights the important role of the financial markets in spreading the risk and directing resources to the country's most productive use.

This kind of process is not considered as a real technology transfer; rather it is called a "pseudo-transfer" (Skarstein and Wangwe, 1986).

DeRosa argues that greater economic development and diversification can be achieved by liberalizing the financial markets.

The third strand studies the impact of financial liberalization and development on the real sector of the economy in developing countries. It is well documented in the literature that the significant increase in financial sector lending, in recent years, was not in favour of productive sectors, e.g. the manufacturing sector.

Across Latin America, Eastern and Central Europe and South and East Asia, credit available to households has been growing substantially and exceeding lending to productive enterprises (Dos Santos 2013). As a mixture of banks' profitability motives and policy agendas (i.e. free market access in the healthcare, education and housing sectors) domestic and foreign banks have supplied the household sector with significant consumption and mortgage financing. By studying the operations of financial institutions and firms in a resource rich country, South Africa, Karwowski (2012) claims that financial deepening has led to asset price inflation, financial instability and deterioration in long-term economic growth. Banks have not been transforming household savings towards real investments; instead they have been extending consumer and mortgage loans to the household sector. Studies of other developing countries have shown similar trends. These include Karwowski and Stockhammer (2017) for emerging economies; Becker et al. (2010) for Chile and Slovakia and Serbia; and Painceira (2012) for Brazil and South Korea.

This strand of the literature, supported by the events of the 2008 financial crisis, has triggered international organizations to generate a set of questions and discussions about the purpose of the financial system, its functions and its relationship with economic development (Van Waeyenberge and Bargawi 2015). The Inter-American Development Bank (IDB) published *The Age of Productivity* (Pagés 2010) which argues that Latin America has been locked in under-development and poverty for such a long time partly because financial resources has not been channelled into high productive enterprises; instead a large share of resources has been channelled into low productive ventures. Furthermore, the book highlights the role of public financial institutions in financing innovation[14].

[14] This strand also highlights the significant increase of micro-finance credit in developing countries. In Bolivia, for instance, the share of micro-finance has reached 37 percent of the total financial credit to private sector (Bateman, 2013). Bateman shows that the micro-finance model is predicted to channel financial resources profitably and efficiently to informal micro-enterprises and self-employment businesses. The problem with this model is that it

Interestingly, economists, such as Beck (2014), have revised their previous consensus on the positive relationship between finance and economic growth. As Beck points out, finance may have insignificant or negative relationship with growth for three main reasons. The first explanation focuses on the credit beneficiary; while most of the theoretical finance-growth literature has mainly focused on credit to firms, financial systems in recent years have provided a large share of their credit to households rather than firms[15]. Secondly, the growth benefit of financial development is associated with financial fragility and crisis. Thirdly, the financial sector in itself has become a source of growth in some countries, while the finance-growth literature has focused on the financial sector as a means to mobilize funds towards productive investment and, thus, to an efficient resource allocation. Thus, some policy makers in recent years have been looking at the financial sector in itself as a source of economic growth and employment.

Furthermore, other economists have raised concern about financial sectors that have become significantly large relative to the real sector. For instance, Rajan (2005) suggested that the presence of a large and complicated financial sector increases the probability of "catastrophic meltdown". Cecchetti and Kharroubi (2012) show, empirically, that financial development is good for the real economy but only up to a point, and then finance becomes a drag on economic growth (i.e. a non-linear effect of financial development and growth). Cecchetti and Kharroubi (2015) have explained the possible negative relationship between finance and growth by showing that financial system growth is expected to crowd out highly productive investments. They explained the crowd out effect by highlighting two main factors. First, the high financial system growth is often coupled with strong progress in low productivity projects, such as construction. Secondly, financial system growth significantly harms R&D-intensive and finance dependent industries.

2.4 Financial development, export diversification, and complexity's empirical measurements

2.4.1 Financial development indicators

This study utilises four standard financial development indices that have been cited widely in the mainstream literature (e.g. Cihak et al. 2012). Private credit to GDP is the most common measure of financial development in the literature. This ratio represents the size of

channels scarce resources to the "wrong" enterprises. This is unlike the East Asian model where long-term financial support was provided to the "right" enterprisers.

[15] On the impact of household credit on economic growth, Beck maintains that the existing literature is ambiguous in this regard.

bank loans relative to the output of the economy. In addition, this study uses three additional proxies of financial system depth that are available for our sample: financial system deposits to GDP, bank deposits to GDP and deposit money banks' assets to GDP (banking size). The four indicators of data were retrieved from the IMF and the Word Bank Databases.

2.4.2 Export concentration and complexity

Looking at the empirical literature on industrial development and international trade, the most commonly used indicator for industrial and export diversification is the Herfindhal-Hirschman index (HI). The index lies between 0 and 1, where lower values indicate more diversification. It computes the sum squares of export shares as in the equation:

$$HHI = \frac{\sum_{k=0}^{n} \left(\frac{x_i}{X}\right)^2 - \frac{1}{n_i}}{1 - \frac{1}{n_i}}$$

X is the total share of exports by a country *i*

x_i is the export value of product *k* from country *i*,

n_i is the number of products exported by country *i*.

There are two factors that lead to a lower HHI value: a large number of exported products (n_i) or a fall in the share of each product. A product to be considered in this index must have an export value higher than 100,000 US dollars or represent more than 0.3 percent of the total exports of a nation (SITC revision3 at a 3-digit level) (UNCTAD database, 2015). In this study, the HHI has been utilised for the available period (1995-2013) from the UNCTAD dataset.

This study uses another indicator to assess export upgrading and complexity, which is the economic complexity index (ECI) (Hausmann et al. 2014). The ECI measures the 'know-how' and complexity of countries through their exported products. It does so by combining revealed information on the diversification of countries (the number of exported products), and the ubiquity of its production structure (the number of countries that export a certain product). The reasoning behind this combination is that products' complexity comes from the fact that, typically, sophisticated economies export diverse products that have limited ubiquity, i.e. a small number of diverse countries that can make highly sophisticated products, while there are many less sophisticated countries that export products with greater ubiquity.

The cornerstone of the ECI construction is the revealed comparative advantage proposed by Balassa (1965): when a country is associated with a product where it has a comparative advantage in producing, it is important to consider the country's export volume

and share of the world trade in that product. Hausmann et al. (2014) utilise the following RCA mathematical formula:

$$RCA = \frac{export_{c\,p}\ / \sum_p export_c}{\sum_c export_{\,p}\ / \sum_p \sum_c export}$$

Where $export_{cp}$ is the exported quantity of product (*p*) by a country (*c*) in USD. Then, Hausmann et al. (2014) use this RCA measure to build a matrix *M* that connects each single country (*c*) to the products (*p*) that it exports. *Mcp=1* if RCA is greater than one, otherwise it is equal to zero. The authors then build Diversity and Ubiquity indexes as follows:

$$\text{Diversity= Kc} = \sum_p Mcp$$

$$\text{Ubiquity index=Kp=} \sum_c Mcp$$

Simultaneously, the Product Complexity Index (PCI) is calculated using a similar process. The PCI measures the 'know-how' and sophistication of each product by considering the exporter's knowledge intensity. Using computational algorithms, this circular process ultimately results in the construction of ECI and PCI indices.

2.5 Export and finance patterns in resource dependent developing countries

The inclusion of resource-dependent developing countries in this study is based on the definition by Ghura and Pattillo (2012). It considers a country to be rich in natural resources if it meets one of the two following criteria: (1) the share of fiscal revenues from hydro-carbons or mineral resources must have been at least 25 percent of total fiscal revenue in the period from 2006 to 2010, or (2) the share of hydro-carbons or mineral resources exports must have been over 25 percent of the total exports. The resulting sample is a mixture of thirty-eight oil, gas and mineral exporting countries.

Before looking at financial development, export diversification and complexity trends in the sample countries, this section first looks at the nature of their exports and their technological intensity in the following sub-section.

2.5.1 What do resource-dependent countries export?

The nature of produced and exported products is critical for long-term growth and industrial development. Some products bring more value and greater long-term growth to the economy

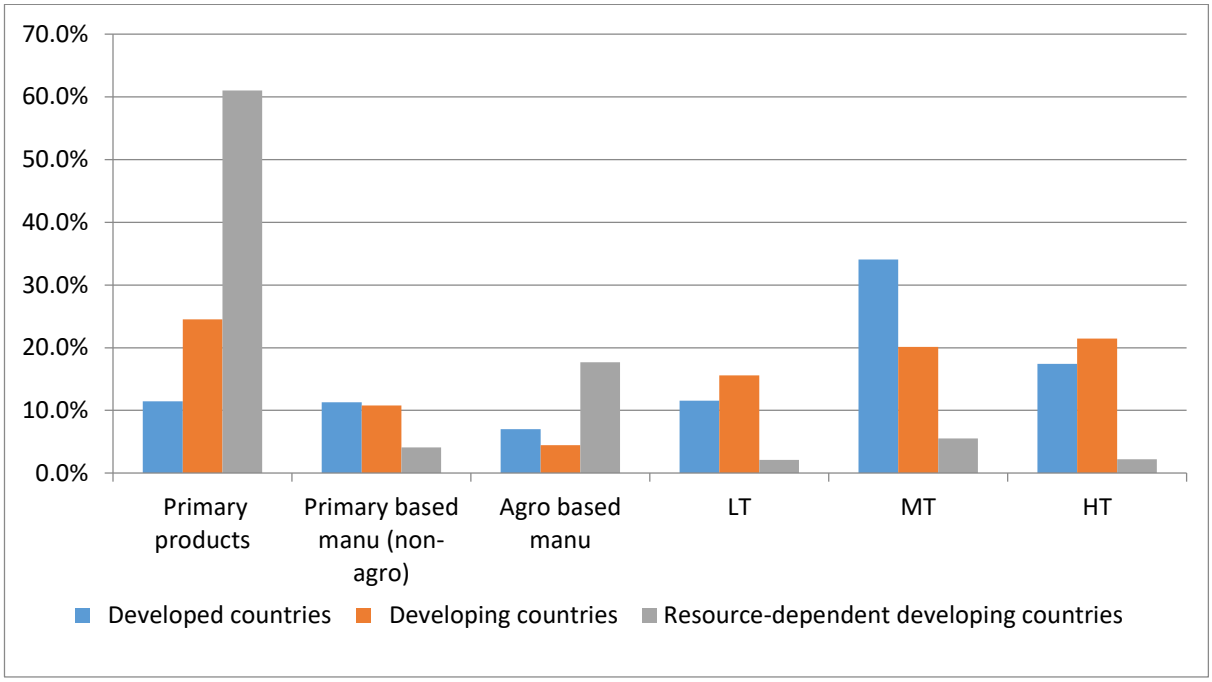
than others (Hausmann et al. 2007). Technology intensive products promote greater future growth because they create new demand and substitute for older products. They also open up areas for new knowledge and techniques that can be used in the future. On the other hand, simple technologies tend to be correlated with slower economic growth because of their limited potential and upgrading capacity, lower entry barrier and higher possibility of developing substitutes (Lall 2000).

This section looks at the nature of exported products in RDDCs using Lall (2000) technological intensity classification. This classification has five main categories of exported products: primary products, resource based products (it includes simple and agriculture based manufacturing), low technology products, medium technology products and high technology products. More details on these five classifications are provided in Appendix 2.

Figure 2.2 shows RDDCs' exports compared to the rest of the world. The high share of primary products is a significant trend in RDDCs; they make up 61 percent of their total exports compared to 24 percent and 11 percent for developing and developed countries. The lack of technology-based exports is another important trend in resource-rich developing countries; their shares of low technology (LT), medium technology (MT), and high technology (HT) exports are 2.1, 5.5, and 2.2 percent respectively. The low share of technology intensive manufacturing backs up the point made earlier about the importance of technology transfer in these countries.

While RDDCs have, on average, a large share of primary products, some countries have different patterns (see **Table 2.2**). Botswana, for example, has a primary exports share of only 4.5 percent, while primary manufacturing represents 83.4 percent of its total exports. Other countries have different patterns for technology-based manufacture. For instance, Mexico and Malaysia have significantly high shares of LT, MT and HT products relative to the other countries.

Figure 2.2 Export nature based on technological intensity (average 2009-2013)



Source: Author's calculations based on UNCTAD data.

Table 2.2 Exports nature in resource-dependent developing countries (Average 2009-2013)

	Primary products	Agro-based manufacture	Primary products manufactures	Low tech manufacture	Medium tech manufacture	High tech manufacture
Algeria	84.3%	0.4%	15.0%	0.10%	0.13%	0.01%
Angola	96.8%	0.0%	2.2%	0.06%	0.80%	0.06%
Azerbaijan	90.3%	1.5%	4.9%	0.60%	1.42%	0.21%
Bahrain	24.6%	3.7%	46.3%	10.15%	11.86%	1.83%
Bolivia	64.7%	5.9%	20.5%	2.63%	1.32%	0.13%
Botswana	4.5%	1.4%	83.4%	3.20%	4.22%	1.59%
Brunei Darussalam	96.8%	0.1%	0.5%	0.81%	1.07%	0.31%
Cameroon	64.5%	15.0%	11.0%	2.83%	4.99%	0.85%
Chad	91.8%	0.2%	6.5%	0.34%	0.32%	0.66%
Chile	49.9%	12.4%	27.6%	2.48%	5.09%	0.74%
Congo	85.0%	2.8%	4.3%	0.12%	7.24%	0.26%
Dem. Congo	50.4%	2.7%	43.9%	0.21%	0.86%	0.20%
Ecuador	78.1%	9.0%	5.1%	2.49%	3.62%	0.54%
Equatorial Guinea	94.5%	0.9%	0.6%	0.01%	3.06%	0.26%
Gabon	75.9%	12.1%	9.2%	0.10%	2.04%	0.53%
Guinea	39.6%	1.5%	51.5%	0.27%	0.59%	0.39%
Guyana	19.2%	20.6%	13.2%	0.95%	2.39%	0.55%
Iran	73.1%	0.6%	9.7%	1.78%	7.93%	0.33%
Kazakhstan	77.3%	1.2%	9.3%	2.59%	4.62%	3.67%
Kuwait	74.3%	0.4%	17.0%	0.62%	6.83%	0.48%
Libya	89.2%	0.0%	7.9%	0.55%	1.33%	0.04%
Malaysia	17.8%	13.7%	7.7%	9.47%	16.40%	34.07%
Mali	32.7%	1.0%	4.8%	2.12%	6.51%	0.86%
Mexico	17.7%	3.6%	4.3%	9.07%	38.41%	23.99%
Mongolia	27.7%	0.4%	57.7%	2.25%	0.82%	0.27%
Nigeria	93.0%	0.3%	4.6%	0.83%	0.74%	0.10%
Oman	69.9%	1.6%	10.6%	1.40%	9.55%	0.67%
Papua New Guinea	28.6%	18.7%	24.5%	0.17%	0.76%	0.60%
Qatar	81.5%	0.0%	8.6%	0.89%	4.38%	0.09%
Russian Federation	54.6%	3.6%	21.8%	2.69%	7.89%	1.42%
Saudi Arabia	79.0%	0.8%	8.6%	1.34%	9.60%	0.27%
Suriname	6.1%	2.4%	19.7%	1.36%	1.41%	0.36%
Trinidad and Tobago	43.5%	2.3%	37.6%	2.35%	13.62%	0.23%
United Arab Emirates	50.0%	3.1%	17.2%	6.15%	11.63%	4.16%
Venezuela	71.5%	1.2%	18.7%	2.06%	5.82%	0.21%
Yemen	84.7%	1.9%	8.5%	0.43%	1.34%	0.23%
Zambia	74.7%	4.4%	10.6%	3.32%	3.97%	0.46%

Source: Author's calculations based on UNCTAD data

2.5.2 Trends in financial development, export concentration and complexity

There has been a significant development in the financial sectors of RDDCs throughout the study period for this chapter (1995-2013). By looking at credit to private sector as a share of GDP, the sample average has grown from 19.8 in 1995 to 33.2 in 2013. This growth can also be seen in other financial development indicators: bank deposits to GDP, deposit money banks' assets to GDP (banking size) and financial system deposits to GDP (see Table *2.3*).

Table 2.3: descriptive statistics of financial development indicators

Year	Mean	Median	SD	Minimum	Maximum
Credit to private sector to GDP					
1995	19.762	10.706	22.560	1.063	124.415
2005	25.013	18.274	22.510	1.201	106.524
2013	33.166	26.864	26.364	5.243	123.994
Bank assets to GDP					
1995	25.738	13.989	25.952	0.501	116.073
2005	26.515	20.857	22.355	2.074	109.353
2013	39.090	35.122	27.156	6.669	132.215
Bank deposits to GDP					
1995	22.970	14.027	22.355	1.159	94.994
2005	26.217	19.258	21.550	2.927	105.942
2013	37.840	32.872	23.174	5.861	130.257
Financial system deposits to GDP					
1995	23.473	14.027	22.635	1.159	94.994
2005	26.538	19.258	21.643	2.927	105.942
2013	38.025	32.872	23.020	5.861	130.257

Source: IMF database.

This section also looks at the two major export structure indicators that are considered in this empirical study: export concentration and complexity. The sample has, on average, increased its export concentration from 52.5 percent in 1995 to 57.3 in 2013. On the other hand, the average economic complexity[16] has declined from -0.67 in 1995 to -0.84 in 2013. Table *2.4* shows some further descriptive statistics for these two variables. Furthermore, a closer look at the above variables shows that in countries that have developed their financial systems the most[17], export concentration has increased by 12.5 percent and economic complexity has declined by 33.3 percent.

In short, this section shows that resource-dependent developing countries have extremely concentrated export baskets of raw materials and primary products' manufacturing. Furthermore, while financial sector indicators have grown significantly during the study period (1995-2013), export concentration has increased and export complexity has declined.

[16] The economic complexity index is available for 28 RDDCs out of 38 countries in the sample used.
[17] These include countries that have higher growth, than average, in private sector credit. These countries are Algeria, Angola, Azerbaijan, Congo Democratic, Russia, Kazakhstan, Suriname, Sudan, and Mongolia.

Table 2.4: descriptive statistics for export concentration and economic complexity

Year	Mean	Median	SD	Min	Max
Concentration					
1995	0.525	0.544	0.211	0.122	0.895
2005	0.572	0.585	0.203	0.144	0.944
2013	0.573	0.566	0.196	0.158	0.968
Complexity					
1995	-0.672	-0.785	0.677	-2.088	0.785
2005	-0.667	-0.790	0.788	-2.322	0.987
2013	-0.842	-0.935	0.763	-2.082	0.847

Source: own calculation based on UNCTAD database and Hausmann et al. (2014)

2.6 Empirical Framework

This section investigates the impact of financial development on export diversification and complexity in resource-dependent developing countries using two econometrics techniques: panel fixed effect and panel cointegration estimations.

2.6.1 Fixed effect estimation

A panel approach is used in this section because of the three main advantages it offers. First, a panel approach has the ability to benefit from the time-series and cross-section variation of the data. Secondly, panel-data provide a greater degree of freedom and more efficiency. Thirdly, it has the ability to control the presence of unobserved heterogeneity (Baltagi 2008). The model can be written in the following form:

$$Y_{it} = \beta_1 FD_{it} + \beta_2 CV_{it} + \varepsilon_{it} \qquad (1)$$

Where Y_{it} is the export concentration index in the country *i* at time period *t*, or economic complexity index in country *i* at time period *t*.

FD_{it}: measures for financial development, and

CV_{it}: set of control variables.

However, the literature suggests that when a large number of individuals are observed over time, specifying the nature of the disturbance term (ε_{it}) becomes difficult. For example, country specific omitted factors might affect the observations. If these unobserved factors are not considered in the estimation, the ordinary least square (OLS) estimation

applied to equation (1) might be both biased and inefficient. Therefore, the model has been transformed to the following form:

$$Y_{it} = \beta_1 FD_{it} + \beta_2 CV_{it} + \mu_i + \varepsilon_{it} \quad (2)$$

μ_i : is the unobserved time-invariant heterogeneity (while the remaining disturbance ε_{it} varies across both time and countries).

where,

$$E[\mu_i] = E[\varepsilon_{it}] = E[\mu_i + \varepsilon_{it}] = 0 \quad (3)$$

which further assumes that ε_{it} and μ_i are independent for each country *i* over time period *t*.

Then, the Hausman test is utilized to help in deciding whether the unobserved heterogeneity should be dealt with by using random (RE) or fixed effect (FE). The test outcome does not support the use of the random effect. Therefore, the fixed effect estimator has been used for the panel dataset. The Stata "robust" option has been employed to estimate the standard errors using the Huber-White sandwich estimators. The robust standard errors option is able to deal with the concerns over the failure to meet the assumption of homoscedasticity (i.e. the presence of heteroskedastisity).

2.6.2 Panel cointegration approach

In addition to the fixed effect estimation, this study also utilizes panel cointegration techniques to control for the issue of non-stationarity that can exist in macroeconomic variables (e.g. private credit to GDP, GDP per capita and export concentration). Not controlling this issue may result in biased estimates (Mark and Sul 2003). In this estimation method, the time series dimension characteristics have been carefully considered.

It begins by investigating the presence of unit roots in the panel dataset. The test devised by Im et al. (2003), commonly known as the IPS test, for panels that contain a time dimension in addition to the cross-sectional dimension. A crucial advantage of using the IPS test is its

ability to deal with unbalanced data[18]. The test begins by identifying the Augmented Dickey Fuller (ADF) regression for the N cross-sections:

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + \sum_{j=1}^{\rho i} \beta ij \, \Delta y_{i,t-j} + \varepsilon_{it} \qquad (4)$$

where Y_{it}: is the variable under consideration

α_i: is the individual fixed effect

p_i: is the auto-regressive parameter which is estimated for each cross-section separately.

The null hypothesis is that the auto-regressive parameter is equal to zero (p_i =0) for all *i* against the alternative hypothesis that it is less than zero (p <0) for some *i*. After estimating N separate ADF regressions, the average *t* statistics for p_i is calculated as follows:

$$\bar{t}_{NT} = \frac{1}{N} \sum_{i=1}^{N} t_{iT}(p_i \beta_i) \qquad (5)$$

Once the variables are confirmed to be stationary, the existence of long run cointegration among the dependent and explanatory variables can then be tested. This study implements Kao (1999) test that uses both DF and ADF to test for cointegation in panels.

There are several panel estimation frameworks proposed in the presence of cointegration for static panels: Fully Modified OLS (FMOLS) and Dynamic OLS (DOLS). Pedroni (1996) proposed the FMOLS which is capable of fixing the pooled OLS for the endogeneity of regressors and correcting the serial correlation that is usually present in long-term estimations. The other estimator proposed by Kao and Chiang (2001) for non-stationary panels is the DOLS. Kao and Chiang use Monte Carlo experiments to show that the FMOLS do not improve over the bias-corrected OLS estimator in general, and that the DOLS outperforms them in estimating panel cointegration regressions. The starting equation for the DOLS is as follows:

[18] Only Im–Pesaran–Shin (2003) and Fisher-type (Choi 2001) allow for unbalance panels, while the rest of the panel unit root tests (such as Levin– Lin–Chu (2002), Harris–Tzavalis (1999), Breitung (2000; Breitung and Das 2005) allow only for balanced panels.

$$y_{it} = \alpha_i + \beta_{1i} x_{1it} + \beta_{2i} x_{2it} + \ldots + \beta_{Mi} x_{Mit} + e_{it} \quad (6)$$

To correct any serial correlation and endogeneity, the DOLS uses parametric adjustment to the errors of the static regression by including past and future values of the regressors in difference I(1):

$$y_{it} = \alpha i + x'_{it}\beta + \sum_{j=-q1}^{j=q2} c_{ij} \Delta x_{i,t+j} + v_{it} \quad (7)$$

where c_{ij}: is the coefficient of either lead or lag of the explanatory variable at difference I(1).

$$B_{DOLS} = \sum_{i=1}^{N} \left(\sum_{t=1}^{T} Zit\, Z'it \right)^{-1} \left(\sum_{i=1}^{T} Z_{it}\, y_{it} \right) \quad (8)$$

Where $Z_{it} = [\, x_{it} - \bar{x}, \Delta x_{i,t-q}, \ldots, \Delta x_{i,t+q}]$

Given the expected presence of endogeneity in the sample, Mark and Sul (2003) show that the DOLS is capable of dealing with it through its inclusion of leads and lags of the regressors.

2.6.3 Control variables

As the export structure variables, concentration and complexity, in addition to financial development indicators have already been introduced, this subsection describes the set of control variables that have been cited in the literature on export upgrading and the rationale behind using them in this empirical work.

The Dutch-Disease literature shows that natural resource revenue increases the demand for non-tradable goods. This increase in demand escalates their prices and contributes to the real exchange appreciation, and then reduces the competitiveness of non-resource tradable goods (Corden 1984; Sachs and Warner 2001). Following the Dutch-Disease theory, the real exchange rate appreciation is expected to encourage the concentration of exports on primary products and to hinder their complexity. To control this phenomenon, the real effective exchange rate (REER) has been utilised in this study using Darvas (2012) database.

Wealth and economic development have always been coupled with export and economic diversification (Reinert 2007). While this negative correlation can be observed

between export concentration and GDP per capita in general (Imbs and Wacziarg 2003)[19], this negative relationship might not exist in resource-dependent countries (Lederman and Maloney 2003). This is because growth in GDP per capita can represent high commodity prices without notable economic development (Carrère et al. 2007; Felipe and Rhee 2015). To account for this relationship, this study utilises GDP per capita data from the World Bank database.

Trade openness and liberalization have been a controversial issue in the literature. Reinert (2007) highlights that trade openness through free trade policies (e.g. liberalisation) may lead some resource-dependent developing countries to specialise more on exporting primary products. Trade liberalization should not take place before developing domestic industrial capabilities (Reinert, 2007). Trade liberalization can contribute to specialization in exporting raw material and simple resource-based manufacturing at the expense of sophisticated products (Khan and Blankenburg 2009; Lall 1995b). However, Amsden (2001) argues that trade openness, if coupled with selective trade and industrial policies, can enable firms to access foreign technologies and increase their competitiveness through exploiting economies of scale. In this study, the sum of exports and imports as a share of GDP is utilized as a proxy for trade openness.

In resource-dependent developing countries, basic and industrial infrastructures are crucial for processing natural resources in addition to establishing and upgrading other manufacturing activities (Morris et al., 2012). The industrial infrastructure development is essential for increasing and sustaining competitiveness in the manufacturing sector, in general, and high technology manufacturing in particular (Lall, 1992; Lin, 2012). Furthermore, Amsden (2001) explains that countries' investment in plants and machinery is expected to promote manufacturing exports. To control for this issue, this study utilizes gross fixed capital formation as a proxy for industrial infrastructure development. This is expected to reduce export concentration and encourage export complexity.

Hausmann and Rodrik (2003) demonstrates that discovering new activities is a major determinant of economic diversification. Larger population size is expected to be coupled with discovering new economic activities and, thus, producing wider range of industrial products (Klinger and Lederman 2004). With regards to economic complexity, in the context of natural resource countries, the process of discovery pushes the production basket

[19] Imbs and Waziarg (2003) show that sectoral and export concentration follows a U-shape: countries diversity during their early stages of development, but ultimately they start specializing on a relatively narrower set of activities at later stages of economic development.

away from raw materials (which are ranked the lowest in the ECI) and thus it may have a positive impact on the export complexity.

2.6.4 Data specification

The dataset used in this research covers the period between 1995 and 2013 for thirty-eight RDDCs. A summary of the statistics of the variables employed in this study is shown in Table 2.5. The export concentration has an overall mean of 55.4 percent with a significant variation between the sample countries; Mexico has the most diversified exports basket with an average HHI of 13.9 percent while Angola on the other hand has the least diversified export basket with an average HHI of 96.7 percent.

The Economic Complexity Index (ECI), on the other hand, is available for twenty-eight countries in this sample (i.e. 522 observations). ECI has an overall mean of -0.698 with substantial variations among the panel countries. In 2013, Mexico had the highest complexity score followed by Malaysia with 0.85 and 0.81 respectively. On the other hand, Algeria had the lowest score of -2.08.

Table 2.5 **Summary of statistics for the used variables annually (1995-2013)**

Variable		Mean	Std. Dev.	Min	Max	Observations
Export concentration (HHI)	Overall	0.554	0.203	0.113	0.968	N = 720
	Between		0.190	0.139	0.924	n = 38
	Within		0.078	0.242	0.903	T-bar = 18.9
Economic complexity (ECI)	Overall	-0.698	0.762	-2.791	1.103	N = 522
	Between		0.718	-2.116	0.925	n = 28
	Within		0.279	-1.769	0.348	T-bar = 18.6
Ln credit to private sector	Overall	2.846	1.012	-1.618	5.066	N = 710
	Between		0.938	0.545	4.800	n = 38
	Within		0.440	0.683	4.063	T-bar = 18.6
Ln bank deposits	Overall	3.081	0.821	0.148	4.870	N = 647
	Between		0.766	1.412	4.718	n = 38
	Within		0.329	1.646	4.232	T-bar = 17.02
Ln bank assets	Overall	3.047	0.953	-0.691	5.101	N = 647
	Between		0.898	0.978	4.823	n = 38
	Within		0.402	1.313	4.528	T-bar = 17.02
Ln financial system deposits	Overall	3.092	0.825	0.148	4.870	N = 647
	Between		0.771	1.412	4.718	n = 38
	Within		0.325	1.657	4.240	T-bar = 17.02
Ln GDP per capita	Overall	8.007	1.466	4.631	11.448	N = 722
	Between		1.356	5.431	10.646	n = 38
	Within		0.597	5.280	9.585	T-bar = 19
Ln trade openness	Overall	4.377	0.477	2.693	6.276	N = 666
	Between		0.451	3.400	5.506	n = 38
	Within		0.181	3.630	5.146	T-bar = 17.5
Ln fixed capital accumulation	Overall	22.285	1.790	18.478	26.833	N = 629
	Between		1.646	19.120	25.769	n = 37
	Within		0.751	19.871	24.398	T-bar = 17
Ln population	Overall	15.843	1.603	12.595	18.972	N = 722
	Between		1.614	12.786	18.792	n = 38
	Within		0.171	15.210	16.722	T-bar = 19
Ln REER	Overall	4.638	0.257	3.492	6.110	N = 722
	Between		0.153	4.351	5.204	n = 38
	Within		0.209	3.779	5.595	T-bar = 19

2.6.5 Empirical results

2.6.5.1 Fixed effect estimation

The fixed effect estimations show the impact of financial development (FD) on export concentration and economic complexity using four different financial depth indicators. Table *2.6* shows the impact of FD on export concentration. It indicates that FD has no significant impact on export concentration across all the FD indicators used in the study. This is to say that FD is not suggested to be a determinant of export concentration.

The first explanatory variable is GDP per capita that has a positive and significant coefficient. This result is explained by the fact that GDP per capita for RDDCs does not only represent economic development taking place, but also shows fluctuations in commodity prices. For example, the average GDP per capita for the sample has risen from 2255 dollars in 2003 to 7563 dollars in 2013 following increases in commodity prices. An important control variable for RDDCs is the real effective exchange rate (REER) which has a positive and significant sign. This predicts that REER appreciation induces export concentration by reducing the competitiveness of the industrial sector.

The positive and significant trade openness coefficient suggests that trade openness promotes export concentration. This is in line with Reinert's (2007) view: in countries characterised by an undiversified production structure based on the exploitation of natural resource, a greater trade openness may encourage these countries to specialize according to their comparative advantage. The negative and significant coefficient of fixed capital to GDP suggests that fixed capital formation reduces export concentration. Finally, the results suggest that countries with a higher population size tend to have less concentrated exports.

Table *2.7* demonstrates the fixed effect estimation using economic complexity as a dependent variable. Three models out of four suggest that greater financial development results in lower economic complexity. In other words, financial system growth may hinder export complexity in RDDCs. The negative and significant coefficient of GDP per capita mainly reflects the increase in commodity prices; the increase in commodity prices reduces the export complexity because it is reflected in a larger share of raw material products in the export basket. Trade openness has a negative and significant coefficient, which suggests that greater trade openness may induce these countries to export less complex products. Finally, a higher population has a positive and significant sign, which suggests that larger population

nations are expected to discover new activities. In this context, producing new activities (non-resource products) can increase the ECI.

Table 2.6 Financial development and export concentration using FE estimator

Dependent variable: Export concentration	Model 1	Model 2	Model 3	Model 4
Ln private credit to GDP	-0.010 (0.021)			
Ln bank deposits to GDP		-0.038 (0.033)		
Ln banks assets to GDP			-0.021 (0.023)	
Ln financial system deposits to GDP				-0.039 (0.033)
Ln GDP per capita	0.089 *** (0.012)	0.098*** (0.015)	0.092*** (0.015)	0.098*** (0.015)
Ln trade openness	0.156 *** (0.052)	0.158*** (0.055)	0.158*** (0.055)	0.158*** (0.055)
Ln fixed capital accumulation	-0.055** (0.033)	-0.047** (0.022)	-0.050** (0.0217)	-0.047** (0.023)
Ln REER	0.059* (0.032)	0.060 (0.039)	0.063* (0.0370)	0.059 (0.039)
Ln population	-0.156*** (0.050)	-0.152** (0.071)	-0.154** (0.072)	-0.152** (0.071)
Constant	1.33 (1.86)	1.275 (1.195)	1.301 (1.194)	1.281 (1.192)

The robust standard errors are presented in parentheses under the coefficients

***, **, * show 1% 5% 10% significant levels respectively

*Table 2.7: F**inancial development and economic complexity using FE estimator***

Dependent variable: Economic complexity	Model 1	Model 2	Model 3	Model 4
Ln private credit to GDP	-0.194*** (0.0591)			
Ln bank deposits to GDP		-0.161* (0.0895)		
Ln banks assets to GDP			-0.097 (0.0609)	
Ln financial system deposits to GDP				-0.153* (0.0877)
Ln GDP per capita	-0.317** (0.154)	-0.380** (0.175)	-0.381** (0.181)	-0.382** (0.175)
Ln trade openness	-0.196 (0.126)	-0.317** (0.150)	-0.319** (0.138)	-0.318** (0.150)
Ln fixed capital accumulation	0.139 (0.123)	0.108 (0.120)	0.0884 (0.123)	0.107 (0.120)
Ln REER	-0.143 (0.0871)	-0.150 (0.100)	-0.128 (0.0868)	-0.154 (0.101)
Ln population	0.581** (0.249)	0.964** (0.380)	0.987** (0.366)	0.964** (0.379)
Constant	-8.846** (3.631)	-13.51** (6.036)	-13.72** (5.660)	-13.47** (6.021)

The robust standard errors are presented in parentheses under the coefficients

***, **, * show 1% 5% 10% significant levels respectively

2.6.5.2 Panel cointegration estimation

Table *2.8* reports the Im, Pesaran and Shin (IPS) panel unit root test for the variables at both level and first difference. The results clearly show that the null hypothesis of a unit root cannot be rejected at the level for the majority of the variables. However, the table reveals that the hypothesis is rejected when the variables are in first difference[20]. The non-stationarity of the majority of the variables suggests the need for considering panel cointegration estimations.

Then, the existence of a long-term relationship using the Kao residual cointegration test is checked. Table *2.9* reports eight test outcomes. Each financial depth indicator is tested with export concentration as a dependent variable (for the first four rows) and then with economic complexity (for the last four rows). The low p-values for the eight tests give strong

[20] Fisher-type test (Choi, 2001) is also implemented for robustness. The test outcomes are very consistent with the IPS reported test. All the variables are stationary at first difference. The exception was the population size variable, which is not stationary in first difference. Thus, it should be eliminated from the estimation model.

evidence of long-term relationships between the dependent variables and the right-hand side variables[21].

Having found that there are cointegrating links, Table *2.10* shows the panel cointegration estimation using the DOLS estimator for export concentration. The coefficient of the four FD variables are positive but not significant. This means the FD is not expected to have an impact on export concentration. It is also important to note that the control variables are robust across the four regressions and all the control variables have significant coefficients with the expected sign (as discussed in Section 2.6.5.1).

Table *2.11* reveals the four models using the DOLS estimator with economic complexity as a dependent variable. The results strongly suggest (at the one percent level) a negative relationship between FD and economic complexity. In other words, FD can hinder export complexity. The other control variables have significant coefficients with the expected signs.

Table 2.8: Im, Pesaran and Shin panel unit root test

IPS unit root test *	**Level**		**1st difference**	
Variable	statistics	P-value	statistics	P-value
Export concentration	-0.99	0.18	-12.36	0.00
Export complexity	1.81	0.96	-9.41	0.00
Ln credit to private	0.54	0.70	-14.05	0.00
Ln bank deposits	1.69	0.95	-12.85	0.00
Ln bank assets	0.04	0.52	-11.43	0.00
Ln financial system deposits	1.13	0.87	-12.81	0.00
Ln GDP per capita	6.70	1.00	-13.03	0.00
Ln REER	-0.22	0.41	-13.71	0.00
Ln Trade openness	-1.87	0.03	-15.58	0.00
Ln Fixed Capital to GDP	-3.41	0.00	-20.57	0.00
Ln population	5.01	1.00	2.37	0.99

* Null hypothesis: the existence of unit root

[21] For robustness, Pedroni (1999) cointegration test was implemented, and suggested a long-term relationship.

Table 2.9: Kao Residual co-integration test

Series	t-statistics	P-value
Series 1: Ln credit to private and concentration	-3.60	0.00
Series 2: Ln bank deposits and concentration	-3.21	0.00
Series 3: Ln bank assets and concentration	-3.16	0.00
Series 4: Ln financial system deposits and concentration	-3.20	0.00
Series 5: Ln credit to private and complexity	-2.11	0.02
Series 6: Ln bank deposits and complexity	-1.86	0.03
Series 7: Ln bank assets and complexity	-1.87	0.03
Series 8: Ln financial system deposits and complexity	-1.85	0.03

* Null hypothesis: no cointegration

Table 2.10 Export concentration models using panel cointegration estimation (DOLS)

Dependent variable: Export concentration	Model 1	Model 2	Model 3	Model 4
Ln sector private credit to GDP	0.005 (0.008)			
Ln bank deposits to GDP		0.007 (0.013)		
Ln banks assets to GDP			0.001 (0.01)	
Ln financial system deposits to GDP				0.007 (0.012)
Ln fixed capital to GDP	-0.071*** (0.013)	-0.072*** (0.012)	-0.074*** (0.013)	-0.073*** (0.012)
Ln GDP per capita	0.053*** (0.005)	0.050*** (0.013)	0.058*** (0.005)	0.050*** (0.006)
Ln trade openness	0.193*** (0.020)	0.219*** (0.021)	0.244*** (0.019)	0.220** (0.021)
Ln REER	0.065** (0.015)	0.074*** (0.016)	0.087*** (0.015)	0.074*** (0.015)

The robust standard errors are presented in parentheses under the coefficients

***, **, and * show 1%, 5%, and 10% significant levels respectively

Table 2.11 ***Economic complexity (ECI) models using panel cointegration estimation (DOLS)***

Dependent variable: Export concentration	Model 1	Model 2	Model 3	Model 4
Ln private credit to GDP	-0.234*** (0.049)			
Ln bank deposits to GDP		-0.286*** (0.077)		
Ln banks assets to GDP			-0.173*** (0.051)	
Ln financial system deposits to GDP				-0.273*** (0.170)
Ln GDP per capita	-0.094*** (0.033)	-0.103*** (0.042)	-0.154*** (0.035)	-0.108** (0.042)
Ln trade openness	-0.306*** (0.097)	-0.290*** (0.109)	-0.354*** (0.103)	-0.290*** (0.109)
Ln fixed capital to GDP	0.379*** (0.079)	0.253*** (0.091)	0.173* (0.102)	0.242** (0.093)
Ln REER	-0.221*** (0.071)	-0.209*** (0.082)	-0.195** (0.081)	-0.206** (0.082)

The robust standard errors are presented in parentheses under the coefficients

***, **, and * show 1%, 5%, and 10% significant levels respectively

2.7 Conclusion

Financial systems have grown significantly in resource-dependent developing countries (RDDC) in recent years. This chapter has investigated the impact of this growth on export concentration and complexity for the period from 1995 to 2013.

The descriptive analysis and econometric results have challenged the mainstream view about financial development in RDDC. This mainstream view states that developing the financial sector in these countries contributes to greater economic and industrial development. It suggests that FD promotes industrial development and diversification through supporting sectors that rely more on external finance.

Contrary to this mainstream argument, the statistical models fail to find any significant impact of financial development on export concentration. Furthermore, the models suggest a negative impact of financial development on export complexity.

These findings can be explained by the banks' risk aversion motives, which may result in funding traditional and non-risky projects. In other words, private banks (if left unregulated) look for short-term and higher profit investments, yet fear the fundamental risks associated with investing in new activities (Ghosh 2008). In an empirical study, Jaud et al. (2017) find that the financial sector development helps countries in promoting certain type of products - products that conform to the country's comparative advantage. A developed domestic financial system, they argue, "can push the country's exports toward products congruent with its comparative advantage" (Jaud et al. 2017, p.1013).

The negative impact of finance on the export complexity is in line with Ebireri and Paloni (2016) study in which they demonstrate that developing the banking sector has a negative impact on export sophistication in a sample of heterogeneous developing countries. They maintain that the process of financialisation is a potential explanation for their finding. Mazzucato (2013) explains that financialisation has changed the role of banks fundamentally from institutions that fund long-term investment and innovation to ones that profit from lending to the household sector and for speculation activities. She further argues that while technological upgrading requires committed, risky and patient finance, private financial institutions are increasingly characterized by risk-aversion and short-term motives. As a

result, private financial institutions are becoming unable to distinguish between the bad risk associated with unproductive firms and the good risk that is associated with innovation[22].

In conclusion, this study has argued that developing the financial sector might not be an appropriate policy recommendation for upgrading the manufacturing industry in RDDCs. In order for financial development to have a major impact on innovation in the developing world, government intervention in the financial sector may be required (see Dymski 2003). Drawing further policy implications from this issue leads to a main limitation of this work: its cross-country analysis does not account for key country-specific characteristics that allow the researcher to suggest further policy recommendations. Thus, a deeper understanding of the relationship between financial development and the industrial structure in RDDCs requires country-specific case studies that consider the role of institutions and history.

[22] Bottazzi et al. (2011) shows that the probability of obtaining a bad credit score for a productive firm is as high as it is for an unproductive one. This is because of the risk calculation method which does not account for the source of the risk; e.g. a firm that is developing a novel innovative product is likely to have a high risk score. Thus, Mazzucato (2013) urges policy makers to establish a new credit score mechanism that support innovators rather than penalizing them. Furthermore, recent studies show that innovative enterprises face a greater financing gap relative to traditional ones. In the UK, firms that have recently developed novel innovations face greater financing difficulties relative to non-innovative firms (Cosh et al., 2009).

3 Financing industrial upgrading and diversification in resource-dependent developing countries: Chile and Malaysia as case studies

3.1 Introduction

Motivated by the previous chapter's findings, which show no significant positive impact of financial development on export upgrading in resource-dependent developing countries, this chapter studies two resource-dependent countries that have successfully diversified their production and industrial baskets: Chile and Malaysia. The former has diversified its industry towards resource-based sectors (i.e. close to its comparative advantage), while the latter has diversified its economy towards a wider range of activities that are dominated by electronics and semiconductors (i.e. significantly far from its comparative advantage). The main objective of this chapter is to answer the following questions: How did Chile and Malaysia finance their industrial diversification and upgrading? What was the role of the state in supporting and financing industrial diversification?

The states in these countries have followed different strategies. In Chile, the state finances the manufacturing industry through public financial institutions, such as the Production Development Corporation (CORFO) and Fundacion Chile (a public venture capital fund). While their assistance was meant to develop the manufacturing sector in general, their support since 1973 has been mainly focused on resource based sectors; namely, fruit, forestry, salmon, wine and other processed food. In Malaysia, on the other hand, in addition to attracting foreign investment to specific manufacturing sectors, the Malaysian government channels funds to targeted sectors using the Development Financial Institutions (DFIs), public venture capital institutions and priority sectors lending. Unlike Chile, Malaysian public finance was not only focused on natural resource sectors (e.g. rubber, oil and tin), but also on electronics, automobiles and other new manufacturing sectors. In order to investigate the role of public finance in the emergence of new industries, this chapter offers greater focus on a new major industry in each country: farmed salmon in Chile and semiconductors in Malaysia.

This chapter is organized as follows. Section 3.2 provides motives for the study, before Section 3 discusses its conceptual framework. Sections 3.4 and 3.5 investigate, respectively, the cases of Chile and Malaysia, by analysing their industrial upgrading and diversification and how state finance plays a role in stimulating these changes. Section 3.6 provides a comparison between the roles of public financial institutions in the two countries. Finally, section 3.7 offers a conclusion.

3.2 Study motives and contribution

Resource-dependent countries are advised to de-regulate their financial systems and to reduce state-directed credit in order to achieve greater economic diversification (Beck and Poelhekke 2017; IMF 2016). The main contribution of this study is to investigate this argument in two resource-dependent countries that have successfully diversified their economies, by examining the role of the state in financing industrial development. Secondly, this paper contributes to the heterodox literature that highlights the role of industrial policies in mitigating the Dutch-Disease (e.g. Chang and Andreoni 2016). This study does so by highlighting the role of public institutions in financing and subsidizing the emergence of non-resource industrial sectors in these resource-dependent developing counties (RDDCs).

Thirdly, it contributes to the limited literature on the role of development banks in economic development (Cozzi and Griffith-Jones 2016). This paper adds to this literature by highlighting the role of development banks and other public financial institutions in promoting structural transformation and industrial diversification. These institutions can be particularly important for RDDCs because financing is considered as a major constraint for their industrial development process (Felipe and Rhee 2015; Kaplinsky et al. 2012).

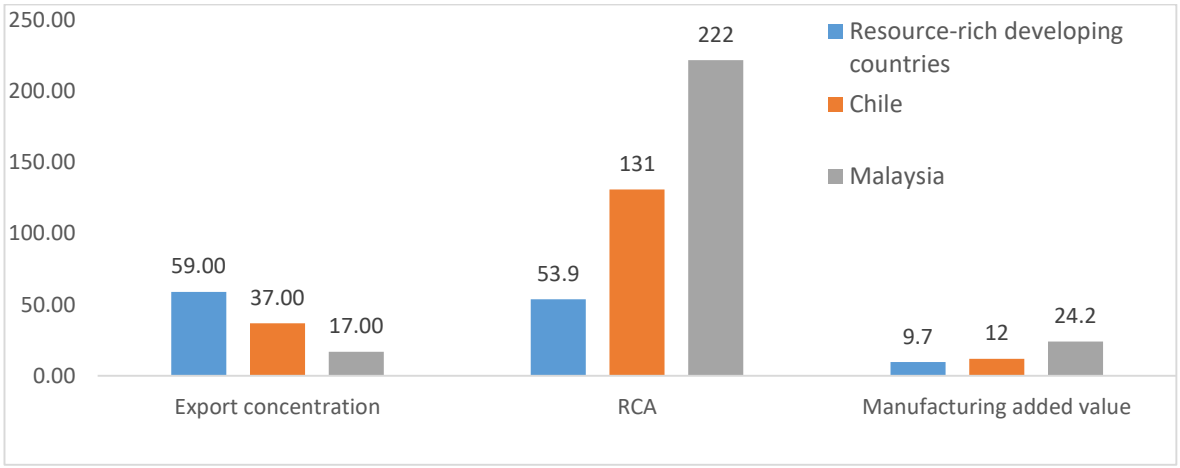
Fourthly, this study provides a case study in each country thus following Nelson (2008) who shows that studying the role of institutional change in technological upgrading is sector- and location-specific. These case studies provide evidence of the role of public financial institutions in the emergence of the farmed salmon industry in Chile and the semiconductors industry in Malaysia.

Fifthly, because some insights and information about public financial institutions are not available in their annual reports or other published forms, this study also uses some unpublished data in addition to semi-structured interviews with some officials and economic advisors in the two countries to carry out this investigation (Appendix 1 provides details about the semi-structured interviews and the rationale for using them).

Chile and Malaysia have been chosen for an important reason. Relative to the average resource-dependent developing countries, Chile and Malaysia have achieved higher industrial GDP, greater export diversification (i.e. number of products exported with revealed comparative advantage (RCA)), and lower export concentration measured by the Herfindahl-Hirschman index (See Figure 3.1). Figure 3.2 presents the composition of

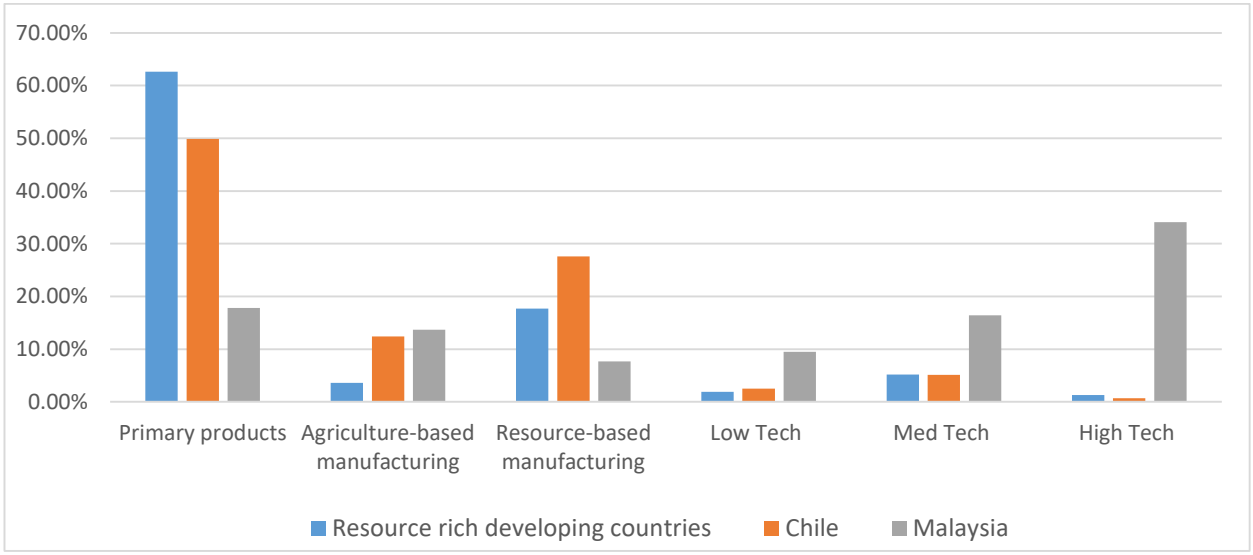
exports for the two countries compared to the other RRDCs in terms of technological intensity, which shows that both countries have lower than average RDDCs in primary products exports[23].

Figure 3.1 Chile and Malaysia's performance in selected indicators (average 2009-2013).



Source: Own calculations based on the UNCTAD and the World Bank databases.

Figure 3.2 Chile and Malaysia's export composition (2009-2013)



Source: Own calculations based on the UNCTAD database.

[23] The figure uses Lall's (2002) definition of technological intensity. In terms of primary product exports, Malaysia is far lower than Chile and the RDDCs' average. This gives Malaysia an advantage over the others because of the high volatility of their primary products' prices. Regarding resource-based manufacturing, Chile's share is larger than that of Malaysia and the other RRDCs. The final three columns show the technology-intensive exports in which Malaysia has a substantial share of technology-intensive exports relative to the other countries (including Chile).

3.3 Conceptual Framework

A properly functioning financial system should provide the private sector with finance that can promote manufacturing sector growth, diversification and upgrading. To achieve these goals, the financial system needs to provide risky and patient finance. In the context of structural transformation, the financial system should also fund targeted (strategic) sectors in line with the national industrial strategy. Nonetheless, it is argued that private finance might not fulfil the industrial development financing needs. There are three main reasons.

Firstly, private finance tends to avoid financing uncertain industrial projects. This uncertainty is underlined throughout the process of technological change that can result in industrial upgrading. Nonetheless, this does not mean that technological change is a result of luck; instead it is an outcome of patient, and committed efforts. This commitment requires certain types of financial institutions (Mazzucato 2013). Furthermore, Establishing a new industrial project is highly uncertain and private banks are unlikely to finance it; they tend not to risk their assets in long-term investments because of the fear that their investments might not be financially profitable (Dymski 2014)[24]. This is also the case in new technology investments. Khan (2009) argues that banks are unlikely to support novel technologies because of the high possibility of project failure in addition to the long period required in learning a new technology.

Secondly, private finance may have no incentive in financing high social value projects. In RDDCs, for instance, there is a definite need to fund projects with positive externalities that can encourage industrial diversification in society (Rodrik 2004). In their "self-discovery" theory, Hausmann and Rodrik (2003) show that information externality is seen as a fundamental hurdle to industrial diversification in developing countries. They indicate that a pioneer who enters a new industry, before others, generates an important information externality about the new industry, and if successful, he can be easily imitated. This process does not compensate the entrepreneur and may result in lower incentives for innovation. While private financial institutions evaluate such projects based on financial profitability with no consideration of social and developmental impacts, public financial institutions can be crucial in funding these projects. By highlighting the importance of industrial policies in this framework, Hausmann and Rordik (2003) show that "government

[24] Firms may need external finance for business creation, relocation, expansion or working capital. However, Dymski (2014) shows that banks are more likely to finance the working capital only because of the less uncertainty involved.

loans and guarantees" are key tools because of their ability to discriminate between pioneers and imitators, in addition to the flexibility to cut financing (i.e. subsidizing) when an activity is well demonstrated.

Thirdly, capital markets around the world are increasingly characterised by short-termism (UNCTAD 2016). Following the process of financial liberalization, there is growing evidence of commercial banks withdrawing from funding long-term projects and gravitating towards easier profits to be earned through lending non-productive sectors and fuelling speculation activities (Ghosh 2005). This change is also coupled with a reduction in state-investment banking. Both factors have reduced the availability of long-term financing (Kregel 2014). Kregel states that "the recent dominance of private financial institutions and the presumption of their efficiency advantage have reduced the availability of long-term finance for development." (p.1)

Public financial institutions, on the other hand, are regarded as a major contributor to industrial development in developed (Diamond 1957; Kregel 2014) and developing nations (Amsden 2001) because of their commitment to providing developmental, high-risk and patient finance. This theoretical framework focuses on two main types of public finance, namely, development banks and public venture capital funds.

3.3.1 Development banks[25]

"Development banks are government-sponsored financial institutions concerned primarily with the provision of long-term capital to industry" (De Aghion 1999, p.83). During the Industrial Revolution, development banks contributed enormously to the rapid industrialization of Europe and Japan. National governments sponsored industrial banks to provide long-term developmental finance because private financial institutions did not have the capabilities and the incentive to provide finance for industry (Diamond 1957; Kregel 2014; Yasuda 1993).

The literature suggests that the oldest industrial financial institution was the Societe General pour Favouriser l'Industrie National which was established in the Netherlands in 1822. Substantially more important industrial and developmental institutions, such as the Credit Mobilier, were created in France in the 1840s and 1850s and they contributed

[25] There is no common name for development banks around the world; their names include state investment banks, industrial banks, development financial institutions, development funds and public credit programmes. Nonetheless, they share a common mission of promoting the state's developmental strategies (Kollatz-Ahen, 2015).

significantly to infrastructure and industrial development (De Aghion 1999). Credit Mobilier became a model for public financial institutions in other parts of Europe and Asia. DeLong (1991) shows that large German banks were founded in "deliberate imitation of the French Credit Mobilier" (cited in Yasuda, 1993, p.10). The existing commercial banks were not able to provide manufacturing industry with the required long-term loans. Firstly, they were not interested in bearing the risks associated with financing new enterprises, and secondly, they lacked the expertise and skills to allow them to work with long-term risky investment (De Aghion 1999).

The need for large infrastructure and industrial investment after World Wars I and II resulted in the establishment of new development banks, such as the Japan Development Bank (JDB) and the German Kreditanstalt für Wiederaufbau (KFW means a 'reconstruction credit institute'). Diamond (1957) maintains that the main role of these institutions was the provision of long-term finance to relatively new manufacturing sectors. This support was in the form of equity investment, loans at low interest rates or guarantees for bonds issued by companies in targeted sectors.

Developing countries, such as South Korea, India, Chile and Brazil, have also made use of development banks to finance their rapid industrial upgrading needs. Amsden (2001) claims that the developmental state is predicted to participate in developmental banking; "the state's agent for financing investment was the development bank. From the viewpoint of long-term capital supply for public and private investment, development banks throughout 'the rest' were of overwhelming importance"[26] (p.127).

Based on the nation's stage of development, a development bank can play different roles and certain roles might be more crucial at one stage than at another. The literature has documented six major roles for development banks in developing countries. First, they play a developmental role by providing long-term finance for projects according to the national development strategy. Promoting strategic investments and structural transformation are considered to be the main roles for the majority of development banks (Amsden 2001). For instance, following the Brazilian Government's goal of making the country an efficient steel

[26] The 'rest' according to Amsden (2001) refers to the following nations: China, Indonesia, Malaysia, Thailand, Taiwan, India, Turkey, Argentina, Chile, Mexico and Brazil. While South Korea was already a developed nation, it was added to her "rest" countries because of its late industrialization experience.

producer in the late 1950s, one half of the Brazilian Development Bank's (BNDES) funds targeted the steel industry between 1958 and 1967 (ibid.).

Secondly, development banks support high-risk innovations and projects that are unlikely to be financed by commercial banks. Investors in new activities tend to face difficulties in accessing external finance. This is explained mainly by the lack of collateral and the lack of a record of profitable investments in addition to the uncertainty that tends to be associated with the innovation process itself (Dymski, 2014; Mazzucato, 2013). Some development banks have established programmes that are designed to support high-risk innovation projects. In Brazil, for instance, since the 1990s the government has decided to promote high-tech firms and innovation. Accordingly, BNDES started several programmes to finance innovations such as Prosoft which focused on financing firms in the software industry; Profarms programme which directs finance for innovation in the pharmaceutical industry; FUNTEC which specialises in funding IT firms; and Criatec which targets firms in the ICT industry and biotechnology sectors. Table 3.1 shows major programmes established by BNDES to finance innovation.

Table 3.1: BNDES selected innovation programmes

Year	Established Programs	Targeted sector
1997	New innovation programs, such as Prosoft	Software industry
2004	Profarma	Pharmaceutical industry
2005	FUNTEC	IT industry
2006	Prodtv and Pro-aeronautics	Digital TV industry
2007	Criatec Fund	ICT and biotechnology sectors
2009	Pro-engineering	Automotive, aerospace, defence, and nuclear energy indsutries
2010	Proplastico	Plastic sector
2011	Pro-P&G	Oil and gas sectors

Source: Mazzucato and Penna (2016).

Thirdly, they tend to be challenge-led institutions. Challenge-led (or mission-oriented) policies are those that target the development of a particular technology or the prevention of certain social problems. One example of this is the generous support of development banks around the world for projects aiming to anticipate climate change (Mazzucato and Penna 2016). Fourthly, they have an ability to direct funds towards targeted industrial sectors and, thus, to mitigate the Dutch-Disease. For instance, Chang and Anderioni (2016) argue that the Brazilian Government has used certain industrial policies, e.g. BNDES lending, to

support certain industrial sectors and mitigate the Dutch-Disease that has resulted from significant influxes of foreign exchange to the Brazilian economy.

Fifthly, they support greater social and geographical inclusion. Projects located in rural areas that lack infrastructure development face larger risks in their operations and, thus, may face financing difficulties and slower economic development as a consequence (Dymski 2014). Sixthly, they can invest in a counter-cyclical fashion and promote industrial investments in periods of downturn. Because of low interest rates during economic recessions, it is argued that commercial banks may disrupt expansionary monetary policy because of their lack of incentive to lend. State banks, on the other hand, have a higher incentive to push the economy out of a downturn through increasing their lending despite the low interest rates (Levy-Yeyati et al. 2004). An example of this is the significant increase in BNDES disbursement from 118 billion in 2007 to 209 billion riyal in 2009 (BNDES, 2015).

Amsden (2001) highlights additional unique features of development banks in recently industrialized countries; high industrial financing capabilities; unique mechanisms to select good projects[27]; the ability to evaluate investment execution and progress; the provision of economic and technical advice; the development of technological and managerial expertise; the means of ensuring financial soundness; the establishment of efficient distribution and marketing practices; and supporting the transfer of foreign technologies[28].

3.3.2 Public venture capital

Venture capital is considered as an important source of finance that can boost start-up firms in new technologies. Lerner (2013) explains the importance of venture capital funds for start-ups by showing that an entrepreneur may not have adequate capital to finance a project on his own. Because such projects are characterized by uncertainty and intangible assets, banks are not likely to finance them. In the meantime, Lerner (2002) shows that private venture

[27] The "picking winner" is an argument that has dominated the industrial development debate. Some argue that selective government policies hinder the economic development process by distorting market competition. Easterly (2009) shows that history tells us that the outcome of picking winners has been very poor. On the other hand, Wade (2012) has argued that successful experiences in developed and developing countries show that governments have been "making" winners through their vertically-targeting industrial policy.

[28] For example, in order to insure that a borrowing firm is not overpaying for foreign technology, BNDES requires firms to register the technology contracts with another government agent that had greater experience in this regard. Furthermore, it asks some borrowers to cut the production costs significantly in order to maintain its competitiveness. In some cases, some borrowing firms were required to modernize their management and marketing systems to enter international markets. As far as financial soundness is concerned, BNDES forced some clients to maintain a certain debt to equity ratio to insure their financial strength (Amsden, 2001).

capital might not solve this financing problem efficiently, and thus he demonstrates the need for public venture capital for two reasons. First, public funds are more capable to certify firms for other investors. Lerner highlights that when a public programme that specializes in financing small firms in specific sectors supports a certain project, it could thereby certify its excellence and potential growth. As an example Lerner (2002) explains that "specialists at the National Institute of Health or Department of Defence may have considerable insight into which biotechnology or advanced materials companies are the most promising, while the traditional financial statement analysis undertaken by bankers would be of little value" (p.78).

The second reason for the importance of public venture capital is its role in encouraging a technological spill-over and thus creating positive information externalities for other producers. In those developing countries that lack industrial diversification, Rodrik (2004) shows that information externalities can be a key. Entrepreneurs try out new products and adapt their technologies from existing markets abroad and then invest in them domestically. Because this process can benefit the society as a whole, public venture capital can play a major role in creating positive information externalities by investing in new activities (ibid.).

The challenge for policy-makers is, therefore, not to provide support for all small firms, but instead to fund and support the development of firms with high potential growth (Mazzucato 2011). By distinguishing between average firms and those with a higher propensity for growth ('gazelles'), Nightingale and Coad (2013) argue that the policy makers must focus on gazelles by boosting their growth rather than promoting horizontal policies to facilitate market entry.

While there is an increase in the availability of venture capital financing, it is argued to be scarce during the early stages of firms' development in new technology activities because of the high uncertainty about the used technology and its demands (Murray 1999). Mazzucato (2011) demonstrates that private venture capital is more likely to be available in the second and third stages rather than in the early stages, because of the significant drop in the associated risk of loss (see Table 3.2). By looking at the behaviour of private venture capital funds, Mazzucato argues that private funds tend to be more speculative and seek short-term profit through exiting in three to five years and benefiting from buy-out or IPOs.

Keller and Block (2012) studied a public venture programme, Small Business Innovation Research (SBIR), in the United States and compared its performance with private venture funds[29]. The study shows that SBIR's funding is significantly higher than private venture capital in early stage technology projects; its funding on average is five to six times higher, with the exception of the Internet bubble in between 1999 and 2000. In addition, private funds tend to be concentrated on a small number of industries. In 2000, for instance, 46 percent of private venture capital targeted firms related to the Internet. In the meantime, promising projects in other industries did not attract these venture capitalists.

Finally, it is important to note that public venture capital funds should accept the high failure rates that result from their developmental effort (Mazucatto and Perez 2014). In the meantime, they should also benefit from the upside in order to cover potential losses in future rounds (e.g. a revolving fund). This is unlike many examples around the world where public funds are socializing the risk but privatizing the reward (Mazzucato 2011).

Table 3.2: The risks associated with the various stages of technology innovation

Innovation stage	Risk of loss
Seed stage	66.2 %
Start-up stage	53 %
Second stage	33.7 %
Third stage	20.1 %
Pre-public stage	20.9 %

Source: Pierrakis (2010) (cited in Mazzucato 2011, p.40).

3.4 The Case of Chile

State directed credit is a major contributor to the development of the Chilean manufacturing sector. Before the wave of neo-liberal policies in 1973, credit allocation was the primary policy tool used to develop the industrial sector following import substitution principles (Hastings 1993). Since 1973, this section shows that state directed credit has been devoted to developing resource-based manufacturing sectors. The section begins with a brief overview of the Chilean economy, including a description of its industrial and export structure. Then, it discusses public financing in terms of public industrial banking and public venture capital. Finally, it investigates the role of public finance in the development of the farmed-salmon industry.

[29] The SBIR programme was established in 1982 and provides on average 2 billion dollars that targets technological innovation projects (Keller and Block, 2012). Their study also considers another programme, the Small Business Technology Transfer (STTR), which collaborates between federal laboratories, universities and small firms.

3.4.1 A brief overview of the Chilean economy

Chile has experienced a structural transformation change since Pinochet's military coup in 1973. This experience is considered by some mainstream economists as a 'miracle' following the neo-liberal reforms (see Ostry et al. 2016). On the other hand, other economists, such as Stiglitz (2005), argue that Chile "did not simply succumb to following the dictates of the Washington consensus willy-nilly. Like the success cases of East Asia, it was selective, adding and subtracting to the standard recipes in ways that allowed it to shape globalization for its purposes" (p2).

Prior to 1973 the country was identified by the active role of the government in the growth of the industrial sector following import substitution principles. However, Chile has implemented some neo-liberal polices immediately after the Pinochet coup. These policies started by liberalizing foreign trade, privatizing the domestic economy and then liberalizing the financial sector. In the meantime, the government continued to support resource based industrial sectors, e.g. mining, forestry, fisheries, vegetables and fruit (Agosin and Bravo-Ortega 2009; Amsden 2001; Pietrobelli 1998).

A crucial government decision that needs to be highlighted here is the non-privatisation of the national copper company (CODELCO). This non-neoliberal reform of development (i.e. public ownership) has been crucial in Chile's industrial development experience in two ways. First, CODELCO has a substantial commitment to local development through supporting small domestic suppliers as well as mining processing activities. In the meantime, foreign companies working in the Chilean mining sector (mainly BHP-Billiton) have been sending raw minerals to China and Australia for processing, with limited support for local suppliers. Second, CODELCO's revenues have been a substantial source of income for the state and its development agencies. While it has been transferring its profits to the Chilean government since its creation in 1955, the foreign mining companies in Chile contribute to government revenues only thorough taxes that are not high relative to other mineral rich countries (interview with industrial economist at CEPAL, April 2018).

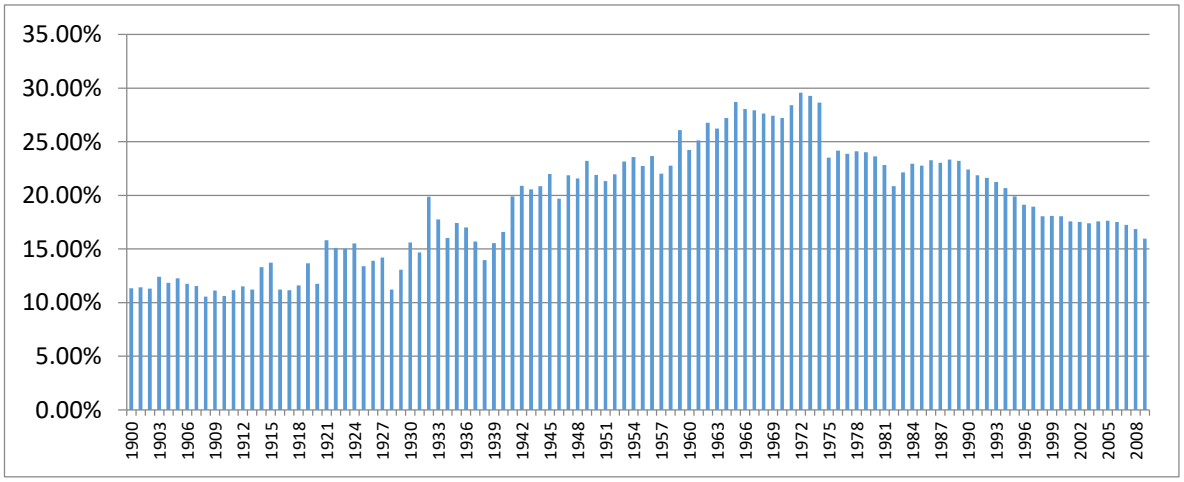
In 1982, the Chilean economy hit a wall when the domestic economy entered a deep recession. Chile had accrued an extremely high level of international debt which led to a severe economic and financial crisis. After the financial crisis of 1982, the Chilean government considered a change in its macro-economic policy. The state imposed some import barriers, introduced some export subsidies and increased regulation of the financial

sector. By 1989 the Chilean economy had almost recovered and, in 1990, a democratic government was elected. Since then, the democratic governments have been intervening selectively to promote specific manufacturing sectors, especially the resource based sectors (Moguillansky et al. 2001; Pietrobelli 1998).

The role of the state in financing industrial upgrading and export diversification cannot be investigated comprehensively without a brief description of the Chilean manufacturing and export patterns. Figure *3.3* shows that industrial GDP has been increasing steadily since the late 1930s. However, it fell substantially after 1973 following the political and economic policy change. Manufacturing added value to GDP has fallen from 23.5 in 1972 to 18.4 in 1982.

Disaggregated industrial data show an increase in the share of resource based manufacturing relative to the other sectors (see Table *3.3*). For example, the share of the food and beverages sector rose from 17.9 percent in the period (1963-72) to 24.3 percent in (2002-08). On the other hand, the share of the motor vehicle sector deteriorated from 6.1 to 0.6 percent in the same periods. Indeed, the machinery and equipment retired in 1973, and since then, Chile's growth relied on minerals and niche resource-based industries (Amsden 2001).

Figure 3.3. Manufacturing added value to GDP (1970=100)



Source: MOxLAD Database.

Table *3.4* presents the evolution of the main Chilean export groups. The Chilean export basket has significantly diversified away from copper. The copper share has declined from 71 percent between 1963 and 1972 to 36 percent between 1993 and 2002. However, after the sharp increase in copper prices in 2003, its share increased until it reached fifty percent of the total exports value in the period between 2013 and 2015. The table also shows

that the increased diversity was towards resource based manufacturing, e.g. salmon, wine, wood and paper products.

Table 3.3: Share of the industry added value by sector (annual average)

	1963-72	1973-82	1983-92	1993-02	2002-08
1. Food and beverages	17.90%	20.60%	22.10%	25.00%	24.30%
2. Wood products (excl. furniture)	1.80%	2.40%	2.90%	4.30%	4.30%
3. Basic metals	19.90%	21.10%	24.70%	NA	N.A.
4. Paper and paper products	3.00%	4.30%	6.80%	6.70%	N.A.
5. Coke, refined petroleum products, nuclear fuel	1.90%	6.10%	6.40%	7.90%	N.A
6. Non-metallic mineral products	3.80%	3.30%	3.40%	4.20%	3.40%
7. Motor vehicles, trailers, semi-trailers	6.10%	4.50%	1.30%	1.00%	0.60%
8. Electrical machinery and apparatus	3.40%	2.90%	1.40%	0.80%	0.40%
9. Machinery and equipment	3.00%	2.50%	1.60%	1.90%	2.10%
10. Textiles	10.60%	5.60%	3.80%	1.90%	0.90%
11. Wearing apparel	5.20%	4.10%	3.40%	3.30%	N.A.
12. Chemicals and chemical products	7.10%	8.60%	9.00%	12.80%	N.A.
13. Rubber and plastics products	3.60%	2.20%	2.50%	3.00%	2.80%
14. Tobacco products	3.40%	3.90%	4.20%	3.70%	N.A.
15. Printing and publishing	3.20%	3.10%	2.50%	2.00%	N.A.
16. Furniture manufacturing	1.00%	0.80%	0.70%	1.20%	0.90%
17. Medical, precision and optical instruments	0.10%	0.10%	0.10%	0.20%	0.10%

Source: UNIDO Database

Table 3.4: Export patterns for the main Chilean categories (annual average)

Industry	1963-72	1973-82	1983-92	1993-02	2002-13	2013-15
Mining	85%	65%	54%	42%	56%	54%
Copper	71%	56%	45%	36%	51%	50%
Agriculture	3%	6%	13%	10%	6%	8%
Manufacturing	12%	27%	32%	42%	37%	37%
Food and beverages	4%	7%	14%	16%	11%	12%
Salmon	0%	0%	1%	4%	4%	6%
Wine	0%	0%	0%	2%	2%	2%
Wood	0%	3%	4%	5%	4%	3%
Paper, wood and pulp products	2%	6%	6%	7%	4%	5%
Chemical and petroleum Derivatives	1%	3%	3%	5%	9%	7%
Base metal products	3%	7%	3%	1%	2%	1%
Metal products, machinery and electrical goods	1%	3%	2%	3%	3%	3%

Source: Chile Central Bank (2016)

3.4.2 Financing the industrial upgrading

This section discusses the role of state finance in Chilean manufacturing diversification by looking at two sources of finance; state industrial banking and state venture capital. Then,

the impact of these two public financing sources is further examined in the farmed-salmon industry.

3.4.2.1 State industrial banking

The collapse of the Chilean economy following the great depression of the 1930s justified the government participation in the credit allocation process. In 1935 the central bank started controlling the interest rate for favoured borrowers. First, a preferential rate was applied to wheat credits. Then, in 1937 the policy was applied to all the agricultural credits. Until 1939 the manufacturing sector did not receive preferential treatment. In the meantime, the majority of commercial banks were offering short-term and low risk loans, and thus the government established a state development agency (CORFO) to provide long-term finance for identified strategic and emerging industries. CORFO was the first of its kind in Latin America (Faúndez 1988).

It began its long-term credit using very limited financial resources. At the outset it received five to six percent of the national budget. However, this share dropped when government revenue declined following copper revenue fluctuations. After an increase in international support for Chilean development agencies, CORFO started receiving foreign credit. These foreign credit sources accounted for twenty-five per cent of the agency's total loans between 1950 and 1964 (Hastings 1993).

CORFO became the basic and central tool for directing credits to preferential industries. Its general investment strategy was based on import substitution principles. The supported products were ranked according to their import value and the expected foreign exchange savings. A product that appears at the top of the list is given priority in industrial policy and in CORFO's agendas. Approved projects fall into one of three categories. First, projects contribute to the import substitution strategy during the final stages of the value adding process (e.g. consumer goods' manufacturing). Secondly, projects contribute to the domestic production of raw materials, oil and steel. Thirdly, projects contribute to the production of capital goods. Normally, this step is considered to be the ultimate stage of an import substitution strategy and a vertical integration of the entire industrial domestic production (Hastings 1993; Mamalakis 1969).

During the 1960s, CORFO substantially expanded its working and capital investments. Its fixed investments in the industrial sector were estimated to amount to fifty-

five percent of the total of fixed investment in the industry. It is also projected that CORFO controlled approximately thirty percent of the total investment in the equipment and machinery sectors during this period (Amsden 2001). In terms of the number of supported firms, CORFO became an investor in 136 firms. Among these firms, it held majority ownership of forty-six firms (Hastings 1993).

The agro-industry received a generous portion of CORFO's direct loans during the late 1950s and 1960s. For example, in the period between 1959 and 1963 the agro-industry received 31.8 billion pesos equating to 45 percent of total direct loans; the manufacturing industry received 23.9 billion pesos accounting for approximately 35 percent of CORFO's total direct loans and the mining sector received 14.2 billion pesos totalling around twenty percent of total direct loans (Mamalakis, 1969).

CORFO has also participated in the chemicals manufacturing development. In an interview with two directors of Dow Chemicals in Latin America around 1970, these directors said CORFO "sets Chile apart from some of the other countries that have engaged in similar activities" (Amsden 2001, p.147). The developmental role of CORFO can also be seen in its establishment and development of giant enterprises in the Chilean economic system. These include the national sugar production company (IANSA), the national petroleum company (ENAP), the steel production company (CAP) and the electricity utility company (ENDESA) (Mamalakis 1969).

State industrial financing remained crucial even after the economic transformation of 1973. Its role was mainly dedicated to resource based industries. A clear example of this is the government's vertical policies targeting the support of the forestry sector. Because some parts of Chile were considered very suitable for growing the radiate pine, the state made a great effort to expand this sector by providing loans, subsidies and labour training[30]. Toro and Gessel (1999) emphasize the role of Decree Number 701 (in 1974) regarding forest promotion in Chile. It guaranteed seventy-five percent of the plantation expenses in addition to providing financial support for firms wanting to establish new plants. The central bank participated in this support by channelling subsidized credit; between 1974 and 1979 it

[30] The Radiate pine in some parts of Chile grows faster than in any other place in the world (Torro and Gessel, 1999).

directed credit lines through private commercial banks and the state bank (Bacno Estado) to firms and farmers in the forestry sector[31].

In 1975, CORFO established the National Agency for Export Promotion (ProChile). The purpose of the programme was to facilitate exporting firms' access to international markets, market research, marketing and feasibility studies, in addition to improving Chilean exports' image abroad and attracting foreign investors to Chile. Regarding the nature of its targeted products and sectors, ProChile gives higher importance to diversifying the Chilean exports basket away from copper to resource-based industries. For instance, in co-operation with the Chilean Wine Association, it organizes annual exhibitions abroad to promote wine exports. Through its international offices, ProChile co-operates with CORFO to attract FDI and strategic entrepreneurs to the Chilean economy (interview with ProChile trade advisor, March 2018).

After electing the first democratic government in 1990 [32], several financial instruments were introduced for the purpose of funding and promoting innovation in specific sectors. These instruments included the Scientific and Technological Development Fund (FONDEF), the National Fund for Technological and Productive Development (FONTEC), and the Fisheries Research Fund (FIP), CORFO's Group Development Project (PROFO) and CORFO's Development and Innovation Fund (FDI). All these funds were established in the period from 1991 to 1995[33].

A crucial council for the identification and articulation of the industrial sectors is the National Council on Innovation for Competitiveness (CNIC), which since 2005 has been

[31] Although Chile's exports in forestry were non-existent in 1975, wood and paper products account for approximately 8 percent of its total exports in 2015 (Central Bank of Chile, 2016).

[32] It is important to note here that since 1990, the promotion of industrial policy has been subject to changes in Chilean politics. Conservative governments have been minimizing the role of state in supporting the manufacturing sector, while socialist democratic governments, on the other hand, have been promoting greater support for industrial diversification policies and programmes (interview with industrial economist at CEPAL, May 2018).

[33] Among these funds, PROFO and FONTEC have a larger role and contribution than the others (Tan, 2009). FONTEC is a fund that provides several financing tools to support the development of new products and production techniques. During the first decade of its establishment from 1991 onwards, it supported more than 1700 innovation projects with a value amounting to 250 million dollars. Eighty-five percent of the participating firms were small and medium enterprises (SMEs). The manufacturing sector accounted for almost 41 percent of the targeted sectors, followed by the agricultural and fisheries sector with 29 percent and the information and communication sector (ICT) with 8 percent (Benavente et al., 2007). PROFO, on the other hand, was established by CORFO. It works by generating groups of eight to fifteen firms from the same sector and geographical area that produce similar or complementary products. The main objective is to develop firms' competitiveness by providing loans, facilitating technology access (or adaptation) and overcoming marketing and management problems. Furthermore, PROFO hires a group manager in order to support firms in developing, executing and monitoring their plans. During the preparatory phase, PROFO covers 70 percent of the operation costs for three years (up to a maximum of 100,000 US dollars) and in the project phase, the agency finances at least 50 percent of the total cost of the project (Perez-Aleman, 2000).

playing a major role in the credit allocation process. Its mandate is to help the government promote innovation through selective intervention policies in specific sectors. One of its goals was to repeat the significant increase in GDP per capita that had occurred during the previous two decades (OECD 2009; Pietrobelli and Puppato 2016). The CNIC recommends targeting the following industrial clusters: copper mining, aquaculture, fruit production, beef, pork and poultry; offshore services, tourism and processed food[34]. It argues that foreign direct investments (FDI), in addition to CORFO and CONICYT's direct credit, are crucial instruments in financing the targeted clusters (OECD 2009).

Agosin et al. (2010) claim that the CNIC's mandate expresses two fundamental issues. First, the Chilean Government has moved away from the idea that horizontal policies are the best way to promote long-term growth. Secondly, the CNIC's ideas represent the 'doomed to choose' view of Hausmann and Rodrik (2006). In this paper, Hausmann and Rodrik show that developing an industry requires the investment of a substantial amount of resources. Given the large market failure in developing countries, in addition to their limited number of resources, they argue that governments are doomed to choose a particular set of sectors that can be targeted. Their argument is in contrast to the "free-market" hypothesis, in which market mechanisms allocate resources efficiently and targeting specific sectors is considered a distortion of market forces.

It is also important to highlight the role of CORFO in promoting linkages from the mining sector. In the context of resource-dependent countries, Hirschman (1981) argues that the production linkages from the resource sectors, in the upstream and downstream, are critical channels for economic development and industrial diversification. In Chile, in addition to the national copper company (CODELCO), CORFO is considered as a main tool in supporting small suppliers for the large mining companies, and thus, in the development of the Chilean mining cluster[35].

CORFO has also been a channel for promoting fiscal linkages from the mining sector[36]. A major channel for this linkages is the Innovation and Competitiveness Fund (ICF) which is funded by the mining sector's royalties. Because of CORFO's expertise in

[34] Because of CORFO's advanced industrial expertise, it plays a major part in designing the CNIC's industrial plans and targeted sectors (interview with high official in CORFO, May 2018).

[35] For instance, in 1997, CORFO contributed to establishing a programme to assist SMEs in meeting the qualification requirements of the mining industry. The programme provides lines of credit, technical, management and marketing assistance. Furthermore, in 2011, the Ministry of Mining, in co-operation with the National Copper Corporation of Chile, promoted a strategy called The Development of World Class Mining Suppliers. The aim of this strategy was to transform 250 Chilean firms into global suppliers by 2014. CORFO has committed to providing 45 million US dollars (USD) for this programme over three years (McMahon and Moreira, 2014).

[36] In addition to production linkages (that is related to developing resource-related manufacturing activities around the resource sector), fiscal linkages refer to government revenue generated from the resource sector that are used to promote non-resource manufacturing sectors (Hirschman, 1981).

supporting innovation, ICF channels large part of its resources to CORFO programs, i.e. copper prices boom is usually reflected in higher support capacity of CORFO (interview with high official in CORFO, April 2018). For instance, following the increase in copper prices in 2003, CORFO's total lending rose from 279 million USD in 2003 to around 5 billion USD in 2013. However, its total lending declined to 2.8 billion USD after the significant decline in copper prices (see Table 3.5).

Table 3.5: CORFO total support relative to copper prices

Year	CORFO support in thousand USD	Copper price (USD per metric ton)
2003	278,977	1779.4
2004	339,922	2863.5
2005	439,915	3676.5
2006	21,994	6731.4
2007	189,194	7131.6
2008	481,292	6963.5
2009	1,310,503	5165.3
2010	1,053,975	7538.4
2011	2,364,029	8823.5
2012	4,626,351	7958.9
2013	5,027,993	7331.5
2014	2,812,824	6863.4
2015	2,532,087	5510.5
2016	2,867,015	4867.9

Source: CORFO unpublished data, and FRED database

3.4.2.2 Public venture capital

In Chile, a major constraint facing innovation firms is inadequate seed and venture capital financing (Benavente et al. 2005). Thus, CORFO participates in the venture capital industry with the aim of fostering innovation within the Chilean SMEs. This participation is either through investing directly in risk capital, e.g. the acquisition of small firms' equities, or indirectly by offering credit to venture capital fund managers. CORFO targets SMEs with high growth potential, insufficient capital and high management skills. Between 1997 and 2014, CORFO approved credit lines standing at 637 million USD (OECD 2016). Table 3.6 shows the major credit lines provided by CORFO and the number of beneficiary funds.

Table 3.6 Major CORFO credit lines for the venture capital industry

Name of credit line	F1	F2	F3	K1	Fenix	FT	FC
Targeted firms	Venture capital	Venture capital	Venture capital	Emerging firms	Mining exploration	Early stage	Growth and Development
Year of creation of the credit line	1997	2005	2006	2008	2011	2012	2012
Number of beneficiary fund managers	5 funds, 3 closed	5 funds 1 closed	17 funds 2 closed	1 fund	6 funds	6 funds	3 funds

Source: OECD database

An important beneficiary fund from CORFO credit lines has been Fundacion Chile (FCh). FCh was created in August 1976 with the purpose of upgrading the manufacturing sector. It is a semi-public investment institution that was funded by the Chilean government and ITT – an American corporation[37]. The agency has two major mandates: to provide seed capital and to transfer technologies by bringing in potentially profitable opportunities in projects, products and technologies which do not exist in Chile. FCh describes itself as: "a 'do tank', creating more than 65 companies in diverse productive areas in the country, promoting new industries and innovative products within the main natural resource areas of the country" (Fundacion Chile 2016).

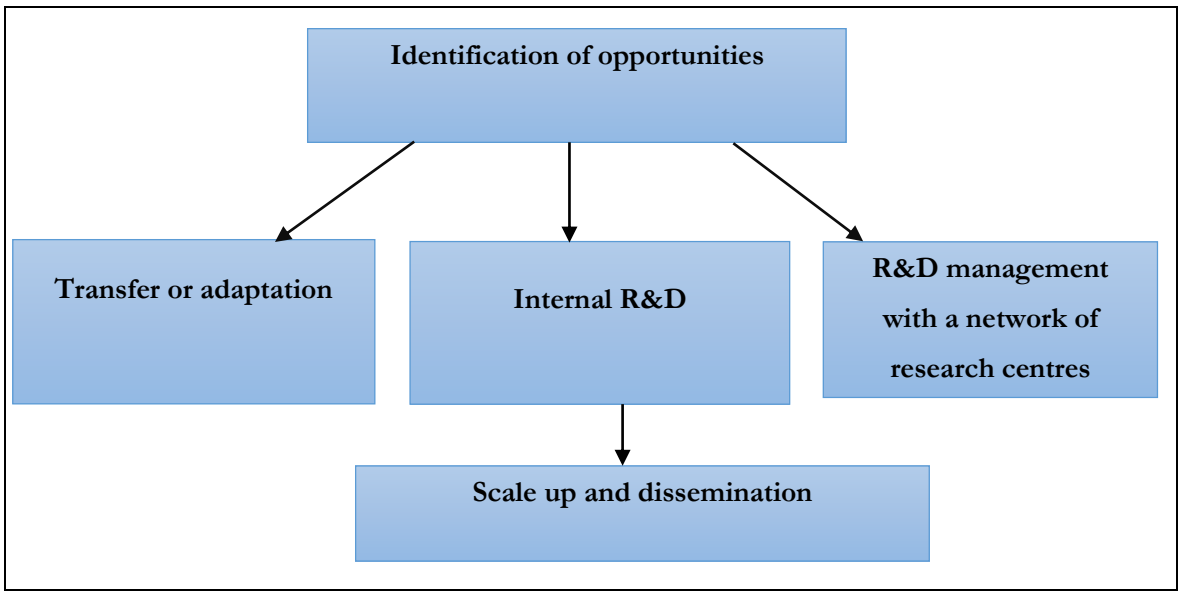
FCh's working model includes three main phases (see Figure **3.4**). First, it identifies opportunities of adding value through innovation. This phase may suggest one of the following: the creation of a new product or service, modification in the production process, or business model modification. Secondly, it obtains a suitable technology, which can be done by three methods: (i) transferring and adapting a technology that has been developed by a foreign entity; (ii) developing it through FCh's own R&D; or (iii) developing it through

[37] FCh's establishment came a few years after the agreement between Allende's government and ITT regarding the nationalization of the Chilean telecommunication company.

collaboration with R&D institutions. Nonetheless, in FCh, the innovation is rarely absolute, i.e. the technology is new for the global market. Instead, FCh introduces relative innovation, which enables the first use of the technology within the Chilean economy. Fourthly, it uses technology scale-up and dissemination (Fundacion Chile 2008). The four stages are carried out by FCh's 350 professionals and over 200 international consultants (Foundacion Chile 2016).

In this way FCh can be seen as a critical tool in spurring industrial diversification through the production of information externalities (Rodrik 2004). FCh produces information and diffuses technology through the use of two main tools: supporting strategic private producers or establishing new ventures that can demonstrate the profitability and reduce the uncertainty around the new technology. Establishing a new firm in a new technology is not only risky because of its existence in what is commonly called, in the entrepreneurial literature, the "valley of death" that faces new start-ups in general (Cardullo 1999), but also because it faces the risk of failure in transferring a new technology to Chile.

Figure 3.4: Fundacion Chile's working model



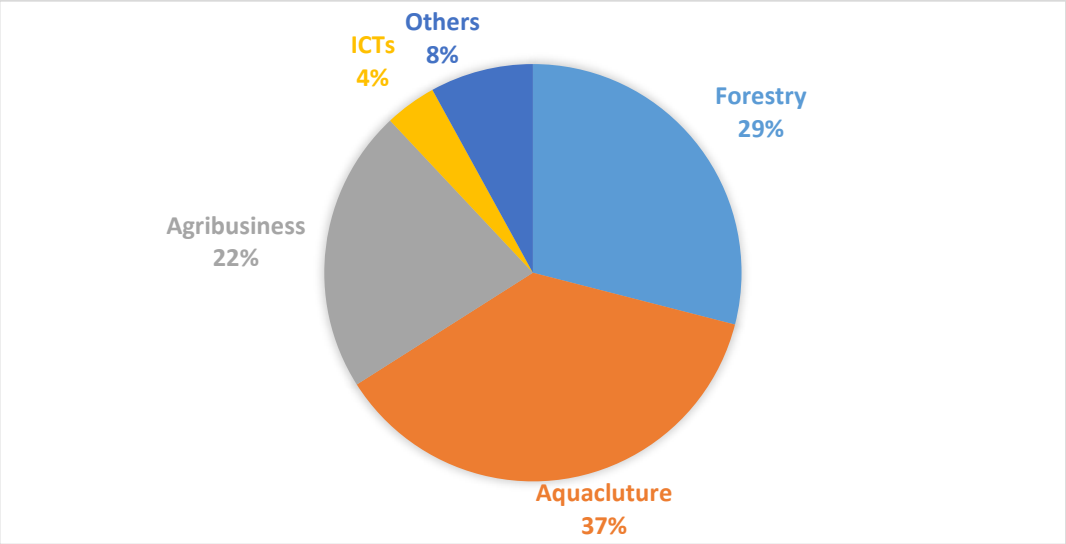
Source: Fundacion Chile (2008)

With regards to the sources of finance, FCh initially finances projects using its own resources. However, over time it could not meet the industry's demands with its limited resources and so it later depended on resources provided by CORFO and the Chilean National Science Foundation (CONICYT)[38]. With regard to its targeted investments, FCh is

[38] CORFO and CONICYT are members of FCh's Board of Directors (Fundacion Chile, 2008).

more focused on seven sectors: agri-business[39], marine resources, environment and chemical metrology, forestry, mining, human capital and information technology. From its creation in 1974 until 2008, aqua-culture industriess have accounted for thirty-seven percent of its total investments, followed by forestry with twenty-nine percent and agri-business with twenty-two percent (see Figure 3.5). Table 3.7 shows major FCh's establishments for the purpose of technology transfer.

Figure 3.5 : Fundacion Chile investments by major sector



Source: Fundacion Chile (2008)

[39] In its explanation for its substantial support for agri-business and food sectors, FCh (2008) argues that Chile can become can become "worldwide food power".

Table 3.7: Selected projects established by Fundacion Chile

Year	Event
1979	The establishment of the 'Asparagus Cultivation' programme. The programme supported the adaptation of cultivation techniques to improve the quality of production. Thus, its asparagus exports increased from 6.2 tons that year to 7,550 tons in the 1990s.
1980	The investment in salmon farming companies led to a boom in the industry. Chile's salmon exports have grown from almost nothing in 1980 to being the second largest salmon-farmed exporter in the world.
1982	The establishment of "Cultivos Marinos Tongoy" which led to the growth of oyster production and exports.
1982	The creation of the 'Boxed Beef' project which aims to export beef using livestock production methods and new methods of packaging it. The project created a pioneer firm in this industry called Procrane which has been successful in producing beef using the vacuum packing methods and 'deboning at origin' technique. Both techniques were critical for the value added production.
1983	The establishment of Caprilac S.A. which is an agro-business firm specializing in the production of high-quality goats' milk and cheese.
1985	The 'Berries La Union' programme was founded in order to bring specific berries' production techniques 'in order to expand the industry.
1987	The creation of Tenagro Cautin (in the berries' industry), Salmon Hullinco (first producer of Atlantic salmon in Latin America).
1988	The establishment of Salmontec (Salmon industry) and Technofrio Cautin (fruit production).
1989	The creation of Granjamar, a company which specializes in producing the turbot fish.
1992	The establishment of the first abalone production company (Campos Marinos S.A.).
1994	In a joint venture with a French firm (Lescure Bougon) it established Chevrita, a company which produces and sells gourmet goat and cow's milk cheeses.
1996	The Establishment of another company (SPASA) specialized in producing abalone to meet the specific demand by the Japanese and US markets.
2002	The establishment of Compania Chilena de Esterilizacion (CCE) in co-operation with the Brazilian Sterilization company. The company uses ionizing energy technologies to increase the safety, quality and competitiveness of the food production processes.
2003	The creation of Vitro Chile (flower producer) in co-operation with the Viollier family. The company was established after an increase in the global demand for flowers and flower bulbs. The company uses bio-technological techniques which are used to export flowers to Europe.
2004	The Foundation of Oloetop, in partnership with three other companies, to produce canola oil that is used as a feed for the farmed-salmon industry.
2005	The creation of AQUAGESTION to meet the high demand for production, control and sanitation services for the aquaculture sector.

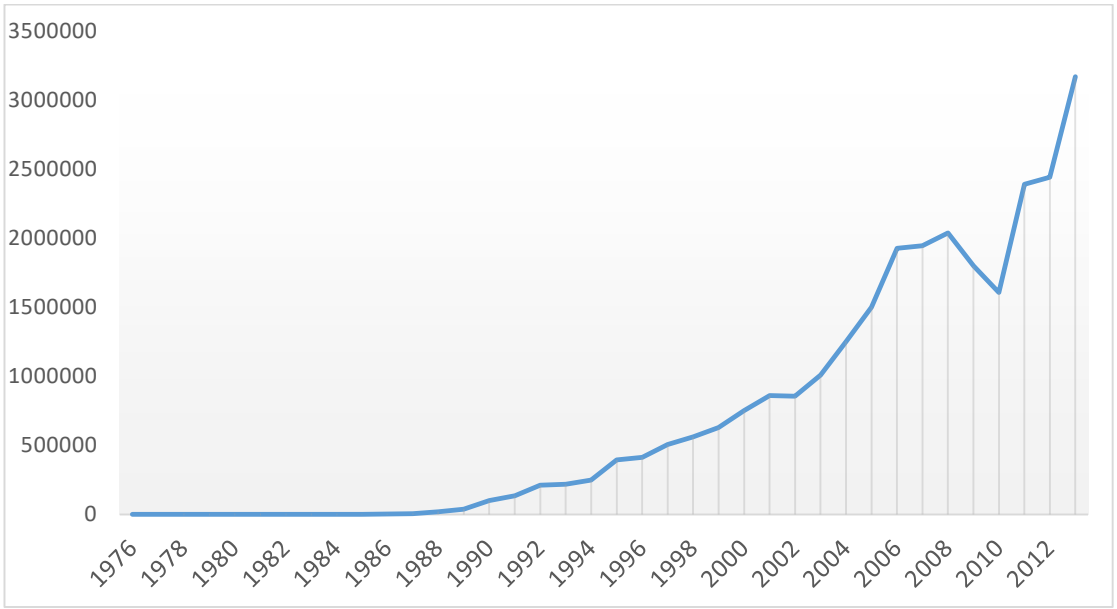
Source: Fundacion Chile (2008), Andreoni and Chang (2014) and Flores-Aguilar et al. (2007)

3.4.3 The farmed-salmon industry

This section investigates the impact of public financial institutions on the emergence of the Chilean farmed-salmon industry. This industry has been chosen as a case study for three reasons. First, among the resource based sectors that emerged after 1973, the salmon industry is the largest sector in the Chilean export basket. Secondly, the sector was established in a period which is considered in some of the existing mainstream literature as an era where the 'free market' mechanism was at the heart of the resource allocation process in Chile. Thirdly, the development of the farmed-salmon sector resulted from technological upgrading in Chile's natural advantages and shows the success in taking advantage of a niche market.

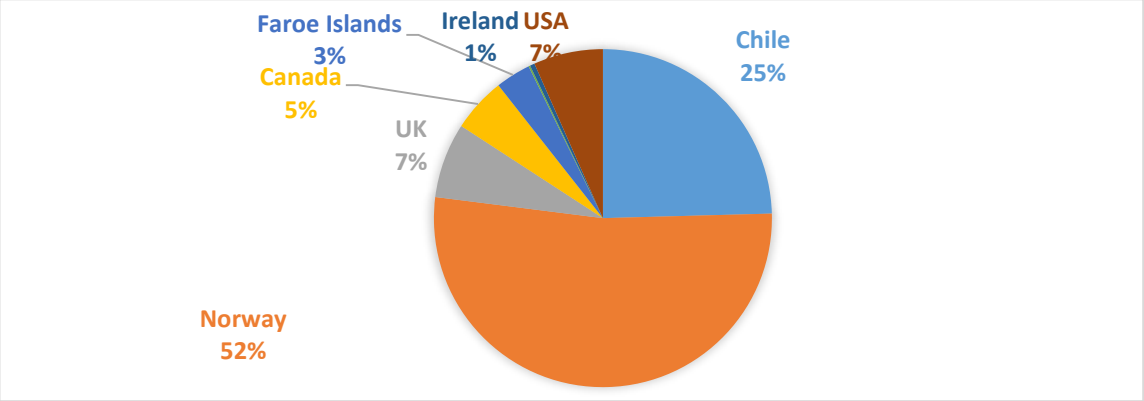
Chile's farmed-salmon exports went from almost nothing in 1985 to 3.1 billion dollars in 2013 (See Figure *3.6*). Salmon now accounts for almost six percent of the total exports basket. In 2013, Chile's share of the world's production was around one quarter, making it the second largest farmed-salmon producer after Norway (see Figure *3.7*). In 2004, the industry employed 38,400 direct jobs and 15,000 indirect jobs (Iizuka et al. 2016).

Figure 3.6: Chile's salmon export evolution (per thousand US dollars)



Source: FAO (2016)

Figure 3.7 : The global share of Chile's salmon exports (2013)



Source: FAO (2016)

In 1974, Lago llanquihue Ltd established the first salmon farm in Chile for commercial purposes. The financial loan for this project was awarded by CORFO. A few years later the firm started exporting small quantities of salmon and trout to France. At approximately the same time another firm, called Domesa Farms Chile, started to produce salmon. Both companies faced many difficulties which arose as a result of the lack of expertise and the disease crises of the 1970s (Iizuka 2007).

In 1981 Foundación Chile (FCh) bought Domesa Farms and established a new company called Salmones Antartica. The purpose was to demonstrate the commercial and technical feasibility of farmed salmon production in Chile (Iizuka 2007). The firm adopted Norwegian and Scottish technologies that were suitable for the conditions of the Chilean Lake District (where the farm is located).

In the 1980s and 1990s, FCh demonstrated a unique role of public venture capital which was identified by Lerner (2002): certifying the industry (or the producer) for investors and financiers and encouraging technological spill-over for other producers in the field. The success of Salmon Antartica has reduced the uncertainty about the profitability of farmed salmon and thus made it easier for entrepreneurs to get loans from private banks. For entrepreneurs to invest, and for financial institutions to lend them, it was crucial to prove the profitability of farmed salmon, and FCh has demonstrated that evidently (Hosono et al. 2016).

The great social value created by the successful experience of Salmones Antartica in the Chilean economy made it easier for other entrepreneurs in the economy to imitate them. Thus, a large number of small and medium firms began to appear from the 1980s onwards. It is important to note that this growth was also triggered by the high price of salmon during the early 1980s (Agosin and Bravo-Ortega 2009; Iizuka 2007).

FCh has also established new firms in the upstream and downstream of the farmed salmon cluster. Within the additive value chains (mainly located in the natural resource industries), an important element of industrial upgrading takes place through promoting the upstream and downstream industries (Kaplinsky 2015). FCh established and supported firms supplying material for the farmed-salmon producers (upstream) in addition to firms processing the farmed-salmon (downstream). For example, between 1985 and 1987, FCh established three firms: Salmones Huillinco S.A. which specializes in producing Atlantic smotls (young salmon); Finamar S.A. which specializes in producing smoked salmon; and Salmontec S.A. which is specialized in hatchery and ranching activities (Iizuka 2007).

Furthermore, FCh and CORFO supported the growth of a wide range of activities related to the salmon industry, such as fishmeal production facilities, fishing nets, net pens and fish feed. While acquiring the production technology of these products followed the imitation process rather than Research and Development (R&D), some of these activities are extremely knowledge extensive.

The government structure relating to the fishing industry has experienced structural change in order to maintain the industry's growth needs. In its effort to strengthen the industry, the Chilean government created the Office of Fisheries and National Fisheries Services (SERNAPESCA) within the Ministry of Economy. In addition, the state established the Local Government Planning Office (SERPLAC) which took a major role in supporting the development of aqua-farming. Furthermore, CORFO supported the establishment of quality certification for salmon producers, both financially and technically which enabled them to access international markets (Hosono et al. 2016; UNCTAD 2006).

During the 1990s, the salmon-farming industry dramatically increased its volume of production. The government recognized this great progress in the industry and it, therefore, introduced a new policy agenda. The state's financial support started to focus on upgrading the production capabilities. One example of this is the state's support of local producers who produce salmon eggs domestically.

Salmon farming production takes place in three stages: hatchery, cultivation and processing. During the hatchery stage, salmon eggs, alevins and smolts are cultivated and produced. This stage requires certain natural resources (such as pure and uncontaminated water) as well as highly skilled labour, engineers and scientists capable of applying quality control routines and environmental protection. In 1991 approximately 51 million salmon eggs were imported from Ireland, Scotland, the United States, Finland, Sweden and Denmark. The number of salmon eggs rose to 114 million in 1994. In order to reduce the

production cost and the rate of disease infection, approximately 74 million were produced locally in 1995 (Katz 2006).

CORFO, along with other public institutions, has participated significantly in promoting and improving the production of domestic eggs. In order to keep the industry in line with international standards, CORFO, Fundacion Chile and some local companies jointly organized and financed local producers' visits to Norwegian and Scottish production facilities and experimentations. They also organized regular seminars in order to spread the knowledge of egg production among domestic producers (Katz, 2006).

Another example is the joint effort between CORFO and other government institutions to control the Piscirickettsia salmonis bacterium. The bacterium seriously affects the production of salmon in Chile and results in a catastrophic disease called Salmon Rickettsial Syndrome (SRS). This disease results in an annual estimated loss of approximately 100 million dollars to the Chilean salmon industry. In a joint project by CORFO, universities and salmon producers, they have developed a vaccine against this kind of disease (UNCTAD, 2006).

It is important to note that several government agencies took part in financing the innovation of the salmon-farming industry in addition to CORFO and FCh. These agencies included the Bureau of Fisheries (under the umbrella of the Ministry of Agriculture), ProChile, the Institute for the Promotion of Fisheries (IFOP), INTESAL, public universities and the National Science and Technology Commission (CONICYT). Table *3.8* shows the innovation projects in the salmon-farming industry financed by public agencies in the period (1987-2008). Examples of these projects are the prevention of disease caused by imported salmon eggs, salmon-feeding technologies, remote sensing for cleaning the sea bottom and the creation of value added products for local firms (Hosono et al. 2016). Figure 3.8 represents the financial support provided for these innovations by the source finding[40].

As shown above, the role played by the Chilean government in the establishment of the salmon industry, mainly through Fundacion Chile and CORFO, was indeed a catalyst. Their early investments made it possible for new entrepreneurs to enter the industry and to gain access to knowledge without taking the risk of learning and adapting a new activity and its corresponding technology. Furthermore, they both funded and coached the salmon farming industry start-ups and provided them with the required technology and knowledge. Katz

[40] It is important to note that, while CORFO accounts for twenty-nine percent of the total public innovation funding, more than eighty percent of its funds came only after 2005 after the establishment of Innova Chile. This clearly shows the substantial increase in CORFO's support and funding for innovation in more recent years.

(2006) states that the Chilean salmon-farming industry teaches us lessons regarding policy planning and implementation:

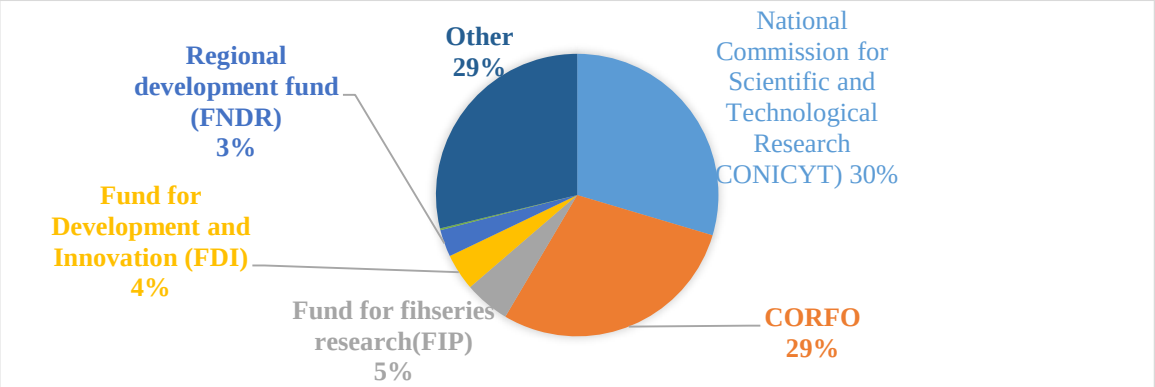
> *"Reaching international competitiveness appears to be the result not just of adequate macroeconomic fundamentals, but also of an extensive set of sector-specific policies that trigger interactions among firms, government agencies, financial institutions, research and development (R&D) laboratories, universities, municipalities and so forth... Both CORFO and Foundación Chile had a proactive strategy of building up production capacity and disseminating knowhow and technology" (pp.193-197).*

Table 3.8: Publicly funded innovation projects in the salmon industry (1987-2008)

Area	No of projects	%	Amount (in thousands)	%
Pathology and sanitary management	77	26.8	12,140,701	28.9
Genetics and reproduction	38	13.2	7,752,516	18.4
Nutrition and food	29	10.1	6,327,948	15.1
Environment and clean production	33	11.5	3,842,839	9.1
Technology centres	5	1.7	3,736,752	8.9
Engineering and technology	44	15.3	3,489,769	8.3
Cultivation and production	14	4.9	1,573,375	3.7
Training and transfer of technology	18	6.3	1,026,484	2.4
Processing and quality control	13	4.5	877,022	2.1
Recreational fishery	10	3.5	829,549	2
Administration and regulation	4	1.4	346,458	0.8
Small-scale aquaculture	1	0.3	46,874	0.1
Biology and ecology	1	0.3	43,043	0.1
Total	**287**	**100**	**420,333,300**	**100**

Source: Bravo (2009)

Figure 3.8: Sources of public support for innovation in the salmon industry



Source: Hosono et al. (2016)

3.5 The Case of Malaysia

The performance of the Malaysian economy is considered amongst the best in the developing world since the 1970s. This performance has generated wide academic interest. On the one hand, Salleh and Meyanathan (1993) and the World Bank (1993) argue that the rapid economic development can be explained by the economic liberalization policies that took place in the 1980s. On the other hand, Lall (1995a), Rasiah and Shari (2001), Jomo (2007) and Khan and Blankenburg (2009) argue that the state selective intervention was a key in developing the Malaysian manufacturing sector.

This section looks at the role of the state in financing the manufacturing sector development and diversification. After a brief economic review, the section presents the main public financing tools in Malaysia: Development Financial Institutions (DFIs), public venture capital funds and priority sectors lending. To investigate the impact of these tools, their role in the largest manufacturing industry, namely, the semiconductors industry, is discussed extensively.

3.5.1 Brief economic overview

After its independence in 1957, Malaysia started to support the manufacturing sector following import-substitution principles. However, this period was dominated by first-stage (light) assembly and packaging tasks (Lall 1995a).The second industrial policy (1971-1985), known by the New Economic Policy (NEP), targeted poverty reduction and wealth distribution among the various Malaysian ethnic groups. The state goal was to reduce the poverty rate from 49.3 percent in 1970 by two thirds (to 16.7 percent) in two decades. At that time, the Malay ethnic group's poverty rate was about seventy-four percent compared to thirty-seven percent for the Indians and twenty-six percent for the Chinese. The NEP considered the manufacturing sector development as the main instrument for accomplishing rapid growth coupled with poverty reduction among all the ethnic groups. Thus, it offered generous fiscal incentives to attract foreign investors to specific industrial sectors.

In the early 1980s, Mahathir's government started stronger state participation in the manufacturing sector. The purpose was to diversify the industrial and export baskets, lead the development in the heavy machinery industry and create more linkages to the local

domestic economic activity[41]. In 1983, the state established the Heavy Industry Corporation of Malaysia (HICOM) (Rasiah and Shari 2001).

In 1986, the state promoted the Pioneer Investment Act (PIA), which is considered as the start of the fourth wave of industrial policy that has been characterised by aggressive state participation in promoting manufacturing and export activities. Indeed, Dr Mahathir's government decided to implement "Looking East" policies (i.e. to use Japan and South Korea as examples). The New Economic Policy (promoted in 1970) was replaced by Industrial Master Plans (IMPs), which are similar to the industrial policies followed by the NIEs. It emphasised the use of selective intervention policies to upgrade the industrial sectors (Lall, 1995). In 1990, the Action Plan for Industrial Technology Development put the electronics industry at the centre of Malaysian economic development. The plan emphasised that the industry was a means to transform Malaysia into a developed country by 2020. Table 3.9 shows the main industrial policy phases and their policy instruments.

Table 3.9: The main industrial policy phases

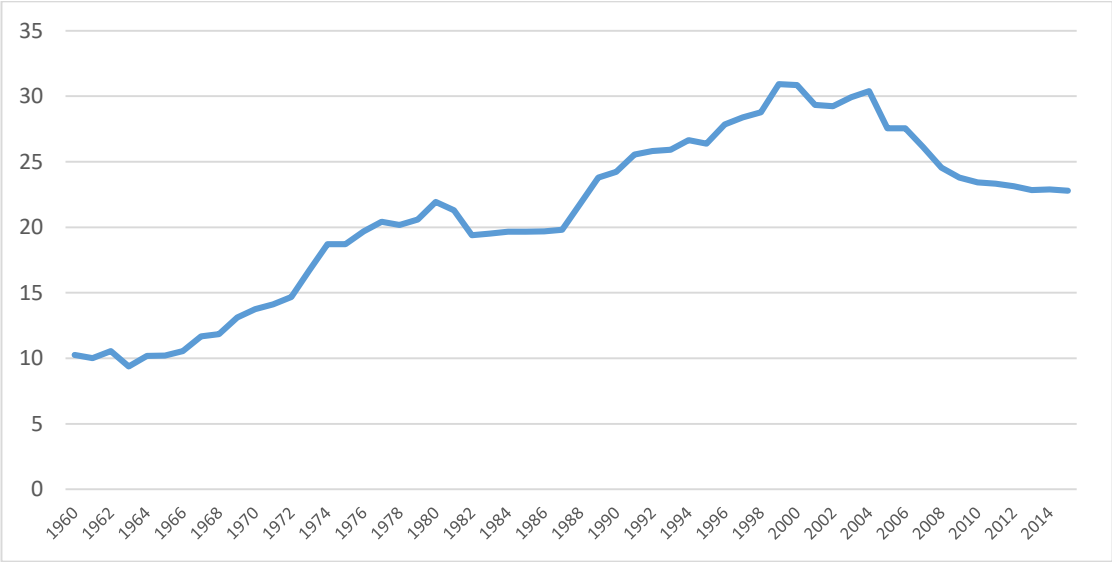
Phase	Trade orientation	Period	Policy instrument
1	Import substitution	1958-72	Pioneer Industry Ordinance, 1958
2	Export orientation	1972-80	Investment Incentive Act, 1968. Free Trade Zone Act, 1971
3	Import substitution	1981-85	Heavy Industry Corporation of Malaysia (HICOM), 1980
4	Export orientation	Sine 1986	Industrial Master Plans (IMPs), 1986. Action Plan for Industrial Technology Development, 1990

Source: Rasiah (2006)

It is important to note that Malaysia has successfully achieved the NEP goals of poverty reduction through, mainly, development in the manufacturing sector. While manufacturing added value increased from 13.7 percent in 1970 to twenty-four percent in 1990, the poverty rate fell from over forty-nine percent in 1970 to 15.6 percent in 1990 (lower than the NEP target). The manufacturing added value continued increasing until it reached its peak in 2000 (approximately 31 percent). However it declined significantly after 2003 because of the oil prices boom (see Figure *3.9*). In the meantime, the poverty rate continued to decrease until it reached 0.6 percent in 2015 (Asian Development Bank 2016).

[41] It is argued that the industrial policies in the 1960s and 1970s failed to promote inclusive growth and create linkages with the domestic economy (Rasiah, 1995; Lall, 1995).

Figure 3.9: Manufacturing added value as a share of GDP



Source: World Bank database

Before investigating the role of the state in financing the manufacturing sector development and diversification, it is important to look at the manufacturing added value by sector and export disaggregated data. Table 3.10 shows the manufacturing added value sector by sector since 1968. The table shows that electrical machinery and apparatus has been the largest industrial segment since the late 1980s; it has grown from 5.8 percent in the period (1968-1976) to 30.0 percent in the period (1997-2006). However, following the increase in of oil prices in 2003, its share declined to 22.7 percent. This decline has been matched with a substantial growth in Coke and refined petroleum products in the last two periods (1997- 2012).

Malaysian exports have grown significantly since the promotion of the NEP policy in 1970. Table 3.11 shows that the export growth was fuelled by the development of machinery and transport equipment, which has become the largest export segment since the late 1980s. It increased considerably from 2.8 percent between 1967 and 1976 to forty-two percent between 2007 and 2014. In the meantime, the share of crude materials and inedible segment has dropped considerably from 49.5 percent to 2.8 percent in the same periods.

Table 3.10: The manufacturing added value by sector

Sector	1968-76	1977-86	1987-96	1997-06	2007-12
Electrical machinery and apparatus*	5.8%	13.6%	23.1%	30.0%	22.7%
Coke, refined petroleum products, nuclear fuel	3.9%	2.9%	2.6%	9.0%	17.5%
Chemicals and chemical products	7.5%	8.9%	11.2%	10.5%	11.6%
Food and beverages	18.6%	19.9%	11.5%	8.2%	10.9%
Tobacco products	5.3%	3.2%	1.9%	0.5%	0.4%
Rubber and plastics products	14.7%	9.3%	8.6%	7.1%	6.5%
Textile	3.6%	4.5%	3.3%	1.8%	0.9%
Wearing apparel, fur	1.5%	2.0%	2.6%	1.5%	0.8%
Wood products (excl. furniture)	12.8%	8.8%	6.2%	3.7%	2.5%
Paper and paper products	0.8%	1.0%	1.6%	1.7%	1.4%
Printing and publishing	5.4%	4.1%	2.9%	2.1%	1.6%
Non-metallic mineral products	5.8%	6.0%	5.8%	4.4%	3.8%
Basic metals	3.0%	3.3%	3.4%	3.1%	4.1%
Fabricated metal products	4.0%	3.6%	3.7%	3.4%	3.6%
Machinery and equipment	2.7%	2.8%	4.0%	3.8%	3.2%
Medical, precision and optical instruments	0.5%	0.6%	1.1%	1.1%	0.5%
Motor vehicles, trailers, semi-trailers	2.9%	4.1%	4.6%	4.2%	3.4%
Furniture manufacturing	1.3%	1.5%	2.0%	2.6%	2.5%

The UNIDO Industrial Statistics Database-ISIC Revision2

* “Radio, television and communication equipment” and “Office, accounting and computing machinery” segments were added to “Electrical machinery and apparatus” segment because the three segments were aggregated in some periods and disaggregated in others.

Table 3.11: Malaysian export patterns

Sector	1967-76	1977-86	1987-96	1997-06	2007-14
Machinery and Transport Equipment	2.8%	14.3%	42.0%	57.9%	42.0%
Mineral Fuels, Lubricants	8.5%	23.9%	13.1%	9.8%	18.2%
Miscellaneous Manufactured Articles	2.3%	3.2%	9.1%	8.5%	9.2%
Manufactured Goods	20.6%	11.2%	8.6%	7.6%	9.0%
Animal and Vegetable Oils and Fat	8.2%	12.3%	7.5%	5.2%	8.0%
Chemicals	0.8%	0.9%	2.2%	4.5%	6.5%
Food	5.8%	4.5%	3.8%	2.0%	2.9%
Crude Materials, Inedible	49.5%	29.1%	13.0%	2.9%	2.8%
Miscellaneous Transactions and Commodities	1.1%	0.6%	0.6%	1.2%	0.8%
Beverages and tobacco	0.4%	0.1%	0.2%	0.3%	0.5%
Total export value (period average in million RM)	6,817.0	28,386.2	110,328.0	389,860.8	668,070.7

Source: Malaysia Department of Statistics (SITC Rev.4)

3.5.2 Financing the manufacturing industry

This section begins by looking at the main public financing tools in Malaysia: Development Financial Institutions (DFIs), public venture capital, and the Central Bank's priority sectors. Then, the impact of these public financing mechanisms is investigated by looking at the semiconductor sector as a case study.

3.5.2.1 The Development Financial Institutions

The establishment of the Development Financial Institutions (DFIs) is considered as a strategic decision to provide long-term and high-risk finance for economic and social development projects (Fay 2001). According to the Central Bank (Bank Negara Malaysia), in 2016, the DFIs' assets stood at 286.1 billion RM, accounting for 23.2 percent of total GDP (Bank Negara Malaysia 2017a). With regard to their targeted sectors, DFIs used to allocate the majority of their credit towards manufacturing, agriculture, forestry, fishery and mining projects. These sectors accounted for 60.3 of total DFIs' financing in 1993. However, their share declined to 23.3 percent in 2002, and 10.7 percent in 2016. The rest of the lending share goes to infrastructure projects, social programmes, exports and imports, the property sector, maritime, transportation and financial services (Bank Negara Malaysia annual reports).

Their existence is also explained by the commercial banks' unwillingness to take the risk of providing long-term finance for development projects, i.e. private banks tend to provide short-term finance with the purpose of maximizing their profits at low risk. Abdul Ghani, who is the Deputy Governor of the Central Bank of Malaysia, expressed the importance of the DFIs for the Malaysian economy:

> *"The commercially-driven and profit-maximising banking institutions would often tend to take a short-term view and consider solely the private benefit of a project, at the expense of the potential long-term social benefit that could be derived from financing a particular project…These are clearly instances of market failure, and the establishment of the DFIs is indeed an attempt to rectify this shortcoming*" (Abdul Ghani 2005, p.1).

In his argument Abdul Ghani shows the social benefit of financing development projects in the sense that some projects have great social value for the overall economic development. However, these projects are not expected to be promoted by the private sector because of the high prevailing risk. Abdul Ghani further shows that the DFIs' mandates are closely linked to the country's development plans. Thus, their roles are not expected to take place only during nation building or transformation period, but also to continue upgrading the manufacturing sector following Malaysian development plans (ibid.).

Currently in Malaysia, there are eleven DFIs owned by the Government: Malaysian Industrial Development Finance Berhad (MIDF), Export-Import Bank of Malaysia Berhad (EXIM Bank), Bank Kerjasama Rakyat Malaysia Berhad, Bank Pembangunan Malaysia Berhad, Bank Perusahaan Kecil dan Sederhana Malaysia Berhad (SME Bank), and Bank Simpanan Nasional, Bank Industri and Teknology Malaysia Berhad, Credit Guarantee Corporation Malaysia Berhad (CGC), Sabah Development Bank, Lembaga Tabung Haji, and Sabah Credit Corporation Berhad (Bank Negara Malaysia 2017b). In an interview with a high official at MIDF (June 2018), he states that "each DFI is mandated to develop and support its niche targeted sectors". He also mentions that a major objective of the DFIs is to support SMEs and provide "companies with medium and long-term financing especially for those companies that cannot seek funding from commercial banks"[42].

[42] In 2015, public financial institutions (mainly DFIs) accounted for more than twenty percent of total SMEs' financing in Malaysia (SMEs Corp. Malaysia, 2016).

The oldest DFI is the Malaysian Industrial Development Finance Berhad (MIDF) which was established in 1960. It was considered the state's main development finance institution. The main motive for its creation was to catalyse the development of the manufacturing sector by providing medium and long-term loans, in addition to reducing Malaysia's dependence on natural resources (MIDF 2016).

The MIDF focused on financing projects that are totally new to the country. It supported the establishment of the first automobile tyres firm in the country, the first flour mill manufacturing, the first automobile assembly firm in the country, the first integrated steel and iron manufacturing firm. Following the strategy of the New Economic Policy (NEP) in the1970s, the MIDF started to promote the manufacturing sector in new regions of the country with the purpose of achieving inclusive growth coupled with poverty reduction. Therefore, besides its headquarter in the capital, Kuala Lumpur, it opened several branches in Johor, Penang, Kota, Kuching, Bharu, and Kinabalu (MIDF 2016). The MIDF's focus on promoting inclusive growth in new geographical regions is highlighted a central role of public banks around the world (UNCTAD 2016). Among a large number of MIDF successful beneficiaries, Table 3.12 presents publicly listed companies that were financed by the MIDF in their early stages.

In synchronization with the Government's efforts to increase the technological intensity of domestic production and to reduce dependency on labour-intensive activities (e.g. activities that rely on cheaper foreign labour cost), the MIDF is currently supporting local companies to improve the automation of their production facilities. Thus, the MIDF is managing a government fund of 750 million RM for modernizing production lines for the period from 2016 to 2020. Furthermore, the MIDF is currently managing 2.4 billion RM that are allocated from different government programmes towards encouraging the export of services, SME manufacturing and services, SMEs' relocation towards industrial parks, modernization of machinery and equipment and the automotive sector (interview with high official in MIDF, June 2018).

Table 3.12: Some publicly listed companies that were financed by MIDF

Company	Sector	Market capitalization	No. Employees
Khind Holdings Bhd	Electrical manufacturing, services and trading.	98.1 million RM	530
Prestar Resources Bhd	Steel manufacturing	227.5 million RM	811
Malayan Flour Mill Bhd	Food production	1.06 billion RM	2250
Hwa Tai Industries Bhd	Food production	37.4 million RM	1750
Kawan Food Bhd	Food production	1.26 billion RM	173

Source: MIDF and Bloomberg (2017)

Another important DFI is the Bank of Industri and Teknology (BIT) which was established in 1979. The main objective of the bank was to fund high technology and capital intensive industries in strategic sectors (Bank Negara Malaysia 2017b). A major scheme that is administered by the BIT Bank is the Export Credit Refinancing scheme (ECR), which attracted the attention of the World Trade Organization (WTO)[43]. The ECR scheme offers exporters two types of loans: pre-shipment finance that is incurred in the production stages (i.e. the purchases of raw materials) and post-shipment finance that is provided to the overseas importer. Another scheme offered by the BIT Bank is the export insurance scheme which protects the exporter from non-payments.

ECR financing has increased from 140 million USD in the late 1970s covering three percent of the total manufacturing exports to 9.6 billion USD covering 22.5 percent of the manufacturing exports in 1989 (Salleh and Meyanathan 1993). While the Malaysian authorities insist that the ECR is not an export subsidy, the WTO continued to argue that the ECR interest rate is below the commercial banks' rate which creates distortion in the market. In 2005 the Government suspended the activities of the Bank of Industri and Technology, and it was, then, replaced by the SME Bank (Gustafsson 2007).

3.5.2.2 Central bank priority lending

After promoting the Malaysian New Economic Policy (NEP) in 1970, the Central Bank started commanding private banks to provide the NEP's targeted sectors with sufficient credit at a lower cost. For instance, in 1975, the Central Bank required commercial banks to allocate at least half of their net lending increase to identified priority sectors. This is in addition to government direct loans that accounted approximately for twenty-two percent of the total banking credit in 1975 (Salleh and Meyanathan 1993). In 1979, Central Bank

[43] The WTO argues that the ECR creates distortion in the international market (Gustafson, 2007).

introduced the annual Priority Lending Guidelines to insure that priority sectors have adequate access to finance[44] (Fay and Jomo 2000).

After the government launch of heavy industries in 1982, the government insured the steel and automobile industries' access to cheap finance. Furthermore, the Central Bank has urged commercial banks to lengthen their average maturity of credit to support the rapid industrialization needs[45] (Fay 2001). This support is a potential explanation for the growth in the manufacturing sector's share of total credit from nineteen percent in 1970 to twenty-three percent in 1990 making it the largest recipient of credit in the Malaysian economy (see Table 3.13).

Another mechanism for priority sectors' lending is the Bilateral Payment Arrangements (BPA). BPA are arrangements by the Malaysian Central Bank which guarantee payment for exported goods and facilitate credit for the importing country if it suffers from foreign exchange shortages. While the first BPA was signed in 1988 with the Government of Iran, the most important arrangement is called the Palm Oil Credit and Payment Arrangement (POCPA) which was promoted in 1992.

The POCPA is used in two ways. First, it can assists developing countries that lack the hard currency to purchase Malaysian palm oil. In exchange, Malaysia can get a needed commodity (e.g. coal, iron, cement or ore) from the other country. Secondly, through POCPA the importing country can postpone the payment for two years at an interest rate determined by the London Inter-Bank Offered Rate (LIBOR) in US dollars dominated payment or other standard rates for loans paid in other currencies such as the yen[46](Gustafsson 2007). Until 2009, there were twenty-two countries that have benefited from the POCPA's 500 million USD allocated by the Malaysia Central Bank[47]. This arrangement is among a bundle of policies designed to support palm oil production which are meant to contribute to the diversification of the agricultural industry away from rubber

[44] It is important to note here that while the Central Bank used to penalize commercial banks that do not meet the Priority Lending Guidelines, this regulation has been relaxed dramatically in recent years (Fay and Jomo, 2000).
[45] The share of short-term financing to total domestic credit has declined from 37.2 percent in 1978 to 29.7 percent in 1990 (Fay, 2001).
[46] In 1994, the IMF argued that POCPA was a violation of its three months' rule for official payment arrangement, because POCPA was an arrangement over two years. However, the Malaysian government have assured that POCPA is valid and will not be affected (Gustaffson, 2007).
[47] For instance, POCPA played an important role in protecting the local palm oil industry when the domestic fertilizer prices escalated by approximately 200 percent in 2008. The Central Bank, through POCPA, approved an exchange of 70 million USD worth of palm oil in exchange for palm oil fertilizer (The Star 2009).

(Kjöllerström and Dallto 2007; Rasiah 2006; UNECA 2016). Figure 3.10 shows the growth of the palm oil share in total agriculture exports.

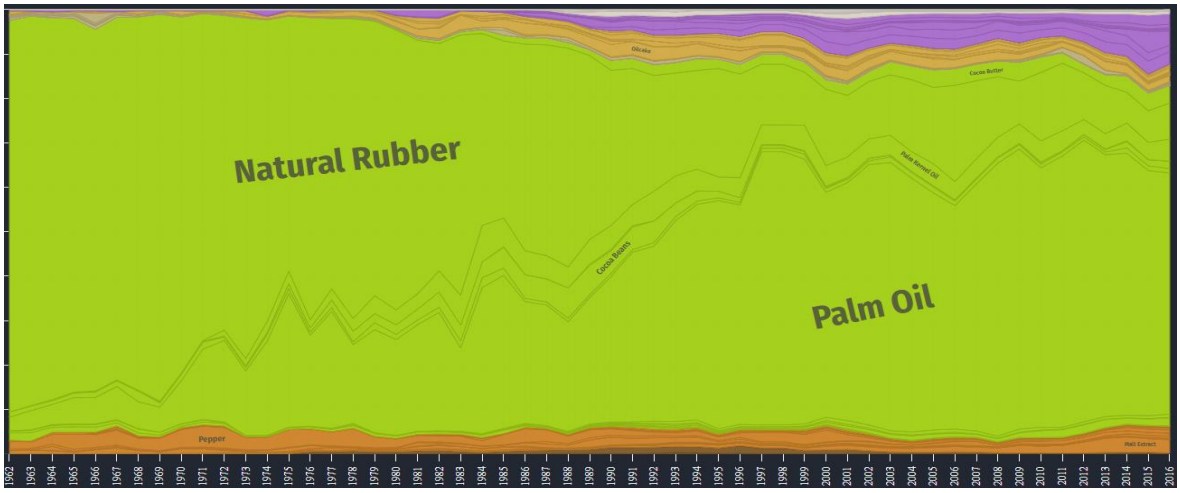
The implementation of such financing mechanisms shows clearly how developing countries can find a way to support their industries without violating the WTO legal framework. It is an example of the argument by Chang (2011) which shows that, while the space for industrial policy has become smaller in recent years, there is still room for supporting priority sectors.

Table 3.13: Total credit to private sector by economic activity (in millions RM)

	1970		1980		1990	
Sector	**Value**	**Share**	**Value**	**Share**	**Value**	**Share**
Agriculture	240	10%	1648	8%	4238	5%
Mining	51	2%	211	1%	833	1%
Manufacturing	466	19%	4694	22%	18742	23%
Electricity	-	-	279	1%	202	0.25%
General Commerce	756	32%	4644	22%	11642	14%
Real estate and construction	207	9%	3117	15%	14599	18%
Housing	-	-	2323	11%	9587	12%
Transport and storage	17	1%	400	2%	1342	2%
Financing, Insurance and business services	80	3%	1297	6%	9105	11%
Others	543	23%	2509	12%	10473	13%
Total	2360	100%	21122	100%	80763	100%

Source: Salleh and Meyanathan (1993)

Figure 3.10: Shares of Malaysia agricultural exports (1962-2016)

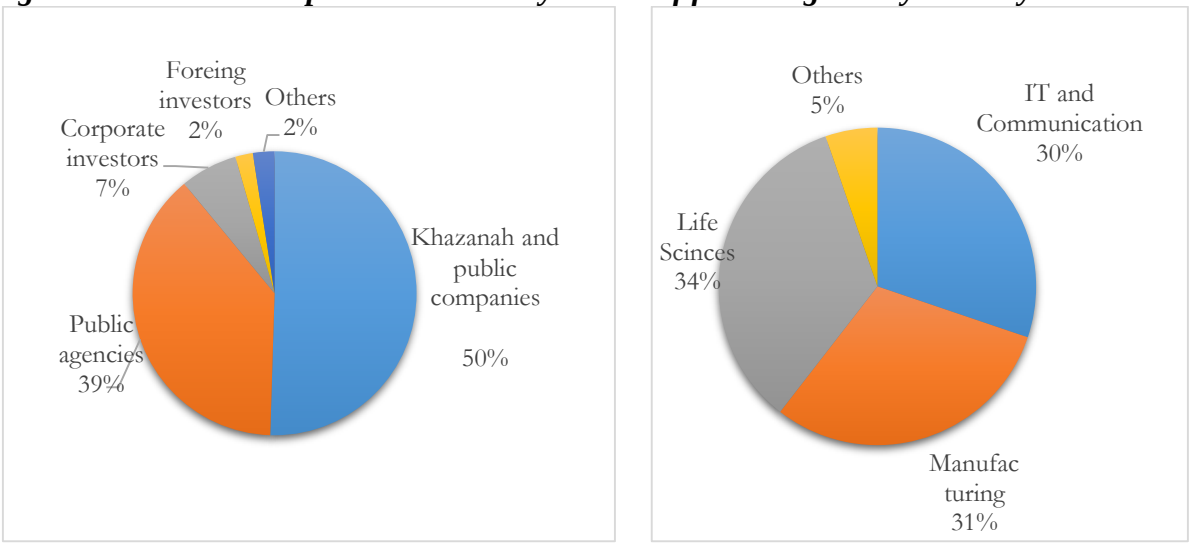


Source: based on Hausmann et al. (2014).

3.5.2.3 Public venture capital

After announcing "Vision 2020" in 1991 which promoted innovation policies, the Government promoted a number of venture capital (VC) funds/programmes that support innovative firms (Wonglimpiyarat 2011). These public VC funds include the Malaysian Technology Development Corporation (MTDC), the Sovereign Wealth Fund (Khazanah) and the Malaysia Venture Capital Management Berhad (MAVCAP). In 2015, public funds contributed with eighty-nine percent (6.2 billion RM) of the total VC committed funds (7.1 billion RM). With regard to the targeted sectors in 2014, the life science sector[48] accounted for 34.2 percent, followed by the manufacturing sector with 30.3 percent and the IT and the communication sector with thirty percent. Figure 3.11 shows the sources of VC and its targeted sectors.

Figure 3.11: Venture capital investment by source of financing and by industry



Sources: The Ministry of International Trade and Industry and the Malaysian Venture Capital Development Council

The largest institution in the Malaysian venture capital industry is Khazanah - the sovereign wealth fund (SWF)- which was established in 1994. It is totally owned by the Ministry of Finance and manages total assets of 40 billion RM. Besides managing the commercial assets of the government, since 2004, Khazanah has been giving greater importance to domestic economic development. Khazanah invests in sectors such as infrastructure, transportation, tourism, ICT, life sciences and manufacturing (interview with Khazanah official, June 2018). An example of Khazanah's role in supporting economic

[48] The life science sector includes chemistry, health care, agriculture, biotechnology projects.

diversification is the establishment of a company called Blue Archipelago Berhad with the purpose of promoting farmed shrimp production[49] (Kharas et al. 2010).

In its overseas activities, Khzanah invests mainly for three motives: financial rewards, accessing new technologies or accessing new markets for Malaysian companies. In the evaluation process of any new investment, a major question to be addressed by Khazanah staff is: how can the Malaysian economy benefit from investing in the targeted company? In the electronics sector, for instance, investee companies are introduced to the Malaysian electronics cluster in Penang to learn about outsourcing and collaboration opportunities (interview with official in Khazanah, May 2018).

Another important public venture capital institution that should be highlighted in the context of industrial diversification is the Malaysian Technology Development Corporation (MTDC). The main motive for its establishment and development is the lack of funding for entrepreneurs in unproven activities[50]. At the outset, MTDC had two funds: the commercialisation of local R&D fund (CRDF) and the technology acquisition fund (TAF). The main purpose of such funds is to finance the development of high-technology seed projects, which are often neglected by private finance because of the high risks involved (Mazzucato 2011). This area is also called "the valley of death" in the venture capital literature (Cardullo 1999).

CRDF is a fund that is concerned with the commercialisation of products and processes developed by local universities and research centres. Since the establishment of CRDF in the late 1990s, it has funded 271 projects (445.6 million RM) in various industrial sectors, including 153 recipients who have successfully commercialized their research and which attracted private investment of 418 million RM. Between 2006 and 2011, these products generated 1.27 billion RM in sales, including 261 million RM of exports[51].

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[49] In co-operation with the Malaysian Department of Fisheries, the Blue Archipelago acquired a poor performing farm (Kerpan Farm) and transformed it into a fully integrated aqua-culture operation. Kerpan Farm is currently running the largest shrimp farm in North Malaysia spanning 420 hectares, which contains all the elements of the shrimp production value chain (from hatchery to processed shrimp) and exports to Japan, Europe and the U.S. In addition to Kerpan, Blue Archipelago Berhad started constructing a larger farm in 2010 that spans 1,000 hectares. The new farm is called iSHARP (integrated shrimp aquaculture park) and started its operations in 2015 (Blue Archipelago, 2018; Kharas et al. 2010).

[50] Bank Negara Malaysia (2016) maintains that Malaysian commercial banks have limited knowledge in supporting innovation and new growth areas. Accordingly, the report highlights the need for alternative financing tools to bridge this gap.

[51] An example of CRDF successful supported projects is a telematics system developed to observe fleet movements. The developer was Bsmart in co-operation with Univesrity Teknologi Malaysia (UTM). The project created approximately 83 million RM of sales between 2007 and 2011, and the product was exported to countries in East Asia, South Africa and the Middle East. Another beneficiary company is Henh Hiap Industries which created a

While R&D is considered a major factor in promoting innovation, developing countries need also to invest in learning production techniques that already exist in technologically more advanced countries. This broader view of innovation is crucial in understanding the technological change and industrial development in the developing world (UNCTAD 2007). The MTDC explained its promotion for the technology acquisition fund (TAF) by showing that acquiring foreign technology is expensive and complicated process. Since its establishment in 1997, it has approved 117 funds for technologies new to the Malaysian economy, and has resulted in 153 million RM worth of sales and forty-nine intellectual property (IP) registrations (MTDC 2013) [52]. Encouraged by accomplishments of the above two funds, the MTDC founded the Business Growth Fund (BGF) in 2011 to support projects at later stages of development (i.e. beyond the seed capital stage).

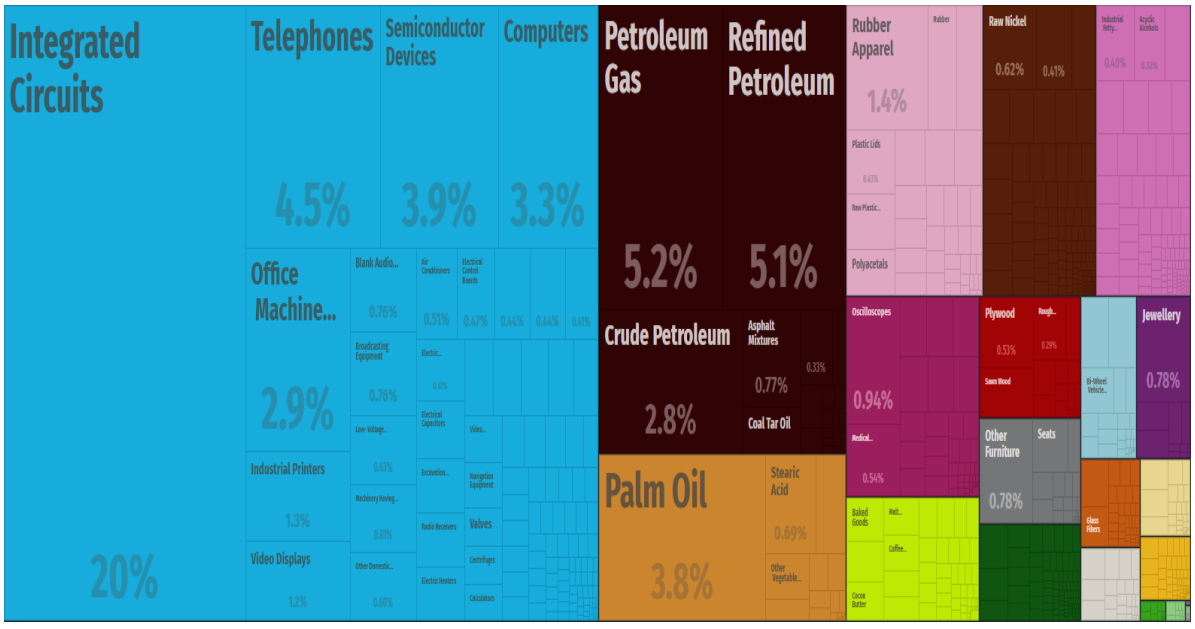
unique recycling system for plastic products. Between 2009 and 2012, it recorded sales of approximately 145 million RM, and exported the system to countries such as the United Kingdom, Australia, Japan and Europe (MTDC, 2013; Tngau 2017).

[52] An example of the success of TAF is the Hi-Essance Cable Company, which is a manufacturer of cables and wires for the oil, gas and chemical industries. Through the support of TAF, the company has acquired a Taiwanese technology which has resulted in the production of different types of heat and fire resistance cables. Currently, the company supplies these products to companies such as Petronas, Exxon Mobile and Shell. Another example is Rakannusa Corporation, which is a manufacturing company in the chemicals industry. Through TAF support, the company has acquired a Japanese technology that is suitable to produce ceramic balls for applications in the oil refining industry. The company now produces its own products for the domestic market and exports to oil companies in the Middle East (MTDC 2013).

3.5.3 The semiconductors industry

During the 1970s, when a large number of MNCs were looking for cheap production facilities for assembly and packaging activities, the Malaysian authorities played a big role in attracting investors to the semiconductors industry (and electronics in general) through offering generous fiscal incentives, establishing special economic zones (SEZs) and developing human resources (Appendix 3 provides greater details on the government role in attracting foreign investors to the semiconductors sectors). Accordingly, a large number of semiconductors firms relocated their facilities to Malaysia. First, National Semiconductors opened a plan in Penang in 1971, which was followed by other foreign firms such as Intel, Hitachi, Siemens, Advanced Micro Devices (AMD), Hewlett Packard (HP), Texas Instruments and Motorola (Hobday 1999). By the 1980s, Malaysia became the largest developing country in semiconductors production (Chen 1999). Currently Malaysia is the third largest semiconductors producer after South Korea and China. Semiconductors exports stood at 61.9 billion USD, accounting for more than twenty-three percent of the total exports and forty-nine percent of the total machinery and equipment exports[53] (see Figure *3.12*). In 2014, the semiconductors sector employed 150,673 people (Ministry of International Trade and Industry 2017).

Figure 3.12: The Malaysian export basket (2015)



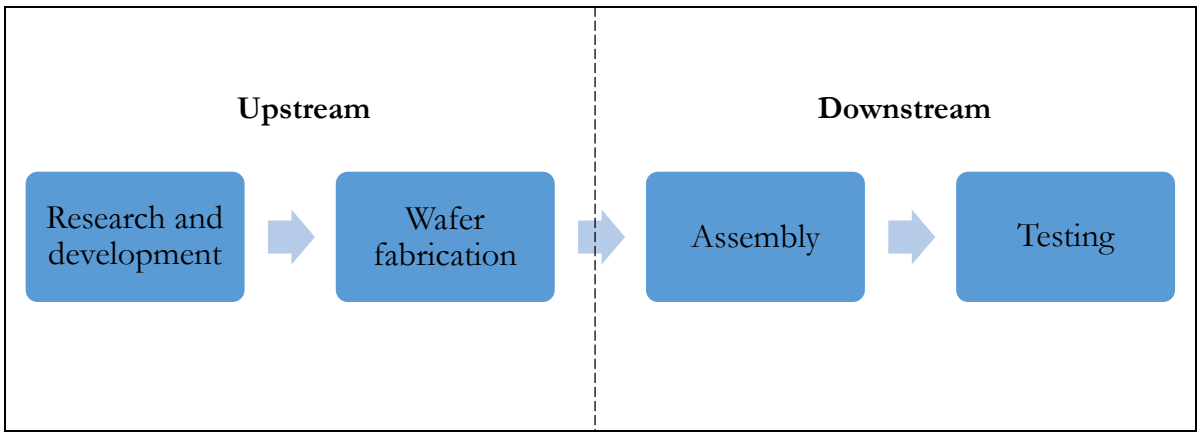
Source: based on Hausmann et al. (2014).

[53] Semiconductors exports include integrated circuits in addition to semiconductors devices.

The semiconductors value chain can be divided into four stages: research and development, wafer manufacturing, assembly and testing (see Figure 3.13). The first two stages are located in the upstream, while the later stages are in the downstream of the semiconductors value chain. The four stages involve substantially different levels of capital, skills and technology. First, the R&D stage, which involves circuits design, is considered the highest technology intensive stage and requires highly qualified scientists and engineers. Next, the new circuit designs have to be integrated onto silicon wafers in the wafer fabrication stage. This stage requires the use of oxygen and pure water in a dust-free operating facility. Through the use of photographic techniques (photomask), engineers and scientists print the designed circuit on the silicon wafer. The difficulty at this stage comes when a new generation of integrated circuits is introduced. This requires a significant change in the production process because of the need for thinner circuits, and thus it needs an additional capital investment (Chen 1999).

The assembly stage is where the wafer is cut and attached to frames and wires are attached to the printed circuit board. Finally, the testing stage entails the inspection of the products to ensure their reliability and performance and this is followed by packaging and delivery. The assembly and testing are labour-intensive and relatively low added value stages (Chen 1999). According to the global value chains' (GVCs) literature, semiconductors production is a vertically specialized value chain, which means that each stage can be produced independently in different geographical areas following their relative production cost (Kaplinsky 2015).

Figure 3.13: The semiconductors' value chain



Source: Chen (1999).

From the 1970s until the early 2000s, the semiconductors production was located mainly in the assembly and testing stages (downstream). During this period, Malaysian

public finance played a big role in the development of domestic suppliers and producers, such as Globetronics and Waftech. Globetronics is a wholly owned Malaysian company that was established in 1991. It specializes in the assembly, testing and packaging of semiconductors. Because of the founders' expansion plans and their need for additional capital, the Malaysian Technology Development Corporation (MTDC) has financed the company in return for a thirty percent equity stake (MTDC 2013). This investment helped the company to grow and expand its production portfolio significantly towards LED devices, quartz crystal oscillator timing devices and optical and sensor devices (Globetronics 2017).

In 1997, Globetronics was listed on the Malaysian Secondary Stock Exchange, and in 2001, the company was promoted to the main Stock Market of Malaysia. Currently, its market capitalization is 1.63 billion dollars and it employs 2,900 workers in six factories (Bloomberg, 2017). Another example is Waftech which was financed by the Commercialization of R&D Fund (part of MTDC) in 2008 to produce a wafer testing and assembling systems. Later, the Business Growth Fund (also part of MTDC) financed its production facility expansion (MTDC, 2014). Waftech currently exports to Singapore, China and the Philippines (Waftech Sdn Bhd, 2017).

Until the 1990s, the majority of semiconductors firms in Malaysian were not seeking to upgrade towards wafer fabrication and R&D stages. However, the government during Mahathir first precedency (1981-2003) did not offer grants for integrated circuits design; instead it acquired a technology company from California called VLSI in 1995 to establish wafer fabrication domestically (Rasiah et al. 2017). Furthermore, following the experience of Taiwan's Industrial Technology Research Institute (ITRI), which created two pioneer companies in the semiconductors industry[54], the Malaysian Institute of Micro-electronics Malaysia (MIMOS) has been established to promote innovation and high added value manufacturing in the Malaysian electronics sector (Ting 2016). This institute operates under the umbrella of the Ministry of Science, Technology and Innovation (MOSTI). In 1997, MIMOS opened the first wafer fabrication facility in Malaysia (MIMOS Wafer Fab) with the mandate of contributing to the upgrading of the semiconductors industry from assembly

[54] ITRI has created the United Microelectronics Corporation (UMC) and Taiwan Semiconductor Manufacturing Company (TSMC). Both companies now are at pioneers in the semiconductors industry (Ting, 2016).

and testing towards fabrication and innovation (MIMOS, 2017). However, MIMOS and VLSI did not have a great success (Rasiah, 2006).

In 2000, the state of Sarawak financed the establishment of another wafer fabrication plant 1st Silicon[55]. In 2001, Khazanah Holdings (the Malaysian sovereign wealth fund) invested in a wafer fabrication plant (Silterra) which operates in the Kulim Technology Park in Kedah state[56]. This developmental and risky investment by the Malaysian sovereign wealth fund (SWF) had a crucial implication for other developing countries. While the majority of SWFs in resource-dependent developing counties are investing in financial securities, real estate or hedge funds in the global markets (Bahgat 2011), Khazanah invests in strategic infrastructure, services and manufacturing projects.

In 2003, when Badawi became Prime Minister, he was convinced by Peneng's Chief Minister to offer grants for foreign and domestic firms which were willing to upgrade their manufacturing towards wafer fabrication and integrated circuits design[57]. Since then three domestic firms opened wafer fabrication facilities (i.e. Globetronics, Carasem and Unisem). In addition, foreign firms have followed suit benefitting from the federal government approval of grants. These firms include Infineon, Osram (a subsidiary of Siemens), Onn and AMD. In 2008, Intel announced its intention to transfer its ordinary Penang production facility to Kulim in order to dedicate its Penang facility to integrated circuits design operations and benefit from the recently promoted government support (Rasiah et al. 2017).

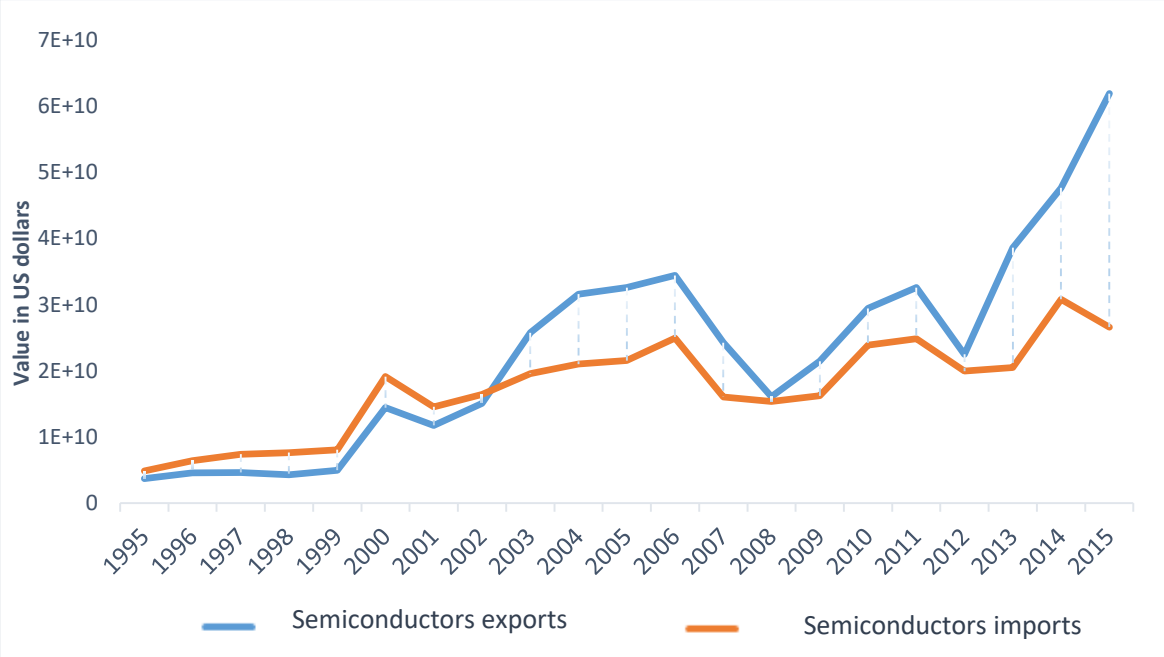
Accordingly, the number of firms in wafer fabrication has increased from none in 1997 to eleven firms in 2014. While none of these firms participates in R&D related to miniaturization of the wafer diameter, which is the most important dimension of frontier technology development in semiconductors, there has been a significant increase in the number of patents registered in the US by Malaysian semiconductors firms from seven patents in the period from 1980 to-2005 to 309 patents in the period from 2006 to 2011 (ibid.). Furthermore, because of the sector' upgrading towards wafer fabrication and design,

[55] 1st Silicon is now called X-FAB Sarawak, after it has been acquired by a German company (X-FAB Silicon Foundries).
[56] Kulim Technology park is a subsidised industrial park that was established in 1996 to accommodate high-tech firms.
[57] Dr Mahathir's government was reluctant to offer grants to support wafer fabrication and R&D activities for foreign firms. This restricted the upgrading of the semiconductors sector before 2003 (Rasiah et al., 2017).

the semiconductors trade deficit has turned into surplus since 2002. This surplus exceeded 35.3 billion RM in 2015 compared to a deficit of 4.7 billion RM in 2000 (see Figure *3.14*).

In conclusion, the state has financed the semiconductors sector development in two ways. First, public financial institutions have been crucial in supporting entrepreneurship among domestic suppliers and producers (e.g. Globetronics). Second, government R&D grants in addition to public investment and financing have contributed to the sector's upgrading from assembly and testing phases towards high added value activities such as wafer fabrication and circuit design. This upgrading has reduced reliance on imported fabricated silicon and increased the domestic added value.

Figure 3.14 Semiconductors exports and imports*



*The export and import graphs are aggregated using 8541 (Integrated circuits) and 8542 (Semiconductor devices) in the four-digit harmonized system (HS4). Source: COMTRADE data.

3.6 Comparison between the role of public financial institutions in Chile and Malaysia

This section compares and contrasts key roles of public financial institutions in the context of resource-dependent countries; namely, innovation supporters, developmental agents, technology change enablers and challenge-led institutions (Amsden 2001; Mazzucato and Penna 2016).

- **Innovation support role**

Innovation has always been promoted by public financial institutions in Chile and Malaysia. According to "Start-up Chile", Chile is ranked first in Latin America and fourth worldwide in its support for start-ups [58]. The OECD (2016) argues that CORFO is the main tool for Chile's support for entrepreneurs and innovation. In an interview with a high official in CORFO, he explained that their support for entrepreneurship takes place through four main programmes: seed capital (Capital Semilla), flexible seed grants (SSAF), regional entrepreneurship and innovation (PRAE), and Start-up Chile. These programmes have supported a total of 2,898 projects between 2014 and 2017, with 98.5 million USD (see *Table 3.14*). A survey by CPRFO shows that, in 2016 alone, 1710 entrepreneurs supported by CORFO have generated around 457 million USD in sales (see *Table 3.15*).

In the venture capital industry, the OECD (2016) also argues that CORFO is the single most important entity in supporting innovation firms in Chile. It finances them directly or indirectly, through venture capital funds, i.e. Fundacion Chile (FCh) or private funds. In the period (2005-2015), CORFO has utilised more than 600 million USD for venture capital investment targeting innovative firms (OECD, 2017). Furthermore, CORFO continues to work closely with FCh, ProChile and other agencies to attract foreign venture capital to Chile in specific targeted innovation activities (interviews with officials in CORFO and ProChile, February and May 2018 respectively).

The Malaysian government supports innovation mainly through R&D grants, innovation commercialization and technology acquisition. Public venture funds are considered an important tool in channelling the government support for innovative firms (Rasiah and Yap 2015). These funds include the Malaysia Technology Development Corporation (MTDC), Khazanah and Malaysia Venture Capital Management Berhad

[58] Start-up Chile has cited the Global Accelerator Report (2015) which is concerned with global start-ups and entrepreneurship.

(MAVCAP). In 2015, these public institutions accounted for eighty-nine percent of the total committed finance in the venture capital industry (Ministry of International Trade and Industry, 2016).

Table 3.14: CORFO innovation support (2014-2017)

Programme	No. of projects	Amounts in USD
Capital Semilla (Seed Capital)	506	20,314,384
PRAE (regional programme for enterpreneurship support)	676	22,809,956
SSAF(seed fund for incubators)	1596	27,978,812
Start Up Chile	791	25,267,257
The S Factorr (female start-ups)	135	2,214,713
Total general	2989	98,585.122

Source: unpublished data from CORFO

Table 3.15: Sales of the projects supported by CORFO in 2016 (in USD)

Programme	No. of projects	Total Sales in Chile 2016
Capital Semilla (Seed Capital)	586	292,182,048
PRAE (regional programme for entrepreneurship support)	344	26,580,893
SSAF(seed fund for incubators)	511	78,590,396
Start Up Chile	263	59,964,969
The S Factorr (female start-ups)	6	11,927
Total	1710	457,330,231

Source: unpublished data from CORFO

- **Developmental agents**

Public financial institutions in the two countries are indeed developmental and policy guided. In Chile, CORFO was established in 1939 to restructure the country after a devastating earthquake and to implement the government development programmes (Mamalakis 1969). CORFO "has acted as a financier, entrepreneur, investor, innovator and researcher, and frontiersman" (p.118). With regard to the targeted sectors and products, CORFO currently targets sectors and products identified by the National Council on Innovation for Competitiveness (NCIC) (OECD 2009).

Similarly, in Malaysia, the Development Financial Institutions (DFIs) and public venture funds finance sectors and products following the guidelines of the national strategy. Since the establishment of DFIs in the 1960s, for instance, their mandate has been to promote and develop specific sectors that are strategic to the economic and social development of Malaysia (Bank Negara Malaysia 2017b). Their involvement is not expected only during

nation building or transformation periods, but also to continue to upgrade the manufacturing sector following the appropriate Malaysian development plans (Abdul Ghani 2005).

Accordingly, the public financial intuitions in both countries have supported different set of sectors. In Chile, they target resource-based sectors such as salmon, wine, vegetables, fruits, forestry and minerals. On the other hand, in Malaysia they target wider range of sectors such as palm oil, aquaculture, biotechnologies, machineries, electrical devices and semiconductors.

- **Technology change enablers**

Technological change requires committed and long-term finance (Mazzucato 2013). In Chile, FCh and CORFO have been instrumental in acquiring foreign technologies. The farmed salmon industry, for instance, has been established in Chile after FCh's investment and support in acquiring Norwegian and Scottish farmed-salmon production techniques. Furthermore, FCh does not only support the acquisition of foreign technology, but also demonstrates its profitability, and then diffuses the associated know-how (Katz 2007).

In Malaysia, similarly, public financial institutions have been financing industrial projects that had never previously existed. Some of these institutions, e.g. MTDC and Khazanah, have an explicit mandate of bringing in foreign technologies. MTDC utilises the Technology and Acquisition Fund (TAF) which specializes in financing the process of transfer and adaptation of technologies that exist overseas. On the other hand, for Khazanah, which invests in foreign markets, the issue of technology acquisition has always been an important consideration in their investment decision analysis (interview with Khazanah officials, March-May 2018).

- **Challenge-led institutions**

Mazzucato and Penna (2016) refer to this role as 'mission-oriented', an expression which describes institutions that tackle certain challenging issues pre-identified by national strategies. A clear example of this role is the public financial institutions' support for the establishment of the first wafer fabrication plants in Malaysia following the national strategy of upgrading the electronics sector to higher value-added activities. Another example is the role of CORFO and Fundacion Chile in establishing the niche resource based industries through the financing of new firms and adapting foreign technologies that suit the Chilean environment.

Yet another example of the challenge-led role is the public banks' support for climate change adaptation projects (ibid). While it is beyond the scope of this study, public banks' role in the environmental challenge shows their commitment in supporting projects with a high social value. Public financial institutions in both countries are taking the lead in supporting green technologies. In Chile, Violic (2015) highlights that CORFO in 2008 launched a programme for Non-Conventional Renewable Energy (NCRE) which has kick-started financing renewable energy in the country. The programme's budget was 138.8 million USD providing cheap and long-term finance for green projects, in co-operation with commercial banks. In Malaysia, similarly, a DFI, the Credit Guarantees Corporation (CGC), is taking the lead in green projects' funding. In 2010, it introduced the Green Technology Financing Scheme (GTFS) programme to promote production and investments in green technologies. Until June 2017, the programme had approved 2.63 billion RM worth of projects (CGC, 2017). Table 3.16 summarizes the comparison between the roles of public financial institutions in Chile and Malaysia.

Table 3.16: Summary comparison between the role of public financial institutions

	Chile	**Malaysia**
Structure	- CORFO is the main government tool to finance industrial diversification. - It coordinates with other public agencies (e.g. FCh) regarding financing.	- While attracting foreign investment has been the main tool to finance the manufacturing development, public financial institutions has been an important instrument in directing financial resources to targeted industrial sectors.
Innovation investors	- CORFO has several programmes that target innovation projects (e.g. Start-up Chile). - CORFO is the most important player in the VC industry. - It supports directly or indirectly (in co-operation with agencies like FCh)	- DFIs are major financiers for industrial entrepreneurs - The VC industry is dominated by publicly specialized venture capital funds, e.g. MTDC
Developmental	- Currently, public finance targets sectors identified by the National Council on Innovation for Competitiveness (CNIC) - Since the 1970s, their support has been more focused on natural resource industries	- Currently, public finances target industrial sectors identified by the Industrial Master Plans - They target the development of a wide range of industries, e.g. electronics, machinery, and natural resource manufacturing
Technology change enablers	- FCh is a unique institution in acquiring technologies for certain domestic challenges and potential industrial opportunities	- MTDC has established a programme called the Technology Acquisition Fund (TAF) which is devoted to finance technology transfer
Challenge led	- Public finance was crucial in establishing industries that did not exist in the country, e.g. farmed-salmon - The main financier for green projects is a programme run by CORFO and some commercial banks	- Public finance was crucial in the upgrading of the electronics sector, e.g. funding the first two wafer fabrication firms in Malaysia - The main financier for green projects is the Credit Guarantees Corporation (a DFI).

3.7 Conclusion

The chapter investigates the role of the state in financing industrial diversification and upgrading in two resource-dependent developing countries that have successfully diversified their economies. This study questions a major mainstream argument concerning resource-dependent counties which states that liberalizing the financial system and reducing state-directed credit are key factors in promoting economic and industrial development (Beck and Poelhekke 2017; IMF 2016). Contrary to this belief, this study provides evidence that the governments of Chile and Malaysia have played a significant role in financing the manufacturing sector's upgrading and diversification. In both countries, industrial diversification did not take place in a "free financial market" setting.

The state-directed credit in these two countries has supported the industrial diversification following two different strategies. In Chile, the state has contributed to financing the development of resource based manufacturing through its development agency (i.e. CORFO) and venture capital institutions (mainly Fundacion Chile). The main targeted sectors are mining, forestry, fruit, aqua-culture and wine. In Malaysia, on the other hand, while this study acknowledges the prominence of attracting foreign investments to finance industrial diversification, this narrative is incomplete without considering the role of the state in directing financial resources towards new activities and strategic sectors. Malaysia has targeted the development of a wider variety of sectors ranging from palm oil and rubber to electronics and semiconductors.

This study also provides two sector-specific sections which examine the role of state finance in the development of two different value chains. In Chile, the role of Fundacion Chile and CORFO was not only crucial in establishing farmed-salmon production, but also in "thickening" the value chain through its support of firms in the upstream and downstream of the salmon cluster. In the Malaysian semiconductors cluster, which had been dominated by FDI since the 1970s, the state has played a significant role in financing the upgrading of the semiconductors cluster from one that was solely dependent on assembly and testing towards original brands manufacturing (i.e. fabricating the integrated circuits domestically).

Finally, the chapter has compared the roles of public financial institutions in both countries, and argued that they share important features for resource-dependent countries; explicitly they are developmental agents, innovation promoters, challenge-led and technology transfer enablers.

4 Promoting and financing industrial diversification in resource-dependent developing countries: the case of Saudi Arabia

4.1 Introduction

Following an investigation of the important role of the state in promoting and financing industrial diversification in Chile and Malaysia (in Chapter 3), this chapter extends this investigation to a country that has not diversified its industrial sector yet: Saudi Arabia. This chapter does so by looking at two main questions. First, what are the sectors that could be targeted by Saudi Arabia? This chapter tries to answer this question by discussing and contrasting three different patterns of industrial diversification from the context of resource-dependent countries. Secondly, how is finance in Saudi Arabia meant to support the intended diversification effort? This chapter tries to answer this question by looking at the structure and role of the existing Saudi financial system, and the potential role of the state in financing the proposed industrial development.

Saudi Arabia is a large, sparsely populated, and resource-dependent developing country. It accounts for 21.9 percent of the world oil reserves, produces around 10.1 million barrels of crude oil a day, and is considered the second largest oil producer in the world after the United States (EIA, 2017). The oil sector is the main driver of the Saudi economy accounting for 22.3 percent of gross domestic product (GDP) and seventy-four percent of total exports (SAMA 2017).

Despite its steady economic growth over the last two decades, Saudi Arabia was hard hit by the crash in oil prices in 2014-15[59], which resulted in a significant decline in total exports and balance of payment deterioration. In 2015, the total export value dropped by 46.2 percent compared to 2014, and the surplus in the balance of payments (276.6 billion SR in 2014) turned into a significant deficit (212.7 billion SR in 2015). This shock was a major reason for the government to promote its Vision 2030 which aims to reduce the country's reliance on oil revenues and to promote sustainable economic development.

This chapter outlines the importance of industrial diversification as a main pillar for the Saudi long-term growth and development, then proposes three industrial diversification strategies and applies them to the Saudi context in addition to comparing them to the recently

[59] Oil prices (for Brent crude) dropped from 114 US dollars a barrel in June 2014 to 45 US dollars in January 2015, before it reached its lowest- since 2003- in in February 2016 when the price stood at 28 US dollars. However, oil price has been increasing since then; the average oil price in 2017 was 54.2 US dollars (EIA, 2018).

promoted Vision 2030. Finally, it investigates the role of the financial system in supporting the industrial development.

This study contributes to the literature in two ways. First, it contributes to the scarce literature on industrial diversification in oil-dependent countries in general, and Saudi Arabia in particular. This chapter is a pioneer work in the extent and nature of its utilization of three major industrial strategies that have been highlighted in the context of resource-dependent countries. The outcome of this study can shed light on the linkages from the oil sector to other manufacturing activities in Saudi Arabia, and can also serve as a reference for other oil-dependent developing countries.

Secondly, investigating the relevant literature carefully indicates that there is no existing research on the role of Saudi public financial institutions (such as the Saudi Industrial Development Fund) in promoting industrial development and diversification. However, analysing their role requires data and information that are not available in published forms. Thus, this chapter conducts semi-structured interviews with high-ranking officials at public and private financial institutions that allow the researcher to investigate their role extensively (Appendix 1 provides more details about the semi-structured interviews process).

The study starts with a conceptual framework. Then, it applies three industrial upgrading strategies to the Saudi context: resource based industrialization (e.g. Hirschman 1981; Perez 2015; Ramos 1998), the product space analysis (Hidalgo et al. 2007) and the growth identification and facilitation framework (Lin and Monga 2011). Finally, it looks at the capacity and capabilities of public financial institutions in financing these strategies.

4.2 Conceptual framework

This section begins by reviewing the resource curse theory, i.e. natural resource exploitation undermines manufacturing sector development and thus hinders economic growth. Then, the section outlines four main challenges facing the resource curse theory. Finally, it contrasts three industrial development and diversification strategies for natural resource-dependent countries.

Influential and widely cited studies by Sachs and Warner (1995, 1999) argue that resource abundance, measured by the share of primary exports to GDP, is negatively correlated with economic growth. Using a cross-country analysis for ninety-seven countries

for the period 1970-1990, Sachs and Warner estimated that doubling the primary products share in total exports led to a reduction of 0.62 to 1.51 of annual GDP growth.

In a later study, Sachs and Warner (2001) show that the Dutch Disease is a main explanation for the resource curse; namely that natural resources crowd out the manufacturing production. They show that the wealth accumulation resulting from natural resources increases the demand for non-traded products and drives their prices up, and more specifically it drives up non-traded inputs, costs and wages. This process squeezes countries' profit in traded products (such as manufacturing products), and makes it harder to compete in the international markets.

Another mechanism through which the Dutch Disease works is exchange rate appreciation. Commodity revenues may force upward pressure on the prevailing real exchange rate, which reduces the competitiveness of non-resource exports (Corden 1984). The decline in British industrial exports during the 1970s, after the discovery of oil, in addition to the Dutch manufacturing decline after the discovery of natural gas in 1959 are recent examples. However, in both countries this negative impact did not last for long (Beck 2011).

There are four major problems with the natural resource curse theory. First, there is strong evidence of the correlation between resource endowment and manufacturing development in several developed nations. Indeed, industrial experiences show that "natural resources are by no means a curse." Ramos maintains that "the good or bad performance of natural-resource rich countries depends on the suitability of their economic policy, and not the mere fact of having natural resources" (Ramos 1998, p.106-7). Historical studies have shown that richness in minerals (including oil) played a crucial role in developing the manufacturing sector and promoting economic growth (Perez 2015). Wright (1990) and Wright and Czelusta (2004) have argued that resource richness in the United States in the 19th Century was a major factor in making it the world's manufacturing leader.

> *"Resource abundance was a significant factor in shaping if not propelling the U.S. path to world leadership in manufacturing. The coefficient of relative mineral intensity in U.S. manufacturing exports actually increased sharply between 1879 and 1914, the very period in which the country became the manufacturing leader… the timing of increases in production of a range of minerals in the United States is striking. Leadership or near-leadership in coal, lead, copper, iron ore, antimony, magnesite, mercury, nickel, silver, and zinc all occurred between 1870 and 1910.*

> *Surely this correspondence in timing cannot have been coincidental" (Wright and Czelusta 2004, p.9-11).*

Wright and Czelusta have also shown that the oil sector was not an exception. Indeed, oil discoveries have been correlated with a significant growth in the manufacturing sector. According to the US Energy Information Administration (EIA) data, US oil production increased from twelve thousand barrel a day in the late 1860s to more than seven million barrels a day in 1960 (see Figure 4.1). In the meantime, its share of industrial GDP increased from approximately twenty-one percent in 1840 to approximately forty percent in the period between 1910 and 1960 (Johnston 2012). Furthermore, the oil sector has contributed substantially to the development of the chemicals industry throughout the US. This development is an example of linkages and innovation that are fuelled by natural resource abundance (Wright and Czelusta 2004).

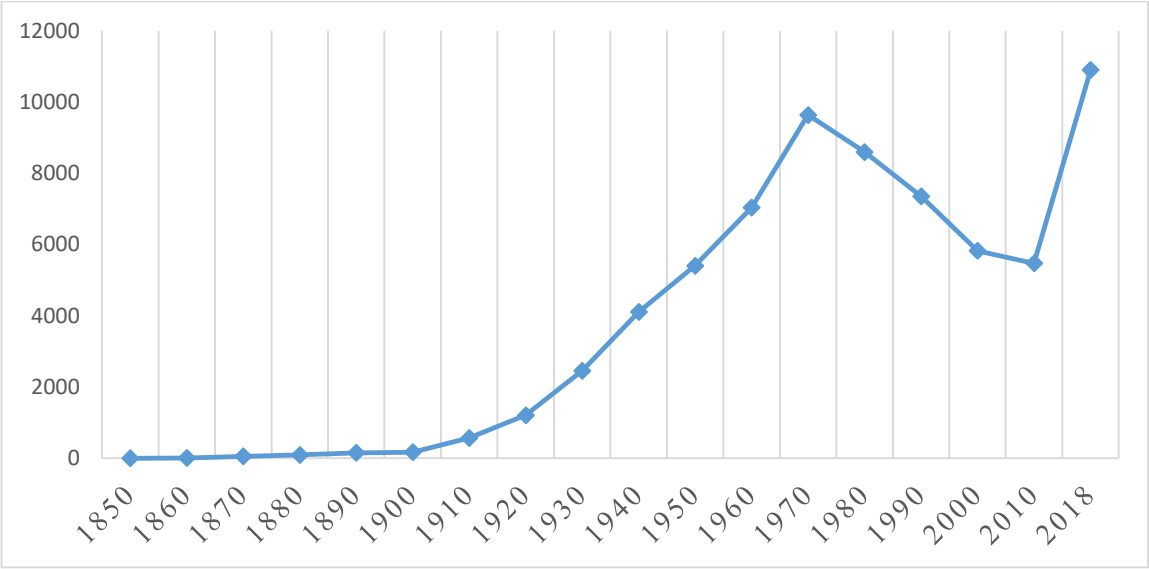
Furthermore, the discovery of oil in Southern California was followed by rapid economic development. According to Wright and Czelusta (2004):

> *"Before 1900, California was a remote, peripheral economy. Between 1900 and 1930, California (not Texas) became the leading oil state in the nation, and the result was a 'sudden awakening' of the regional economy. Spurred not just by jobs in oil but also by the dramatic fall in the cost of energy, California's share of national income nearly doubled. Contrary to Dutch disease models, the size of the state's manufacturing sector quadrupled." (p.20).*

Although California's industrial performance lagged behind the national level during the late 19th Century, the sector grew dramatically in the 20th Century after the oil boom (see Figure 4.2 and Table 4.1). Between 1899 and 1904[60], the number of industrial establishments increased by thirty-seven percent, and the number of industrial workers rose by twenty-six percent. In comparison, the national number of industrial establishments increased by only four percent and the number of production workers rose by fifteen percent (ibid.)

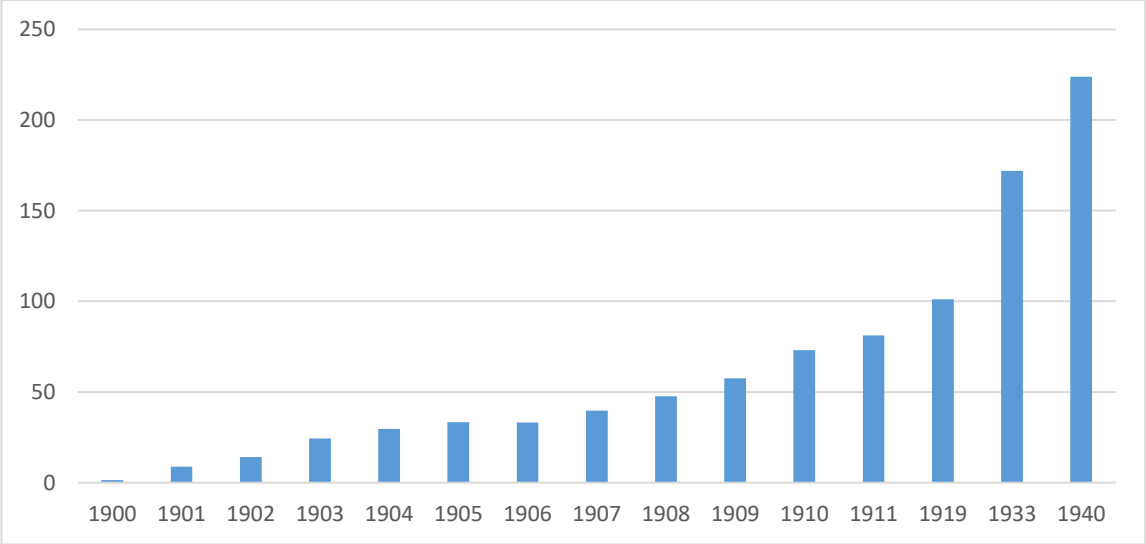
[60] This period is crucial in this regard, because in 1903, California became the largest oil producing state in the US (Rhode, 2001).

Figure 4.1: The US crude oil production (in thousand barrel per day)



Source: The US Energy Information Administration (EIA)

Figure 4.2: California oil production (in million barrels a year)



Source: Andreano (1970) and Adamson (2010)

Table 4.1: California manufacturing sector (1859-1997)

Year	No. of establishments	No. of production workers	Wages	Value added
1859	1,218	6,052	5,047	10,792
1879	4,231	39,525	18,427	38,510
1899	4,925	71,976	35,954	86,940
1904	6,755	90,404	57,267	114,739
1919	10,155	217,312	286,033	705,859
1939	11,558	271,290	358,734	1,122,545
1958	28,735	838,671	4,107,200	12,048,000
1977	45,289	2,224,200	13,150,500	45,862,400
1997	49,079	1,193,550	-	204,119,356

Note: wages and value added are in current thousands USD.
Source: Rhode (2001).

In Los Angeles, oil production has "literally fuelled" different manufacturing sector activities. By the mid-1920s, Los Angeles became a leading industrial centre; it became the leading US state in producing oil machineries and oil-related services (Schmitt et al. 2002). Cooke (2014) maintains that in addition to technological and industrial progress, oil production in Los Angeles has promoted considerable infrastructure development.

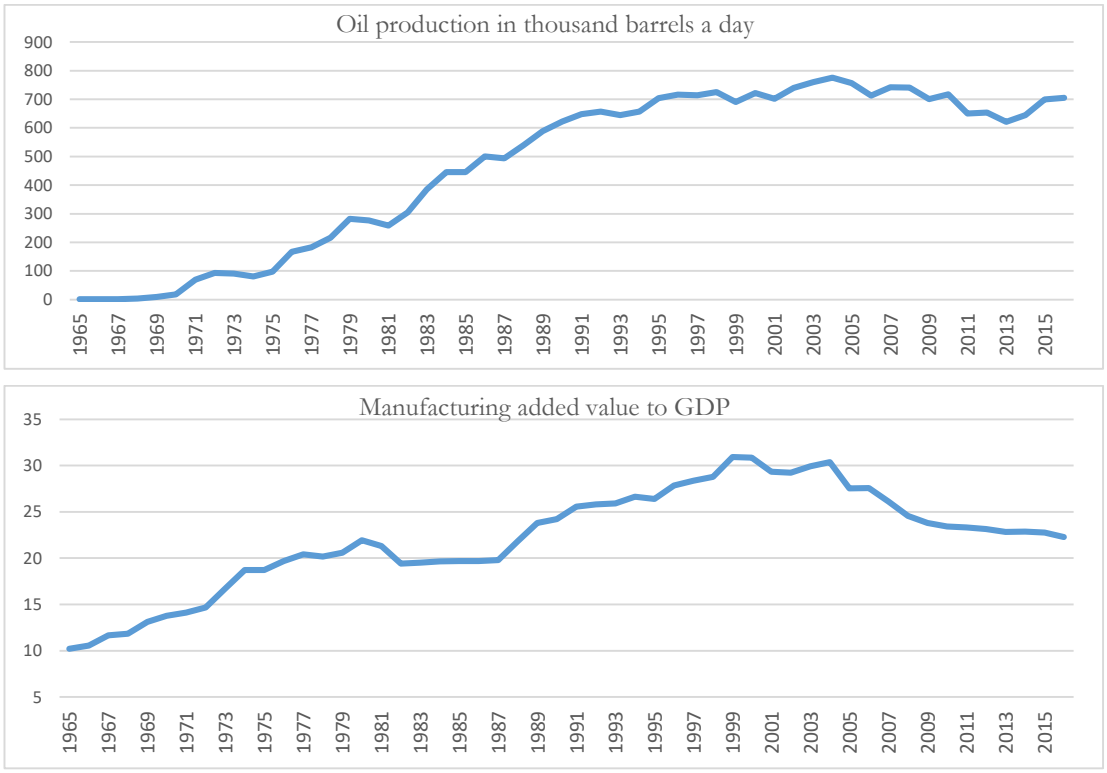
It has also been documented that linkages from mineral resources were important factors in the Canadian economic development process (Watkins 1963). Similarly, studies on Sweden (Venables et al. 2007), Norway (Andersen 1993), Australia (Wright and Czelusta 2004) and Finland (CCSI 2016; Ramos 1998) show the importance of the natural resource linkages in developing their manufacturing sectors and the overall economic activity.

Secondly, there are studies that have empirically challenged Sachs and Warner's findings. By avoiding having GDP in the denominator of the resource dependence indicator (as used by Sachs and Warner), Lederman and Maloney (2007) use natural resources exports per capita (instead of natural resources exports to GDP), and they do not find a negative correlation between natural resource dependence and economic growth. They further show that Australia, Canada, Norway and New Zealand are more dependent on natural resources than Papua New Guinea and the Democratic Republic of Congo. In other words, they argue that the resource curse theory explicitly claims that a country like Norway is not considered resource-dependent because it has diversified its export basket.

Thirdly, Sachs and Warner (2001) do not explain an interesting trend showing countries with poor resource endowment at the beginning of their study period (1970) and how, as they increased their dependence on natural resources, they grew rapidly in GDP (this trend is shown in *Figure 1* of their paper on page no. 829). These countries are Malaysia, Iceland and Mauritius. A potential explanation for this trend, the researcher argues, is that these countries were able to achieve economic diversification and manufacturing development. Throughout Sachs and Warner's study period (1970-1990), Iceland's manufacturing sector exports grew from 3.3 percent to 8.1; Malaysia's has grown from 6.5 percent to 53.7 percent; and Mauritius's has grown from 1.8 percent to 65.8 percent (World Bank database). In Malaysia, for instance, oil production increased from one thousand barrels a day in 1965 until it reached its peak of 776 thousand barrels a day in 2004. During the same period, manufacturing added value to GDP increased from ten percent to 30.3

percent. These trends clearly questions Sachs and Warner's main argument which states that the natural resource accumulation crowds out manufacturing sector activity.

Figure 4.3: Oil production and the industrial development in Malaysia



Source: British Petroleum statistical review (2017), and the World Bank database.

Fourthly, it is argued that the reliance on the resource fiscal linkages and neglect of the production linkage explains the weak manufacturing performance in some resource-dependent states (Karl 1997). The pioneer development economist Hirschman (1981) argues that resource abundance provides linkages and opportunities for developing and diversifying the industrial sector. These linkages are classified into fiscal, consumption and production linkages. The first shows rents generated by the government from the natural resource in the forms of direct income, royalties or taxes. These rents could be invested in other independent activities within the economy. The second linkage describes the demand for output of unrelated sectors as a result of income generated through the natural resource. The third, production linkages, describes forward and backward linkages from the resource sector. Hirschman considers it to be the major driver for industrial development (as will be discussed later in this section). However, this channel has not emerged effectively in many oil and mineral producing countries because of their reliance on fiscal linkages financed by high commodity revenues (Karl 1997).

A major conclusion emerging from the review of the resource curse literature is that the high resource dependence in many developing countries can be explained in terms of underdeveloped manufacturing sectors. Having abundance in a natural resource should not be considered "a curse". The poor industrial performance in many natural resource countries is mainly explained by public policy failure (Kaplinsky et al. 2012; Ramos 1998; Wright and Czelusta 2004).

Because of the importance of targeting suitable sectors in any industrial policy[61], the industrial development literature suggests different strategies for this purpose. Kaplinsky et al. (2012) have reviewed the following strategies in the context of resource-dependent developing countries: Hirschman's production linkages which is known as resource based industrialization (RBI); "the monkeys in trees" using the product space theory (PST), and the "flying geese" theory using the Growth Identification and Facilitation Framework (GIFF)[62].

There is a growing literature focusing on the above strategies in the developing world in general. In resource-dependent countries, in particular, Lin and Treichel (2011) and Lin and Xu (2015) have applied the GIFF to Nigeria and Uganda (respectively); Felipe and Rhee (2015) have suggested the use of the GIFF and PST for Kazakhstan; Hausmann and Chauvin (2015) have applied the PST to Rwanda. This paper, therefore, follows this strand of the literature and applies the three main suggested industrial strategies to the Saudi context: the RBI, the GIFF and the PST.

4.2.1 Resource based industrialization

Rather than looking at natural resources' abundance as an obstacle, resource based industrialization (RBI), through technological change, can be seen as a window of opportunities for generating employment, creating wealth and ensuring well-being for resource-dependent countries (Morris et al. 2012; Perez 2015; Ramos 1998). According to Hirschman (1981), RBI is explained by production linkages, which refers to the forward linkages and backward linkages from the resource sector. The former is located downstream and describes the processing of natural resource and its transformation into manufacturing

[61] Targeting suitable sectors is considered a fundamental factor in the success of any industrial policy. For example, Khan and Blankenburg (2009) show that the failure to choose suitable industrial sectors can result in the failure of the whole industrial policy.

[62] Kaplinsky et al. (2012) also highlights a fourth theory: the capabilities theory (i.e. Lall, 1992). However, they argue that it has a large overlap with the other three theories. Thus, the researcher in this study has focused on the other theories, with some reference to the capabilities theory throughout the analysis.

products, while the latter is located upstream and refers to the production of input material, equipment and services utilized in the resource exploration and production.

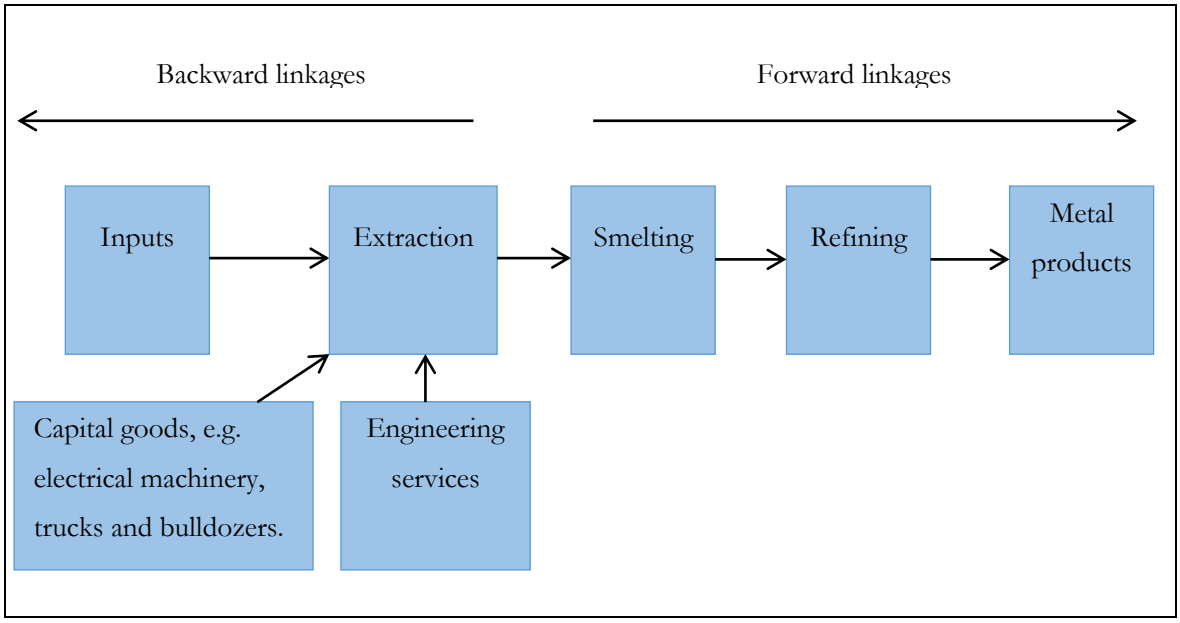
The abundance of resources in developing countries has encouraged the exploitation and exporting of raw materials. Nonetheless, industrialization in these countries depends on the pace of mastering their processing techniques for natural resources in addition to manufacturing the input material and equipment necessary for the resource extraction (Ramos 1998).

What these countries need to consider in their development strategies is more emphasis on policies to strengthen activities upstream, such as supplying inputs, machinery and engineering in addition to policies to strengthen raw material processing. The targeted sectors in this development strategy are different from those adopted by newly industrialized economies in East Asia (which are relatively poor in natural resources). By contrast, the strategy should be similar to those used by developed countries with rich natural resources such as Canada, Australia, New Zealand, and the Scandinavians (Ramos, 1998).

The development of industrial clusters around the natural resource could significantly foster the linkages from the resource[63]. In his analysis, Ramos uses the mining cluster as an example in order to show the importance of both forward and backward linkages from the resource sector (see Figure 4.1). He further proposes an RBI strategy that goes over four major phases (see Table 4.2). In the first phase, developing countries extract resources and export them with very limited local input. Machinery and engineering services are likely to be imported at this stage. In the second stage, exports may include first level processing. The main input materials are targeted in the import substitution strategy in addition to engineering services. In the third stage, the country starts exporting more specialized and sophisticated products, while inputs materials and basic machinery (that are already targeted in import substitutions strategy) begin to be exported. In the fourth stage, all types of products and services are exported. This includes inputs and machinery, design and maintenance services, and specialized consultation services.

[63] The existence of industrial sectors creates greater spillover inter- and intra-sector. The success of firms within industrial clusters is very dependent on the success of other firms existing in the same cluster (Porter, 1998).

Figure 4.4: The forward and backward linkages in the mining cluster



Source: Ramos (1998)

Building on Hirschman's theory, Morris et al. (2012) developed a model of linkages with an additional linkage dimension: a horizontal dimension[64]. This dimension refers to capabilities developed in the resource cluster and could be utilized in the advancement of unrelated industrial and service sectors. For instance, developing manufacturing capabilities in producing drilling equipment for oil fields can be used in the production of other kinds of drilling equipment and machineries in non-oil activities.

Table 4.2: The development of a production cluster

	Phase 1	**Phase 2**	**Phase 3**	**Phase 4**
1. **Downstream exports**	Unprocessed natural resource	First level of processing	More specialized first level processing, in addition to second level processing	Investment abroad
1. **Upstream input materials**	Imported	Import substations production of the main inputs for the domestic market	Export of inputs	==
2. **Upstream machinery**	Imported (repairs carried out locally)	Production under license for the domestic market	Export of basic machinery to less sophisticated markets; development of specialized equipment	Export of all types of machinery to sophisticated markets
1. **Upstream engineering** - Production - Project design - Consultancy	 - Semi-imported - Imported - Imported	 - Domestic - Partly domestic - Partly domestic	 - Domestic - Domestic - Domestic (except for specialities)	Export all types of engineering activities

Source: Ramos (1998)

[64] This dimension has an overlap with the product space theory which will be discussed in the next theoretical section

Unlike the forward and backward linkages that can be identified without any difficulty, the horizontal linkages are relatively difficult to recognize because linking an emerging sector to another existing one is not always obvious. Nonetheless, policy makers are encouraged to pay great attention to its potential development, because industrial experiences (such as in Finland and South Africa) show that it has been of extreme importance in developing unrelated industrial sectors. In these experiences, the horizontal linkages were mainly based on well-established upstream industry (Colombia Center for Sustainbale Investment, CCSI 2016).

It is well documented in the literature that there have been significant developments in resource based manufacturing in recent years which further emphasizes the RBI strategy (Morris et al. 2012; Perez 2015). First, the rise in natural resource prices in recent years is expected to be maintained. Secondly, there is a high segmentation in resource based commodities. Perez argues that there is a wide spectrum of products and activities ranging from high volume and low price to small volume and high price commodities. Thirdly, the development in ICT makes information easily accessible to developing countries and enables them to enter more product segments and services.

Fourthly, there has been a transformation of MNCs in the resource sector from foreign isolated firms into more interacting entities. Indeed, the concavity[65] of the natural resource sectors has decreased substantially in the last four decades and has resulted in more opportunities for linkages to the rest of the economy (Morris et al. 2012). The deepening of globalization has intensified firms' competition, which drives them to focus on activities in which they have distinctive competencies. Therefore, the other activities (non-core) are increasingly being outsourced to lower cost suppliers. In current global value chains (GVCs), this development has pushed large firms to concentrate in their core competencies, instead of mastering the whole value chain. This tendency to outsource non-core activities may create great opportunities for local suppliers (Kaplinsky and Morris 2001).

Because of these changes in the nature of RBI in recent years, Perez (2015) argues for the importance of building networks around the resource sector and creating a system of innovation. The complete network (value chain) should be developed, starting from capital goods to processing activities, and ultimately to packaging and distribution to the end users.

[65] The natural resource concavity refers to the isolation of leading firms, which tend to be MNCs, from the domestic economy.

The system of innovation, she argues, should also include universities, R&D institutions and high-tech business. In such a system, this continued development in all the network players is crucially important.

> *"Success in the natural resource industries depends on continuous improvement of technologies, companies, products and human capital, across networks that encompass research, engineering and design; construction, adaptation, installation, compatibility and maintenance; software and systems services; equipment and instruments; laboratory services; quality control, evaluation, measurement, certificates; conservation and packaging; transport, marketing and distribution; technical service to users; market intelligence; improvements and new products; patent lawyers; contract negotiation; training and education of specialized personnel; financial services; and so on: a far cry from raw materials only." (p.18).*

Ramos (1998), Perez (2015) and Morris et al. (2012) show that industrial clustering is critical for the promotion of manufacturing development around the resource sector. The importance of regions and geography in economic and industrial development can also be seen in the new economic geography (NEG) literature (Krugman 1991; Porter and Stern 2001; Scotchmer and Thisse 1992). This literature has constantly maintained that selected regions, where the industrial activities are located in transaction-intensive networks, have a powerful impact on the national industrial development.

The NEG view can be explained by three major factors: economies of scale, transaction cost and external economies (Krugman 1991). First, economies of scale are predicted to push firms to concentrate their manufacturing activities in a specific location rather than dispersing the industrial activities in multiple locations. In other words, increasing returns to scale is a major incentive for firms to concentrate the production activities geographically (Krugman 1991; Scotchmer and Thisse 1992).

Secondly, transportation costs are considered fundamental factors that influence location and clustering choices. While the neoclassical trade theory, in general, assumes no transportation costs, the NEG expects that only a fraction of the shipped product's value arrives at the customer, and the rest of the cost is treated as a shipment cost. Therefore, larger firms and their suppliers may be encouraged to concentrate in certain geographical regions in order to reduce their transportation costs (Krugman 1993; Porter and Stern 2001). Thirdly, the NEG considers external economies to be a major contributor to firms' clustering because

of labour pooling, technology spillover and the availability of specialized intermediary inputs (Krugman and Venables 1996).

It is important, here, to mention a related and growing strand of research within the Evolutionary Economic Geography (EEG) literature which is concerned with regional diversification and path creation[66] (e.g. Dawley 2014; Isaksen 2014; Martin 2010). This strand is based on the view that region-specific endowments and conditions have a substantial impact on the emergence of new industrial and services activities (Isaksen 2014). As Martin (2010) puts it, "the pre-existing industrial structure of a region or locality does have an influence on whether a particular new industry develops there" (p.6). In this context, Boschma et al. (2012) identify four possible mechanisms for regional diversification: labour mobility between firms or sectors, social networking, entrepreneurial activities (such as start-ups and spin-offs), and firms' diversification. However, this literature, in general, has viewed regional diversification as an endogenous process whereby firms move into related activities within the same region (Trippl et al. 2017). Despite their importance in the emergence of new activities, actors such as research institutes, universities and public institutions have received only limited attention in this strand of literature (Mackinnon et al. 2018).

Mackinnon et al. (2018) have developed a more comprehensive theoretical framework of regional path creation from the perspective of Geographical Political Economy (GPE). This broad framework emphasises five fundamental elements of regional path creation: regional and extra regional assets (e.g. infrastructure, human capital and institutional assets); social, economic and institutional actors (e.g. local state and political leaders); market construction; the mechanism of path creation (e.g. transplantation and labour mobility); and institutional environments. This wide framework can provide an integrated explanation for the emergence of new economic activities in specific geographical locations. Accordingly, from the perspective of this GPE structure, the emergence of new activities in specific regions should be associated with the dynamics of capital accumulation, infrastructure development, technological upgrading, labour development, banks and venture capital funds and state regulations (ibid.).

4.2.2 The Product Space Theory

In a series of studies, Hausmann and Klinger (2007), Hausmann et al. (2007) and Hausmann and Hidalgo (2011) show nations' economic development as a process of producing and

[66] Path creation here refers to the growth and emergence of new economic activities within specific regions (Mackinnon et al., 2018).

exporting more diverse and more sophisticated products. Their analysis shows that, as countries grow, they extend their export baskets towards higher-technology products that are made by few other countries.

In this framework, economic development is slow in countries with a production structure categorized by low value-added, agricultural, natural resources products, i.e. low-wage and low-productivity activities. On the other hand, development is expected to be fast in countries producing high-added value and more sophisticated products, i.e. high-wages and high productivity activities.

Hidalgo et al. (2007) have developed the 'product space', which represents all the exported products in the world. They show that a country's economic development is pre-determined by its capabilities to produce more sophisticated products. 'Capabilities' here refers to all the factors needed to produce a specific product, such as capital, human resources and institutions. At the firm's level, capabilities refer to production knowledge ('know-how'). This productive knowledge is what explains countries' economic complexity. Unlike the neo-classical trade theory, this product space theory (PST) considers the industrial knowledge costly to transfer and to acquire (Hausmann et al. 2014).

The network is created using product level rather than aggregate sector level data. The authors use export data because it is more comprehensive and more readily available than the industrial output data. Although the authors are aware of some limitations in using export data[67], this does not undermine the strength of the model or invalidate it (Felipe and Rhee, 2015). Figure 4.5 shows the product space adapted from Hausmann et al. (2014) using 1240 products (using a 4 digits Harmonized System). Appendix 4 outlines more details about the PST construction.

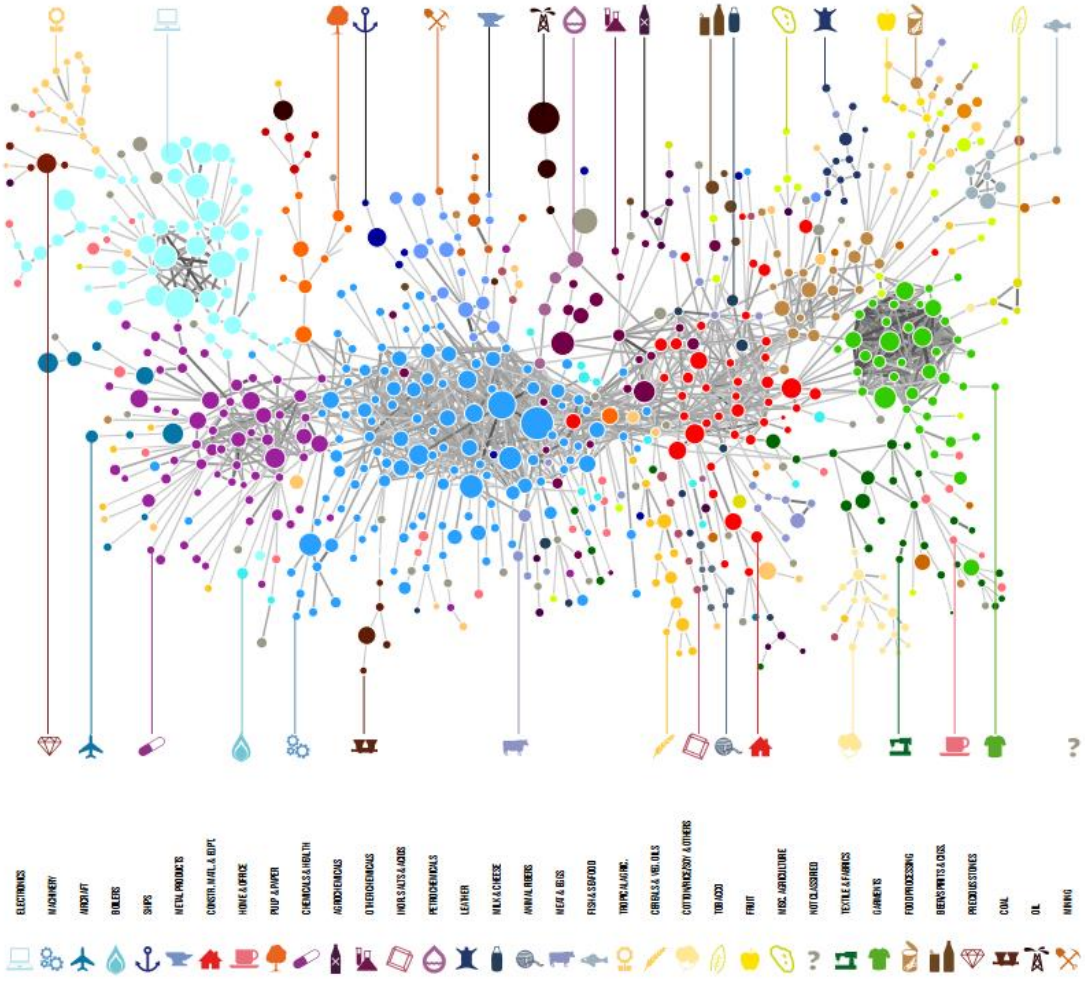
The product space represents products that are naturally grouped into linked communities. This may suggest that these communities require similar sets of industrial knowledge. Hausmann et al. (2014) identify thirty-four communities. Each community shows products that are more connected than outside the community[68].

[67] The product space theory is based on the utilization of export data. While it is widely considered a proxy for industrial output, in some cases it deviates from the actual industrial production. This can be explained by the domestic market size and trade openness. Nonetheless, highly disaggregated output for large number of products (i.e. 1024) and countries is not available.

[68] Hausmann et al. (2014) use network science algorithms to generate these communities.

An important implication of the product space is the lack of connectivity for products at the periphery (isolated) relative to those in the core. Core products, which include machinery, transportation and chemical products, are considered sophisticated products with high added value. On the other hand, peripheral products, which include petroleum, tropical agriculture and animal products, are considered simple products with low added value. Furthermore, they are considerably less connected to other products than those in the core. This reflects the difficulty facing countries concentrating on producing peripheral products (such as the case of Saudi Arabia with its concentration on petroleum products) to diversify their production structure. On the other hand, countries that produce an abundance of core products find it relatively easy to jump from one product to another.

Figure 4.5: The Product space network



Source: Hausmann et al. (2014)

4.2.3 The Growth Identification and Facilitation Framework

The growth identification and facilitation framework theory (GIFF) demonstrates the 'flying geese' theory, which assumes that previous experiences are a good guide for the future and

that countries with specific endowments can follow the footpath of similar countries. The GIFF is proposed by Lin and Monga (2011), and shows that economic development is not only about higher income and low poverty but is also about more complex production structures. This framework explains that governments are able to incentivize the private sector to upgrade and diversify the production structure by targeting specific sectors according to the country's comparative advantage. Lin and Monga argue that firms investing within the comparative advantage are more likely to be profitable without significant government support. However, comparative advantage evolves over time. Thus, investing in the current comparative advantage alters the endowment structure, which then alters comparative advantage in the future. This continued process results in sustainable industrial upgrading and diversification.

The GIFF operationalizes a strategy proposed by Lin (2010) which identifies sectors where a country may have a latent comparative advantage. Then it provides a guide for eliminating obstacles and providing incentives that facilitate the private sector's entrance to the identified sectors. In this strategy, Lin prescribes six steps for government intervention. First, the government specifies a list of goods and services that have been produced over the last twenty years in a growing country with 100 per cent higher GDP per capita and with the same endowment structure. Secondly, from the list of targeted goods and services, the government gives priority to products already produced by the private sector and tries to support them by removing the obstacles in their development path.

The third step is that, from this list, some products may be totally new to the domestic market, in which case the government may adopt certain procedures to attract firms from more industrialized countries and which are specialized in these particular products, to invest domestically. The fourth step is that the government should recognize and pay attention to any activities that were not specified in the first step and that have been self-discovered by entrepreneurs domestically and then to provide them with the necessary support. The fifth step is that, in countries with an unfriendly business environment and a poor infrastructure, the government should invest in industrial and export zones that can improve the environment in such a way as to attract domestic, as well as foreign investors, to invest in the specified sub-sectors. Finally, because of the great social value created by pioneers in these newly targeted activities, the government should reward them by providing some compensation.

4.3 Saudi industrial development strategies

This section examines the industrial diversification strategies from the perspective of the three theories highlighted in the previous section: RBI, PST and GIFF. Each strategy is used in two ways: assessing the existing industrial performance and proposing potential targeted sectors.

4.3.1 Resource based industrialization in Saudi Arabia

This part evaluates the performance of the Saudi upstream and downstream of the oil sector. Furthermore, it suggests sectors (which can also be sub-sectors or products) as potential targeted activities according to the RBI strategy.

Before the 1930s, the Saudi economy utilized very limited natural resources. The government relied solely on import taxes and pilgrimage services (related to Hajj). However, the extraction of oil changed the economic situation dramatically. In 1933, a series of geological surveys were undertaken by California-Arabian Standard Oil Company (CASOC). Fruitless drillings had been taking place for nearly five years before oil was discovered in commercial quantities in 1938. The Saudi government increased its ownership in the company steadily until 1980 when it acquired the entire ownership of the oil company. In a royal decree, the company name was changed to the Saudi Arabian Oil Company (Aramco) in 1988. The government assigned Aramco the sole rights for exploration of petroleum resources. Other investors can participate in oil extraction but only in partnership with Aramco.

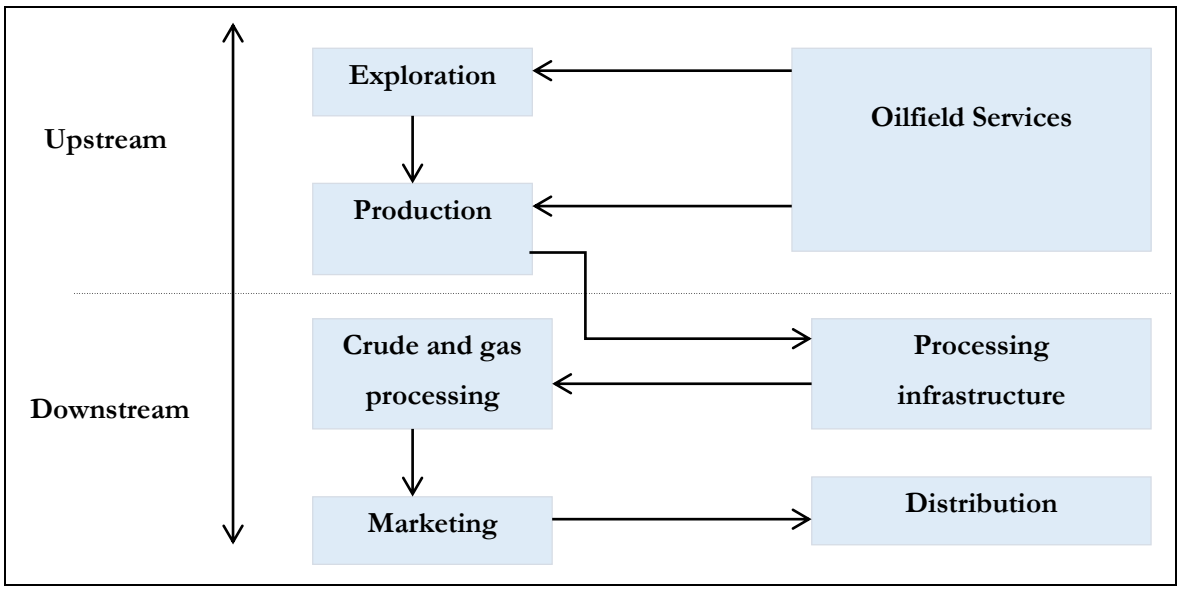
To understand the industrial development in the oil cluster, it is necessary to analyse the backward (upstream) linkages and forward linkages (downstream) from the oil sector separately (see Figure 4.6).

- **Backward linkages**

The backward linkages exist in the upstream sector and can be divided into oil exploration and production. Exploration involves oil discovery, field evaluation and field development. Production, on the other hand, mainly involves oil extraction. This upstream sector comprises embodied inputs (such as machinery, equipment and structures) and disembodied inputs (human resources and services) that enable oil exploration and production to take place (Teka 2011).

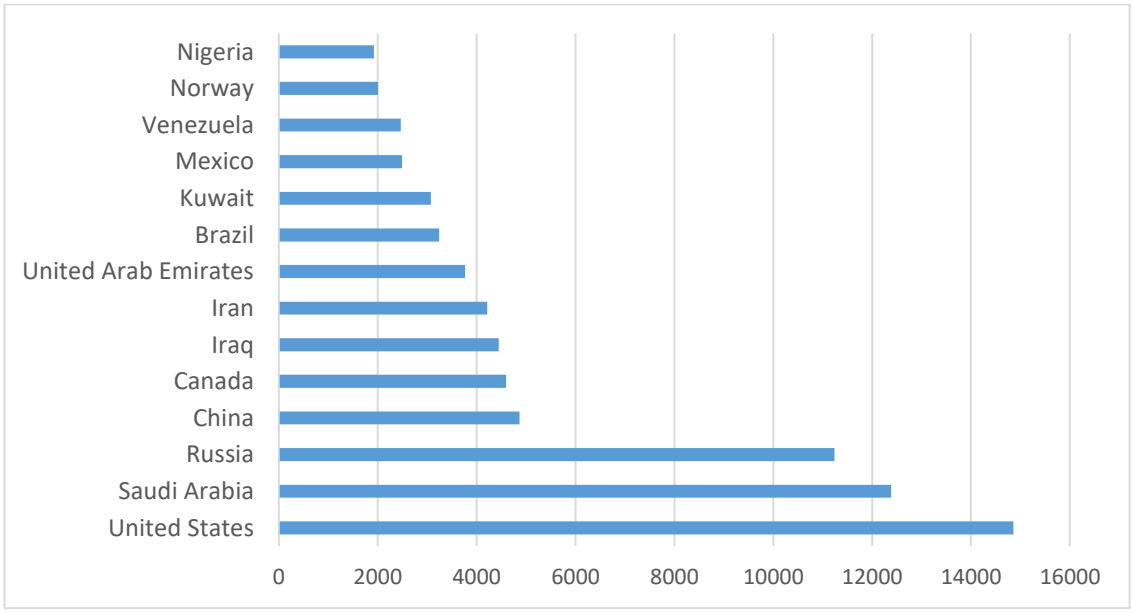
The Saudi upstream capacity is enormous. In 2016, oil production capacity was 12.3 million barrels per day making Saudi Arabia the second largest producer after the US (see Figure 4.7). The oil sector accounts for 28.6 of GDP[69] (see Table *4.3*), 74.2 percent of total exports, and 64.2 percent of total government revenues (SAMA 2017). In the meantime, the sector employs only 1.8 percent of private sector employment (179.6 thousand people[70]).

Figure 4.6: The Saudi oil upstream and downstream industries



Source: Own elaboration based on Teka (2011)

Figure 4.7: Oil production by country in 2016



Source: Energy Information Administration (2017).

[69] Including oil refining activities.
[70] Aramco alone employs 65,282 people.

Table 4.3: GDP by economic activity in 2016 (in million SAR)

Economic activity	Share	Value
1. Agriculture , Forestry and Fishing	2.5%	65,290.18
2. Mining & Quarrying	25.4%	654,891.8
a. Crude Petroleum and Natural Gas	25.0%	643,125.2
b. Other	0.5%	11,766.62
3. Manufacturing	12.9%	331,376.3
a. Petroleum Refining	3.2%	81,956.76
b. Other	9.7%	249,419.5
4. Electricity , Gas and Water	1.6%	40,620.9
5. Construction	6.0%	154,592.1
6. Wholesale & Retail Trade, Restaurants and hotels	10.7%	274,969.9
7. Transport , Storage and Communication	6.4%	165,172.9
8. Finance , Insurance , Real Estate and Business Services	13.1%	338,133.5
a. Ownership of Dwellings	7.7%	197,241
b. Others	5.5%	140,892.5
9. Community , Social and Personal Services	2.3%	58,592.68
10. Imputed Bank Services Charge	0.9%	22,826.06
11. Producers of Government Services	19.1%	491,077.3
12. Import Duties	0.9%	23,378
Gross Domestic Product	100.0%	2,575,269

Source: Saudi General Statistics Authority

The state ownership of Aramco has given the government authority to impose a series of policies and programmes on the oil and gas value chain to increase the linkages to the domestic economy. The public ownership of the leading firms in the resource sector has been documented as a central factor in promoting RBI (Kaplinsky et al. 2012). Until 2015, Aramco had been giving local suppliers priority and support in their bidding process. However, there was no clear local content policy for Aramco's local suppliers. This has been reflected on the local suppliers' poor share of Aramco's procurements. Over the last six years, Aramco's local procurement has been around thirty percent, while seventy percent of machinery, materials and services were imported (Aramco 2016).

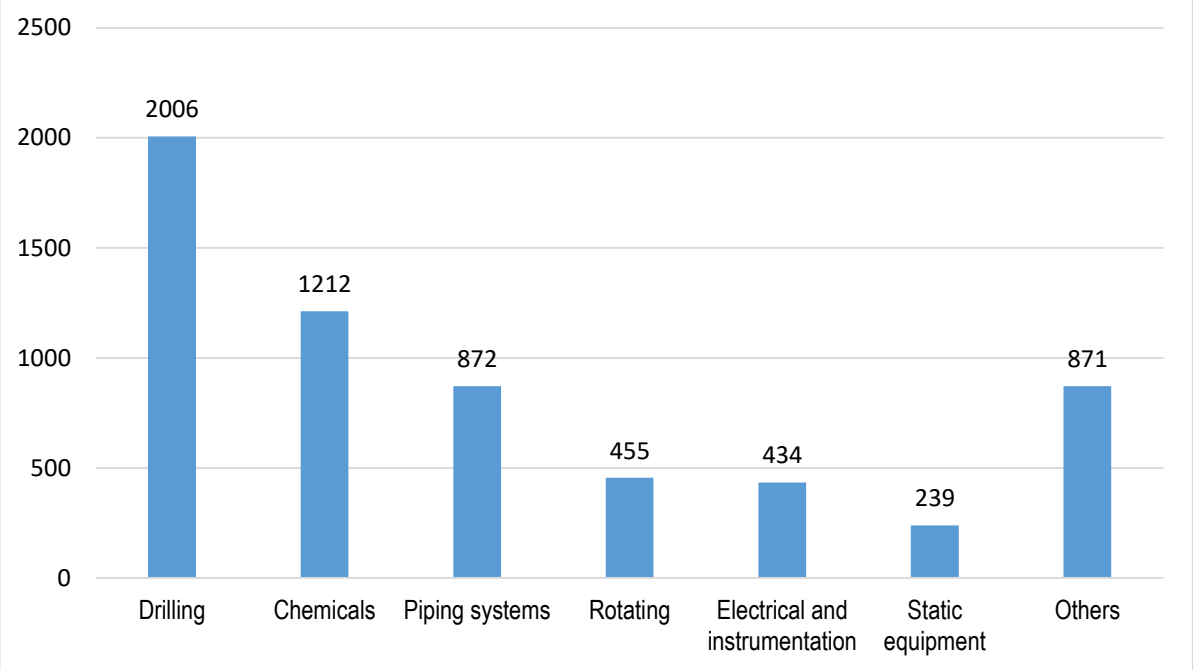
A closer look at imported products and services that are not being produced domestically at all (around 6.5 billion SR annually)[71] shows that drilling equipment is the largest segment with annual average purchasing of 2.0 billion SR, followed by chemical materials with 1.21 billion SR (see Figure 4.8). Table 4.4 represents major imported products in the two largest segments (drilling and chemical materials). This expenditure on imported products and services strongly emphasizes the need for policies towards greater domestic development of the upstream manufacturing and services. In other words, these products should be prioritized in the Saudi

[71] There are other imported segments that are being produced domestically but with limited capacity.

industrial policy. Following Ramos (1998) and Perez's (2015) industrial strategies, Saudi Arabia could have been a regional exporter of oil related manufacturing and services as opposed to being a net importer.

In their work on resource based industries, Morris et al. (2012) argue that developing these backward linkages can also promote horizontal linkages into a wider range of products and services. For instance, developing the capabilities in producing certain electrical equipment for the oil extraction process allows Saudi firms to produce other sophisticated equipment that requires a similar set of capabilities.

Figure 4.8:Largest imported products and services (in million SAR)



Source: Aramco (2016)

Table 4.4: Totally imported drillings and chemicals

Item	Average spending in million SR
1. Drilling	
1.1. Down hall equipment	
1) Liner hangers	364
2) Packers	374
3) Installation services	181
4) Valve: sub-surface safety	80
5) Isolation valves & accessories	75
6) Nipple: landing	33
7) Laterals & accessories equipment	19
1.2. Advanced well completion	
1) Equalizer/ screens access	270
2) Smart, accessories	140
3) Gauges	53
4) Expandable, casing & accessories	41
5) Downhole wet connect system	26
6) Cable, monitoring system	24
7) Permanent downhole monitoring systems., accessories	13
8) Coupling protector	8
9) Expandable, screen	7
2. Chemicals	
1) Salts	426
2) Lubricants	111
3) H2s scavenger	98
4) Shale/borehole stabilizer	50
5) Spotting fluid	22
6) Thinner	16
7) Emulsifiers & surfactants	9
8) Oxygen scavenger	8
9) Defoamer	6

Source: Aramco (2016)

- **Forward linkages**

The development of forward linkages (downstream industry) in oil producing countries is categorized into oil refining and petrochemicals. In oil refining, crude oil is transformed into useful consumption and production products such as gasoline, diesel, fuel oils, jet fuel, kerosene and liquid petroleum gas (LPG). Aramco refinery capacity reached 3.1 million barrels per day in 2016, making Saudi Arabia the fifth largest in the world in terms of refining capacity after the US, China, Russia and India (British Petroleum, 2017).

The Saudi petrochemicals industry, on the other hand, was promoted in the 1970s to promote economic diversification in addition to reducing the environmental impact and economic loss of burning the associated gas. This gas is either dissolved with oil or found free above the oil reserves (gas cap). Rather than flaring, the government decided to transform this gas into petrochemical exportable materials. In 1975, the Royal Commission for Jubail and Yanbu (RCJY) was established in order to develop world-class infrastructure

of the two cities (Yanbu and Jubail) and to accommodate petrochemicals related plants[72], and the Master Gas System (MGS)[73] was developed to feed these industrial cities. The cost of the two cities, in addition to the MGS, was 35 billion USD[74].

In 1976, the government founded a national company called the Saudi Arabian Basic Industries Corporation (SABIC). However, the company's development was hindered by the lack of know-how in petrochemicals' manufacturing. The first CEO of the company explains that they had capital, infrastructure and raw material (feedstock), but "what we did not have was the technological know-how and the commercial experience in the markets of the world" (Al-Zamil et al. 2017).

In order to access the 'know-how' and to transfer petrochemicals technologies, SABIC set up joint ventures with a number of leading foreign chemical producers. SABIC was offering a guaranteed right to buy oil to attract foreign investors, which was particularly important after the Arab oil producers' embargo in 1973. Back then, petrochemical companies were uncertain about future supply, and SABIC partnership was an opportunity to process and produce through guaranteed oil access. Therefore, companies, such as Exxon Mobil, Shell, Taiwan Fertilizer Company and Mitsubishi Gas Chemical, have established joint venture firms with SABIC.

In order for firms to acquire sophisticated technologies, follow up investment might be necessary to adopt foreign technology (Lall 1992). For SABIC, after signing joint ventures with foreign technology leaders, further major investments were made to acquire know-how in petrochemicals manufacturing. Young Saudis were sent to Japan, Taiwan and the US to get on-the-job training abroad. The on-the-job abroad training was done through agreements with the companies that already had joint ventures with SABIC. However, SABIC's administration found that in many cases foreign companies taught Saudis in classes rather than in plants, and thus, the administration threatened to quit these joint-venture agreements if the training was not within the production facilities in order to ensure greater technology transfer (Al-Zamil et al. 2017).

[72] Algusaibi (1999) argues that the RCJY with its unique management and governance structures is a critical factor in the later success of the Saudi petrochemicals industry.
[73] The MGS is a system of pipelines and gathering facilities that collect the associated gas by product.
[74] The cost of the project, 35 billion USD, is around the total annual Saudi budget in that period (Alzamil et al., 2017)

SABIC played a critical role in the development of the Saudi petrochemical industry in two ways: developing human resources to lead many other, smaller petrochemical firms and creating positive information externalities and technology spill-over. Former SABIC employees are now leading (e.g. CEOs) several petrochemicals listed companies[75]. Creating technology spill-over, on the other hand, by SABIC was an opportunity for smaller firms, that had entered the market later, to copy some production and management expertise at zero cost (Al-Zamil et al. 2017). These two unique characteristics have been documented as major roles of SOEs in developing the domestic industries in recent successful industrial experiences (Amsden and Hikino 1994).

Since the 1980s, the Saudi petrochemicals industry has been growing steadily. Currently, the industry accounts for the largest export segment after oil. In 2016, it accounted for twenty-one percent of total exports (sixty-seven percent of non-oil exports) generating over 38 billion USD. The industry has accounted for 2.7 percent of GDP, and twenty-one percent of the total manufacturing sector (SAMA, 2017). In terms of employment, the petrochemicals industry provided approximately 121,760 direct jobs in 2017[76]. Table 4.5 shows that petrochemicals (chemicals and plastics) account for around thirteen percent of total industrial employment. Furthermore, data on fixed capital formation reveal that it accounts for more than forty-six percent of total industrial capital formation in 2015 (see Table 4.6).

While there has been a substantial development in the Saudi petrochemicals industry since the 1970s, its production output mainly lies within less sophisticated products. Table 4.7 shows the Saudi production capacity since 2006 by major segments. Speciality chemicals, which is the most sophisticated segment, accounts for only 0.3 percent of total production capacity. Furthermore, it accounts for less than three percent of total sales. Figure 4.9 shows total sales of petrochemicals output in 2016, where speciality chemicals are included in the category "Others".

Saudi exports, accordingly, are also skewed towards less sophisticated products. Petrochemicals exports are dominated by basic organics such as ethers, acyclic alcohol, cyclic hydrocarbons (accounting for approximately thirty percent), and basic polymers (forty-three percent) (see Figure 4.11). This is unlike other developing countries, such as

[75] This is in addition to other ex-SABIC employees who became leaders in private and government institutions.
[76] In addition, the petrochemicals sector generates significant indirect jobs, which was estimated to be between 267 and 356 thousand in 2014 (GPCA, 2015).

India, China and Malaysia, that developed speciality and final consumer chemicals where petrochemicals exports are dominated by final consumption products, such as rubber tyres, rubber apparel, plastic housewares, soaps and paints.

Table 4.5: Manufacturing labour force by size of firm

Economic activity	Total		More than 20	(5-19)	Less than 5
	Number	Share			
Food products	109,830	11.4%	74,780	13,888	21,162
Beverages	28,774	3.0%	25,468	2,002	1,304
Tobacco products	220	0%	47	61	112
Textiles	22,252	2.3%	15,137	1,958	5,157
Wearing apparel	80,925	8.4%	7,645	14,654	58,626
Leather and related products	2,192	0.2%	1,884	150	158
Wood and of products of wood and cork	27,966	2.9%	7,165	12,206	8,595
Paper and paper products	16,672	1.7%	15,149	1,294	229
Printing and reproduction of recorded media	18,329	1.9%	12,188	3,618	2,523
Coke and refined petroleum products	18,352	1.9%	17,059	1,144	149
Chemicals and chemical products	94,494	9.8%	88,290	5,268	936
Products and preparations pharmaceutical	7,104	0.7%	6,848	207	49
Rubber and plastics products	27,266	2.8%	23,406	3,224	636
Other non-metallic mineral products	132,953	13.9%	112,402	15,696	4,855
Basic metals	47,675	5.0%	45,487	1,887	301
Fabricated metal products	135,367	14.1%	54,644	41,219	39,504
Computer, electronic and optical products	2,767	0.3%	2,302	327	138
Electrical equipment	22,199	2.3%	20,666	945	588
Machinery and equipment	25,790	2.7%	24,220	1,288	282
Motor vehicles, trailers and semi-trailers	7,806	0.8%	6,133	1,429	244
Other transport equipment	2,817	0.3%	2,671	100	46
Furniture	57,034	5.9%	23,187	17,722	16,125
Other manufacturing	7,575	0.8%	6,167	720	688
Repair and installation of machinery and equipment	63,283	6.6%	34,171	5,399	23,713
Total	959,642	100%	627,116	146,406	186,120

Source: Saudi General Statistics Authority

Table 4.6: Capital formation by manufacturing activity (in thousands SAR, 2015)

Manufacturing activity	Gross capital formation	Share
Food products	4,082,931	6.70%
Beverages	807,328	1.30%
Tobacco products	1,985	0.00%
Textiles	703,127	1.20%
Wearing apparel	756,530	1.20%
Leather and related products	98,469	0.20%
Wood and of products of wood and cork	498,138	0.80%
Paper and paper products	640,444	1.10%
Printing and reproduction of recorded media	593,532	1.00%
Coke and refined petroleum products	4,838,908	8.00%
Chemicals and chemical products	27,580,673	45.40%
Products and preparations pharmaceutical	197,914	0.30%
Rubber and plastics products	490,706	0.80%
Other non-metallic mineral products	11,091,681	18.30%
Basic metals	379,019	0.60%
Fabricated metal products	733,467	1.20%
Computer, electronic and optical products	209,382	0.30%
Electrical equipment	643,330	1.10%
Machinery and equipment	460,545	0.80%
Motor vehicles, trailers and semi-trailers	295,031	0.50%
Other transport equipment	339,979	0.60%
Furniture	1,254,976	2.10%
Other manufacturing	189,568	0.30%
Repair and installation of machinery and equipment	3,805,238	6.30%
Total	60,692,900	100%

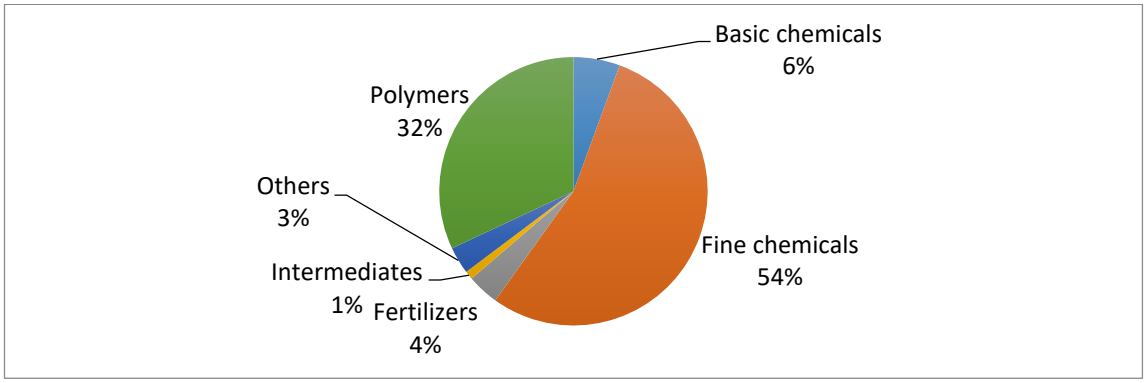
Source: Saudi General Statistics Authority

Table 4.7: Saudi petrochemicals production capacity (in metric tons)

Petrochemicals production	2006		2011		2016	
	Capacity	**Share**	**Capacity**	**Share**	**Capacity**	**Share**
Organics						
- Basic	15630000	35.3%	27760952	35.5%	35597330	36.9%
- Fine chemicals	566285	1.3%	1002575	1.3%	2551154	2.6%
- Intermediates	12064774	27.3%	21151161	27.1%	22110244	22.9%
- Polymers	6375598	14.4%	14047533	18.0%	17352607	18.0%
Basic Inorganics						
- Fertilizer Raw Material	4369800	9.9%	5625961	7.2%	8280105	8.6%
- Inorganic chemicals	909312.5	2.1%	1128313	1.4%	1796175	1.9%
- Mainstream Fertilizers	4210000	9.5%	7310000	9.3%	8430000	8.7%
Specialty Chemicals						
- Specialties	94000	0.2%	164000	0.2%	290800	0.3%
Total	44219769		78190494		96408416	

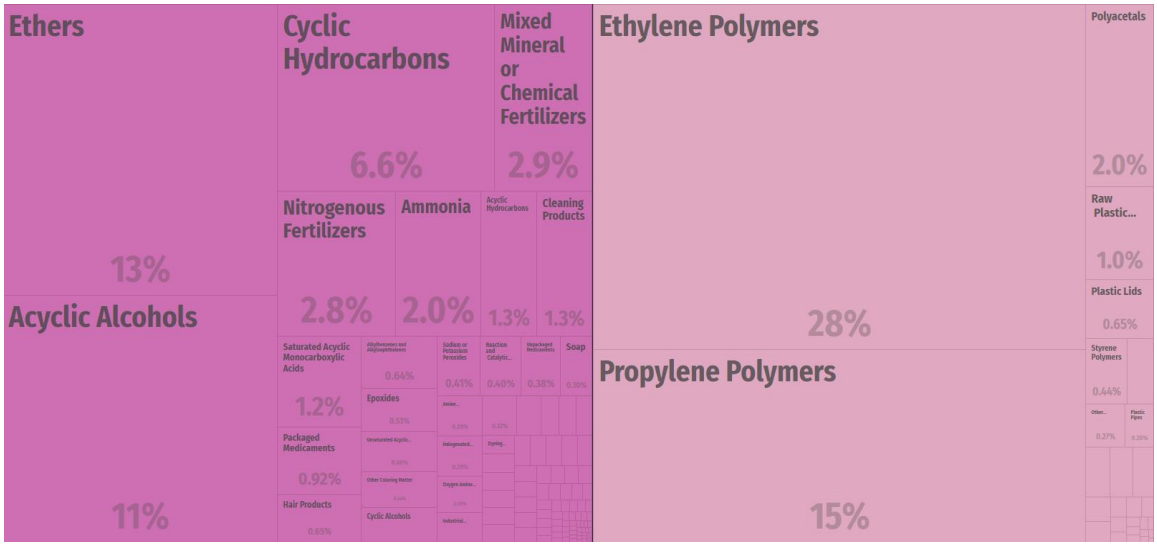
Source: unpublished data from the Gulf Petrochemicals & Chemicals Association.

Figure 4.9: Saudi petrochemicals sales by major groups (in 2016)



Source: unpublished data from the Gulf Petrochemicals & Chemicals Association.

Figure 4.10: Saudi Petrochemicals exports in 2016



Source: Hausmann et al. (2014).

In addition to its low added value, basic petrochemical prices are extremely volatile following the crude oil price. On the other hand, manufacturing and speciality chemicals, which are produced with a limited capacity in Saudi Arabia, are superior to the other types of petrochemicals because of their low price elasticity of demand and high added value. Figure 4.11 shows the correlation between crude oil prices, basic chemicals and manufacturing chemicals[77]. The figure demonstrates the high correlation between oil and basic organic chemicals. In the meantime, manufacturing chemicals have been increasing steadily since 2007 with a low correlation with oil price volatility. This trend emphasizes the

[77] According to the North American Industry Classification System, the chemicals manufacturing group refers to organic and non-organic raw materials that have been transformed through a chemical process. This sub-sector is distinguished from basic and intermediate chemical products because of its further processing of basic chemicals (CENSUS, 2018).

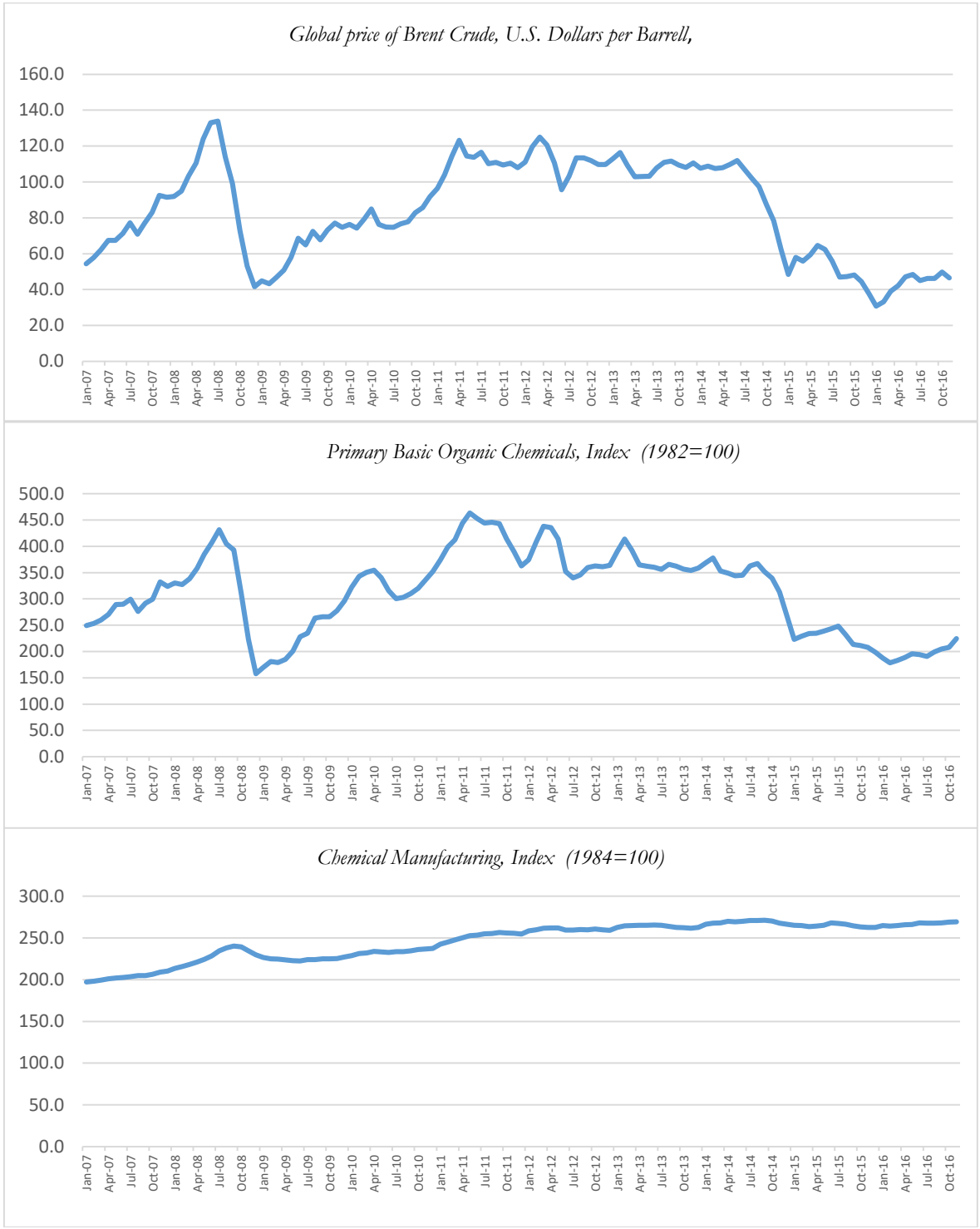
need to diversify away from basic chemicals towards speciality and final consumption products, which can lower the Saudi exports volatility following oil price fluctuation.

A final feature of the Saudi oil cluster (both downstream and upstream) that should be highlighted here is the lack of development in major components of the oil innovation system. One example is the limited development of human resources (mainly technicians) who are capable of operating in more advanced upstream and downstream industries[78]. This is despite the long-lasting high demand for skilled workers by firms working in the oil sector (the limited supply of technicians in the oil sector is discussed in the Saudi Vision section).

Another example is the limited R&D in oil activities by universities and public research institutions. Nonetheless, a significant amount of R&D resources is being devoted to research on activities and industries in which Saudi Arabia has no competitive advantage (such as nuclear power, semiconductors, computer networks and artificial intelligence). Lall (1992) shows that technology transfer in under-developed sectors (such as semiconductors in Saudi Arabia) does not take place through R&D; rather it can be acquired through the process of reverse engineering and assimilation. In more advanced Saudi industries (such as oil, gas and petrochemicals in which Saudi Arabia has a revealed comparative advantage), R&D can be a crucial tool in competing with countries in the upper frontier in these industries.

[78] In an interview with Ex-Aramco and investor in the upstream sector in March 2018.

Figure 4.11: Basic and specialty chemicals compared to oil prices



Source: FRED database.

4.3.2 The Saudi Product Space

In their product space theory, Hidalgo et al. (2007) use product level data, and measure countries' diversification using Balassa (1965) concept of revealed comparative advantage (RCA). The RCA is the ratio of a country's exports of a certain product in its total exports relative to the same share for the entire world. This study uses COMTRADE database data at the HS4 product level that allows the researcher to observe 1,024 products. Then, it is possible to construct the RCA indicator using the following equation:

$$RCA = \frac{export_{c\,p} \ / \sum_p export_c}{\sum_c export_{\,p} \ / \sum_p \sum_c export}$$

The indicator compares the share of a country (*c*) exporting a product (*p*) to the share of the world exports of that product. If a country has a value of 3 in exporting a certain product, this indicates that this country exports three times the world average, i.e. three times the fair share as Balassa defines it. Following Hidalgo et al. (2007), it is possible to identify the threshold of RCA to be equal to 1.00 to determine whether a country has a comparative advantage in a certain product. Accordingly, Saudi Arabia in 2015 has eighty products with RCA.

Table 4.8 represents these eighty products according to their product groups. The table clearly shows the concentration on exporting minerals, with eight mineral products making more than sixty-nine percent of the total exports basket. The chemical and plastic products are the second and third largest groups with 9.6 and nine percent respectively. Table 4.9 represents the eighty products exported with RCA. The table reveals that crude petroleum oil is the largest exported product with RCA of 11.9, generating export value of 105.4 billion US dollars, and making approximately fifty-six percent of the total export basket. Crude petroleum is followed by refined petroleum oil with an export value of 18.4 billion USD. The two petroleum products are followed by three petrochemical products, polymers and ether, with a total value of around 20.2 billion USD. The table also shows that ethers has the highest RCA value among the all the exported products with 24.9. This means that Saudi Arabia exports more than twenty-four times the average global export of ethers.

Table 4.8: RCA products according to product groups

HS2	Number of products with RCA>1	Their percentage of total exports
Animal and animal products	5 products	0.48 percent
Vegetable products	1 product	0.07 percent
Foodstuffs	5 products	0.44 percent
Mineral products	8 products	69.50 percent
Chemical and allied industries	27 products	9.61 percent
Plastics and rubbers	4 products	9.00 percent
Raw hides, skins, leather and furs	2 products	0.03 percent
Wood and wood products	3 products	0.41 percent
Textile and textile articles	6 products	0.16 percent
Footwear	None	0 percent
Stone and glass	6 products	0.142 percent
Metals	10 products	1.85 percent
Machinery and electrical products	None	0 percent
Transportation	3 products	1.05 percent
Total	80 products	92.36 percent

Source: own calculations based on COMTRADE database

Table 4.9: Description and value of products with RCA

HS4	**Description**	**Export value (in million USD)**	**RCA**
2709	Petroleum oils, crude	105,434.0	11.9
2710	Petroleum oils, refined	18,660.6	2.8
3901	Polymers of ethylene, in primary forms	10,332.0	11.9
3902	Polymers of propylene or of other olefins, in primary forms	5,781.0	12.2
2909	Ethers	4,929.5	24.9
2711	Petroleum gases	4,235.1	1.2
2905	Acyclic alcohols	4,137.5	12.0
2902	Cyclic hydrocarbons	2,489.4	5.0
8904	Tugs and pusher craft	1,624.3	24.8
7601	Unwrought aluminium	1,271.8	2.1
3105	Mineral or chemical fertilizers, mixed	1,124.2	4.0
3102	Mineral or chemical fertilizers, nitrogenous	1,070.5	3.6
2707	Oils and other products of the distillation of high temperature coal tar	1,040.4	4.5
2814	Ammonia	797.6	7.8
3907	Polyacetals	739.7	1.2
7404	Copper waste and scrap	583.3	2.4
2901	Acyclic hydrocarbons	512.5	2.1
3402	Cleaning products	478.1	1.3
2915	Saturated acyclic monocarboxylic acids	469.7	3.1
4819	Cartons, boxes, cases, bags and other packing containers of paper	410.2	1.7
2712	Petroleum jelly	396.8	8.4
2503	Sulphur	394.4	7.8
2009	Fruit juices	374.3	2.2
4818	Toilet paper of a kind used for household or sanitary purposes	357.9	1.2
8805	Aircraft launching gear	303.0	11.8

403	Fermented milk and cream products	273.4	5.5
7602	Waste or scrap, aluminium	265.2	1.8
401	Milk and cream	262.8	3.0
2202	Waters flavoured or sweetened	260.9	1.3
3305	Hair products	248.5	1.7
3817	Mixed alkyl benzenes and mixed alkyl naphthalene	241.0	9.0
402	Milk and cream, concentrated	239.9	1.1
7305	Other tubes and pipes of iron or steel having circular cross section	214.6	1.7
2910	Epoxides	201.9	4.5
5603	Non-woven textiles	199.1	1.2
2916	Unsaturated acyclic monocarboxylic acids	187.7	1.7
7612	Aluminium cans and similar containers	181.9	3.2
8309	Stoppers, caps and lids	177.5	2.4
3206	Other colouring matter	172.7	1.3
2906	Cyclic alcohols and their halogenated, sulfonated, nitrated or nitro-sated derivatives	163.8	7.5
2815	Sodium hydroxide; potassium hydroxide; peroxides of sodium or potassium	158.2	2.9
3003	Medicaments, not packaged	144.2	1.3
804	Dates, figs, pineapples, avocados, guavas and mangoes	132.5	1.2
3401	Soap	125.5	1.7
1902	Pasta	124.3	1.2
2903	Halogenated derivatives of hydro-carbons	111.9	1.1
6807	Asphalt	100.5	4.3
2931	Other organic and inorganic compounds	83.6	1.2
5702	Carpets, woven, not tufted or flocked, hand-woven rugs	76.9	1.5
7005	Float glass	76.5	1.3
1515	Linseed oil, crude	71.1	1.5
106	Live animals, except farm animals	69.3	4.4
7303	Tubes, pipes and hollow profiles, of cast iron	66.7	2.7
8709	Works trucks, self-propelled	55.4	3.7
407	Birds eggs, in shell	54.9	1.1
4105	Tanned skins of sheep or lambs	45.5	3.0
2912	Aldehydes	42.7	1.7
6809	Plaster articles	40.4	1.8
2942	Other organic compounds	38.3	2.5
2823	Titanium oxides	33.0	3.3
2505	Natural sands	32.7	1.6
2621	Other slag and ash, including seaweed ash (kelp)	28.6	6.1
7223	Wire or stainless steel	28.2	1.2
7004	Glass, drawn or blown	25.3	1.1
2919	Phosphoric esters and their salts	20.4	2.1
6906	Ceramic pipes, conduits, guttering and pipe fittings	20.1	9.8
5404	Synthetic mono-filament	18.9	1.1
4106	Tanned skins of other animals	17.7	1.5
2802	Sulfur, sublimed or precipitated	12.3	3.7
5704	Carpets of felt	12.3	1.6
2839	Silicates; commercial alkali metal silicates	11.8	1.5
7902	Zinc waste and scrap	11.2	1.7
7903	Zinc dust, powders and flakes	7.4	1.5

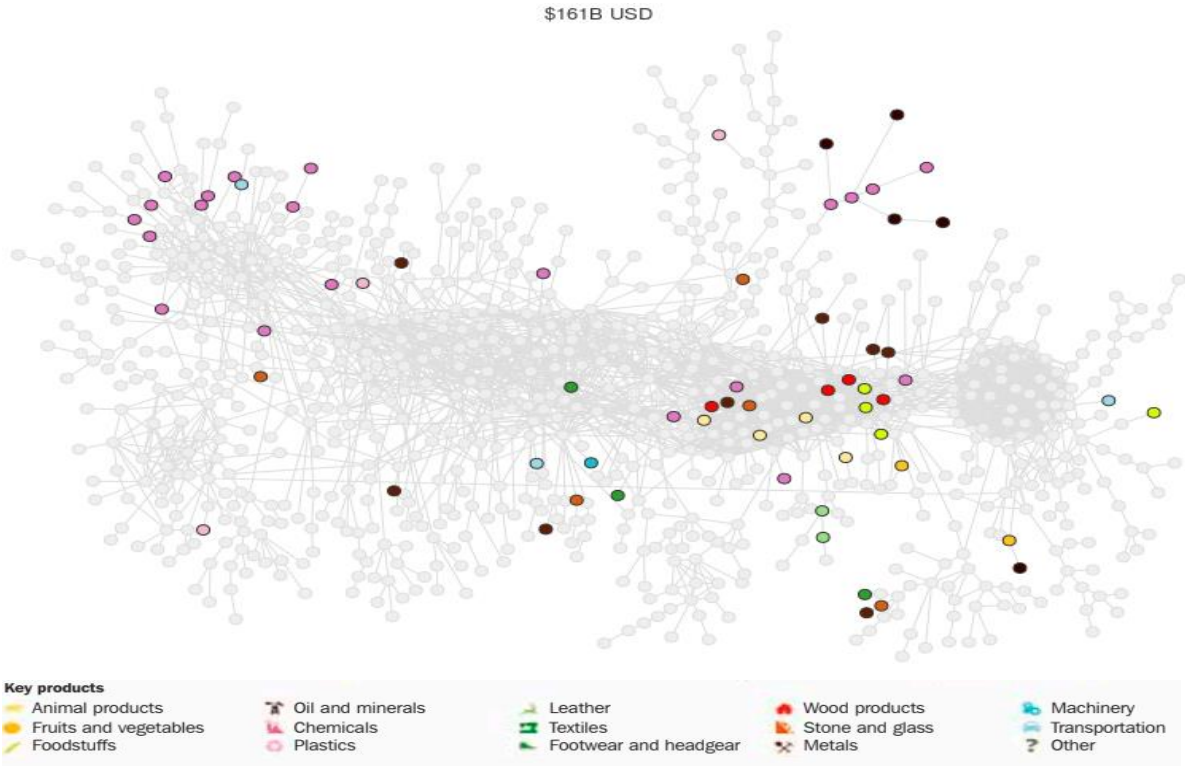
4006	Other forms of vulcanized rubber	6.6	1.2
3813	Preparations and charges for fire extinguishers	5.3	1.8
6814	Mica articles	4.6	1.4
5905	Textile wall coverings	2.9	2.3
1522	Residues from treatment animal and veg waxes	1.5	1.4
4502	Natural cork, debarked	0.5	1.3
5405	Artificial mono filament	0.4	1.1

Source: own calculations based on COMTRADE database

After constructing the RCA indicator for Saudi Arabia, the products are then visualized into the product space with colours reflecting their product groups. Figure 4.12 represents the Saudi product space, which is dominated by minerals and metals, chemicals and plastic products. These products account for 61.2 percent of the number of products with RCA (90.0 percent of total export value). The figure also shows that the Saudi product space has no machinery and electronics products (in blue colour), which tend to be more central in the network (and more sophisticated) and thus are connected to a higher number of other products. Indeed, Hausmann et al. (2014) explain that the two highest communities in their product complexity index (PCI) are machinery and electronics, indicating that they require advanced industrial capabilities that are difficult to acquire. The lack of these central products in the Saudi industry makes it harder to move towards new sophisticated export groups, and thus might slow its industrial upgrading progress.

For comparison purposes, this section compares the Saudi product space with other resource-dependent developing countries: Venezuela, Chile and Malaysia. Figure 4.13 shows that Saudi Arabia has a significantly more diversified and more sophisticated export basket than Venezuela. There are eighty products with RCA in Saudi Arabia, whereas Venezuela has only twenty-five. Furthermore, Saudi Arabia has more core products that are more complex and sophisticated. On the other hand, Chile and Malaysia are substantially more diversified than the other two countries with 134 and 222 products with RCA (respectively). The figure also shows that Malaysia has more connected products in the core, which makes it easier for its industry to diversify (jump) into more sophisticated products.

Figure 4.12 The Saudi product space

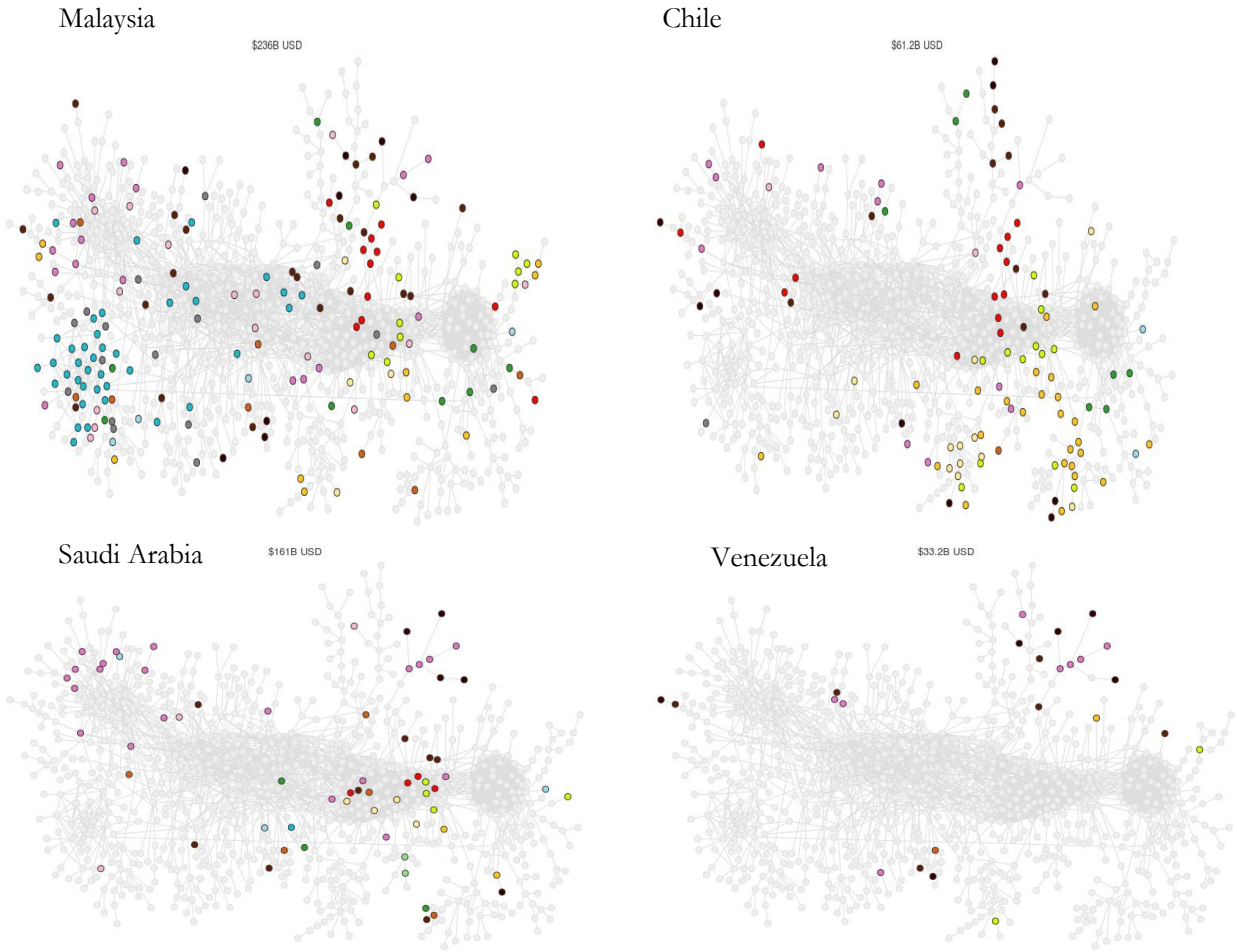


Source: based on Hausmann et al. (2014)

The product space demonstration of Saudi Arabia reveals the lack of diversification in addition to the concentration on peripheral products with low populated core. This production structure has a crucial implication for structural transformation. The revealed capabilities, by the current product space, show that it is difficult for Saudi Arabia to jump into a large number of sophisticated products. On the other hand, it is easier for Saudi Arabia to shift towards peripheral products, which will contribute relatively little to the industrial and overall economic development.

Jumping towards more sophisticated products requires the government to promote policies, offer financing and provide an infrastructure that allows the private sector to invest in new, sophisticated products (Hausmann et al. 2014). The priority in choosing more sophisticated products (i.e. to be targeted in the industrial policy) should be given to "close by" products to the existing products with RCA. These products are likely to be developed more quickly with a smaller amount of resources, because they require a similar set of capabilities to those eighty products with existing RCA.

Figure 4.13: The product space for selected countries in 2016



Source: based on Hausmann et al. (2014)

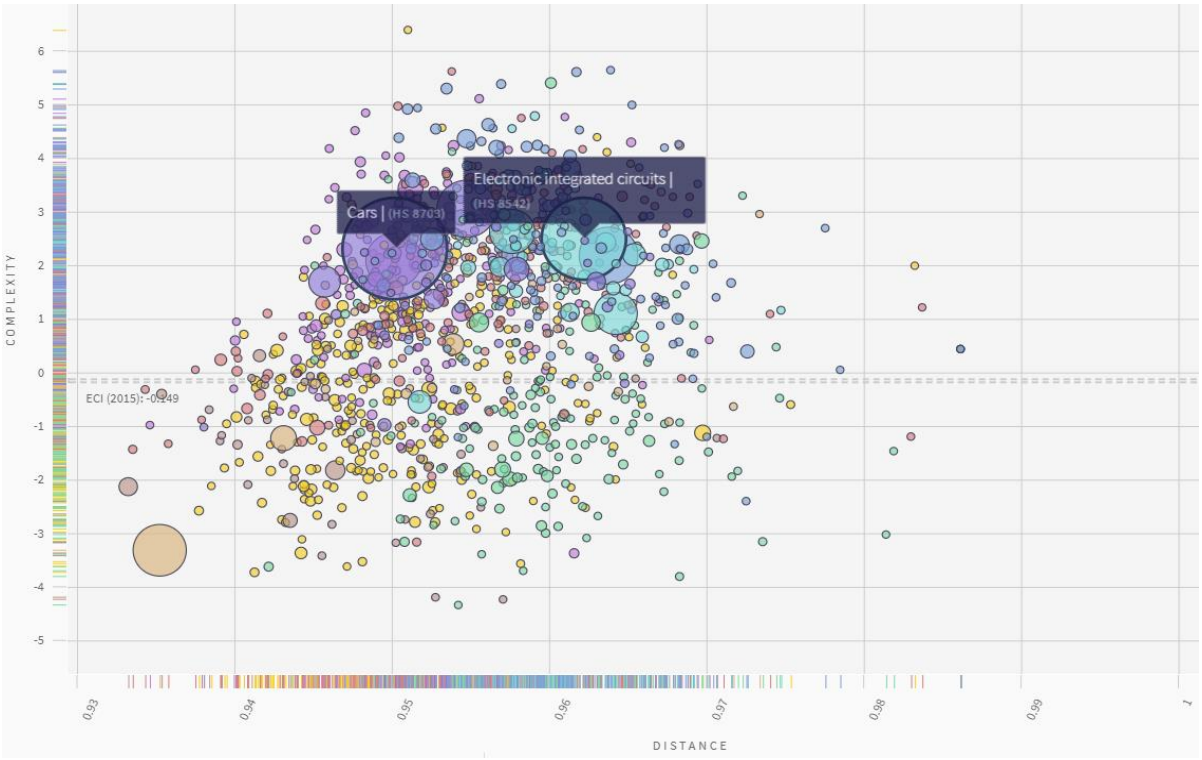
Saudi Arabia, according to this theory, should target "close-by" products with a greater complexity such as more sophisticated chemical products (e.g. paints, chemical acids, artificial colours and artificial waxes), food stuff and wood products (e.g. frozen vegetables, mustard oil and packing boxes), transportation (e.g. space craft launch vehicles), machinery (e.g. surveying instrument) in addition to processed stone, glass and mineral products.

To demonstrate the move towards closer products, Figure 4.14 shows two core sophisticated products in which Saudi Arabia has no RCA: Electronic integrated circuits and Cars[79]. In the Saudi product space, the former is considered far because it is isolated by products where Saudi Arabia has no RCA, i.e. Electronic integrated circuits require a set of capabilities that are significantly different from the existing Saudi capabilities. On the other hand, Cars is not far because it is located near to a product with a RCA, i.e. Cars is close to

[79] This Figure uses two dimensions that serve this comparison: distance and complexity. The former refers to the distance between the existing Saudi products with RCA and the potentially targeted products. The smaller distance indicates relatively similar capabilities to the existing product structure. While the complexity dimension ranks products according to the Products' Complexity Index (PCI).

"Self-propelled work trucks", in which Saudi Arabia currently has a RCA. This implies that it is less difficult for Saudi Arabia to start producing cars than producing Electrical integrated circuits, because the capabilities needed to produce cars are assumed to be relatively similar to what Saudi Arabia already has. Hidalgo et al. (2007) do not claim that products 'further' from the existing RCA should not be targeted, but rather suggests that there is a trade-off between risk and return[80].

Figure 4.14: A comparison between targeting "close by" and "farther" product for Saudi Arabia



Source: based on Hausmann et al. (2014).

[80] In this regard, Hidalgo et al. (2007) argue that the industrial policy objective is also an important factor in choosing targeted products.

4.3.3 The Growth Identification and facilitation theory

4.3.3.1 Factor Endowment Analysis: What does Saudi Arabia have?

Saudi Arabia is a capital-abundant and resource rich country. It is not only rich in oil and gas, but also minerals. These minerals include aluminium, gold, phosphate and nitrogen. On the other hand, the country is known for its high temperatures and water-scarcity. There are neither natural lakes nor rivers and the average rainfall is significantly low. For instance, in the capital city, Riyadh, the average rainfall is four inches per year. The decreasing fresh water resource has forced the government, recently, to play an important role in rationalizing water consumption.

The country's long East and West coasts have given three important benefits to the Saudi economy that should be highlighted in this context. First, the water scarcity problem has been partly solved using sea-water desalination techniques. Through its twenty-one plants, Saudi Arabia is currently the largest producer of desalinated water in the world with 4.2 million m^3 per day (Saline Water Conversion Corporation, 2017). Nevertheless, it is only permitted for households but not for the agricultural sector, because of its enormous production costs. Secondly, it provides the country with the opportunity to invest in aqua-culture industries (i.e. fishing related activities). Thirdly, the Arabian Gulf in the East and the Red Sea in the West have been important channels in facilitating international trade.

From a comparative perspective, Saudi Arabia is not considered a labour-abundant country. It has low population density and is ranked 212th globally with a ratio of 12.7 persons per km^2 (World Bank, 2017). Immigrant workers account for 37.4 percent of the total population[81] (see Table *4.10*). Despite high unemployment among Saudi youth, which reached 12.7 percent in 2017, immigrant workers account for 81.7 percent of private sector employment (see Table 4.11).

Looking at the number of private sector workers by economic activity, there is a salient feature. The mining and quarrying sector, which is the main driver of the economy, accounts for only 1.8 percent of private sector employment. In contrast, the construction sector is the largest employer followed by trade, while the manufacturing sector employs

[81] The percentage shows non-Saudis with working visa, which includes their families and dependents.

less than ten percent (see Table 4.11). By looking at the cost of labour, the average monthly salary for the private sector worker is 6,190 SR (see Table 4.12).

Table 4.10: Distribution of Population by Age Group

Age	Nationals	Immigrant workers	Total
0-4	2,173,984	560,332	2,734,316
5-9	2,124,889	710,768	2,835,657
10-14	1,901,515	582,469	2,483,984
15-19	1,791,351	474,121	2,265,472
20-24	2,020,844	505,299	2,526,143
25-29	1,937,788	1,173,982	3,111,770
30-34	1,748,949	1,398,881	3,147,830
35-39	1,528,304	1,974,875	3,503,179
40-44	1,285,343	1,846,826	3,132,169
45-49	1,070,936	1,257,060	2,327,996
50-54	853,736	772,475	1,626,211
55-59	656,335	468,162	1,124,497
60 and above	479,774	262,737	742,511
69 - 65	310,377	104,157	414,534
74 - 70	222,847	53,256	276,103
79 - 75	143,601	20,636	164,237
+ 80	176,784	19,248	196,032
Total	20,427,357	12,185,284	32,612,641

Source: Saudi General Authority for Statistics

Table 4.11: Private sector employment by economic activity

Economic activities	Total	Percentage of total	Saudis		Immigrant workers	
			Number	Percentage of sector	Number	Percentage of sector
Post and Telecommunications	370,698	3.60%	84,386	22.80%	286,312	77.20%
Trade	2,479,032	24.30%	398,038	16.10%	2,080,994	83.90%
Construction	4,158,907	40.70%	441,827	10.60%	3,717,080	89.40%
Mining and quarrying	179,649	1.80%	99,130	55.20%	80,519	44.80%
Other collective and social services	877,095	8.60%	372,242	42.40%	504,853	57.60%
Agriculture and fishing	102,817	1.00%	17,083	16.60%	85,734	83.40%
Manufacturing	998,880	9.80%	200,268	20.00%	798,612	80.00%
Electricity, gas and Water	112,618	1.10%	52,642	46.70%	59,976	53.30%
Financial, insurance, real estate and business services	929,579	9.10%	204,729	22.00%	724,850	78.00%
Other activities	1,520	0.00%	1,520	100.00%	0	0.00%
Total	10,210,795	100.00%	1,871,865	18.30%	8,338,930	81.70%

Source: Saudi General Authority for Statistics

Table 4.12: Average monthly wages per worker by educational level (wages in SR)

Education level	Saudi	Non-Saudi	Average
Illiterate	4,753	1,774	2,003
Read and Write	4,915	2,020	2,137
Primary	5,816	2,152	2,625
Intermediate	7,502	2,271	3,140
Secondary or Equivalent	8,309	2,908	5,930
Diploma	9,587	4,339	7,319
Bachelor Degree	12,003	7,771	10,074
Higher Diploma/Master Degree	16,639	14,587	15,473
Doctorate	25,622	16,085	18,561
Total average	9,911	3,876	6,195

Source: Saudi General Authority for Statistics

4.3.3.2 Latent Comparative Advantages: What can Saudi Arabia potentially do well?

The GIFF starts by choosing targeted products; tradable products that have been produced for the past two decades in fast growing economies with a similar endowment structure and GDP per capita that is not significantly higher than Saudi Arabia. However, there is a problem with choosing benchmark countries. Using the GDP per capita as an indicator for the industrial development of a resource-dependent country can be misleading (Felipe and Rhee 2015). For Saudi Arabia, the GDP per capita is 20.1 thousand USD, which falls just behind the average European country s (25.5 thousand USD), while the majority of industrially advanced developing countries are far behind (World Bank Database, 2017). In other words, the GDP per capita for Saudi Arabia does not reflect development of its industrial sector. Thus, using European developed countries as benchmarks is not suitable for Saudi Arabia according to the GIFF.

Alternatively, this study uses two indicators that reflect the industrial development of Saudi Arabia and serve the GIFF comparative purpose, namely the industrial GDP (manufacturing added value to GDP) and the Economic Complexity Index (Hausmann et al. 2014). The first indicator has been used as an additional criterion in Lin and Xu (2016) in choosing benchmark countries in their GIFF case study on Uganda, while the latter indicator is widely utilized to evaluate and compare countries' industrial sectors.

In order to choose appropriate benchmark countries, three lists of countries are used: the first is for developing countries with higher industrial GDP and ECI; the second is for countries with a similar endowment structure to Saudi Arabia; and the third group is for developing countries that have been growing in the last two decades. From the three groups,

five benchmark countries have been chosen that are included in all of them. The countries are Malaysia, Mexico, Russia, South Africa and Brazil[82].

In terms of its endowment structure, Russia appears to be the country with the greatest similarity to Saudi Arabia. Russia is rich in oil. In 2016, it was the third largest oil exporter after the United States and Saudi Arabia. It accounts for twelve percent of global crude oil output with 11.2 million barrels per day (EIA, 2017). Moreover, Russia cannot be considered a labour-abundant country. Russia's population intensity is 8.8 people per square kilometer (compared to 12.7 for Saudi Arabia). As for industrial performance, the industrial GDP of Russia is 14.5 percent (compared to 10.6 for Saudi Arabia). Finally, Russia's ECI is 0.14 relative to minus 0.35 for Saudi Arabia. Table 4.13 shows all five benchmark countries and compares them to Saudi Arabia.

Table 4.13 Selected indicators for the benchmark countries

Country	World ranking	ECI	MVA to GDP 2007-2016	Growth rate 1997-2006	Growth rate 2007-2016	Natural resource	Population density
Russia	34	0.14	14.5	5.13	1.72	Oil	8.8
Brazil	44	-0.10	13.7	2.68	2.06	Oil	23.8
South Africa	42	-0.03	16.8	3.44	2.13	Minerals	39.6
Mexico	25	0.57	17.6	3.28	2.16	Oil	65.6
Malaysia	14	1.03	23.3	4.43	4.78	Oil	94.9
Saudi Arabia	92	-0.35	10.6	2.93	3.86	Oil	12.7

Source: Hidalgo et al. (2007); World Bank database (2017)

After choosing the five countries, the next step is to identify products that have been produced by these countries in the last two decades, which are potential comparative advantage for Saudi Arabia. Following previous studies, key exported products are considered through calculating the revealed comparative advantage (RCA) and the export shares for each country (Lin and Treichel 2011; Lin and Xu 2015). Using these criteria, the key exports for Russia, Brazil, Russia, South Africa, Mexico and Malaysia have been evaluated and are shown in Table *4.14*.

[82] Following Lin Xu (2015) and Lin and Treichel (2011), this analysis allows for some heterogeneity in the selected countries.

The resulting list of products could be shortlisted through analysing their potential feasibility, given the Saudi endowment structure. First, extremely labour intensive should be eliminated from the list, given that Saudi Arabia is not a labour intensive country. As a result, products that fall within the textile and garments sectors should be eliminated from the list. Secondly, agricultural and food products that need large amounts of water in the production process should not be shortlisted given the scarcity of underground water and the non-existence of rivers and lakes in the country. Thus, agricultural, dairy and meat products should not be targeted in this strategy, with the exception of aqua-culture and poultry sub-sectors.

Apart from products exported by the benchmark countries, the GIFF uses two additional criteria. One criterion targets sub-sectors based on the domestic market demand. In addition to the international markets' demand, the domestic market demand is vital in targeting a sub-sector. Following Lin and Xu (2015), the shares of top imported products are used as an indicator of the Saudi market demand for products. Among the largely imported manufacturing products, the country should consider those with limited economies of scale and, hence, might be produced domestically. Table 4.15 shows the top fifteen imported products to Saudi Arabia.

The other criterion is to scale up domestic self-discoveries. To identify domestic manufacturing discoveries, Lin and Xu (2015) suggest using the gain of products with Revealed Comparative Advantage (RCA) over time. The RCAs are calculated for 1995 and 2015 for Saudi Arabia, and the gained (explored) products are shown in Table 4.16. Saudi Arabia did not have the comparative advantage in producing these forty-two products in 1995, but was able to produce them in 2015 with a comparative advantage. The GIFF states that these products should be supported in the Saudi industrial policy. It worth mentioning that the first two products in the table (with the highest RCA) are among very few transportation products in the Saudi exports basket.

Table 4.14: Key exports in Mexico, Malaysia, Brazil, Russia, South Africa

	Mexico	Malaysia	Brazil	Russia	South Africa	Saudi Arabia potential
Animal products	Bovine meat, crustaceans and honey	Concentrated milk, poultry and eggs.	Poultry, bovine and pig meat, edible offal, crustaceans, concentrated milk, eggs and honey	Frozen fish and crustaceans	Fish fillet, bovine meat and crustaceans	Animal products are mainly produced for the domestic market, with the exception of dairy products that are being exported to neighbouring countries.
Fruit, vegetables and food products	Tropical fruits, vegetables, nuts, beer, sugar, chocolate, fruit juice, cereals and canned food	Palm oil, rice, flowers, pepper and cocoa butter, coffee and tea extracts	Soybeans, coffee, corn, rice, fruits, sugar, soybean meals, fruit juice and waxes	Wheat, barley, linseed, and cereals	Fruits, nuts, wine, fruit juice and soybean oil	Fruit, vegetables and food products are mainly produced for the domestic market. The major exception is date products which are exported to global markets.
Textile, garment, footwear and leather	Hats	Textured yarn, shorts, trousers, water proof footwear, and gloves	Twine and rope, coconut fibers, rubber footwear, footwear parts, and bovine leather	-	Tent and sails fiber, prepared wool, and shirts	There is no significant manufacturing in the textile, garments and footwear products.
Processed metals, stones, and glass	Padlocks, iron springs, copper pipes, razor blades, metal stoppers, iron radiators	Copper wires, copper bars, copper foil, iron structure, articles of cement and concreate, glass materials	Steel ingots, copper wires, building stones, glazed ceramic and refractory bricks	Copper wires, ferrous products, rolled iron, asphalt and cement articles	Rolled stainless-steel and iron, aluminium plating, , and float glass	Metal stoppers, iron pipes, aluminium bars and cans, asphalt, float glass, plaster materials and ceramic materials are produced with a RCA.
Wooden and paper products	Wood charcoal, facial tissue, paper notebooks and labels	Plywood, sawn wood, rough wood, shaped wood, wood fiberwood, particle boards, veneer sheets paper notebook, postage stamps and sulfate chemical wood pulp	Shaped wood, plywood, swan wood, wood carpentry, wood fireboard, sulfate chemical wood pulp, coated and uncoated pulp, and dissolving pulp	Swan wood, rough wood, plywood, fuel wood, veneer wood, sulfate chemical wood pulp, uncoated paper, newsprint and chemical wood pulp.	Fuel wood, rough wood, wood charcoal, wood stakes, chemical wood pulp and uncoated paper	Paper containers are the only product produced with RCA. The lack of wooden products is mainly a result of the absence of trees and forestry in commercial quantities.
Manufactured fertilizers	Phosphate fertilizers	Nitrogenous fertilizers	Mixed mineral fertilizers	Mixed mineral fertilizers, potassic fertilizers and nitrogenous fertilizers	Mixed mineral fertilizers	Already has a revealed comparative advantage in mixed mineral fertilizers and nitrogenous fertilizers.

Plastic and rubber	Rubber tyres, plastic lids, rubber pipes and rubber belting	Rubber apparel, plastic lids, rubber pipes, rubber thread, pharmaceutical rubber products and rubber sheets	Rubber tyres and plastic pipes	Rubber tyres	Rubber tyres and rubber belting	While intermediary plastic and rubber products exist, there is no final product with revealed comparative advantage.
Medical and pharmaceutical products	Medical and pharmaceutical products	-	Medical and pharmaceutical products	-	-	Limited medical products targeting the domestic market with small export value.
Specialty or consumer chemicals	Hair products, dental products, essential oils	Soap, chemical material for electronics, and photographic films	Dental products, gelatin, hair products and vegetable tanning extracts	Radioactive chemicals and precious metal components	Soap, radioactive chemicals, pesticides and dentifrices	Products such as soap, cleaning products and hair products have RCA. However, their share is relatively small compared to the intermediary (basic) chemical products.
Transportation	Cars, trucks, tractors, vehicle parts and trailers	Bi-wheel vehicle parts and tug-boats	Planes, ships, buses and tractors	Planes, ships, boats and tractors	Cars, trucks, boats and trailers	Cars, ships and planes production does not exist. However, there is a RCA in work trucks and air-craft launching gears.
Machinery	Engine parts and electric motors	-	Engine parts, construction vehicles , electrical motors, electrical motor parts, stone processing machines, harvesting machinery and gas turbines	Nuclear reactor parts and power engines	Centrifuges, stone processing machines, and construction vehicles	There are no products exported with RCA. Even in the domestic market, the size of Saudi machinery products is trivial. However, there is a potential growth of machinery related to the upstream oil sector.
Electrical and electronics	Computers, telephones, video displays, insulated wires, air conditioners, refrigerators, lighting, electrical control boards, microphones and headphones	Semiconductor devices, printed circuit boards, computers, telephones, office machine parts, broadcasting equipment and air conditioners	-	Navigation equipment	Broadcasting equipment and telephones	There are no products with RCA. However, some electrical products such as fridges and air conditioners assembly have been growing in recent years.

Source: Own calculations using the revealed comparative advantage analysis and export shares in the last 20 years, based on COMTRADE database.

Table 4.15: Top fifteen imported products

	HS4	Product description	Import value	share
1	8703	Motor vehicles for transport of people (except buses)	12875937695	9.9%
2	8525	Radio and TV transmitters, television cameras	4069602154	3.1%
3	3004	Medicaments, therapeutic, prophylactic use, in dosage	3544087363	2.7%
4	8803	Parts of aircraft and spacecraft	2704286581	2.1%
5	8704	Motor vehicles for the transport of goods	2190769672	1.7%
6	7108	Gold, unwrought, semi-manufactured, powder form	2162853637	1.7%
7	8471	Automatic data processing machines (computers)	1661070076	1.3%
8	8481	Taps, cocks, valves for pipes, tanks, and boilers	1625588965	1.3%
9	8708	Parts and accessories for motor vehicles	1440211667	1.1%
10	4011	New pneumatic tyres of rubber	1327815260	1.0%
11	8415	Air conditioning equipment, machinery	1251979432	1.0%
12	2402	Cigars, cigarettes, tobacco or tobacco substitute	1181299610	0.9%
13	8517	Electric apparatus for line telephony, telegraphy	1173430267	0.9%
14	8431	Parts for use with lifting or moving machinery	1095527236	0.8%
15	8504	Electric transformers, static converters and rectifier	1010654597	0.8%

Source: own calculation based on COMTRADE database.

Table 4.16: Products that have gained RCA (1995-2015)

	HS4	RCA	Product description
1	8904	24.76	Tugs and pusher craft
2	8805	11.82	Aircraft launching gear
3	2712	8.36	Petroleum jelly
4	2906	7.46	Cyclic alcohols and their halogenated, sulfonated, nitrated or nitro sated derivatives
5	2621	6.06	Other slag and ash, including seaweed ash (kelp)
6	2707	4.50	Oils and other products of the distillation of high temperature coal tar
7	2910	4.50	Epoxides
8	3105	4.00	Mineral or chemical fertilizers, mixed
9	8709	3.65	Works trucks, self-propelled
10	2915	3.09	Saturated acyclic monocarboxylic acids
11	2942	2.54	Other organic compounds
12	5905	2.29	Textile wall coverings
13	2009	2.15	Fruit juices
14	7601	2.13	Unwrought aluminium
15	2919	2.08	Phosphoric esters and their salts
16	6809	1.77	Plaster articles
17	3813	1.75	Preparations and charges for fire extinguishers
18	2916	1.74	Unsaturated acyclic mono-carboxylic acids
19	7305	1.72	Other tubes and pipes of iron or steel having circular cross-section
20	7902	1.69	Zinc waste and scrap
21	4819	1.68	Cartons, boxes, cases, bags and other packing containers of paper
22	2912	1.66	Aldehydes
23	5704	1.63	Carpets (felt)
24	2505	1.59	Natural sands
25	7903	1.49	Zinc dust, powders and flakes
26	2839	1.47	Silicates; commercial alkali metal silicates
27	1522	1.38	Residues from treatment animal and vegetable waxes
28	4502	1.32	Natural cork, debacked
29	3003	1.29	Medicaments, not packaged
30	2202	1.28	Waters flavoured or sweetened
31	3206	1.27	Other colouring matter
32	7005	1.26	Float glass
33	1902	1.24	Pasta
34	5603	1.23	Non-woven textiles
35	3907	1.22	Polyacetals
36	4006	1.19	Other forms of unvulcanized rubber
37	7223	1.18	Wire or stainless steel
38	2931	1.16	Other organic and inorganic chemical compounds
39	7004	1.13	Glass, drawn or blown
40	5404	1.12	Synthetic monofilament
41	5405	1.07	Artificial monofilament
42	402	1.06	Milk and cream, concentrated

Source: Own calculation based on COMTRADE data

4.3.3.3 What sub-sectors can be targeted based on this analysis?

Combining the three criteria used in this section - products produced by benchmark countries, products with high domestic demand and self-discovered products – results in wide range of sub-sectors that can be targeted by the Saudi government.

From the first criterion, six sectors (or sub-sectors) emerge very noticeably: aqua-culture, consumer plastics and rubber (i.e. final products), medicines, speciality chemicals, small trucks and boats (i.e. assembly manufacturing) and fridges and air conditioners. From the second criterion, there are also six sub-sectors: motor vehicles, telecommunication and television cameras, computers, parts for vehicles, parts for aircrafts and parts for lifting machinery. Finally, from the self-discovery criterion, there are five major products: tugs and pusher craft, aircraft-launching gear, processed glass, processed metals, milk and cheese.

What, therefore, are the specific sectors that should be targeted from the above list? Lin and Monga (2011) argue that the criterion for choosing from the list of sub-sectors should focus on three main elements: the sector's upside potential in terms of employment and growth, the growth feasibility given the private sector's industrial capabilities and the public sector regulatory structure. A detailed firm level value chain analysis, they argue, can be a useful way to address this question. This value chain analysis should also compare the domestic production costs relative to other competing countries.

Nonetheless, previous studies show that the list could be narrowed using a simpler screening criterion (Lin and Treichel 2011; Lin and Xu 2015). This screening relies on the previously discussed endowment structure of Saudi Arabia in addition to the existence of a supply chain. Export or domestic production values are used as indicators of the supply chain's existence in the country. To assess the existence of the supply chain in some Saudi sub-sectors, this analysis uses export data at the product level from COMTRADE, published and unpublished reports of the Saudi Industrial Development Fund, and the Saudi Industrial Clusters Programme (SICP) reports. Table 4.17 shows whether the pre-identified sub-sectors satisfy the screening criterion.

The majority of the sub-sectors satisfy the screening criteria. Exceptions are milk and cheese, electronics and car industries. Milk and cheese do not meet the criteria because of their reliance on large amounts of water in the production process. This is unlike the aquaculture and poultry industries, which can be great opportunities to meet the Saudi government goal of achieving high food security levels without exploiting the scarce water reserves. Electronics and cars do not satisfy the screening method because of the non-existence of the domestic supply chain. Nevertheless, the GIFF argues that the government can still promote industries that are totally new to the domestic manufacturing sector, such as the car industry. This can take place by attracting foreign investors through setting up joint ventures or promoting export processing zones (Lin 2010). However, for electronics

manufacturing, Saudi Arabia has a significantly larger labour cost than those developing countries that have a RCA in the electronics sector (such as China, Malaysia, and Philippines), which makes it difficult to enter this industry through export processing zones as suggested by Lin[83].

Table 4.17: Potential subsectors screening

Subsector	**Product is not labour intensive**	**Low water consumption in production**	**Supply chain exists in Saudi Arabia and raw material exists**
Aquaculture	Relatively yes.	Yes, for seawater farming.	In addition to the domestic production, Saudi Arabia exports small quantities of fisheries, which indicates the existence of the supply chain.
Poultry	Relatively yes.	Yes	The domestic production is significant. In addition, Saudi Arabia exports small quantities of poultry to neighboring countries, which indicates the existence of the supply chain.
Milk and cheese	Relatively yes.	No.	Yes. There is a large domestic production. The government has supported the sector in the past for food security reasons.
Speciality plastics and rubber and rubber tires	Yes	Yes	The supply chain for speciality plastics and rubber exists because of the production and export of a number of these products. In addition, there is an abundance of raw material coming from the petrochemicals industry. For rubber tyres, there is a significant demand, and the input materials are available; however, domestic production does not exist.
Medicines and speciality chemicals	Yes	Yes	Yes. There is an abundance of raw material coming from the oil and petrochemical industries.
Cars	Yes	Yes	For cars, the supply chain does not exist, because there is neither car vehicles nor car-parts production domestically. However, key input materials such as aluminium, rubber, and plastic are available abundantly in Saudi Arabia.
Small trucks, boats and lifting machinery	Yes	Yes	Yes, supply chain exists for small trucks, boats, and lifting machinery, because of the existing domestic production and exports.
Fridges and air conditioners	Yes	Yes	There is a significant production for domestic use, which indicates the existence of the value chain.
Electronics	Relatively no.	Yes	The supply chain does not exist at all, because of the non-existence of domestic production.
Tugs and pusher craft, aircraft launching gear and aircraft parts	Yes	Yes	The first two items are produced with RCA, which indicates the existence of a supply chain. However, aircraft parts exist for very limited applications; mainly for military aircraft.
Processed glass and metals and construction materials	Yes	Yes	Yes. The supply chain does exist. Raw materials are available; they come from the mining and petrochemical industries. The construction materials industry, particularly, has grown in terms of capacity and diversity significantly in the last two decades.

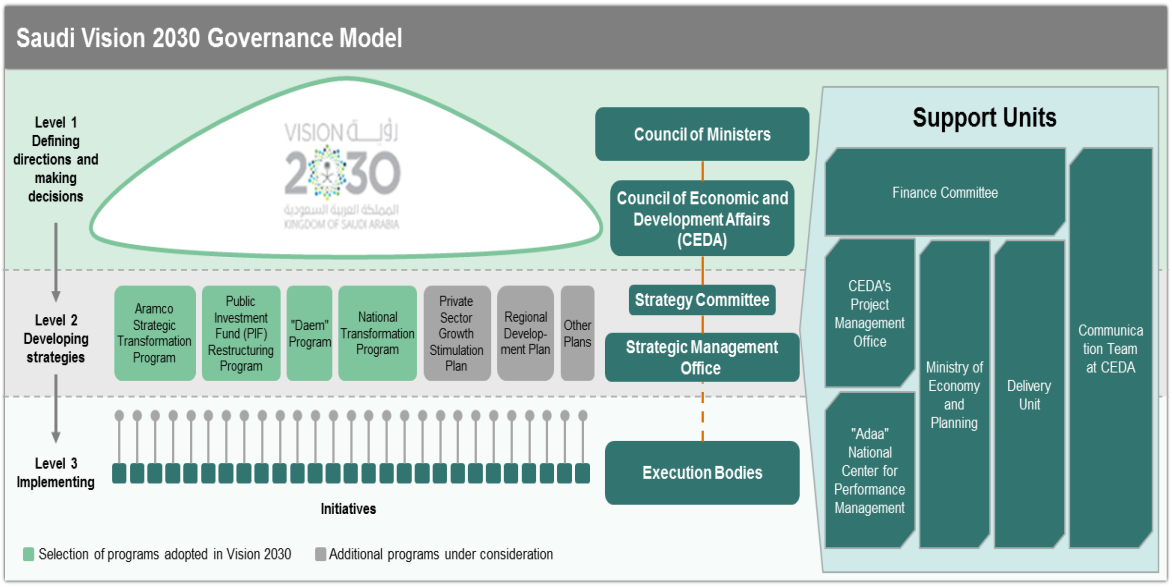
Source: own analysis based on COMTRADE data, the Saudi Industrial Development Fund's reports and the Saudi Industrial Clusters Programme reports.

[83] The East Asian tigers entered the electronics industry through labour-intensive industries. However, over time countries were able to move up the value chain towards high value added activities (Wade, 1990).

4.3.4 Saudi Vision 2030

Saudi Vision 2030 was promoted in 2016 to reduce the economy's reliance on oil revenues and to promote its diversification[84]. Unlike the previous five-year national development plans that had started in the 1970s, this vision is considered to be the roadmap for economic and social developmental actions[85]. The Vision's promotion was coupled with a governance model that supported the realization of the development goals (see Figure 4.15). A major strategic objective of the vison is to develop and diversify the Saudi manufacturing sector.

Figure 4.15: Vision 2030 Governance



Source: Vision 2030

Under the National Transformation Program (NTP), which was a first phase of Vision 2030, the government targets the development of the following major manufacturing sectors: oil and gas, minerals, petrochemicals, pharmaceuticals and renewable energy. Targeting these sectors was coupled with specific milestones. For instance, the NTP expects to increase dry gas production capacity from 12 to 17.8 billion standard cubic feet (SCF) per day, the oil refining capacity to increase from 2.9 to 3.3 million barrels a day, the mining sector contribution to GDP to increase from 64 to 97 billion SR, and the pharmaceutical industry's share of GDP to increase from 0.98 to 1.97. Within the agriculture and food industries, the NTP have mainly targeted the aqua-culture and poultry industries, because of

[84] In addition, Vision 2030 targets increasing the efficiency of government and the development of the education, health, infrastructure, tourism and entertainment sectors.

[85] The former Minister of Industry, Abdulaziz Alzamil, has argued that the previous five-year plans were not actual plans that were based on clear targets and strategies. Instead, they were like a "wish list" for the Saudi ministries (Alzamil et al., 2017). To large extent, this can explain the failure of the government to achieve economic and industrial diversification despite the written plans to promote new industries and activities since the early 1970s.

their suitability for the Saudi natural resources and water scarcity condition. Finally, the government targets the increase of local content in public procurement. This also includes the localization of state and SOEs' expenditure, which can promote the growth of a number of sectors and activities. Table ***4.18*** shows the manufacturing targets detailed in the NTP.

The government has also announced several Vision realization programmes and initiatives that foster achieving 2030 goals. One of the programmes targets the promotion of one hundred national promising companies. The criteria for promoting these companies are based on their potential non-oil exports, manufacturing added value and employment. Indeed, supporting leading domestic firms can be a crucial factor in developing the domestic manufacturing sector (see Amsden and Hikino 1994).

Table 4.18: Major manufacturing sector targeted in the NTP

Strategic objective	**2015**	**2020 Target**	**Unit**
Increasing annual non-oil commodity exports	185	330	Billion SR
Increase the number of exporters	1190	1500	Number of exporting firms
Lower the average time to export	15	7	Days
Promote high value-added manufacturing	432	516	Number of products with high added value
Increase the dry gas production capacity	12	17.8	Billion standard cubic feet per day
Increase the capacity introduced from renewable energy and localize its manufacturing - Increase the share of renewable energy	3,450 0	7,107 4%	Megawatts Share of total energy sources
Develop and expand the mining sector - Increase the mining sector employment	64 65	97 90	Contribution to GDP output in SR Thousand jobs
Increase local content in capital and operational expenses	30	40	Percentage of total government and SOEs' procurements.
Increase domestic added value in the chemicals related industries	252	309	The total industrial production in the four Saudi petrochemicals industrial cities of Yanbu, Jubail, Ras Al-Khair and Jazan
Develop the pharmaceutical manufacturing	0.98	1.97	Share of GDP
- Promote local producers	20%	40%	Share of locally produced to total market size
Promote production in aquaculture farms	30	100	Thousand tons
Promote poultry production	42%	60%	Share of locally produced to total market size

Source: Saudi Vision 2030

In cooperation with the Ministry of Energy, Minerals and Industry (MEMY), Aramco promoted a unique programme to support oil upstream manufacturing. Until 2016, local suppliers were heavily supported by Aramco but with no official mechanism. In some cases, the local supplier wins a bid to supply materials to Aramco even though its price is twenty percent higher than a global supplier. However, the government and Aramco were not satisfied with the local content levels. Thus, they decided to take a further step in growing the linkages from the oil sector by introducing a local content strategy called In Kingdom Total Value Add (IKTVA)[86]. Aramco's CEO explained that continuing to import machineries, material and services is not sustainable in the long-term. What Saudi Arabia and Aramco are missing is a mechanism that enables local suppliers to compete with foreign suppliers (Alnasser 2016).

IKTVA targets an increase in Aramco's locally produced purchases from thirty to seventy percent by 2030, creating 500,000 jobs and exporting thirty percent of the locally produced materials. The programme is expected to increase the domestic added value and to promote industrial diversification (Aramco, 2016). To drive, monitor and measure this programme, Aramco developed a formula to rank the localization of its suppliers:

$$\text{IKTVA score} = \frac{A+B+C+D+R}{E} * 100$$

Where A: the localized goods and services (in USD)

B: the total amount of salaries paid to Saudis (in USD)

C: training and development paid for Saudis (in USD)

D: the development of small suppliers (i.e. tier two or three suppliers) (in USD)

R: research and development (in USD)

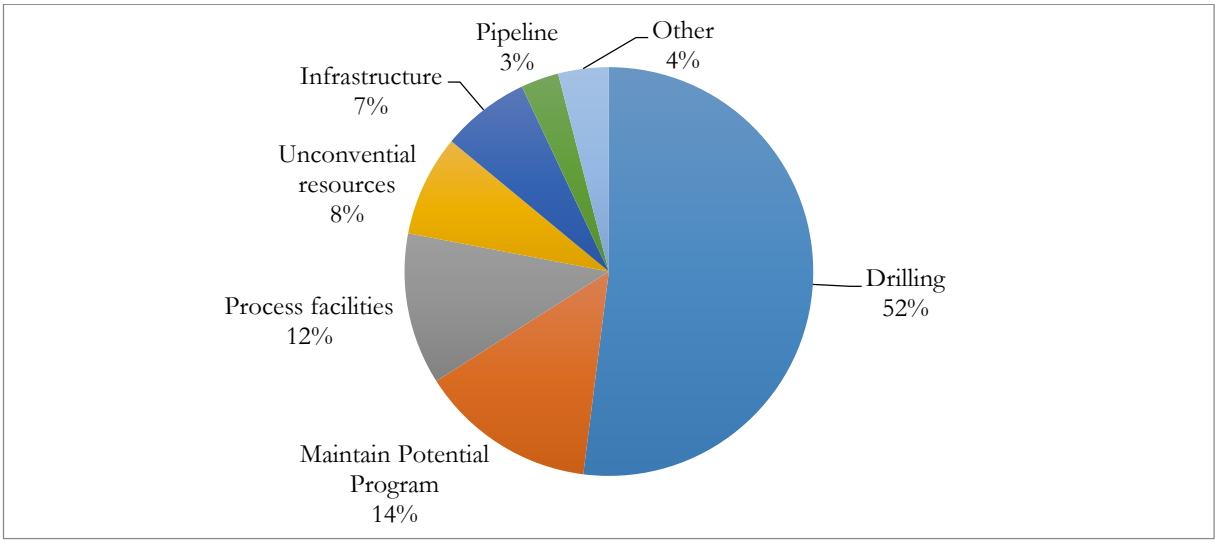
E: expected revenue from Aramco's purchases or contracts (in USD)

To encourage potential suppliers to produce locally, Aramco announced the amount of its expected spending on materials and services in the period (2017-2026) in extensive detail. The amount is projected to be 1.4 trillion SR (330 million US dollars) over ten years, and will be spent as follows: drilling equipment is expected to account for fifty-two percent of

[86] The word "IKTVA" in Arabic means satisfaction.

the total amount, followed by the Maintain Potential Program[87] with fourteen percent and process facilities with twelve percent (see Figure 4.16). Within each segment, Aramco projected the details of the quantities needed. The projected demand for drilling equipment, for example, is shown in Table 4.19.

Figure 4.16: Aramco's projected spending by sectors (for 1.4 trillion SR over 10 years)



Source: IKTVA (2016)

Table 4.19 Projected demand for drilling and equipment (2017-2026)

Item	**Quantity**
Inflow and injection control devices	1.2 million units
Oil well trees	13,900 units
Hanger assemblies	33,000 units
Casing heads	14,00 units
Cement	6.8 million tons
Mud products (drilling fluids)	636 million gallons

Source: IKTVA (2016)

Kaplinsky et al. (2012) have shown that local content policies, such as IKTVA, are a critical factor in promoting linkages from the resource sector. A strategic vision to develop production linkages should be coupled with policy instruments like "local content policy" (p.57). Furthermore, IKTVA's in-advance procurement agreements can reduce local

87 Aramco's Maintain Potential Program (MPP) is responsible for managing all the maintenance, expansion and revamping operations of the company.

suppliers' production and borrowing costs. Columbia Centre of Sustainable Investment (CCSI, 2016), on promoting linkages around the extraction sector, have argued that in-advance purchasing agreements can help small suppliers who do not have adequate capital to access finance at lower cost.

In the Saudi case, after 2016, if a supplier wants to win a new contract, it has to pay attention to its IKTVA score. Therefore, companies such as General Electric (GE), which is a first-tier supplier to Aramco, are negotiating with some of its foreign suppliers to locate their manufacturing in Saudi Arabia in order to increase its score in IKTVA and to ensure the sustainability of its contracts with Aramco. Such a process reduces the reliance on imported products and services and increases the manufacturing added value significantly.

In 2016 Siemens announced the production of a gas turbine facility in Dammam (Siemens 2016). Similarly, GE in 2017 announced the establishment of a joint venture firm in Dammam to produce special power turbines (Reuters 2017). In the same year, during the IKTVA annual conference, Schlumberger announced that it would open a drilling equipment facility in Dammam. The facility will specialize in oil and gas extraction equipment. Schlumberger expects that Saudi-workers in the firms will be approximately sixty-two percent. Similarly, several other first-tier suppliers have moved some of their production facilities to the Eastern region of Saudi Arabia (Aramco 2017). By the end of 2017, the local content of Aramco purchasing is expected to be approximately 43 percent. This number is considered the highest in the company's history (IKTVA, 2017).

IKTVA is expected to generate 69,000 direct jobs by 2030. However, the challenge facing Saudi Arabia in oil related manufacturing is the limited number of high-skilled human resources (mainly technicians). At the moment, there are six training institutions that qualify Saudi technicians to meet the demands of the oil cluster. This is in addition to ten centres currently under development. However, the Ministry of Labour, in co-ordination with Aramco, plans to establish twelve additional centres by 2030 to meet the high demand for a high quality Saudi technical workforce (Aramco 2016).

The limited number of skilled technicians might also hinder the opportunity to absorb foreign technical knowledge and thus can be an obstacle for the Saudi industrial development strategy. Amsden (2001) argued that the training of technicians is a critical factor in industrial development and, above all, in absorbing foreign technologies. "A critical factor

in the transfer of technology is the extent to which the technology is completely understood by the transferor" (Teece 1977, p.247). Indeed, reverse engineering (copying and adapting), which is a fundamental mechanism in transferring technologies to developing countries, is not expected to take place without having highly skilled technicians (and engineers) who can learn the tacit of the imported technology (Lall 1992).

In coordination with the Ministry of Energy, Minerals and Industry SABIC, in 2018, promoted a similar programme to IKTVA called Nusaned[88]. The programme aims to increase its local content purchasing through: procuring its plants' requirements from domestic suppliers, and attracting foreign suppliers to Saudi Arabia (i.e. mainly seeking to transfer foreign technology). In addition to the procurement spending, it offers opportunities for product conversion of its basic chemicals and the commercialization of its technologies and patents. The programme, furthermore, offers advice, support and financing to its beneficiaries (SABIC 2018).

Furthermore, the government in 2018 has organized an event to promote further local content through domestic industrial suppliers. In this event, over 82,000 products were offered to local suppliers by ministries, public institutions and SOEs. These entities include Aramco, SABIC, the Saudi Mining Company, the Saudi Electricity Company, the National Water company and the National Water Sanitation Company. These products range from simple pipes and wires to equipment and engines, which are imported from abroad. The government targets localizing these products in order to reduce balance of payment pressure and to create greater job opportunities.

4.3.5 Industrial strategies review and implications

This section compares and contrasts the industrial strategies discussed earlier, and then provides some policy implications for Saudi industrial policy makers:

The RBI strategy seeks to develop the manufacturing sector around the natural resource, i.e. upstream and downstream. Applying the RBI strategy to Saudi Arabia shows that the oil cluster is under-developed in general. The upstream industry supplies only forty-two percent of Aramco's procurement while fifty-eight percent was imported in 2017. With regard to the downstream industry, and despite its steady growth in the last four decades, sophisticated speciality and consumer chemicals are produced with limited capacities. The

[88] "Nusaned" means support in Arabic.

RBI analysis suggests that Saudi Arabia needs to promote materials, equipment and machinery for the upstream industry, in addition to high-tech products within the downstream industry that can increase the domestic added value and reduce export value fluctuations following changes in oil prices.

The second strategy is the product space theory (PST), which identifies industrial diversification opportunities that require industrial capabilities that are similar to Saudi Arabia's existing capabilities. The PST shows that Saudi Arabia exports eighty products with RCA. These products are concentrated on the "periphery" (which tends to be simple manufacturing and natural resource products) with fewer products at the "core" (which tends to be high added value and more sophisticated products). Nevertheless, the PST does not suggest jumping towards "far-by" products such as electronics, planes and ships; rather it suggests starting with "near-by" chemical products (such as chemical acids, artificial colours, artificial waxes and paints), food stuff and wood products (such as frozen vegetables, mustard oil and packing boxes, dairy products), transportation (such as space craft launch vehicles), surveying instruments and electrical wires, in addition to processed minerals and stones.

The third strategy, the GIFF, suggests targeting sectors based on products that are produced by benchmark countries, products with high domestic demand, and self-discovered products. For Saudi Arabia, the GIFF suggested targeting a wide range of industries: aquaculture, poultry, speciality plastics, speciality rubber (including rubber tyres), speciality chemicals and medicines, processed glass and stones, small trucks, boats, aircraft parts, lifting machines, fridges and air-conditioners. The GIFF shows that the cars and electronic sectors can be targeted but only through attracting FDI because of the limited domestic industrial knowledge in these sectors. In short, targeting the GIFF industries by the government can substantially upgrade the existing production structure.

Fourthly, the Saudi Vision's industrial plans have great similarities with the RBI because of their emphasis on the oil upstream industry, downstream industry, the mining industry and other resource-based activities. In addition, the Vision targets the increase in local content public procurements.

While the evaluation of these strategies depends on several factors, including the Saudi government's capacity and commitment in promoting industrial policy[89], it is necessary to briefly highlight some limitations and strengths of these strategies. The RBI, which focuses mainly on promoting sectors in the upstream and downstream of the oil sector, has a major advantage over the other strategies because of the state ownership of the oil company (Aramco) and other leading chemicals and mining companies (e.g. SABIC and Maaden). This gives the government a substantial authority to implement this strategy[90]. However, the RBI is unlikely to generate adequate employment opportunities and synergy to other sectors of the economy[91] (Roemer 1979). In addition, it does not solve the export fluctuation problem following the rapid changes in the oil price, because it suggests a range of activities and products that have high price correlation with oil.

The PST suggests products that are closely related to the existing product structure and does not suggest great diversification towards sophisticated products. In other words, the PST shows that the Saudi industrial capabilities allow it to produce a range of relatively simple products (mostly on the periphery) with a limited number of sophisticated products (in the core). However, Wade (2012) and Chang (Lin and Chang 2009) show that Newly Industrialized Countries (NIC) have upgraded their industrial structures significantly by targeting sectors that are not close to the existing comparative advantage.

Finally, the GIFF suggests a more sophisticated industrial structure and greater employment opportunities than the PST and pays greater attention to the Saudi endowment structure (e.g. water scarcity). In addition, unlike the PST, it gives domestic demand major importance in choosing the targeted sectors.

By looking at the four industrial strategies, including Vision 2030, in terms of industrial upgrading, potential job creation and export stability, this research suggests

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[89] For example, Khan and Blankenburg (2009) argue that targeting high-tech and machinery products requires a greater role and capacity by the government relative to resource based manufacturing.

[90] Kaplinsky et al. (2012) argue that the national ownership (as opposed to foreign companies) of the extraction firms is a fundamental factor in the success of the RBI. In addition, Kaplinsky (2015) shows that in additive value chains, which exist mainly around natural resource production, governments have greater power to impose traditional industrial policies; because the production process takes place sequentially within a relatively small geographical area (typically in the same country). This is unlike other types of manufacturing (e.g. machinery and electronics) that exist in vertically fragmented GVCs.

[91] Roomer (1979) also shows that the dominance of multi-national corporations (MNCs) in the downstream sectors of natural resources has created a great barrier for domestic firms, because they enjoy a significantly lower production cost due to their economies of scale and technologies, in addition to their economies of marketing and management.

maintaining the support of RBI industries (as in Vision 2030), in addition to complementing it with the GIFF sectors which can stimulate greater industrial diversification.

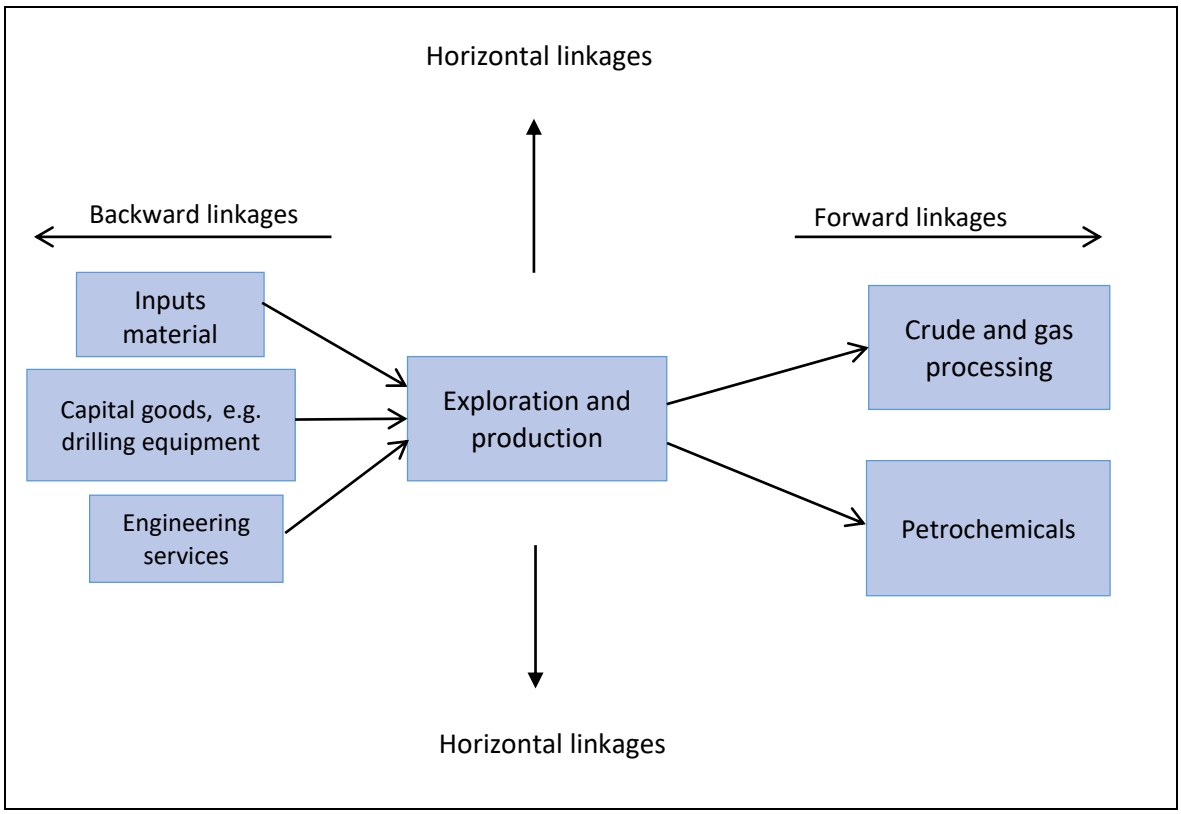
- **Industrial policy recommendations**

Based on the above analysis of the three industrial strategies and Saudi Vision 2030, this study suggests the following policy recommendations:

1. Saudi Arabia should further support the resource-based industrialization (RBI) both upstream and downstream. Greater attention has to be paid to the upstream industry because of its lack of development and its importance in creating horizontal linkages to non-related industries (CCSI 2016). In the downstream industry, consumer and speciality chemicals should be promoted because of their high-added value and low correlation with oil prices.
2. In addition to the RBI, this research encourages the government to target the set of sectors proposed by the GIFF, namely: poultry, aqua-culture, speciality plastics, speciality rubber, rubber tyres, speciality chemicals and medicines, processed glass, processed stone, boats, small trucks, aircraft parts, lifting machines, fridges and air-conditioning systems.
3. The targeted set of sectors should be evaluated and reviewed periodically in terms of development in their domestic and international demands.
4. The government should encourage horizontal linkages from the oil sector towards other, non-related, activities (i.e. see Figure 4.17). Ramos (1998) and CCSI (2016) suggest the formation of industrial clusters to stimulate these synergies (linkages) from oil sector manufacturing to non-oil activities.
5. The local content policy promoted by Vision 2030 should be maintained and further supported. In addition to its importance in supporting the upstream oil industry, this local content policy can support the targeted sectors (i.e. in Step 2) by requiring SOEs and government agencies to purchase them locally.
6. Finally, coordination and alignment between the Saudi National Industrial Strategy, the Local Content Unit[92], other government agencies, the national oil company (Aramco) and other SOEs should be ensured. This is particularly important because a lack of coordination between the industrial policy stakeholders may result in the failure of the industrial diversification process (Rodrik 2004).

[92] A government office that is responsible for applying the local content policy. This office reports directly to the Council of Economic and Development Affairs.

Figure 4.17: Production linkages from the Saudi oil cluster



Source: own elaboration based on Ramos (1998) and Morris et al. (2012)

4.4 Financing the industrial diversification plan

Innovation and industrial diversification requires risky, patient and developmental finance, not any kind of finance (Mazzucato 2013), whereas private financial institutions are risk-averse and prefer funding traditional projects (UNCTAD 2014). Furthermore, such institutions shy away from funding long-term industrial projects. Felipe and Rhee (2015) argue that in developing countries that target the development of the industrial sector, it can be difficult to fund large scale industrial projects as private banks and investors are reluctant to offer long-term financing. However, as far as natural resource countries, such as Saudi Arabia, are concerned, using natural resource revenues to finance structural transformation and industrial diversification plans through development banks, for instance, can actually be an effective fiscal strategy (Lin 2011).

Industrial entrepreneurs face serious financing difficulties in Saudi Arabia, where private financial institutions do not like funding the establishment of highly sophisticated and long-term industrial projects. Instead, they favour funding projects within traditional sectors, such as construction, trade and hospitality. Within the manufacturing sector, they tend to finance the operational costs of existing firms, but when it comes to establishing new projects, they typically finance them through personal loans or by supporting another already existing business for the same entrepreneur, because of the high risk involved in establishing a new industrial project. In both cases, the entrepreneur has to have significant collateral assets and a high credit score. Furthermore, firms investing in risky projects (which is the case in the majority of high-tech products) can be charged substantially higher interest rates (interviews with officials in corporate departments in Saudi private banks, March 2018). The question that needs to be addressed here is: What about funding industrial entrepreneurs who do not have an extended credit history or personal assets that allow them to get personal loans or other existing running businesses?

This section examines the role of public financial institutions in bridging the financing gap facing industrial entrepreneurs and in promoting the government's industrial diversification plans. It starts by studying the role of the Saudi Industrial Development Fund, and then looks at the role of the state in funding industrial SMEs.

4.4.1 The Saudi Industrial Development Fund

The single most important institution for funding the Saudi industrial sector is the Saudi Industrial Development Fund (SIDF). Indeed, Vision 2030's industrial development plan identifies the SIDF as an "industry enabler". This Fund was established in 1974 to develop the industrial sector by providing medium- and long-term loans. Since its establishment, the Fund has been guided by several developmental considerations; namely, achieving high local added value, introducing new products to the domestic market, providing import substitutions, creating new job opportunities, transferring and localizing foreign technologies, promoting regional development and encouraging non-oil exports (interviews with officials in the SIDF, February and March 2018).

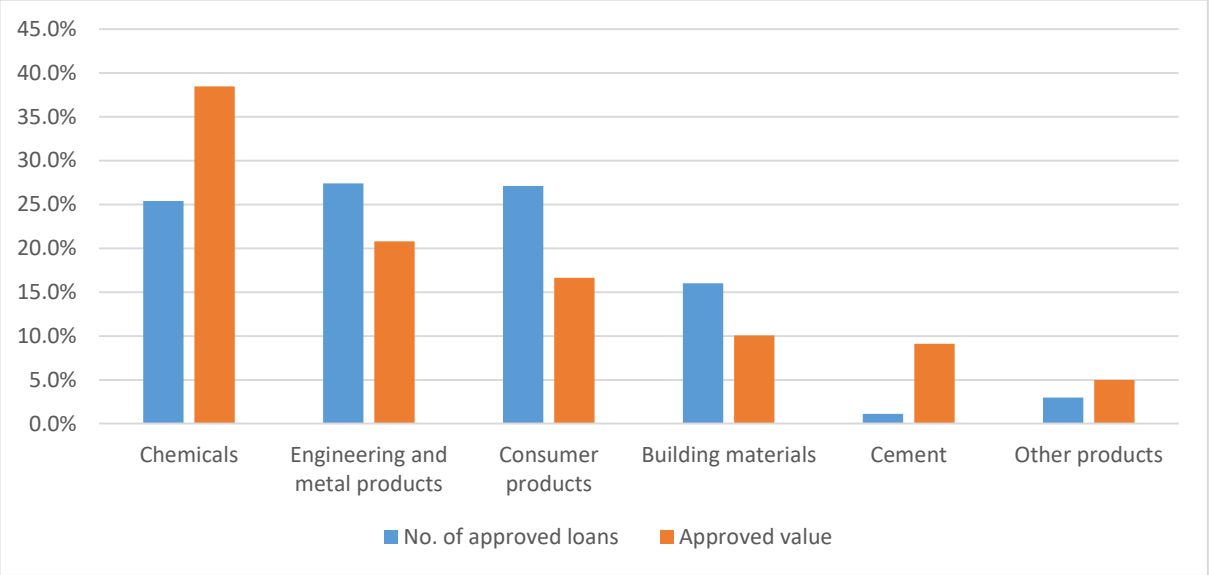
Since its creation, the SIDF has approved a total amount of 137.3 billion SAR through 4,079 loans. These loans contributed to the creation of 2,988 new industrial firms (38.5 percent of the total number of factories in the country) and the expansion of 1,091 existing firms. A review of the total approved funding for the major industrial sectors shows that the chemicals sector received the highest total amount, 52.8 billion SAR, accounting for 38.5 percent of the total value. This percentage is a clear reflection of the demand for chemicals projects by entrepreneurs (interview with high official at the SIDF, March 2018). This was because of the sector's competitiveness, in terms of cheap feedstock prices and greater industrial capabilities, and which has been evolving since the government's establishment of SABIC in the 1970's. The second largest sector is engineering and metal products with 28.6 billion SAR of approved loans, representing 20.8 percent. Figure 4.18 shows the shares of the major industrial sectors in terms of value and number of approved loans.

To some extent, SIDF lending has followed the country's development stages. For instance, between 1975 and 1985, the cement and building materials sector was by far the largest recipient of SIDF funding because of the significantly high demand for construction projects for infrastructure and residential development. However, since the late 1980s after the petrochemical infrastructure had been established by the government, the chemicals sector has been the largest recipient (SIDF annual reports).

SIDF contributes to industrial diversification by encouraging entrepreneurs to invest in new areas. When the technological knowledge becomes available and the profitability is evident in a particular sector, SIDF no longer approves any further loans in this sector. For instance, the Fund has supported several cement and cement brick factories since the 1970s but has recently stopped because of the increase in the local supply and a significant reduction in the associated risk. In other words, the Fund is sending out a signal to

entrepreneurs, encouraging them to search for new opportunities (new products) in order to be supported. On the other hand, investors in these sectors can still access credit through private banks that clearly understood the sector, given that a considerable number of firms have already demonstrated its profitability (interview with a credit analyst at SIDF, February 2018).

Figure 4.18: The number and value of approved loans from SIDF



Source: SIDF annual report (2017).

While SIDF has been considering different developmental factors, such as import substitutions, in their targeted sector criteria, there has, in fact, been a lamentable lack of coordination between the Fund and other government agencies, such as the Ministry of Economics and Planning, the Ministry of Trade and Investment and the Ministry of Energy, Industry and Mineral Resources. A clear example of the coordination failure is that the SIDF used to target sectors or projects based on their own economic and financial analysis, i.e. there was almost no communication with other agencies in this regard. This can be explained to a large extent by the absence of a proper industrial strategy and a governance framework in Saudi Arabia (interviews with officials at SIDF, February and March 2018). It is argued in the literature that such a lack of coordination can be a major reason for the under-developed industrial sectors in many developing countries despite strong support from the government (Khan 2015) as well as from state development banks in particular (Macfarlane and Mazzucato 2018).

Nonetheless, since the promotion of Vision 2030 in 2016, SIDF officials have noticed a significantly higher degree of communication and coordination between the Fund

and other public entities and SOEs. Currently, the Chairman of the Fund is the Minister of Energy, Industry and Mineral resources (MEIM) instead of the Minister of Finance. This has allowed the Fund to closely align its strategies with MEIM's industrial strategy, especially in terms of targeted sectors. Furthermore, the Fund has now established a Vision Realization Office (VRO) which is responsible for aligning the Fund's decisions and activities with Vison 2030.

An example of the Fund's increased coordination with other relevant agencies is that when Aramco officials went to Europe to promote their local content programme (IKTVA), SIDF accompanied them to provide funding opportunities (of up to seventy-five percent of the total project cost) for foreign suppliers who wanted to move to Saudi Arabia. Another example is that, when MEIM announced that it would remove the government's energy and electricity subsidies in 2017, SIDF provided an extensive study for MEIM, showing the potential difficulties domestic producers would face because of the sudden increase in their production costs, and, therefore, recommended keeping the subsidy or at least postponing its demise until firms get prepared to meet the new tariff. As a result, the Ministry followed the Fund's advice and postponed its orders for the industrial sector, while applying the new (higher) tariff to the agricultural and residential sectors (interview with a researcher at the SIDF, February 2018).

An important consideration for any project appraisal by SIDF is the promotion of regional inclusive growth and employment. While SIDF funding covers up to fifty percent of the total project costs, the funding reaches seventy-five percent if the region is targeted by the government[93], with the repayment period stretching to twenty years (instead of fifteen years). In 2016, fifty-one percent of approved loans (twenty-five percent of the value) went to projects in targeted regions (SIDF annual reports). Indeed, this was a major contributor to the development of Jizan Industrial City, for instance, which is located in the far south of the country [94].

Moreover, SIDF provides its customers with a wide range of unique technical, financial and marketing expertise, in addition to monitoring and supervising the project implementation process[95]. In some cases, leading industrial enterprises apply to the Fund, not only for funding, because their connections and credit records allow them to easily access finance, but because they are interested in the Fund's industrial expertise. For instance, the

[93] The Saudi government target some regions and cities for inclusive growth purposes.
[94] According to SIDF annual reports and official's interviews in February 2018.
[95] Interviews with officials in domestic private banks reveals that domestic private banks do not offer wide range of industrial expertise, because it costs them a significant amount of resources. Instead, they target sector, projects or operations with significant lower risk, that do not require advanced technical know-how.

Fund prepares an Industry Study that covers the domestic market opportunities, export markets, an extensive forecast of domestic supply and demand, an evaluation of the production process, the domestic availability of input materials, a fixed capital and operational costs analysis, and the potential machinery required and its foreign suppliers. In specific cases, the Fund even sends some of its analysts abroad to test the technology that is to be used by a potential borrower. Such trips include investigating the production materials and facilities as well as meeting potential foreign partners (interviews with officials at SIDF, February and March 2018).

Furthermore, the Fund deals with firms as partners rather than customers. In some cases, beneficiary firms have suffered from serious financial problems and the Fund has then offered them some help in the form of financial expertise and by contacting potential equity investors who could help solve their problem. The goal here is to maintain (or develop) these productive firms because of their contribution to the national economy (interview with a CEO in a chemicals manufacturing group, March 2018).

Unlike the so-called crowding-out argument whereby state investment banks push private banks away from lending to productive firms, SIDF has been crowding-in private banks. In an IMF publication, Gonzalez-Garcia and Grigoli (2013) show that a rise in the share of state-owned banks is associated with lower credit to the private sector. In another IMF publication, Andrews (2005) shows that state-owned banks are likely to channel the limited financial system resources to unproductive activities and this crowds out more productive activities. In Brazil, the development bank (BNDES), which is considered as an important enabler for industrial development and responsible for seventy percent of long-term banks lending between 2013 and 2015, is accused of crowding-out private lending (see Macfarlane and Mazzucato 2018). For instance, in its survey of the Brazilian economy, OECD (2013) criticized BNDES for crowding-out private lending and hindering the development of domestic financial markets[96].

Nevertheless, interviewing Saudi officials in private banks has shown that the SIDF has been stimulating their lending for industrial projects. The SIDF crowding-in process has four aspects. First, before the establishment of the Fund in 1974, credit to the manufacturing sector was insignificant. Banks were more familiar with the household, trade and construction sectors. But after its creation, the Fund demonstrated, to private banks, the feasibility and profitability of lending to the industrial sector. Secondly, the Fund does not

[96] The OECD (2013) argued that while credit in Brazil is rising substantially, there is a scarcity in long term financing. The report maintains that this lack of financing by private banks is mainly caused by the heavy participation of BNDES in the long-term lending (p.10).

provide loans that cover operational costs and this has created new opportunities for private banks to capture. Thirdly, the Fund's borrowers usually have short-term loans, called "bridging loans", from commercial banks, because the Fund's borrowers receive their loan payments based on actual expenditure (i.e. the procurement of machinery or the construction of a building). Thus, in many cases borrowers are able to get short-term loans (bridge loans) from private banks that allow them, for example, to purchase the machinery they require. They then have to provide specific documents, such as receipts and customs documents, to receive disbursements from the Fund[97].

Fourthly, it was frequently emphasized during this research - by interviewing officials in private banks - that sharing the risk with SIDF was a major incentive for private banks to lend some risky industrial projects. Despite the fact that they preferred syndicated loans for risky projects, private banks had considerable respect for the Fund's proven industrial capabilities. In other words, private bankers have claimed that they get encouraged to fund specific firms that have been approved by SIDF.

Some of the most sophisticated products that have been recently produced in the country could not have been introduced to the domestic industry without the support of the SIDF. For instance, in 2008, the Fund approved 1.2 billion SAR for the establishment of a firm (a subsidiary of a company called Cristal) which is specialized in the production of titanium dioxide (Tio2). In 2014, SIDF funded Cristal with an additional 1.2 billion SAR for another factory to produce titanium sponge, which has a wide variety of applications in airplane production to reduce fuel consumption and weight. Currently, the company is among the top titanium industrial application suppliers in the world[98]. In its 2014 report, Cristal's CEO claimed that:

> *"Cristal would not have been established, were it not for the financial, material and technological support of the Saudi Industrial Development Fund (SIDF), the indisputable backbone of Saudi industry, set up by the government to develop the industrial sector in the country. When SIDF was approached for support to set up in YIC [Yanbu Industrial City] the first TiO2 producing factory in the Middle East and North Africa, it offered considerable help, despite the fact that at the time such projects were outside the scope of SIDF's expertise, making it therefore unable to properly evaluate it. But instead of declining the request for support due to a lack of*

[97] While users of SIDF resources have claimed that this process (bridge loan financing) increases their cost of lending, others have been struggling to get short-term bridge loans from private banks (according to an interview with an SIDF beneficiary in February 2018). To solve this issue, the SIDF plans to offer a "letter of credit" by the middle of 2018 to solve this problem (according to a high official at SIDF in March 2018).

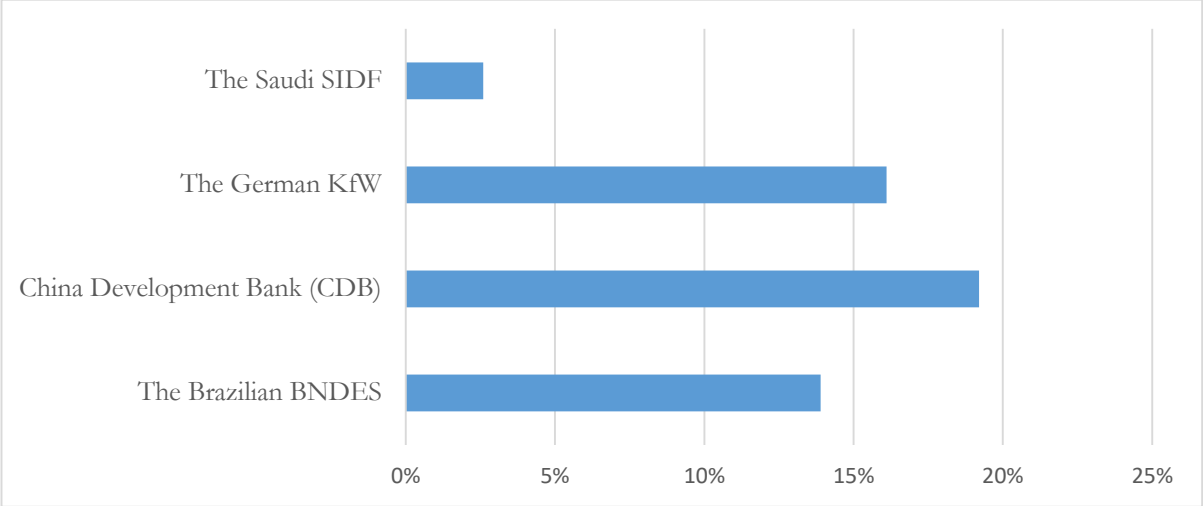
[98] According to an SIDF unpublished report (2015).

the necessary expertise to evaluate it, SIDF took the enterprising step of recruiting experts and did a detailed study and approved the project. This decisive action taken by SIDF led to the creation of Crista" (Cristal 2014, p.10).

Nonetheless, it is still important to question whether the size of SIDF assets is sufficient to meet the country's needs and plans for a more sophisticated and diversified industrial base. The Fund's initial capital was 500 million SAR but was continuously increased until it reached 40 billion SAR in the late 2000s. In 2017, the government raised its capital to 65 billion SAR, in order to meet the Vision's industrial development plans (SIDF annual reports). While this increase is expected to give the Fund greater capacity to increase its lending in the future, SIDF officials have nevertheless argued that meeting the government's industrial plans may require an even larger capital size (interviews with officials in SIDF, February and March 2018). Compared to other national development banks, namely, KfW in Germany, BNDES in Brazil and CBD in China, SIDF's total assets to GDP are only 2.5 percent, which is significantly smaller than those in these other countries (See Figure 4.19).

Given the current constraints on fiscal resources in Saudi Arabia following the fall in oil prices, which has resulted in a tighter fiscal policy, one SIDF official has argued that raising funds on the local financial market is the key to increasing the Fund's lending capacity (an interview with a high official in SIDF, March 2018). This would have only a limited impact on the fiscal deficit but could leverage the Fund's resources significantly. Indeed, this process is already taking place in many state development banks around the world (de Luna-Martínez and Vicente 2012). Nonetheless, this should not side-track the SIDF from following its original developmental agenda. In other words, it should not be deterred from funding strategic, risky and long-term projects. Indeed, Chandrasekhar (2016) argues that some development banks have adopted market-oriented practices, including accessing capital from the financial markets, and this has ultimately resulted in transformations of institutions' agendas. He explains that some of these development banks have become purely commercial banks. For instance, Chandrasekhar highlights that, in India, the State tried to reduce the reliance of the Industrial Finance Corporation of India (IFCI) on the central bank and the govenrment, and thus requred it to access finance through the finanical markets. Because this would mean borrowing at the market's prevailing interest rate, the role of IFCI has been transformed. This transformation has resulted in limited access to long-term finance for the industrial sector and infrastructure projects.

Figure 4.19: Assets to GDP for SIDF compared to other national development banks



Source: SIDF, KfW, CDB and BNDES 2016 annual reports.

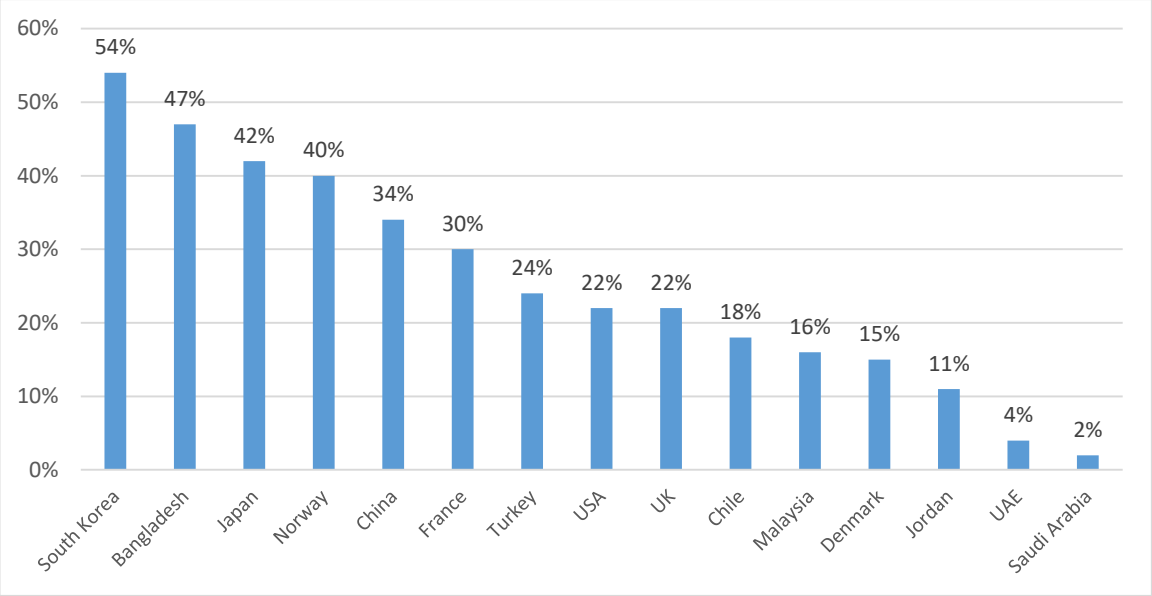
4.4.2 Financing SMEs

Although the 2030 industrial plan is heavily dependent on local content requirements, in which small- and medium-sized suppliers play an important role, financing is a critical obstacle facing SMEs. According to the Saudi SMEs Authority (SMEA), fifty-nine percent of SMEs consider financing to be a major difficulty. By looking at their share of credit, it can be seen that Saudi SMEs receive only two percent of the total domestic credit provided to the private sector (See Figure 4.20). These modest funding figures reveal how essential the role of the state is in financing SMEs in general and small industrial firms in particular.

In 2006, the government started a loan guarantee programme for SMEs (Kafalah), with initial capital assets of 200 million SAR. Since its establishment, the programme was managed by SIDF until 2016, and it is currently under the auspices of SMEA. In 2016, the programme supported 1,711 SMEs, but manufacturers represented only ten percent of the total number of businesses guaranteed by Kafalah (See Figure 4.21). After creating this programme, some banks realized there was some profitability in lending to small businesses and therefore initiated departments for the financing of SMEs. Officials in private banks have shown that, for businesses that have an annual revenue lower than 30 million SAR, there is a significantly high risk in lending to them (especially in the industrial sector) and such businesses could not have been funded without the Kafalah programme (interviews with officials in private banks, February and March 2018). The government therefore needs to play a much bigger role in financing industrial SMEs.

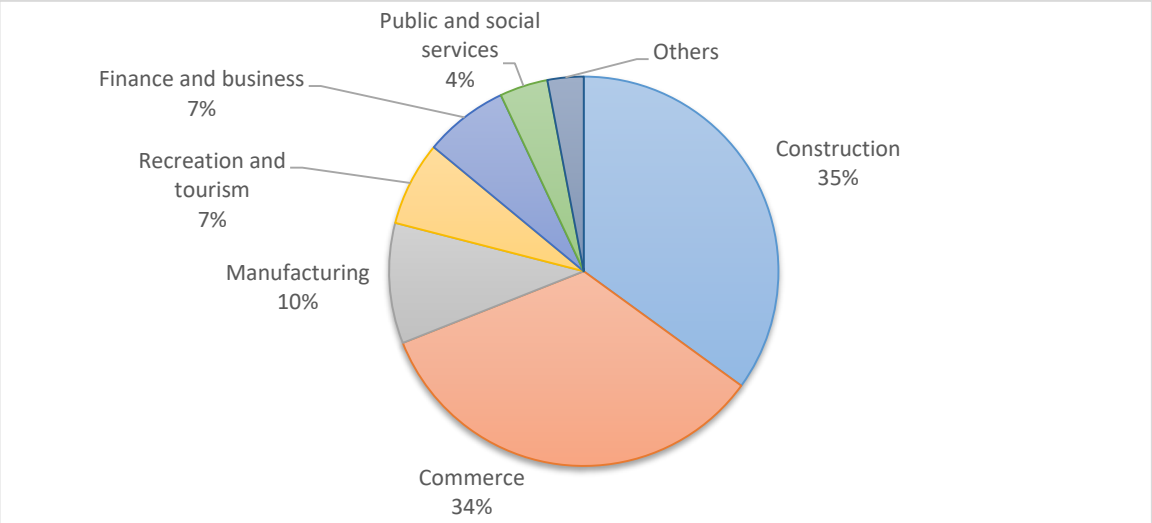
A senior official in Kafalah programme has argued that the sector must be further supported by the state through some regulations, such as specifying a share for SME credit within the banks' total credit portfolio. He also maintained that creating a public SME bank with sufficient capital could be a vital tool for tackling and easing some of the SMEs' funding struggles (interview with a senior official in the Kafalah programme, March 2018). However, supporting enterprises based on their size (as he suggested) may not solve the problem. It should be highlighted here that such a proposed bank (SME bank) should focus on sectors and products that are targeted by industrial policy makers.

Figure 4.20: SME finance as a share of the total credit to the private sector



Source: The Saudi Financial Sector Development Program (2018)

Figure 4.21: Kafalah guarantees by sector



Source: Kafalah annual report (2017).

Within the agricultural sector, SMEs are mainly supported by the Saudi Agricultural Development Fund (SADF)[99]. Because of the high risk associated with lending for agricultural projects (mainly because of limited rainfall and water reserves), private banks focus on lending to large corporations only (interviews with officials in SADF and private banks, February and March 2018). This makes the role of the state even more important when it comes to funding the government's targeted sectors in Vision 2030: aquaculture production, poultry, and highly efficient greenhouses.

Like other public financial institutions before 2016, SADF has had only limited coordination with other public entities, such as the Ministry of Economics and Planning or the Ministry of Environment, Water and Agriculture. Thus, there was no clear SADF strategy in place for targeting specific sectors. However, there has been a noticeable change in the degree of coordination and communication with the other relevant agencies since the 2030 Vision was launched and promoted. Currently, the fund focuses on the Vision's three targeted agricultural sectors. These sectors accounted for 69.7 percent of SADF lending in 2017 (SADF, 2018). In addition, SADF has been recently concerned about supporting the production of fabricated cattle feed, commonly called cattle cubes, which serve as a substitute or a supplement for grass. This sector is jointly supported by SADF and the Saudi Industrial Development Fund (SIDF), because of the latter's expertise in supporting manufacturing activities (interview with a high official in SADF, March 2018).

Industrial SMEs' access to venture capital (VC) is trivial in Saudi Arabia, despite its importance in promoting innovation in manufacturing related activities (Keller and Block 2012; Murray 1999). The supply of venture capital is mainly focused on low-risk services such as trade, hospitality, ITC and mobile applications. Indeed, VC investors have been deterred from investing in manufacturing start-ups because of the significantly high associated risks and the large initial fixed capital costs (interview with a private venture capital investor, March 2018).

While venture capital investment in new companies, such as SMEs, has been promoted by state investment banks around the world (Griffith-Jones and Tyson 2013; Mazzucato and Penna 2016), the Saudi Industrial Development Fund (SIDF) has, since its establishment, been focusing solely on debt financing, with no consideration of venture capital financing. Furthermore, the Public Investment Fund, which is amongst the largest Sovereign Wealth Fund (SWF) in the world, focuses exclusively on mega-domestic

[99] SADF is a state owned fund that was established in 1963 and manages capital assets of 30 billion SAR.

development and infrastructure projects, in addition to promising opportunities abroad[100]. In other words, both SIDF and PIF do not provide VC funding for SMEs [101].

Thus, in addition to the establishment of SME bank, the researcher argues here that establishing a Saudi public venture capital fund (or programme) specializing in funding targeted strategic sectors and products can be a major instrument in financing industrial diversification plans.

4.5 Conclusions:

This study has examined the issue of promoting and financing industrial diversification in Saudi Arabia. First, it showed the importance of industrial diversification as a main pillar of the Saudi long-term growth and development. Then, it applied three industrial upgrading strategies to the Saudi context, and finally evaluated the role of the financial system in supporting the industrial diversification and upgrading.

First, the resource based industrialization (RBI) analysis reveals that the upstream industry is underdeveloped. While the downstream industry is relatively well established, it lacks diversification towards speciality and consumer products. Thus, the RBI suggests further development in the upstream and downstream sectors. Secondly, the Product Space Theory (PST) shows that the Saudi industry is concentrated on producing petroleum, mineral and petrochemical products, but not machinery and electronics. Nonetheless, the PST suggests a wide range of products that are close to the existing structure, with limited sophisticated products.

Thirdly, the Growth Identification and Facilitation Framework (GIFF) suggests a wide range of products (including transportation and machinery) that can upgrade the industrial basket significantly. After contrasting the four strategies in terms of industrial sophistication and potential employment opportunities, this study shows that the GIFF is superior to the others for the Saudi context. Thus, in addition to maintaining Vision 2030 which focuses on RBI and local content policy, this study suggests also utilizing the GIFF to achieve greater industrial diversification and sophistication.

This research also shows that Saudi private financial institutions are not likely to fulfil the potential industrial demand for financing. Indeed, private banks are already shying

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[100] PIF invests domestically in mega-projects within the mining, entertainment, tourism and technology sectors and infrastructure. This is, in addition, to its investment abroad in companies such as POSCO engineering and construction, UBER and others.

[101] This is despite the existence of initiatives by the state and SOEs for establishing small venture capital programmes in the last decade. The two major initiatives are Wa'ed and Dussur. The former was established by Aramco to facilitate debt and venture funding for entrepreneurs in various industrial and service sectors. Dussur, on the other hand, was jointly established by Aramco, SABIC and the PIF to invest in small firms within the oil, gas, maritime, power and water sectors.

away from funding the establishment of new industrial enterprises, providing financing for sophisticated industrial activities and long-term manufacturing projects, whereas in the venture capital industry, private funds are mainly focused on investing in low-risk services like hospitality, trade and IT applications.

Thus, the study stresses the importance of public financial institutions in financing industrial upgrading. While their role has been crucial in promoting the industrial sector in the past, Saudi public financial institutions should now play an even greater role in order to meet the potential demand and to promote greater industrial diversification. The most important financial institution in supporting the manufacturing sector is the Saudi Industrial Development Fund (SIDF), which has been a critical enabler of industrial development through its financial and technical support. Nonetheless, the industrial upgrading requires of SIDF an even greater capacity and a larger role. Its current total assets represent only 2.5 percent of GDP, which is substantially smaller than the size of other national development banks, such as KfW, BNDS and the CDB, despite the fact that their countries have a lesser need for structural change and industrial diversification.

Furthermore, in spite of the government's emphasis on increasing the role of local suppliers for SOEs and government agencies, SME firms face a huge challenge in terms of accessing debt and equity funding. On the debt side, Saudi SMEs' share is 2.5 percent of the total credit to the private sector, which is considered to be among the lowest in the world. In the venture capital sector, on the other hand, there are no public institutions that are specialized in funding small entrepreneurs, despite the existing financing gap. Therefore, establishing public financial institutions (or programmes) specialized in funding SMEs through debt and equity financing in targeted industrial sectors could be a critical tool for achieving industrial innovation and diversification.

5 Concluding remarks

Despite a significant windfall in resource revenues, many resource-dependent developing countries have not been able to channel them towards innovative and higher-technology industrial activities. These countries suffer from highly concentrated production and export baskets on primary products that have resulted in low employment opportunities and high balance of payment fluctuations. This lack of industrial development in many resource-abundant developing counties is mainly explained by public policy failure (Ramos 1998; Morris et al. 2012). Nevertheless, despite its wealth and dominance, the mainstream resource-curse literature does not provide policy makers in these countries with instrumental policy implications. The researcher embraces Wright and Czelusta's view in this regard:

> *"The resource-curse hypothesis seems anomalous as development economics, since on the surface it has no clear policy implication but stands as a wistful prophecy: Countries afflicted with the 'original sin' of resource endowments have poor growth prospects. The danger of such ostensibly neutral ruminations, however, is that in practice they may influence sectoral policies" (2004, p.36).*

This research aims to study the role of financial and industrial policies in promoting and financing industrial diversification in resource-dependent countries. After examining the related literature carefully, this research tried to answer these important questions in three separate chapters:

A. Does financial deepening promote industrial diversification and upgrading in resource-dependent developing countries?
B. Can state-directed credit and financing help to promote industrial diversification?
C. What type of industrial strategy should a resource-dependent country follow? What are the sectors that can be targeted? What is the role of the financial system in supporting these targeted sectors?

Chapter 2 examined Question A on the relationship between financial development and the diversification and complexity of exports. Developing and liberalizing the financial system are standard recommendations for these countries by the IMF and the World Bank. The IMF (2016), for instance, maintains that developing and deregulating the financial

market is a key to economic diversification in these countries. Furthermore, a growing strand of literature claims that there is a financial sector curse in these countries, i.e. lack of development, which contributes to the lack of economic and industrial development. Financial deepening, this strand argues, is an essential instrument to escape the resource curse through the channelling of resource revenues towards productive investments (e.g. Beck and Poelhekke, 2017; and Beck, 2011). Contrary to this view, this study examined thirty-eight resource-dependent developing countries between 1995 and 2013, and showed that, while the financial system has grown significantly, export diversification and complexity have declined. Statistically, panel data regression models have failed to find a significant impact of finance on export diversification, but found a negative impact of finance on export complexity. This chapter speculates that by the financial sector' risk aversion and short-term motives. Rather than funding risky and high technology projects that are expected to result in greater industrial upgrading, unregulated financial development might benefit traditional projects and sectors within the country's comparative advantage. Therefore, this study argued that a general financial development policy recommendation is not expected to be a key for industrial diversification in these countries.

Chapter 3 examined Questions B and C regarding the role of the state in promoting and financing the industrial diversification and upgrading. This chapter did so by looking at two countries that were resource dependent, yet managed to diversify their economies, namely Chile and Malaysia. In Chile, industrial diversification has been towards resource-based sectors, whereas in Malaysia it was towards a wider range of activities including electronics and machinery. The main goal of this chapter was to investigate the role of government in financing the emergence of what have become major industrial sectors. Contrary to Beck and Poelhekke (2017) and IMF (2016) who argued for the need to deregulate the financial system and reduce state-directed credit to achieve economic diversification, a central finding of this study is that the government, in both countries, has been a catalyst in financing the emergence and development of targeted industrial sectors. Among other tools, public development banks and venture capital institutions were vital in providing pre-identified sectors with risky and developmental finance. Finally, in a closer look at the major roles of public financial institutions in both countries, in the context of industrial diversification and structural transformation, this chapter provided evidence that they are developmental (e.g. policy-guided), innovation supporters, technology transfer enablers and challenge-led institutions.

Chapter 4 is concerned with Questions B and C, but focuses on promoting industrial diversification in a resource-dependent country that has not successfully diversified its economy: Saudi Arabia. The chapter highlighted the role of industrial policies in promoting industrial diversification in these countries. It reviewed three main industrial strategies for resource-dependent countries: resource-based industrialization (e.g. Perez 2015), the Growth Identification and Facilitation Framework (i.e. Lin 2011) and the product space theory (i.e. Hausmann et al. 2014). These strategies have been used to assess the current Saudi production basket and, then, to outline a possible diversification strategy. Furthermore, these strategies have been compared and contrasted with the recently launched Vision 2030 by the Saudi Government. Furthermore, the chapter investigated the role of the Saudi financial system in supporting industrial development. Semi-structured interviews were conducted with high-ranking officials at major development financial institutions to evaluate their role.

This chapter argued that Saudi Arabia should maintain its support for resource-based industries (e.g. as in Vision 2030). However, it should also target a set of non-resource industrial sectors that can generate greater employment opportunities, reduce export fluctuations following oil prices and increase the sophistication of the industrial basket. More specifically, the analysis suggested the utilization of the sectors identified by the GIFF as a guide for targeting these non-resource sectors. Finally, after analysis of the role of the financial system, the chapter argued that private financial institutions in Saudi Arabia are not likely to provide the industrial sector with the needed financing because of their extreme risk-aversion behaviour. This can be seen in their reluctant to finance small entrepreneurs and industrial enterprises in general. Greater state participation in the financial system is required to bridge these financing constraints and to promote industrial diversification.

- **Study contribution**

This thesis makes the following contributions to the existing literature:

1. It contributes to the Dutch-Disease literature by raising doubts on the claim made by mainstream economists and international institutions such as the IMF about the need for financial development and deepening in resource-dependent countries to mitigate the Disease and to achieve industrial and economic diversification (i.e. Beck 2011; Van der Ploeg and Poelhekke 2009). Indeed, this research questions the willingness of private banks to fund high-tech and largely sophisticated manufacturing activities because of the high risk involved. This work not only argues that unregulated financial development is not likely to promote industrial diversification, but also that it may encourage firms in resource-dependent countries to specialize on producing products within the existing comparative advantage (i.e. raw materials) and other already established competitive sectors.
2. It questions the argument made in the existing literature on the negative impact of state-directed credit on economic diversification in natural resource countries (Beck and Poelhekke 2017; IMF 2016). In order to counter this claim, this research provides evidence on the critical role of industrial banks and public venture capital funds in providing developmental, patient and risky finance that has contributed to the upgrading of the manufacturing sectors in resource-dependent countries.
3. It adds to the industrial policy literature by supporting the argument of Chang and Andreoni (2016) in which they show that certain policies, e.g. state directed credit, may help countries to mitigate the Dutch-Disease. This study provides strong evidence for this view by showing the role of state-directed credit in promoting new industrial activities in resource-dependent countries, namely Chile, Malaysia and Saudi Arabia.
4. It reviews different industrial strategies, in the case of Saudi Arabia, that can serve as a reference for other resource-dependent countries and suggests targeting a set of sectors and products that are suitable for resource-dependent countries. These suggested sectors include resource-based industries and non-resource-based industrial sectors, that can result in greater industrial diversification.

This thesis also makes secondary contributions that include the following:

5. Unlike the public banks crowding-out argument that has been highlighted in the mainstream literature (e.g. Andrews 2005; Gonzalez-Garcia and Grigoli 2013), this

research argues that public banks can crowd-in private financial institutions to fund the industrial sector.

6. It supports the argument of Macfarlane and Mazzucato (2018) which claims that the lack of coordination between public financial institutions and other industrial policy stakeholders, may hinder their potential role in supporting industrial development. An example of this coordination is in the nature of targeted sectors.

- **Policy implications**

The policy recommendations derived from this research have already been discussed in Chapters 1, 2 and 3. The following summarizes the key implications:

1. This research suggests that financial development and de-regulation are not appropriate recommendations for industrial diversification and upgrading in resource-dependent developing countries. This is because financial institutions may not be motivated enough to fund risky and long-term industrial projects because of their risk-averse and short-term aims. Therefore, a generalized financial development (or deepening) policy proposal may benefit currently competitive sectors or those within the existing comparative advantage. In free market setting and without government selective policies towards more sophisticated manufacturing, technological upgrading is not expected to take place (Amsden 2001; Chang 2011; Lall 1992; Wade 1990). For financial development (or deepening) to be effective in promoting innovative industrial activities in the developing world, in general, government intervention may be required to assure the financing of innovation (Dymski 2003).
2. Rather than investing natural resource rents in sovereign wealth funds (SWFs) that typically invest in foreign financial markets[102], this research argues for the need to utilize part of these rents in the establishment of, and support for, development financial institutions (i.e. development banks) that support domestic industrial development. In the context of structural transformation, such institutions can play a vital role in supporting strategic and higher technology products. This is particularly important when private financial institutions are mainly focused on funding traditional sectors at the expense of high technology and strategic sectors[103].

[102] Van der Ploeg and Venables (2009 and 2012), for example, strongly suggest establishing SWFs to invest the resource windfalls overseas to mitigate real exchange rate appreciation and economic volatilities.
[103] In addition to the literature reviewed in Chapter 2 that demonstrates targeting traditional sectors by private financial intuitions, interviewing officials in the Saudi financial system strongly supports this view.

3. This work by no means underestimates the macro-economic and industrial challenges facing resource-dependent countries as a result of the influx of wealth[104] and instead it highlights the importance of suitable economic and industrial policies, e.g. directed credit to targeted sectors, to mitigate the Dutch Disease and promote industrial upgrading.
4. It suggests the establishment of institutions (or programmes) that specialize in investments in acquiring technologies that exist overseas, e.g. Fundacion Chile. Such institutions are critical for industrial diversification and upgrading. This is because technological upgrading in developing countries typically takes place through relative innovation, e.g. copying and adapting already existing technologies abroad (Lall 1992; UNCTAD 2007).
5. This research suggests that the focus on only resource-based industries (RBI) may not be sufficient to achieve great industrial diversification. The case study of Saudi Arabia, which was analysed in this context, suggested continuing the promotion of RBI sectors (the oil and mineral upstream and downstream industries) in addition to the wide range of industrial activities that were identified by the Growth Identification and Facilitation Framework (GIFF). More specifically, it suggests targeting the following sectors: oil and mineral upstream and downstream manufacturing, speciality chemicals and medicines, speciality plastics, speciality rubber, rubber tyres, processed glass, processed stone, building materials, boats, small trucks, aircraft parts, lifting machines, fridges and air-conditioning systems, poultry and aquaculture.
6. Because of its significantly low share of credit given to SMEs (2 percent of total credit), Saudi Arabia needs to establish institutions (or programmes) that focus on supporting small entrepreneurs in targeted sectors. This is particularly important since one of the objectives of Vision 2030 is to increase the local content level in public and SOEs procurements.
7. While some resource-dependent countries are considering privatizing public resource-leading firms, this research suggests that this can have a substantial negative impact on the industrial and economic development process, because national extraction companies are typically more committed to domestic economic development (Morris et al. 2012). Therefore, governments should not look at privatizing these companies through financial

[104] In addition to historical evidence that shows the short-term negative impact of resource revenue on real exchange rate, the first chapter supports this notion empirically by showing that exchange rate appreciation has a negative impact on export concentration and complexity.

cost and benefit analysis only (i.e. IPO income) but policy makers should also consider industrial, economic and social development aspects.

- **Conclusion**

Contrary to the rich literature on the natural resources curse that maintains an adverse impact of natural resource wealth on economic and industrial development, this research argues that wealth in natural resources can fuel the manufacturing industry in two ways. Firstly, resource revenues can be channelled to non-resource manufacturing sectors. The state, through its participation in the financial sector, can play a critical role in directing the resource revenues towards strategic and innovation sectors. This research maintains that public industrial banks and venture capital funds can be instrumental tools supplying the industrial sectors with patient, risky and developmental finance. Secondly, through technological upgrading, linkages from the resource cluster can stimulate diverse industrial activities. Nonetheless, because technological change is not a straightforward process, this development is not expected to take place without the promotion of suitable industrial policies. Therefore, this thesis argues that industrial diversification and upgrading in resource-dependent developing countries are not likely to take place in industrial and financial market settings free of state intervention.

With regard to research limitations, the researcher acknowledges several shortcomings in this thesis and suggests possible areas for future work.

First, in relation to the empirical analysis of the impact of financial development on industrial diversification in Chapter 2, the implemented cross-country statistical analysis did not account for major country-specific factors that can be critical in the industrial diversification process. Thus, a deeper understanding of the determinants of industrial diversification requires country-specific analyses that can consider the role of critical factors such as society, history, politics and geography.

Secondly, in relation to the case studies on Chile and Malaysia in Chapter 3, the chapter has examined the role of the state in promoting and financing industrial diversification although it has focused solely on one major industry in each country, i.e. farmed-salmon in Chile and semiconductors in Malaysia. A more complete story of the industrial diversification in both countries requires a study of other major industrial sectors. In Chile, these sectors include wine, fruits, forestry and chemicals, whereas in Malaysia those sectors include steel, machinery, telecommunications, chemicals and palm oil.

Thirdly, Chapter 3 has examined promoting and financing the emergence of new industrial sectors in Chile and Malaysia; however it did not explore production linkages from the main resource sectors (copper in Chile and petroleum in Malaysia) to new emerging industries. Thus, Chapter 3 could be extended to investigate expected linkages from the main resource sectors to relatively new industrial activities (e.g. expected linkages from oil production to electronics and machinery manufacturing in Malaysia) following the traditions of Hirschman's (1981) production linkages and Morris et al. (2012) horizontal linkages. Examples of studies that are concerned with linkages from the resource sector to unrelated industrial activities are Ramos (1998) and Columbia Centre on Sustainable Investment (CCSI) (2016), which highlight critical linkages from the Finnish forestry sector to the telecommunications and machinery industries.

Fourthly, Chapter 3 has discussed the role of some institutions in acquiring foreign technologies – but only briefly- despite the importance of technology transfer for industrial diversification in developing countries (Amsden 2001; Lall 1992). One institution, in particular, that could be further investigated is Fundacion Chile (FCh) which played a critical role in the emergence of several industrial activities in Chile through its investment in over sixty-five companies (Fundacion Chile 2008). Despite many studies that have highlighted its importance in promoting economic diversification in Chile (Andreoni and Chang 2014; Katz 2006; Rodrik 2004), the related literature noticeably shows that the role of this unique institution in promoting technological change needs to be further examined. More particularly, the researcher suggests future research on FCh's process of identifying potential opportunities in the Chilean industrial sector, its establishment of new firms that can demonstrate new technologies and, more importantly, its diffusion of transferred technologies to other entrepreneurs in the economy.

Fifthly, in relation to Chapter 4 which is concerned with promoting and financing industrial diversification in Saudi Arabia, the chapter has contrasted three diversification strategies, namely Resource Based Industrialization (e.g. Ramos 1998), the Growth Identification and Facilitation Framework (Lin 2011), and the Product Space Theory (Hidalgo and Hausmann 2009). However, these strategies mainly consider the existing industrial capabilities, endowment structure, production diversification away from oil and gas, the cost of labour, job creation and water scarcity. This analysis could be extended to account for other important factors in targeting new sectors, such as balance of payment considerations, regional economic development, production linkages with local economic activities and environmental impact factors. One possible way to account for some of these

considerations is to apply a detailed supply chain analysis for each potential product or sector. Another possible way that would account mainly for cross-sectorial production linkages is to use input-output analysis (Leontief 1951, 1986) in targeting new economic activities (for instance, see Marconi et al. (2016) for a recent work on industrial strategy using input-output approach).

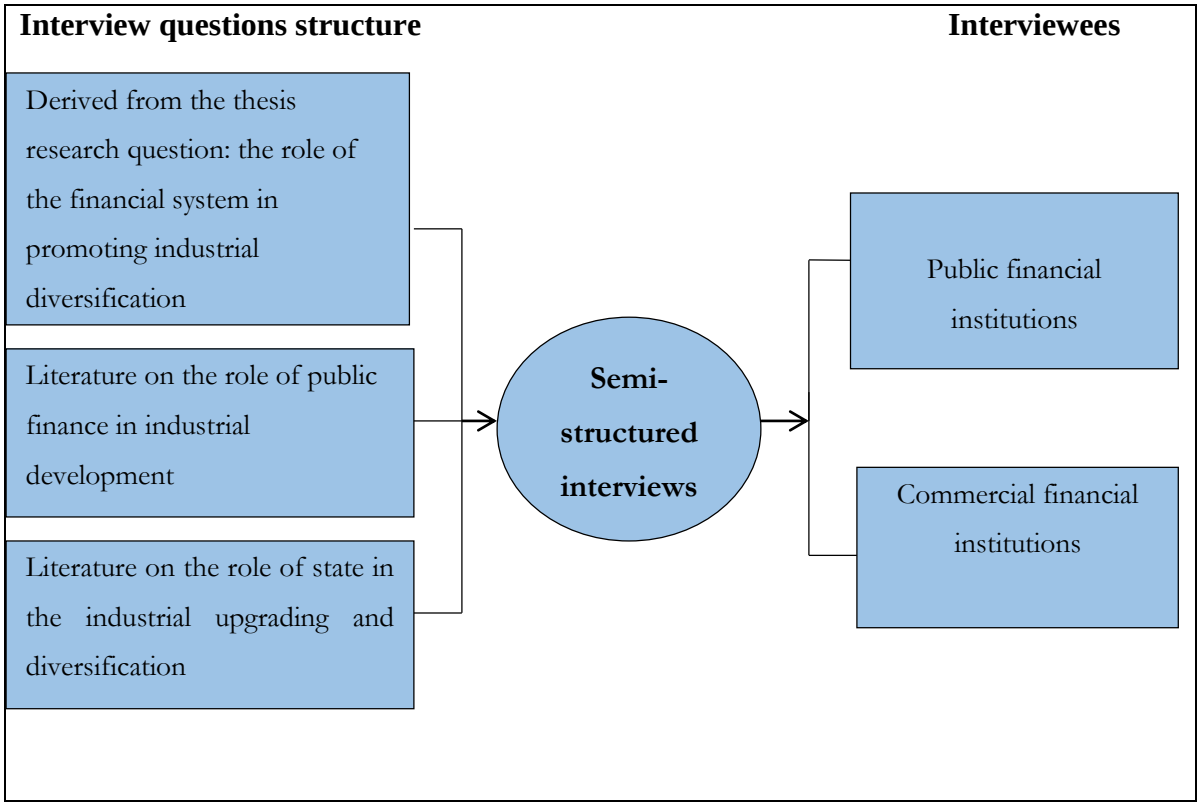
Finally, the research has investigated the role of public development banks, in Chapters 3 and 4, in three resource dependent developing countries. However, there is a need for further quantitative research that can examine the role of public development banks in supporting technological upgrading and industrial diversification empirically (Lazzarini et al. 2015). More specifically, investigating their impact in developed, emerging and developing countries using longitudinal data (e.g. panel longitudinal data) can be instrumental in advancing our understanding of their role in technological change and industrial upgrading.

Appendixes

Appendix 1: Data collection

This research has utilized available data in the form of published reports, studies and open databases to investigate the role of governments in financing industrial development. However, some data and information about some financial institutions are not available publicly (e.g. in published form). Thus, the researcher contacted these institutions to obtain access to unpublished data. Nonetheless, they were not sufficient because some important insights are not available in published forms. In such a case, Kriksson and Kovalainen (2015) argue for the effectiveness of collecting the required information using interviews; "a common reason for the use of interviews in business research is that they are an efficient and practical way of collecting information that the researcher cannot find in a published form" (p.94). Table A.1 summarizes the semi-structured interviews process, followed by Tables A.2, A.3 and A.4 which present the interviews guide, questions guide, interviewees' details and a copy of the academic ethical approval.

Table A.1: Interviews guide



Source: author's design

Table A.2: Questions guide

i. Interviews with public financial institutions

Panel A: Diversification mission
1- How do you evaluate the role of your institutions in promoting industrial diversification?
2- What criteria do you use to evaluate a potential project? Do you give a higher priority for projects that introduce more sophisticated products to the national industry?
3- What criteria do you use in estimating the interest rate and collateral on your loan? Do you charge firms investing in new activities/technologies similar rate to those investing in traditional industries?

Panel B: Coordination
1- Do you take into consideration the national development goals when you lend to a private firm?
2- Can you talk about your coordination with other public/private agencies before and after you fund a project?

Panel C: Industrial expertise
1- Do you offer your customers any set of industrial expertise? i.e. the provision of economic and technical advice; the development of technological and managerial expertise; the means of ensuring financial soundness; and the establishment of efficient distribution and marketing practices

Panel D: Capacity
1- How do you evaluate your financial capital size relative to the domestic industrial sector needs for finance?
2- When you have a shortage of capital, what tools do you use to overcome it? have you considered issuing financial guarantees?

Panel E: Accountability
1- How do you prevent firms from enjoying "free ride"? i.e. firms accessing cheaper finance and industrial expertise without contributing to the industrial development.
2- What kind of requirements and conditions that your clients should meet? i.e. export percentage or output quality standards?

ii. Interview with private financial institutions

Panel A: Diversification mission
1- How do you evaluate the role of your institutions in promoting industrial diversification?
2- How do you evaluate a potential project? Do you give a higher priority for projects that introduce more sophisticated products to the national industry?
3- What criteria do you use in estimating the interest rate and collateral on your loan? Do you charge firms investing in new activities/technologies similar rate to those investing in traditional industries?

Panel B: Industrial expertise
1- Do you offer your customers any set of industrial expertise? i.e. the provision of economic and technical advice; the development of technological and managerial expertise; the means of ensuring financial soundness; and the establishment of efficient distribution and marketing practices.

Panel C: Risk decision
1- For a certain project that is investing in a new technology project, do you prefer a syndicated loan? Does it matter whether the co-investor is the SIDF or another bank? Why?
4- For projects in new activities/technologies, what impact do public financial guarantees have on your lending decision?

Table A. 3: Interviewees details

Category	Participant employer	Number of participants	Positions
Saudi public financial institution	The Saudi Industrial Development Fund (SIDF)	Four	Two senior managers, an economic researcher and a financial analyst.
Saudi public financial institution	The Saudi Agriculture Development Fund (SADF)	Two	Senior manager
Saudi public financial institution	The Saudi development fund (SDF)	One	Senior manager
Saudi private financial institutions	Commercial banks	Two	Senior managers
Saudi private financial institutions	Venture capital institution	One	Fund founder
Chilean public institution	The Chilean export promotion agency (ProChile)	One	Trade advisor
Chilean public financial institution	The Production Development Corporation (CORFO)	One	Senior manager
Malaysian public financial institution	The Malaysian Industrial Development Finance	One	Senior manager
Malaysian public financial institution	The Malaysian sovereign wealth fund (Khazanah)	Two	A senior manager and an economic researcher
Independent development institutions	The United Nations Economic Commission for Latin America and the Caribbean (CEPAL)	Two	Industrial economists

Table A. 4: Ethical approval

University of Glasgow

College of Social Sciences

5/02/2018

Dear Sultan Altowaim

College of Social Sciences Research Ethics Committee

Project Title: Financing industrial and export diversification in resource dependent developing countries.

Application No: 400170095

The College Research Ethics Committee has reviewed your application and has agreed that there is no objection on ethical grounds to the proposed study. It is happy therefore to approve the project, subject to the following conditions:

- Start date of ethical approval: 10/02/2018
- Project end date: 30/09/2019
- Any outstanding permissions needed from third parties in order to recruit research participants or to access facilities or venues for research purposes must be obtained in writing and submitted to the CoSS Research Ethics Administrator before research commences. Permissions you must provide are shown in the *College Ethics Review Feedback* document that has been sent to you.
- The data should be held securely for a period of ten years after the completion of the research project, or for longer if specified by the research funder or sponsor, in accordance with the University's Code of Good Practice in Research: (https://www.gla.ac.uk/media/media_490311_en.pdf) (Unless there is an agreed exemption to this, noted here).
- The research should be carried out only on the sites, and/or with the groups and using the methods defined in the application.
- Any proposed changes in the protocol should be submitted for reassessment as an amendment to the original application. The *Request for Amendments to an Approved Application* form should be used:

  https://www.gla.ac.uk/colleges/socialsciences/students/ethics/forms/staffandpostgraduateresearchstudents/

Yours sincerely,

Muir Houston, Senior Lecturer
College of Social Sciences Ethics Officer
Social Justice, Place and Lifelong Education Research
University of Glasgow
School of Education, St Andrew's Building, 11 Eldon Street

Appendix 2: Technological intensity classification

Lall (2000) classified exported products into five major groups. First, primary products (PP) group includes coal, crude petroleum, gas, ore concentrates, fresh fruit, and meat. Secondly, the resource based (RB) group includes simple manufacturing products and has two sub-segments: agriculture based products (e.g. prepared fruits, processed meat and beverages) and other resource based products (petroleum products, base metals (except steel), cement, and gems). In general, these products arise from the availability of natural resources, and so they do not give an important indication of the competitiveness of the exporting country.

The third group is the low technology (LT) group, which has well-diffused and stable technologies. Barriers to entry and scale economies for LT products are generally low. Examples of these products are footwear, textile fabrics, plastic products, clothing, leather manufacturing, furniture, jewellery and toys. Fourthly, there are medium technology (MT) products, which tend to have scale and skill-intensive technologies. In mature economies, MT products are at the heart of industrial activity, which includes automotive products and parts, motorcycles and parts, chemicals and paints, synthetic fibres, iron and steel, pipes and tubes, engines, industrial machinery and ships. Finally, the high technology (HT) group comprise products with high R&D investment and rapidly changing technologies. This group requires a high level of technology infra-structure and specialised technical skills, e.g. telecommunications equipment, television sets, cameras, transistors, optical and instruments, power generating equipment, pharmaceuticals, and aerospace.

Appendix 3: The role of the Malaysian Government in attracting foreign direct investment

Penang state is considered the least endowed state with natural resources in Malaysia, which explains why it used to be called the "dying fishing village" (Wigdor 2016). In the 1970s, the government was advised to shift its export oriented manufacturing towards the North; to Penang state. This advice was implemented in the early 1970s after promoting the National Economic Policy (NEP), which started attracting foreign investors through Free Trade Zones (FTZ) and Licensed Manufacturing Warehouse (LMWH). These are planned to accommodate the manufacturing activities for export purposes. The two policies were also coupled with the Malaysian Investment Development Agency (MIDA) fiscal incentives.

In the period (1971-1979), employment and manufacturing added values have risen by 44.7 and 46.4 percent respectively. This growth was mainly led by foreign investors such as Intel, Motorola, Hitachi, Advanced Micro, and National Semiconductor, with a few local firms such as Penang Electronics which was established in 1970 (Best and Rasiah 2003). In some cases, the state played a stronger role by directly approaching potential investors from the US, Europe, and Japan to relocate in Malaysia (Rasiah 2015).

Following the currency appreciation in the mid-1980s, several foreign electronics firms threatened to leave Malaysia if MIDA did not renew their expired financial incentives. For example, in 1985, Intel announced that it would consider moving its assembly plant to Manila. This indeed motivated the government to offer more incentives[105]. In 1986, Malaysia launched its first Industrial Master Plan (IMP1) which continued to utilize the Pioneer Status (PS) and the Investment Tax Allowance (ITA) incentives. In addition, the state designed a new incentive scheme for High Tech Companies (HTC). A HTC qualifies for a PS with 100 percent income tax exemption for a period of five years, or ITA of 60 percent of its capital expenditure for five years. In order for companies to benefit from these incentives, they must meet two requirements. First, the company must be engaged in one of the activities identified by MIDA. Table A.5 shows the most recent list of activities which has been effective since March 2012. Secondly, the company must either spend at least one percent of its gross sales on local R&D, or ensure that at least seven percent of its employees in the scientific and

[105] Intel opened its first international production facility in Penang in 1972. Now, Malaysia now accommodates several Intel operations (Intel, 2006).

technical staff hold diplomas, college degrees, or experience of five years in the field (MIDA 2016).

Another important incentive is the Reinvestment Allowance (RA) which was introduced in 1986. It is designed for existing firms that re-invest for the purpose of diversification, expansion, automation or modernization. The RA gives a sixty to seventy percent tax deduction for capital expenditure. This incentive is given for a period of fifteen years beginning from the re-investment date. It is argued that the RA incentive is very critical for companies in the electronics industry because of the rapid change in technologies, and thus firms continuously need to upgrade their production facilities (Best and Rasiah 2003).

Export processing zones (EPZ) have played a critical role in the growth of electronics exports. Currently, there are eighteen zones. The main reason for their growth in Malaysia (and in East Asia in general) is the increase in production fragmentation. This is explained from the perspective of GVC theory by the nature of the vertically specialized GVCs. In this chain, production takes places in a parallel fashion which makes it possible for firms to specialize in their core competencies and outsource the other activities. Thus, EPZs are a very effective instrument for developing countries in order to "thin in" the GVC. However, countries are expected to move up the value chain by upgrading their manufacturing capabilities (Kaplinsky 2015; UNIDO 2015).

In response to complaints by foreign investors engaged in high-tech production about the low labour skills, the state acted remarkably quickly to overcome this problem (Felker and Jomo 2007). Thus, different types of incentives were promoted for the private sector to co-operate with the Government in developing the labour capabilities. The first is the Human Resource Development Fund (HRDF) which requires firms with fifty employees or more to contribute to the fund with one percent of their total training invoice. Then, firms use the one percent as an approval to reclaim their total training expenditure. The HRDF was an instrumental tool to push foreign investors such as Intel and Motorola to develop domestic labour skills (Lall 2004).

Table A. 5: List of promoted activities and products for High-Tech fiscal incentives

I. Design, development and manufacture of advanced electronics and computing
1. High-density modules or systems 2. Advanced display 3. Advanced semiconductors devices 4. Advanced connectors 5. Data storage devices or systems 6. Advanced substrates 7. Information and telecommunication products, systems or devices 8. Digital entertainment or infotainment products 9. Optoelectronic equipment, systems or devices 10. Electronic security and surveillance systems or devices 11. Electronic machines, equipment, system or devices 12. Advanced electronic components
II. Professional, medical, scientific and measuring devices or parts
1. Medical equipment, parts or components 2. Medical implants, medical devices, parts or components **3.** Testing, measuring or laboratory equipment or apparatus
III. Bio-technology
2. Pharmaceuticals 3. Fine chemicals 4. Bio-diagnostics
IV. Advanced materials
3. Development and manufacture of: a) polymers or bio-polymers b) fine ceramics or advanced ceramics c) high strength composites 2. Nano-particles and their formulations thereof
V. Alternative energy technology
Design, development and manufacture of products, equipment, systems , devices or components for use in alternative energy sectors
VI. Iron and Steel
Super fine wire of diameter 2.0 mm and below

Source: MIDA (2016).

In 1989, Penang state, with some foreign firms, established the Penang Skills Development Centre (PSDC). The centre's mission is to promote and share the manufacturing sector knowledge and experience. There are members of the Government, education sector and the manufacturing sector all participating in this Centre. Each participating firm is authorised to send a representative agent to the Training Committee which is divided into sub-committees. Each sub-committee has the task of evaluating firms' training and their effectiveness, in addition to helping knowledge sharing between the members. The number of companies participating in the centre rose from twenty-four with thirty-two courses in 1989 to 81 firms with 495 courses in 1998 (Best and Rasiah 2003). Lall (2004) argues that the centre was a critical mechanism to bring MNCs together with local firms to solve different labour skills difficulties. Since then, eleven states out of thirteen in

Malaysia used the PSDC concept to establish their own labour-skills development centres (PSDC 2016).

In addition to establishing specialized training institutions, the government offered two other fiscal incentives targeting the labour skills development: the double deduction for firms' approved training which is designed for smaller companies with fewer than fifty employees, and the exemptions from import duties, excise duties, sales tax for any equipment, machinery or materials used for training purposes (Best and Rasiah 2003)

Following the successful experience of Korea, Singapore and Taiwan, high-technology companies were also attracted by specialized infrastructures called technology parks. These technology parks (or technology industrial clusters) are argued to be an important element of upgrading the industrial sector and increasing manufacturing added value (UNIDO, 2015). These technology parks could offer large pools of labour specialized in technology related activities, a large pool of firms supplying input materials required for electronics manufacturing, reduce transportation costs and locate firms near to regional research and innovation centres (Kaplinsky 2015).

The Ministry of Science, Technology and Environment founded the Technology Park Malaysia (TPM) in 1988. The park is located in the capital, Kuala Lumpur, and contains an automation and design centre, technology training centre, laboratories for advanced manufacturing materials, a centre for technology and communications, and Innovation and Incubation Centre (IIC). Furthermore, the park offers rental offices equipped with high quality infrastructure for low cost. By 2011, the park hosted 192 companies employing 5,564 workers in the information communication technologies, green technologies, and bio-technologies (TPM 2011).

In partnership with the government of Kedah state, the Ministry of International Trade and Industry founded the Kulim High-Technology Park (KHTP) in 1995. This park specializes in hosting firms qualified for MIDA's new incentive "High-Technology Companies". The Park currently hosts thirty companies with a total investment of approximately 34 billion RM. Major tenants are Intel, Fuji Electric, and Panasonic (KHTP,

2016). Governments of other states followed suit later; the states of Penang, Malacca[106], Sarawak, and Johor established similar high-tech parks. After promoting the "2020 Vision" to transform Malaysia into a developed country, the Malaysian Super Corridor (MSC) was established in 1996 as a high-technology manufacturing and trading zone. Beside various non-financial incentives, the MSC offers its tenants the following financial incentives: Pioneer Status with 100 percent tax exemption for five years or 100 percent Investment Tax Allowance; R&D grants (this is specific for Malaysian majority ownership companies), in addition to duty-free import of multi-media equipment (MSC 2016).

[106] Malacca Technology Park was established in 1993 to accommodate government supported projects in aerospace components and advanced composite materials.

Appendix 4: The product space construction

The product space shows a network connecting products that are more likely to be co-exported. This method is based on a product complexity measure called the Product Complexity Index (PCI), which represents the capabilities required for its production. “It is calculated as the mathematical limit of a measure based on how many countries export the product and how diversified those exporters are” (Hausmann et al. 2014). Accordingly, the authors use the PCI to devise the Economic Complexity Index (i.e. on average, how complex the country’s exports are). The higher the ECI is for a country, the more complex the products it exports.

Each circle in the product space represents a product. The different colours symbolize a product group. The link between two products represents the similarities in the required capabilities to produce them. For example, the link between cotton and shirts is stronger than the link between cotton and automobiles. The similarity between the capabilities needed to produce the two products is presumed by the likelihood of co-exporting both of them. For example, the likelihood of a country to export shirts given it exports cotton and vice versa is the conditional probability P(shirts/cotton) and P(cotton/shirts). Hence, products that show few common capabilities are not likely to be co-exported and connected in the product space (Hausmann et al. 2014).

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