INFORMATION AND COMMUNICATION TECHNOLOGY AND EXPORT PERFORMANCE OF FIRMS: A STUDY OF FOOD PROCESSING INDUSTRY IN INDIA

Thesis

Submitted in partial fulfilment of the requirements for the degree of

DOCTOR OF PHILOSOPHY

by

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DECLARATION

by the Ph.D. Research Scholar

I hereby declare that the Research Thesis entitled, **'Information and Communication Technology and Export Performance of Firms: A Study of Food Processing Industry in India'** which is being submitted to the National Institute of Technology Karnataka, Surathkal in partial fulfilment of the requirements for the award of the Degree of Doctor of Philosophy in Economics is a *bonafide report of the research work carried out by me*. The material contained in this Research Thesis has not been submitted to any University or Institution for the award of any degree.

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CERTIFICATE

This is to *certify* that the Research Thesis entitled **'Information and Communication Technology and Export Performance of Firms: A Study of Food Processing Industry in India'** submitted by **Navyashree G. R., (Reg. No. 138025HM13F06)** as the record of the research work carried out by her, is accepted as the Research Thesis submission in partial fulfilment of the requirements for the award of degree of Doctor of Philosophy.

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ABSTRACT

The role of ICT in enhancing the performance of an economy and business enterprises cannot be neglected in the present era of globalization. The use of ICT can be one of the strategic ways or tools for the firm to improve efficiency and performance, which leads to the long-term survival of the firm in the market. Several studies in the context of developed countries have examined the relationship between ICT and firm performance and found a significant relationship between the two. However, there are very few studies that have examined the impact of ICT on firm performance in the case of developing countries, particularly in India. Therefore, the objective of present study is to examine the determinants of investment in ICT and its impact on export performance of food processing firms in the context in India. The study also tries to understand the perceptions of owners or managers of food processing firms about investment in ICT. The sample and data for the study are extracted from a secondary source, namely Prowess Database for a period of seven years from 2012 to 2018. The econometric method, namely generalized method of moment (GMM) is used to identify the significant determinants of investment in ICT and its impact on export performance of food processing firms. The study also adopted a case study method to understand the owners'/managers' perceptions regarding the investment and use of ICT.

The result of GMM model shows that the firm's previous year investment in ICT, size of the firm, international exposure, labour intensity, capital intensity, and government intervention are the significant factors in determining the investment in ICT. With respect to impact of ICT investment on export performance, the study found no significant relationship between the two. However, it is found that the affiliated firms' investment in ICT has significant impact on the export performance of food processing firms. The result also shows that import and adopt (IAT) strategy is one significant factor to improve the export performance of food processing firms in India. Other factors like the age of the firm, capital-labour ratio, research and development intensity, and government intervention are also found to be significant in explaining the export performance of the firms. These result also supported by the findings the case study conducted in the present study.

Keywords: Information and communication technology (ICT), food processing industry, structure-conduct-performance paradigm, technology organization environment framework, resource based view, dynamic panel data model, generalized method of moments, developing countries, India.

CONTENTS

CHAPTER 1

INTRODUCTION

This chapter provides the background of the study. It discusses the importance of the information and communication technology (ICT) to an economy and a firm. The chapter also gives an overview of the food processing industry and the importance of ICT investment in food processing industry. Further, it explains the significance of the present study and identifies the research gaps. This chapter also presents the research questions and the research objectives. Finally, it provides an overview of the chapters in the dissertation.

1.1 BACKGROUND OF THE STUDY

Section 1.1.1 gives an overview of ICT and its importance to a country and a firm. Section 1.1.2 provides an overview of the food processing industry in general and its importance to the Indian economy. Section 1.1.3 explains the role of ICT in supporting the food processing industry.

1.1.1 ICT and Its Importance to an Economy

In the present era of economic and technological globalization, the adoption of modern technologies in the production and distribution of goods and services has become crucial for the innovation-led development of countries (Prasad, 2008). One of these technologies is the information and communication technology or ICT, which is defined as "any kind of technology such as hardware, software, and communication infrastructure such as computers, mobile and wireless communication devices, satellite communication gadgets, videoconferencing equipment, networks, internet, website, email, and social media platforms that are used to create, store, manipulate and communicate information" (Gbadegeshin et al., 2019, pp: 2). ICT is considered as a general-purpose technology (GPT) that is universally used in many sectors of the economy and has the potential to contribute to further innovations and changes in the production processes (Basu and Fernald, 2007; Guerrieri et al., 2011; Pradhan et al. 2015; and Liao et al., 2016). The adoption of ICT has dramatically transformed government and business processes by bringing in changes in the way people work,

learn, communicate, spend time, and interact (Erumban and Das 2016; Jorgenson and Vu 2016; Majeed and Ayub 2018). A strong ICT infrastructure provides people, firms, and governments with better access to information, knowledge, and wisdom in terms of scale, scope, and speed (Bahrini and Qaffas 2019).

At the country level, ICT reinforces connections between economic and social activities. It is considered as a pivotal tool to participate in the global market as it encourages political accountability and improves the delivery of services and local development opportunities (Tiago et al., 2007). It provides a basis for a new development process in any economy by uplifting traditional sectors and giving rise to new industries (Mendonca et al., 2008). It also plays a significant role in the transformation of an economy by generating new knowledge and improving the competitiveness of business enterprises through the launch of new products or services and the introduction of new business processes (Ollo-Lopez and Aramendia-Muneta, 2012). Another significant role of ICT is that it has the potential to reduce poverty by helping poor people to access the necessary information about education, health, government, and other financial services (Cecchini and Scott, 2003).

There are various empirical studies that have examined the role of ICT and other related technologies like mobile phone, computer, internet, and broadband on the growth and development of a country (Jorgenson and Motohashi 2005; Papaioannou and Dimelis, 2007; Vu, 2011; Yousefi, 2011; Dedrick et al., 2013; Shahiduzzaman and Alam, 2014; Jin and Cho, 2015; Kumar et al., 2015; Pradhan et al., 2015; Das et al., 2016; Ward and Zheng, 2016; Aghaei and Rezagholizadeh, 2017; Laitsou et al., 2017; Niebel, 2018; Njoh, 2018; Pradhan et al., 2018; Bahrini and Qaffas, 2019; Garcia, 2019; Haftu, 2019; Sepehrdoust 2018). These studies have invariably found that the adoption of ICT has significantly contributed to the growth and development of various countries.

For example, Laitsou et al. (2017) have examined the impact of ICT on the economic growth of Greece and European Union countries for the period of 1990-2016 with special focus on the period from 2008 to 2016, considered as a period of economic crisis. The study found that from 1990 to 2016, ICT contributed to around 30% and

23% to the GDP growth of Greece and Europe, respectively. The study further noted that ICT was the only production factor that had a positive impact on the GDP growth even during the period of economic crisis. Hence, the study concluded that ICT contributed positively to economic growth and helped the countries to overcome the crisis.

A recent study by Das et al. (2016) examined the effect of ICT development on the economic growth in select Asian countries, including India. The study used the GMM approach and found a positive effect of ICT diffusion on the economic growth of these countries. In particular, the study found that around 2 per cent of the total economic growth was explained by the growth of mobile subscriptions and internet diffusion. The study concluded that ICT is vital for the growth of developing countries in Asia. Other studies also supported the view that investment in ICT contributed significantly to economic growth and development in the cases of developed as well as developing countries.

In the present era of globalization, the growth and survival of any business has become a challenge. Business firms need to identify strategic ways to improve their competitiveness in the market. The adoption of ICT can be one such strategic way or tool that can strengthen a firm's competitiveness in the domestic as well as in the global market. ICT is a tool that can completely transform the business operations of a firm (Cline and Guynes 2001). Every firm's ICT usage is unique, which gives some firms competitive advantage over their rivals (Bhatt and Grover 2005). The decision-makers of the firm can use ICT to acquire relevant information at the right time (Bhagwat and Sharma 2007; Pispa and Eriksson 2003; Roberts and Grover 2012), and thereby, enhance the capabilities and efficiencies of the operating firm (AlBar and Hoque 2017; Ding, Chen, and Lyu 2011). Since many firms have started to focus more on ICT investments to manage their businesses, it is becoming an essential part of the contemporary business firms all over the world (Gerguri-Rashiti et al. 2017). The use of ICT provides relevant information to the firms' decision-makers at the right time (Bhagwat and Sharma 2007; Pispa and Eriksson 2003; Roberts and Grover 2012), and thereby, enhances efficiency and capabilities (AlBar and Hoque 2017; Ding, Chen, and Lyu 2011).

ICT significantly changes not only the firm's business processes, but also the structure and relationships of the firm with other firms (Campo, Rubio, and Yague 2010). With the help of ICT, firms can enter new markets, introduce new products, respond quickly to customers' demands and market changes, and integrate activities across the world (Franco and Garcia 2018; Yunis, Tarhini, and Kassar 2018). The use of ICT reduces transaction and communication costs, improves information management, improves control over distribution channels, reduces inventory holdings, and improves efficiency in the reallocation of factor inputs (Dimelis and Papaioannou 2010).

There are a number of studies that have examined the relationship between the use of ICT and the performance of business firms (Ng and Chang, 2003; Falk, 2005; Ravichandran et al., 2005; Nurmilaakso, 2009; Wu et al., 2011; Bayo-Moriones et al., 2013; Azam, 2015; Grazzi and Jung, 2016; Lee et al., 2016; Benitez et al., 2018; Naidoo and Hoque, 2018; Tang et al., 2018; Yunis et al., 2018; Chege et al., 2019). These studies have found a significant positive impact of ICT on the performance of the firms in terms of labour productivity, revenue growth, profitability, and sales growth. There are a few studies that have also examined the relationship between ICT and export performance and found a positive impact of ICT on the firm's export performance (Lu and Julian 2007; Ghalandari 2013; Makanyeza and Ndlovu 2016; Sojoodi 2016; Hagsten and Kotnik 2017).

Thus, investment in ICT helps business firms within countries to improve their performance, thereby leading to growth and development of the countries. In other words, investment and use of ICT has indeed become one of the important ways for firms and countries to survive in the present competitive and globalized world.

1.1.2 Food Processing Industry in India

The success of food processing firms is considered as the main engine of economic growth and employment (Gill et al., 2018). Therefore, it is important that food processing firms strive continuously to improve their efficiency, quality, and productivity to sustain in the present competitive and globalized economy. This in turn, contributes to the overall growth and development of an economy like India,

which is traditionally an agrarian society. The current status of the agricultural sector and food processing industry in India is given below.

1.1.2.1 Current Status of Agricultural Sector and Food Processing Industry in India

India is one of the fastest-growing Group of Twenty (G20) economies where the agriculture sector plays a significant role in terms of its contribution to both employment and GDP (OECD/ICRIER 2018). Due to improved access to inputs such as fertilizers, seeds, better irrigation, and credit coverage, the production in the agriculture sector has been increasing since 2011 at an average annual rate of about 3.6 per cent (OECD/ICRIER 2018). In India, agriculture is one of the primary sources of food supply. Further, during 2017 to 2018, around 54.6 per cent of the total workforce was engaged in agriculture and allied sector activities, accounting for 17.1 per cent of the country's Gross Value Added (GVA) (DACFW 2019). Agricultural foods or fresh foods are usually vulnerable to early spoilage. Hence, many of the agricultural food/products require some amount of processing to increase their shelf life or to convert the raw product into easily consumable forms. Thus, the food processing industry plays a central role in supporting agriculture by increasing the shelf life of the products.

Food processing refers to the conversion of raw materials or ingredients into consumer food products (Heldman and Hartel, 1998). In India, food processing is referred to as the process of transforming raw products of agriculture, animal husbandry or fisheries in such a way that the original physical shape of the products gets changed and value is added to the products in terms of increased shelf life, and are ready for consumption (MOFPI 2019). The food processing sector is considered as a major segment of the Indian economy in terms of its contribution to GDP, employment, and investment. The food processing sector is the largest in India, which accounts for 32 per cent of the country's total food market. The output of the food processing sector is expected to increase to US$ 958 billion by 2025 (MOFPI 2017). The industry contributes around 8.83 per cent to GVA in the manufacturing sector for the period of 2017-18. Further, the Government of India considers the food processing

industry as a ‘priority sector’, which is growing rapidly in the past five years with an investment of 20 per cent annually (MOFPI 2019).

The products provided by the food processing industry can be the outcome of any of the three processing levels, namely, primary processing, secondary processing, and tertiary processing. Primary processing involves the process of transforming raw products into food ingredients. Secondary process is the processes of converting food ingredients into edible foods. And finally, tertiary processing is the process of producing ready-to-eat pouched, boxed, canned, or frozen meals (Ozilgen and Ozilgen 2016). With higher levels of processing, the food processing industry is able to reduce wastages and improve value addition of the food products. The presence of more secondary and tertiary level food processing firms promote crop diversification, provides better employment opportunities, leads to better returns to farmers, and even aids in increasing export earnings (MOFPI 2019). Further, the sector also plays a vital role in addressing issues related to food security, food inflation, and supply of wholesome and nutritious food to society. The food industry is growing in India and demand for processed food is increasing over time due to urbanization, changing demographics and lifestyle, evolving preferences for branded items, and modernization of the retail sector (MoFPI, Ernst & Young LLP (EY) and Confederation of Indian Industry 2017; Confederation of Indian Industry 2019).

Hence, the Government of India has proposed various schemes to support the food processing industry in India. An overview of these schemes is presented in the next sub-section.

1.1.2.2 Overview of Government Schemes for Food Processing Industry in India

The food processing industry plays an essential role in building linkages and synergies between the two pillars of the economy, that is, agriculture and industry. It plays a vital role in satisfying the basic needs of humans by supplying food for consumption. To improve the food processing sector, the Ministry of Food Processing Industry (MOFPI) of the Government of India has initiated a scheme called Pradhan Mantri Kisan SAMPADA Yojana to create a modern infrastructure, reduce food wastage, and promote ease of doing business. Under this scheme, the government has

allocated Rs. 6,000 crore for the period 2016 to 2020 to create a modern infrastructure with efficient supply chain management from farmers' field to retail outlets. The scheme is intended to generate better income for farmers, create substantial employment opportunities in rural areas, reduce agricultural wastage, increase the processing level of food, and enhance the export of processed food.[1]

There are several other sub-schemes under the PM Kisan SAMPADA Yojana such as Mega Food Parks, Integrated Cold Chain and Value Addition Infrastructure, Creation/Expansion of Food Processing/Preservation Capacities, Infrastructure for Agro-processing Clusters, Creation of Backward and Forward Linkages, Food Safety and Quality Assurance Infrastructure, Human Resources and Institutions, and Operation Greens.[2] The scheme 'Mega Food Parks' is developed to create a link between agricultural production and the market. It includes supply chain infrastructure such as collection centres, primary processing centres, central processing centres, cold chain, and fully developed plots for entrepreneurs to set -up their food processing units.[3] The objective of the 'Integrated Cold Chain and Value Addition Infrastructure' scheme is to provide an integrated cold chain and preservation infrastructure facilities from farmers to the consumer.[4] The scheme 'Creation/Expansion of Food Processing/Preservation Capacities' aims at creating processing and preservation capacities and modernization or expansion of existing food processing units to increase the processing level and value addition so as reduce the wastage of food products.[5] The objective of 'Infrastructure for Agro-processing Clusters' scheme is to develop modern infrastructure and common facilities to motivate entrepreneurs to set -up food processing units based on cluster approach through the linking group of farmers or producers to the processors and markets.[6]

The scheme called 'Creation of Backward and Forward Linkages' provides effective and continuous backward and forward integration for the food industry by filling the

[1] http://mofpi.nic.in/Schemes/about-pmksy-scheme
[2] http://mofpi.nic.in/Schemes/about-pmksy-scheme
[3] http://mofpi.nic.in/Schemes/about-mega-food-park-scheme
[4] http://mofpi.nic.in/Schemes/cold-chain
[5] http://mofpi.nic.in/Schemes/creation-expansion-food-processing-preservation-capacities-unit-scheme
[6] http://mofpi.nic.in/Schemes/agro-processing-cluster

supply chain gaps.[7] The scheme 'Food Safety & Quality Assurance Infrastructure' provides financial assistance to food processing units to set-up or upgrade quality control, food testing laboratories, HACCP, ISO Standards, Food Safety, and Quality Management Systems to maintain the quality of the food products.[8] Another scheme 'Human Resources and Institutions' covers the various activities related to research and development, promotional activities, skill development, and strengthening of institutions.[9] Finally, the scheme 'Operation Greens' provides financial assistance to promote farmers, producers, organizations agri-logistics, processing facilities, and professional management.[10]

Thus, the Government of India is striving hard to increase the growth and performance of the food industry. However, it should be noted that there is limited scope for procurement of ICT under these different schemes and sub-schemes, although there are studies that have found that ICT is important even in the case of the food processing industry. The following section gives insight into the role of ICT in the food processing industry.

1.1.3 ICT in Food Processing Industry

The investment in ICT and its use is important for any firm, irrespective of what they manufacture and market. Flow of information throughout the firm is essential to manage and coordinate business operations efficiently. Effective communication with business partners, suppliers, and customers is of significant concern for the success of business firms. Thus, the use of ICT in business processes becomes vital for every business firm. Hence, firms can improve the flow of information and communication by using ICT (Corso et al., 2010).

There are studies that have examined the impact of ICT adoption and use in various industry sectors like electrical and electronic goods manufacturing industry (Lal, 1996, Lal, 2002), chemical industry (Liu et al., 2007), pharmaceutical industry (Kanungo, 2004; Kandukuri, 2016), auto industry (Albadvi et al., 2007; Kannabiran

[7] http://mofpi.nic.in/Schemes/scheme-creation-backward-and-forward-linkages
[8] http://mofpi.nic.in/Schemes/food-safety-quality-assurance-infrastructure
[9] http://mofpi.nic.in/Schemes/human-resources-and-institutions
[10] http://mofpi.nic.in/Schemes/operation-greens

and Dharmalingam, 2012), textile and apparel industry (Andersen and Segars, 2001), and the banking sector (Malhotra and Singh, 2007). Few studies have examined the importance of ICT investments for farmers and its impact on agriculture (Ali and Kumar, 2011; Maumbe, 2013; Dlodlo and Kalezhi, 2015). There are hardly any studies that have examined the extent of the use and the impact of ICT investment in the food processing industry, an industry that is one of the important industries in many developing countries like India.

One of the reasons for the lack of research with regard to ICT investment and use in the food processing industry might be the perception that the food processing industry is a low-tech industry (Zawislak et al., 2018), where there is less need for high ICT investments (Abri and Mahmoudzadeh, 2015). However, some studies from across the world like the United States, Canada, Turkey, Greece, Italy, and even India have examined the importance of ICT use in the food processing industry and found that the use of ICT is essential and necessary even in the case of this industry, which is traditionally classified as low-tech industry (Hill and Scudder, 2002; Akkerman and Donk, 2008). The following paragraphs give summaries of some of the studies that have examined the effects of ICT technologies in the context of food processing and related industries in various countries.

Hill and Scudder (2002) examined the use of electronic data interchange (EDI) in coordinating the supply chain activities of the food industry in the US. The study used a survey method and found that the firms were using EDI to maintain everyday transactions like invoices and purchase orders, and concluded that the food firms were using EDI to improve their business efficiency.

Baldwin et al. (2004) examined the impact of ICT and advanced technology on the performance of Canadian food processing firms. The study found that ICT had a significant impact on the firms' performance. The study noted that the use of advanced technology had little effect on the firms' productivity growth; however, the effect became significant when ICTs and advanced packaging technologies were combined.

Cetin et al. (2004) studied how ICT can be used for marketing products in agri-food companies in Turkey. The study using the survey method concluded that small agri-food firms could sustain in the global market with the help of the Internet, a technology that would help the firms to connect to the international market and build long-term customer base. The study suggested that small firms that used internet technologies could maintain market position by accessing the world market and increase their business efficiency.

Matopoulos et al. (2007) studied the effect of e-business adoption on the logistic processes of food companies in Greece. The study, based on case studies of six food companies, came to a conclusion that e-business had a significant impact on food companies that were using e-business intensively compared with companies that were not. Further, the study noted that these food companies were using e-business to reduce the time related to customer services, ordering and procurement, and to improve quality.

Akkerman and Donk (2008) examined the effect of decision support tools in reducing product losses in the food processing industry. The study, based on a case study of a dairy plant, found that the tool helped the plant company to reduce around 20% of planning-related losses. The study suggested that decision support tools can improve planning and reduce product losses, which is a productive way to improve the profitability and sustainability of the food processing industry.

Schimmenti et al. (2013) examined the role of the information and communication technology on the economic performance of the fruit and vegetable processing firms in Sicily, Italy. The study, that used multiple regression analysis models, found that firms were using ICT software for business activities such as accounting, payment, warehousing, sales orders, and contracts. This, in turn, improved the economic performance of these firms.

In the context of India, Bhaskaran (2013) did a case analysis on information communication technology adoption by size small and medium food processing firms. The study noted that four out of six food manufacturing firms achieved increased operating efficiency and business growth due to the adoption of ICT in their business.

To summarize, in the present competitive business environment, ICT can be used as an important tool for improving performance even in the case of the food processing industry. However, there are limited studies that have analysed the role of ICT in the food processing industry in India.

1.2 RESEARCH GAP IDENTIFICATION

Nowadays, manufacturing firms are keen to invest in ICT in their business processes due to the enormous benefits provided by the use of these technologies. However, investment in ICT is not easy since it includes various kinds of ICT technologies from basic to advanced, and involves continuous changes and updates. Hence, it becomes important to understand the factors that influence investment in ICT. This, in turn, will help the firms and policy makers to design suitable policies. Some of the previous studies have examined the determinants of firms' investment in ICT. However, most of the earlier studies are in the context of developed countries (Ramdani et al., 2013; Cao et al., 2014; Walker et al., 2016). Though some researchers have started exploring determinants of ICT investment in developing countries (for example, Ahmad et al., 2015; Awa et al., 2017), there are very few that focus on India.

Moreover, the factors determining investment in ICT and the impact of ICT investment on firm performance can vary across different countries and different industry sectors. Due to differences in economic growth, regulation levels, labour costs, IT skills and availability, and heterogeneity, competition and complementary organizational innovations and culture across the countries (Zehir et al., 2010). Although studies exploring the role of ICT in high-tech industries in India are available (Lal 1999; Lal 2005), there are hardly any studies that have examined the same in the case of the food processing industry. Hence, there is need to examine the factors determining investment in ICT and its impact on the performance of firms operating in the food processing industry. This is the first gap in the existing literature that the present study tries to fill.

Many of the earlier studies have mainly used the technology-organization-environment (TOE) framework to identify the factors influencing ICT investment (for example, Awa et al., 2017; Leung et al., 2015). They have only considered common

organizational factors like age of the firm and size of the firm and ignored the role of other important organizational factors like the firm's liquidity position, international exposure, and government intervention that may also have a significant impact on ICT investment. The present study tries to fill this second gap in the existing literature by including more explanatory variables.

Investment in ICT is a dynamic process. Investment in information technology is an ongoing process where the firm either replaces or adds to the existing systems (Hinton and Kaye 1996).The firms need to update their ICT technologies and software whenever new developments happen in order to give superior products and services to their clients. The success in previous investment in ICT may encourage firms to increase current investment in ICT, and consequently, lagged ICT investment may have a positive impact on the current investment in ICT. Hence, firms with greater ICT investment in the past year are more likely to have a greater investment in ICT at present. However, it is observed that most of the previous studies in developed as well as developing countries have applied traditional econometric methods such as Ordinary Least Square (OLS), Probit, Tobit, and SEM. There are hardly any studies that have considered a dynamic econometric model to understand the factors affecting ICT investments. This is the third gap that the present study tries to address.

The Indian food processing sector is highly export-oriented,[11] and hence, there is need to understand how investment in ICT can be useful in achieving further export success. A study on the role of ICT and other factors on the export performance of food processing firms would help policy makers and managers of Indian food processing firms to initiate suitable measures to promote ICT in the food processing sector. However, there are hardly any studies that have examined the impact of ICT on the export performance of food processing firms in India. The present study tries to fill this fourth research gap in the existing literature.

The advocates of qualitative study assert that to have an in-depth understanding of any phenomenon such as factors that influence ICT adoption, case study methodology is appropriate (Yin 2018). An in-depth case study on ICT adoption can give insights

[11] http://agriexchange.apeda.gov.in/news/NewsSearch.aspx?newsid=22359

into managers'/owners' perception regarding ICT investment in the firm including the challenges that they face and the purposes for which ICT is used in the firm's business operations. Hence, there is need for more case studies on ICT investments in the food processing industry. The present study tries to address this fifth research gap in the existing literature.

Thus, the present study tries to fill the above-mentioned research gaps by examining the various factors that determine investment in ICT in food processing firms. The study then tries to examine the impact of ICT and other factors on the export performance of firms belonging to the food processing firms in India.

1.3 RESEARCH QUESTIONS

The following are the research questions formulated based on the research gaps identified from the literature review (presented in detail in Chapter 2):

- What are the factors that determine investment in ICT in food processing firms operating in India?
- What is the impact of investment in ICT on the export performance of food processing firms operating in India?
- What is the perception of owners/managers of food processing firms regarding investment in ICT?

1.4 RESEARCH OBJECTIVES

The following are the research objectives based on the research questions of the present study:

1. To identify the factors determining investment in ICT in food processing firms operating in India;
2. To understand the impact of investment in ICT on the export performance of food processing firms operating in India; and

3. To understand the perception of owners/managers of food processing firms regarding investment in ICT.

The first and second objectives are achieved using quantitative techniques based on secondary data analysis, while the third objective uses qualitative technique, namely, case study analysis.

1.5 SIGNIFICANCE OF THE PRESENT STUDY

Research on ICT is not a new phenomenon, but it is continually evolving as one of the essential tools in the economic growth of both developed as well as developing economies. Many developing countries are trying hard to internalize ICT to catch up rapidly with developed countries (Pradhan et al. 2018). Even though the development of ICT infrastructure has become a significant challenge, there is a considerable rise in the number of internet and mobile users in many developing countries in Asia, including India (Das et al. 2016). Thus, formulating policies related to the adoption of ICT has become one of the top agendas for governments in most developing countries (Pradhan et al. 2018). Hence, it is becoming increasingly important to understand the adoption, use, and subsequent impact of ICT in the context of developing countries.

In the present era of digitalization, the adoption and use of ICT has become necessary for every type of business activity. It is often proved that the use of ICT is one of the tools that lead to improved firm performance. However, the adoption of ICT is a significant challenge for firms in the case of developing countries, particularly India. According to the NASSCOM (2010) report, the manufacturing sector in India is lagging in the adoption of ICT compared with other developing countries like China and Brazil. The manufacturing sectors in India are also quite behind the service sector in ICT adoption, even though there is still considerable potential for ICT use in the manufacturing sector (Erumban and Das 2016). Hence, there is need to understand ICT adoption and use in the manufacturing sector in India.

Although there are studies that have examined the use of ICT in manufacturing sectors like the electrical and electronic manufacturing industry, pharmaceutical industry, chemical industry, and the auto industry, researchers have largely neglected

the importance of ICT in the food processing industry, a sunrise sector of the Indian economy. With rapid digitalization and modernization of business processes across the world, firms, irrespective of the type of industries they belong to, are forced to adopt ICT. Thus, to stay competitive and to survive in the current global market, it has become necessary for firms in all industries, including the food processing industry, to shift towards modern ways of doing business from their traditional business processes. The food processing industry in India, that is commonly assumed to be a low level of ICT adopter and user, might be losing out on opportunities to grow by not adopting ICT. Only an in-depth study can confirm this.

Further, continuous growth in the urban population, increase in employment rates, and rise in the proportion of working women, both in urban and rural areas, have changed the lifestyle of the population (CII 2015; Zia 2016). Due to the busy lifestyle, there is limited time available for cooking and meal preparation, leading to increasing demand for processed and ready-to-eat food products. To meet this increasing demand for processed food from the consumers, the food processing firms will have to adopt various new technologies including the latest ICT.

The present study will be useful for researchers, practitioners, and policy makers working in the areas of ICT investment and the food processing industry. The results of the study can provide the managers and decision-makers of the food processing firms as well as the information technology firms with an idea about the factors that drive ICT investment in the food processing industry. The results will also help policy-makers in developing countries to make better policies related to ICT investment that would benefit firms operating in the food processing industry. The study can be a basis for future research in the area of ICT investment in the food processing industry in the context of developing countries.

1.6 ORGANIZATION OF THE CHAPTERS

The following are the chapters in this dissertation.

Chapter One: The first chapter is “INTRODUCTION,” which discusses the background of the study. It presents the importance of the information and

communication technology, overview of the Indian food processing industry, and the role of ICT investment in the food processing industry. The chapter then discusses the significance of the present study, research gaps, research questions, and research objectives of the present study. The chapter ends with information on the organization of the chapters.

Chapter Two: This chapter "THEORETICAL BACKGROUND, LITERATURE REVIEW, AND HYPOTHESES DEVELOPMENT" discusses the major theories and frameworks used in the present study. Then it reviews the previous literature related to the present study's research objectives. It then provides theoretical framework developed based on the theories and the literature review of the study.

Chapter Three: This chapter "RESEARCH METHODOLOGY" describes the research design of the study. It explains the processes of sample selection for the present study. Then it discusses the sources of data collection and the procedure of data collection. It provides details on the definitions of the variables used in the study and the descriptive statistics for the variables used in research objective one and research objective two. Finally, it ends with a description of the methods used for data analysis.

Chapter Four: This chapter "RESULTS AND DISCUSSION" begins with the result of the pilot study. Then it presents the correlation matrix and econometric results for research objective one and research objective two of the present study. Next, it gives the findings of the case studies. Finally, it discusses the results of econometric analysis and case studies along with examples of food processing firms from the sample of the study.

Chapter Five: This chapter "CONCLUSION AND IMPLICATIONS" is the final chapter of the present study. It begins with overall summary of the findings. Then, it discusses the theoretical and practical contributions of the study. It discusses the limitations of the study. Finally, it gives directions for further research.

CHAPTER 2

THEORETICAL BACKGROUND, LITERATURE REVIEW, AND HYPOTHESES DEVELOPMENT

2.1 THEORETICAL BACKGROUND OF THE STUDY

The present study is based on three important theories, namely, structure-conduct-performance (SCP) paradigm, technology-organization-environment (TOE) framework, and resource-based view (RBV). The following sections give more details on these theories.

2.1.1 The Structure-Conduct-Performance (SCP) Paradigm

The structure conduct performance (SCP) is a paradigm of industrial organization, which explains causal relationships between the structure of the market, the conduct of firms in the market, and economic performance (Bain 1951). The theory consists of three elements related to industrial organization, which are structure, conduct, and performance. The structure represents the characteristics and composition of markets and industries in an economy. It further describes the number and size distribution of firms and the importance and characteristics of individual markets within the economy. The structure explains the environment within which the firms operate in a particular market.

The second element of the SCP model is conduct, which refers to the behaviour and/or action of a firm within a particular market. It deals with the decisions that the firms make and how these decisions are implemented. The decisions may pertain to price setting and expenditure on advertising, innovation, and other activities of the firm.

The third and final element of the SCP paradigm is performance that explains how the firm’s operations enhance economic welfare. It focuses on how the firms satisfy their customers' necessities in the current period. This element mainly considers the aspects of performance such as the relationship between prices and costs and the level of profits earned. Thus, the traditional SCP paradigm explains that the industrial

structure influences the conduct of the firms, and which in turn, determines the overall performance of the firms and the industry.

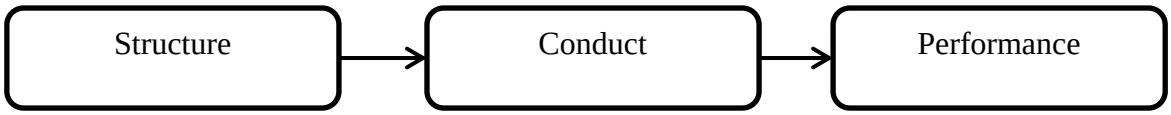

Figure 2.1: Traditional SCP approach (Source: Ferguson and Ferguson 1994)

Many firm level empirical studies have adopted the traditional SCP paradigm to analyse the relationship between structure, conduct, and performance at firm level (Acquaah and Chi 2007; Galbreath and Galvin 2008; Lee 2009; Kahiya and Dean 2014). These studies have invariably used firm level variables like firm size, firm age, research and development (R&D) activities, and advertising activities to understand the effect of the firm structure and conduct on the firm's overall performance. In the context of India, Lal (1996) adopted the SCP paradigm to understand the performance of electrical and electronic goods manufacturing firms. However, the author studied only the relationship between conduct and performance and did not include any structural variables to understand the firm's performance. Thus, these studies suggest that the SCP paradigm can be adopted at firm level to understand the effect of a firm's structure and conduct on the firm's performance. The present study uses the SCP paradigm to understand the determinants of ICT investment and export performance of the firms.

2.1.2 Technology Organization Environment (TOE) Framework

The technology organization environment (TOE) framework is developed and explained by Tornatzky and Fleischer (1990). It is an organizational theory, which focuses on both internal and external characteristics of the organization, as well as technological characteristics that influence technology adoption in an organization (Ahmad et al. 2015). According to this framework, there are three elements of a firm's context, namely, technological context, organizational context, and environmental context that influence technology adoption decisions (Baker 2012). The framework suggests that the adoption of technology is influenced by technology

development, organizational conditions, and its business reconfiguration and industry environment (Awa et al. 2015).

The technological context includes all those technologies that are relevant to any business firm. It includes technologies that a firm already adopted in its business and the technologies that are available in the market, but not currently adopted and used in the firm (Baker 2012). The successful adoption of any technology, including information and communication technology is dependent upon internal technology resources like technology infrastructure, technical skills, developers' time, and users' time. Technology related resources give better competitive advantages to a firm since they include intangible assets like technical skills and know-how, which are difficult to imitate by rival firms (Awa et al. 2015).

Organizational context refers to the characteristics and resources of the firm that impact the decision of technology adoption. These characteristics include firm scope, firm size, managerial beliefs, firm mission, trust, top management, and quality of human resources, centralization, formalization, expertise, and organizational knowledge accumulation (Baker 2012; Cao et al. 2014; Gangwar et al. 2014; Ahmad et al. 2015; Awa et al. 2015; and Gutierrez et al. 2015). Thus, a well-structured organization promotes adoption of technology, including information and communication technology.

The external context focuses on areas in which the firm operates its business, specifically external factors that influence the industry such as government incentives and regulations (Gangwar et al. 2014; and Awa et al. 2015). It includes the firm's customers and suppliers, competitors, and government regulations. Thus, the intensity of market competition, the presence of dominant firms within the value chain, and government rules and regulations influence a firm's technology adoption.

2.1.3 Resource Based View (RBV) Theory

RBV is one of the major theories that explain the relationship between firm resources and firm performance. The theory asserts that resources that possess specific characteristics like valuable, rare, and difficult to imitate and substitute lead to

sustainable competitive advantage and superior performance of the firm (Barney 1991). The RBV theory mainly focuses on internal resources that are unique and heterogeneous (Barney 1991; Wernerfelt 1984). Empirical studies based on RBV theory have found that a firm's internal resources play an essential role in enhancing export performance (Dhanaraj and Beamish 2003; Lopez et al. 2005; Sousa et al. 2008). Bharadwaj (2000) asserts that among the firm's resources information technology is one of the essential resources that differentiate successful firms from less successful ones. Information and communication technologies (ICTs) like computer systems, internet, database management, enterprise resource planning (ERP) system, supply chain management (SCM) system, customer relationship management (CRM) system, and e-commerce are viewed as resources that contribute to a firm's sustained competitive advantage.

Castiglione and Infante (2013) noted that the use of ICT not only offers technical solutions, but also opens up new economic and social opportunities to the business sector. It is believed that the use of ICT reduces the costs associated with production and labour and thereby, improves innovation capability, competitive ability, and efficiency of business operations (Lal 2002; Higon 2012; Nguyen et al. 2013). Successful adoption of ICT helps firms to adopt any sophisticated business model and to efficiently participate in the global supply value chain (Boothby et al. 2010). The use of information technology also increases a firm's productivity by enhancing inventory control and relationship with customers and suppliers (Chun et al. 2015).

2.2 THEORETICAL FRAMEWORK OF THE STUDY

On the basis of the SCP paradigm, TOE framework, and RBV theory, the present study uses three theoretical frameworks for the three research objectives of the study. The SCP paradigm is considered as the overarching theory in the present study, which explains how market/firm structure impacts the firm's conduct and how conduct impacts the firm's performance. The TOE framework is used to classify market/firm structure into technological, organizational, and environmental structures. Finally, the RBV theory is employed to consider ICT as a critical resource for any firm, thereby, leading to the idea that ICT investments can improve a firm's performance. Thus, the

three theoretical frameworks are used in the present study. Section 2.3 gives literature support for the different variables included in the theoretical frameworks.

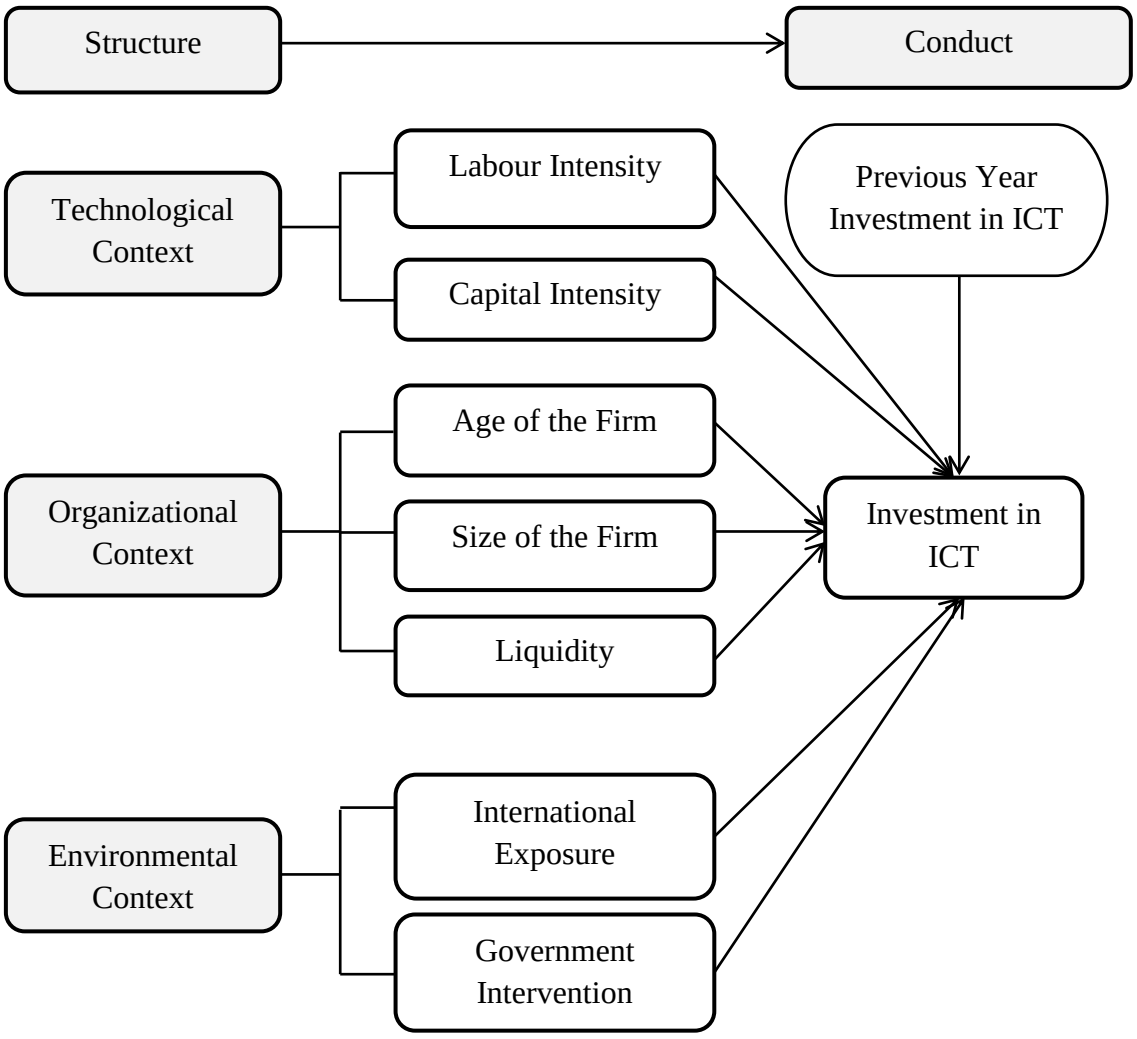

Figure 2.2: Theoretical Framework for Research Objective 1 of the Study

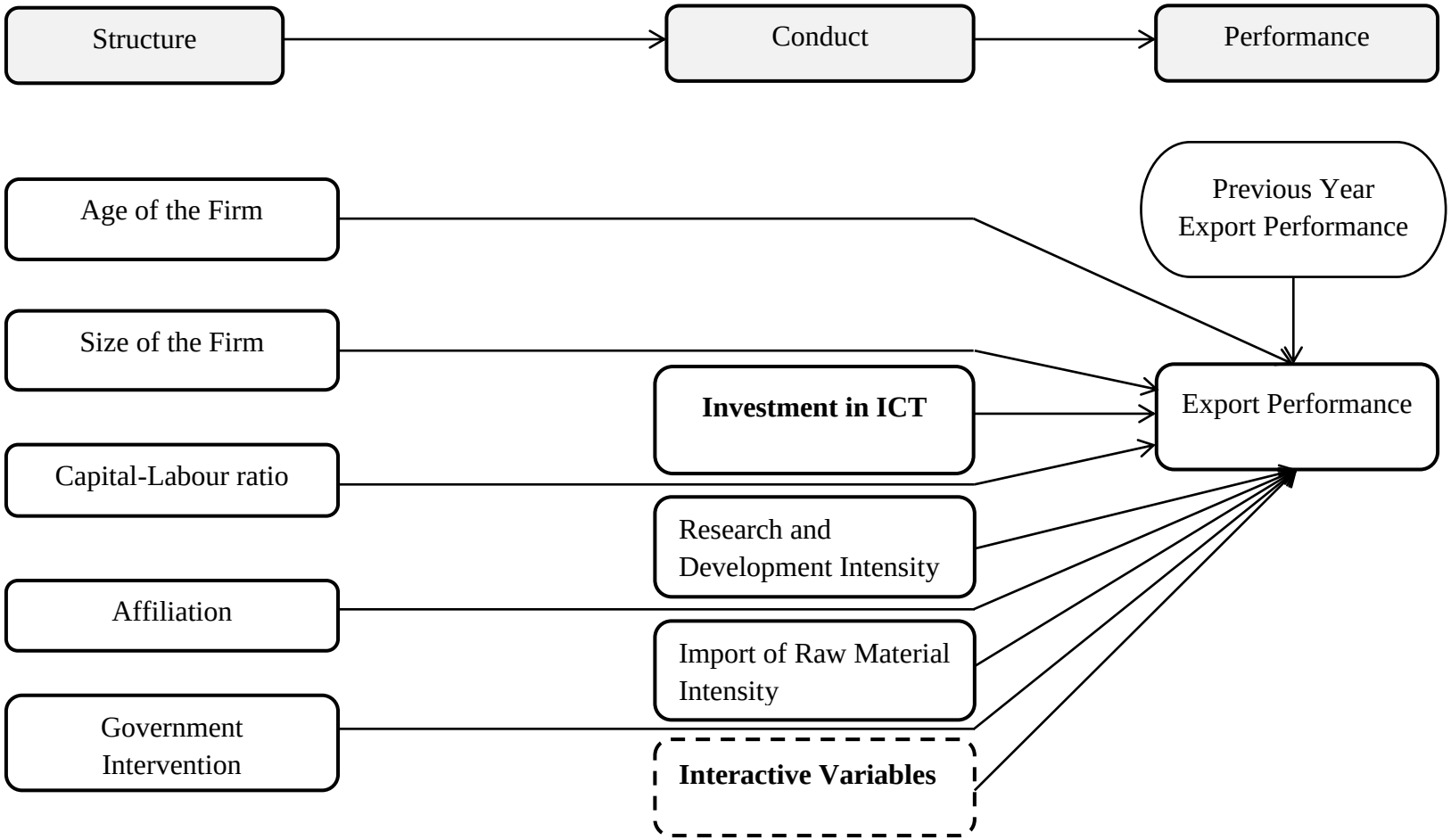

Figure 2.3: Theoretical Framework for Research Objective 2 of the Study

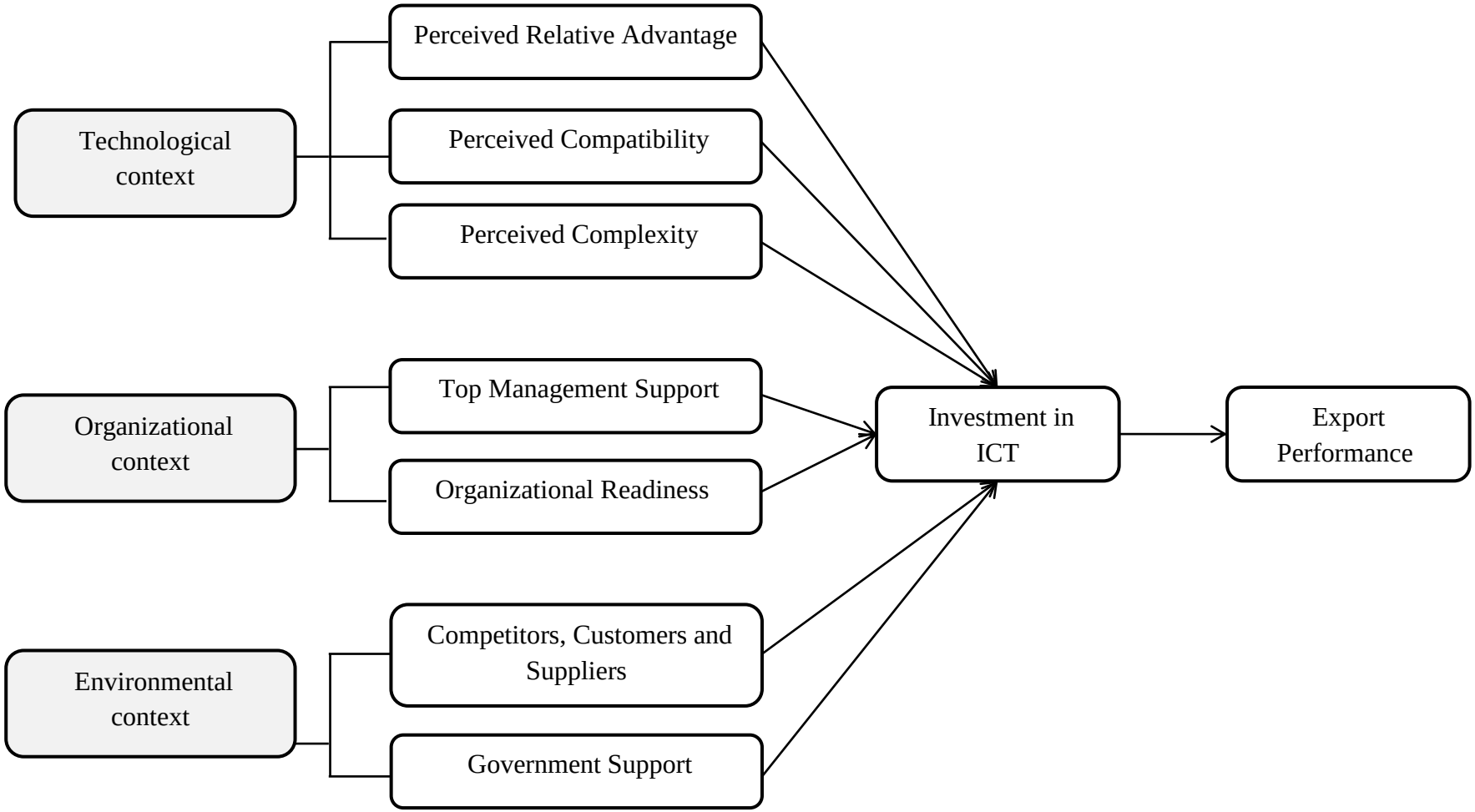

Figure 2.4: Theoretical Framework for Research Objective 3 of the Study

2.3 LITERATURE REVIEW

As noted in the research gap, there are limited studies regarding determinants of ICT under the SCP paradigm. Hence, the following sections review the literature on the factors determining investment or adoption of technology in general, impact of investment or adoption of ICT on firm performance, particularly export performance as well as the other control variables that determine export performance at the firm level, and studies that have utilized TOE framework in the context of technology adoption.

2.3.1 Factors Determining Investment in ICT at Firm Level

Here, empirical literature related to factors that are found to be critical in determining investment or adoption of technology in the firms is reviewed. Studies specific to ICT adoption are highlighted. Earlier empirical studies have considered labour intensity, capital intensity, age of the firm, and size of the firm as factors that can determine a firm's technological/ICT investment. Few of the empirical studies have also considered the impact of other factors like the firm's liquidity position and international connections. The present study considers all these factors as determinants of a firm's investment in ICT. The relevance of these factors is explained in the following sections.

2.3.1.1 Labour Intensity

Labour and their skills are essential resources of manufacturing firms. In the RBV perspective, labour can be considered as one of the sources of a firm's competitive advantage since the skills owned by the labour are not easily imitable by other firms. Hence, these skills are important for the firm to realize maximum benefit from ICT investment. The probability of firms adopting new technologies increases with a highly skilled labour force. Advanced ICT software like ERP, CRM, and SCM require high technical knowledge for installation and use in the business. Hence, business firms need to possess skilled labour to handle such sophisticated ICT tools and software (Bayo-Moriones and Lera-Lopez 2007; Alderete and Gutierrez 2014). Thus, the adoption of ICT in the firm demands up-gradation of the skills of the

employees (Fabiani et al. 2005). The diffusion of new technology is associated with uncertain returns and up-front costs of adoption. As such, the quick adjustment of firms to the uncertainties depends on their employees and skills. Further, Hollestein (2004) noted that lack of human capital like shortage of skilled labour, including ICT specialists, may hamper the adoption of ICT at the firm level. Hence, labour and their skills are essential for firms to adopt ICT.

There are some studies which have examined the relationship between labour/human capital and technology adoption and found that skilled labour workforce enables new technology adoption (Lal 1996; Lal 1999; Martins and Oliveira 2008; Haller and Siedschlag 2011; Alderete and Gutierrez 2014; Riddell and Song 2017). In the context of India, Lal (1999) asserted that to realize benefit from the adoption of information technology requires changes in the organization and redesign in its production processes. This, in turn, requires more skilled labour to adopt ICT and manage the changes caused by it. Thus, the skill intensity of labour influences the adoption of ICT in the firms. Lal (1999), in his study, found that firms with higher skill intensity are more capable of adopting advanced technologies. Similarly, Martins and Oliveira (2008) examined the determinants of information technology diffusion in firms in Portugal. The study noted that the information technology skill of the employees is vital for firms to develop information technology applications successfully. The study found positive and significant relationship between labour skills and firms' information technology use.

However, in contrast to the above studies, Choi et al. (2011) found no significant impact of labour intensity on Korean firm’s information system adoption. In the context of India, it was observed that food processing is more labour-intensive compared with other industry sectors and thus, demands more domain-specific skilled labour (Rais et al. 2013). Hence, in the present study, it is hypothesized that,

RO1-H1: Labour intensity has a positive impact on the ICT investment intensity of food processing firms.

2.3.1.2 Capital Intensity

Capital intensity can represent a relatively high degree of capital invested in the automation of an organization (Statt 2004). Thus, a firm is considered to be capital intensive if it has invested highly on plants and machinery, rather than on labour. Previous studies have noted that the adoption of information technology necessitates investment in technological infrastructure like hardware and software (Shaharadin et al. 2012; Bagale 2014; Rahayu and Das 2015). Advanced technology and e-commerce are more likely to be adopted by those firms, which are highly capital intensive (OECD 2004). Chung and Snyder (2000) noted that the use of advanced software like ERP demands high capital investment, and hence, ERP is traditionally used by firms operating in highly capital intensive industries like manufacturing, construction, aerospace, and defence.

The food processing sector, though traditionally classified as a labour-intensive industry, in recent years, appears to be relatively more capital intensive too (Kumar 2010; Bhardwaj 2013). Further, to invest in ICT, the firm needs necessary infrastructure like electric connections and hardware to better utilize the ICT. Thus, a firm that is highly automated or one that investments heavily on various types of plants and machinery are likely to be more interested in ICT investments to complement its existing technologies. Hence, it is hypothesized in the present study that,

RO1-H2: Capital intensity has a positive impact on the ICT investment intensity of food processing firms.

2.3.1.3 Age of the Firm

The age of the firm represents the experiences and insights acquired by the business firms (Narayanan and Bhat 2009). The experience gained over time helps the firms to improve their production processes and quality, and reduces the costs (Loderer and Waelchli 2009). The evolutionary theory of the firm states that as firms grow older and older, they can discover their strengths and weaknesses, and this in turn, helps older firms to make better decisions concerning ICT and other investments. Thus, a

positive relationship can be expected when older firms are better equipped to manage the risks associated with technology adoption. However, one can also expect a negative relationship between the age of a firm and ICT adoption when younger firms are more flexible in managing the changes caused by ICT adoption (Grazzi and Jung 2016).

Many studies have examined the relationship between age of the firm and information technology adoption (Dunne 1994; Lal 1996; Hollenstein 2004; Gunita and Trivieri 2007; Choi et al. 2011; Haller and Siedschlag 2011; Alderete and Gutierrez 2014; Grazzi and Jung 2016). However, the results are not conclusive. On the one hand, some studies by Youssef et al. (2010), Alderete and Gutierrez (2014), and Grazzi and Jung (2016) have found a positive relationship, while on the other hand, others like Hollenstein (2004) and Haller and Siedschlag (2011) have found a negative relationship. There are even studies that have found no significant relationship between the age of a firm and the adoption of ICT at the firm level (Dunne 1994; Lal 1996; Gunita and Trivieri 2007; Choi et al. 2011).

In the case of developing countries on the whole, the age of the firm is found to be favourable for ICT investments. For example, Alderete and Gutierrez (2014) investigated the determinants of information and communication technology (ICT) adoption in Colombian service firms using micro-level data. They found a positive and significant relationship between firm age and the use ICT. Similarly, Youssef et al. (2011) examined the intra-firm diffusion of ICT in the case of Tunisian firms from June 2004 to February 2005. The study using a face-to-face survey found a positive and significant relationship between firm age and the adoption of ICT. However, in a more recent study, Khalifa (2016) in the case of Tunisian firms, found that the age of the firm had no significant impact on ICT adoption.

Meanwhile, in the case of U.S. manufacturing plants, Dunne (1994) examined how the use of technology varies by plant age and size. The study found that plant age and technology use to be comparatively uncorrelated. The study noted that both old and young plants used advanced manufacturing technology at similar frequencies.

The present study, based on the evolutionary theory, believes that the age of a firm has a positive impact on investment in ICT. Further, since studies in the context of developing countries have found a positive relationship, it is hypothesized that,

RO1-H3: Age of the firm has a positive impact on the ICT investment intensity of food processing firms.

2.3.1.4 Size of the Firm

The size of the firm is one of the prominent variables in studies related to technology adoption (Hollenstein 2004). It represents the availability of the firm's slack resources, including managerial and financial resources (Penrose 2009). It is also one of the significant factors which influence the technological profile of the firms (Giunta and Trivieri 2004). In general, large size firms invest more in ICT than small size firms since large firms enjoy the benefits of economies of scale, easy access to the capital market, and superiority in research compared with smaller business firms. With ease of access to the capital market, larger firms have generally better financial position that makes it easier for them to invest more in ICT and related technological activities. Also, larger firms may have internal information system support, which helps them to create awareness, and initiate and facilitate the adoption of different technologies (Premkumar and Roberts 1999).

Some earlier studies examined the relationship between the size of the firm and the adoption of ICT. Although, the size of the firm was found to be an essential factor in the adoption of ICT technologies like RFID, e-commerce, and ERP (Awa et al. 2016), the result was not conclusive. While some studies (Dunne 1994; Lal 1999; Premkumar and Roberts 1999; Vishwasrao and Bosshardt 2001; Oyelere et al.,2003; Fabiani et al. 2005; Bayo-Moriones and Lera-Lopez 2007; Bruque and Moyano 2007; Giunta and Trivieri 2007; Pan and Jang 2008; Arpanutud et al. 2009; Wang et al. 2010; Gomez and Vargas 2012; Arvanitis and Ley 2013; Ashrafi et al. 2014; Panayiotou and Katimertzoglou, 2015; Awa and Ojiabo 2016; Awa et al. 2016) found a positive and significant impact of firm size on technology adoption, others (such as Teo et al. 1997; Lefebvre et al. 2005; Love et al. 2005; Jeon et al. 2006; Bayo-Moriones and Lera-Lopez 2007; Bocquet and Brossard 2007; Bocquet et al. 2007;

Hollenstein and Woerter 2008; Martins and Oliveira 2008; Al-Gharbi and Ashrafi 2010) found a negative or statistically insignificant relationship between size of the firm and the adoption of ICT.

In the case of developed countries, most of the studies found size of the firm to have a positive effect on ICT and technological investments. Ramdani et al. (2013) explored the determinants of enterprise applications of small and medium enterprises (SMEs) in England. The study using partial least squares techniques found that the size of the firm positively determined the adoption of enterprise applications. The study suggested that larger firms have enormous resource, skills and the ability to manage failures than smaller firms, and hence, larger firms invest more in ICT. Thus, the above studies suggest that larger firms enjoy economies of scale, have access to the capital market, and can absorb risks related to ICT investment. This in turn, allow larger firms to invest more in ICT. Similar results were found by Oyelere et al. (2003) in the case of New Zealand; by Arvanitis and Ley (2013) in the case of Switzerland, and by Panayiotou and Katimertzoglou (2015) in the case of Greece.

However, in the case of developing countries, the effect of size on ICT investments is not clear. For example, Lal (1999) analysed the determinants of information technology adoption in electrical and electronic goods manufacturing firms in India. The study used the ordered probit model and found that firm size had a positive impact on information technology adoption. The study suggested that larger firms invested higher in information technology due to their sufficient resources, which aided larger firms in employing more skilled personnel to use ICT. On other hand, more recent studies in the context of other developing countries did not find a positive relationship between size of the firm and adoption of ICT. For example, Jeon et al. (2006) studied the factors that influence the adoption of e-business by SMEs in Korea. The result of the study found that there was no significant difference in business size between adopters and non-adopters of e-business. The study concluded that business size does not seem to play a significant role in e-business adoption by SMEs in Korea. Similarly, Al-Gharbi and Ashrafi (2010) examined the factors determining the internet adoption by private sector organizations in Oman. The result of the study found that there was no correlation between organization size and internet adoption.

The study observed that one-third of the large firms had not adopted the internet in their business. Thus, the study concluded that there is no direct relationship between size of the organization and internet use.

Thus, the results concerning the relationship between the size of the firm and ICT adoption are not conclusive. However, based on the argument by Penrose (2009) and the result found by Lal (1999) in the context of India, it is likely that larger firms, due to their size advantage, are more likely to invest in new ICTs. Hence, it is hypothesized that,

RO1-H4: Size of the firm has a positive impact on the ICT investment intensity of food processing firms.

2.3.1.5 Liquidity

It is predicted under the theory of financing that there is a positive relationship between a firm's investment expenditure and internal cash flow. That means an increase in internal cash flows leads to more savings on external financial expenses, and thereby, increases the firms' investment expenditure (Lee and Choi 2015). Liquidity indicates the ability of a firm to meet its current obligations. It is prerequisite for the survival of every business firm (Khan and Jain 2005). It further shows the relationship between cash and other current assets to its current liabilities (Brigham and Houston 2015). The more liquid firms are the ones that can make better investment decisions and take the risks associated with any new investment (Mansfield 1963). The firms operating in an imperfect market find external funds more expensive and hence, their investment decisions are sensitive to the availability of internal funds (Cleary 1999, Aggarwal and Zong 2002, Gupta and Mahakud 2019). Further, a fall in internal cash flows results in low investment and delays further investment in the future (Boyle and Guthrie 2003). The study by Mansfield (1963) found a positive impact of liquidity on intra-firm diffusion of new process technologies. Similarly, Cleary (1999) found a positive and significant coefficient for liquidity, which suggested that firm investment decisions are sensitive to the availability of internal funds.

The study by Aggarwal and Zong (2002) examined the relationship between internal cash flows and investment decisions of firms in the U.S. and found that the investment decisions of the firms are positively related to the internal cash flows of the firms. Similarly, a recent study by Gupta and Mahakud (2019) in the case of India also found a positive impact of cash flows on investment decisions of manufacturing firms in India.

A study by Crisostomo et al. (2011) found that liquidity plays a vital role in the firm's innovation in Brazil. Similarly, in a study related to technological investments by Lee and Choi (2015) stated that securing liquidity from profits earned by the firm can be considered as direct sources for R&D investments. The authors stated that greater liquidity implies that the company has enough cash to make ongoing R&D investments.

Thus, liquidity can indeed play a significant role in firms' investment decisions. According to Canepa and Stoneman (2005), although there is growing emphasis upon the importance of financial factors and constraints in the field of investment and R&D, the role of liquidity has been neglected in the field of diffusion research. Thus, the present study tries to examine the impact of liquidity as one of the factors influencing ICT adoption at the firm level. Hence, based on the previous studies, it is hypothesized that,

RO1-H5: Liquidity has a positive impact on the ICT investment intensity of food processing firms.

2.3.1.6 International Exposure

Growth by international expansion is one of the important strategic options for both small and large business firms (Lu and Beamish 2001). International expansion in the form of import and export is essential for business firms, since it enhances the relationship between the firm and its stakeholders. This relationship can further be strengthened by adopting ICT technologies for effective communication with the firms' global suppliers and customers. The study by Kyobe (2011) noted that exposure to the international market enables the transfer of knowledge and

technology. A firm's connection with the external world can reduce costs, expand the speed of their connection, and disseminate the information of emerging technologies. The study found that exposure to international environment was one of the critical determinants that influenced ICT adoption in South Africa.

Since the use of ICT allows for cost-efficient way to maintain and develop long-term relationship with international markets and thereby, reduces barriers to international market (Moen et al. 2008), firms that are intending for international exposure are more likely to use ICT in their business. The study by Winklhofer et al. (2007) examined the drivers of website sophistication of SMEs exporters and found that export diversity is one of the significant drivers of firms' website sophistication.

ICTs like the internet and electronic commerce have become increasingly diffused globally and thereby, bring countries together into a global networked economy (Gibbs and Kraemer 2004). The study by Kraemer et al. (2005) and Fatima (2017) confirmed that globalization and international activities like export and import are crucial drivers to adopt and transfer technology. Therefore, based on these studies, the present study also introduced variable related to international exposure with the idea that the variable will have favourable impact on ICT adoption even in the case of food processing firms in India. Hence, it is hypothesized that,

RO1-H6: International exposure has a positive impact on the ICT investment intensity of food processing firms.

2.3.1.7 Government Intervention

Government institutions are considered as dominant institutional forces for innovation adoption (Teo et al. 1997). Government regulations are obligatory legal restrictions introduced and imposed by the Government to outline the market environment and to control the behaviour of concerned actors (Blind et al. 2017). However, these government regulations can either benefit or harm the adoption of technology.

Historically, government intervention is considered as an important factor in improving economic growth and promoting the diffusion of technological innovations (Scupola 2006). The study by Xu et al. (2004) asserts that government intervention is

important for many developing countries since the markets of these countries are characterized by information asymmetry and immature institutional structure. In such economies, government intervention in the form of supportive business and tax laws accelerate the adoption of technologies, including ICT like internet and e-business. Studies such as Scupola (2003), Xu et al. (2004), Seyal et al. (2007), and Zhang et al. (2007) examined the impact of government intervention in the form of regulations, and support and incentives on the adoption of ICTs and found that government intervention plays a significant role in business firms' adoption of information technology.

However, there are studies that argue that government regulations can create a barrier to innovation by increasing the uncertainty and costs of the development processes.[12] The study by Hall and Bagchi-Sen (2002) found that government regulatory process is the most significant barrier for a firm's technological innovation. D'Este et al. (2012) examined the barriers to innovation in the case of UK enterprises and similarly found that regulation is one of the barriers that hampered innovation in firms. According to AlBar and Hoque (2017), a firm operating in an environment restrained by government policies and regulations may have low rate of ICT adoption. In India, around 68% of small firms and 75% medium firms considered following government policies and regulation as a barrier to innovation (Pachouri and Sharma 2016). Further, high costs associated with meeting a large number of regulations affected the innovation capacity of firms in India (Pachouri and Sharma 2016).

In the present study, government intervention was represented by the firms' manufacturing sugar in India. The Indian sugar industry is the second-largest producer as well as largest consumer of sugar in the world. The sugar industry in India is highly intervened and regulated by the Government, at both Federal and State levels, to maintain self-sufficiency and to protect sugarcane producers and consumers (OECD 2007). India's sugar industry is the most highly regulated industry sector in the world (Gudoshnikov et al. 2004) as well as in India (Policepatil 2018). The intervention and regulation is throughout the supply chain, starting from sugarcane to the end product (Policepatil 2018). Hence, due to these reasons, the present study considers the sugar

[12] https://www.oecd.org/sti/inno/2102514.pdf

manufacturing firms as a suitable proxy to measure government intervention impact on investment in ICT.

The impact of government intervention on the adoption of ICT has not been much explored. Hence, there is no conclusive result with regard to the same. Thus, government intervention may have either a positive or a negative impact on food processing firms' investment in ICT. Hence, it is hypothesized that,

RO1-H7: Government intervention has a statistically significant impact on the ICT investment intensity of food processing firms.

The sign on the coefficient will indicate whether the effect is positive or negative in the present study.

2.3.2 Impact of ICT and Other Factors on Firm Performance

Due to limited literature on the effect of ICT on export performance, the following section gives an overview of the literature where ICT is considered as a factor affecting firm performance in general. In the subsequent sections, literature reviews on other factors that determine export performance are presented.

2.3.2.1 ICT Impact on Firm Performance

ICT is one of the strategic resources that business firms need to invest in to become more innovative and sustain the growth of the firm. Adoption of information technology helps the firms to reduce the cost of production and labour by adding value to the products and services offered by the firms (Nguyen 2009). The use of information technology improves not only the growth, but also enhances survival, innovative capabilities, and competitive ability of the firm (Higon 2011; Nguyen et al. 2013). There are some studies (Chowdhury 2006; Esselaar et al. 2007; Higon 2011; Bayo-Moriones et al. 2013; Piget, and Kossai 2013; Setiowati et al. 2015) that have examined the role and impact of ICT on the growth and performance of SMEs. Chowdhury (2006) found that the adoption of ICT helped SMEs to increase their market share. According to it, ICT acts as a substitute for other forms of capital and labour investments for the firms and thereby, generates high returns for the SMEs.

Esselaar et al. (2007) noted that ICT is one of the inputs that have increased the productivity of SMEs in thirteen African countries.

In the case of UK SMEs, Higon (2011) noted that ICT mainly acted as a cost-reducing and efficiency-enhancing technology. The adoption of ICT enhanced product and process innovations in the firms and thereby, improved the performance of SMEs. More recently, Bayo-Moriones et al. (2013) studied the effect of ICT use on the performance of Spanish manufacturing SMEs. The study showed that the use of ICT had improved the SMEs performance by enhancing the firms' internal and external communication.

In the case of developing countries, there are some studies that have explored the effect of ICT adoption on the performance of SMEs. For example, Piget and Kossai (2013) examined the relationship between the use of ICT and firm performance in Tunisia's electrical and electronic manufacturing industry. The study found statistically significant impact of ICT on the economic performance of Tunisia's firms. Hence, the study suggested that the use of ICT can have a positive impact on the performance of SMEs in developing countries. Setiowati et al. (2015) examined the relationship between ICT use and the performance of Indonesian firms. The study found that the use of ICT helped the firms to reach new customers and provided SMEs with low-cost infrastructure to grow their businesses. The study found a positive relationship between the use of ICT and the performance of SMEs.

With regards to competing in the international market, it is not easy for many firms since they have to understand and cater to the tastes and preferences of diverse consumers. According to Avgerou (1998), the use of information and communication technology (ICT) can help firms to eliminate time and distance barriers among the countries by creating a global link. ICT can be used to get timely information and to make the business processes more efficient, innovative, and internationally competitive.

More recently, Bianchi and Mathews (2016) found that internet marketing capabilities positively influence the availability of information and improve international business relationships, thereby improving the export performance of firms in Chile. In another

study, Hagsten and Kotnik (2017) investigated the role of ICT on the export activities of small and medium firms in the context of twelve European countries for a period from 2001 to 2010. The study found a significant and positive impact of ICT on the export activities of the firms. The results of the study showed that the presence of its own website influenced the firm's decision to export.

Exporters in developing economies generally face more challenges compared with exporters in developed countries due to poor technological infrastructure, limited resources, and inadequate global exposure in the country of production (Racela and Thoumrungroje, 2019). Therefore, investments in ICT can play an important role in transcending these challenges and can have a significant influence on the export performance of firms. Hence, it is hypothesized that,

RO2-H1: ICT investment intensity has a positive impact on the export intensity of food processing firms.

2.3.2.2 Age of the Firm

The age of the firm, as mentioned earlier, represents the experience and knowledge gained by the firms. As the firms get older and older, they learn about their abilities and how to do things better (Capasso et al. 2015). Older firms can make better decisions during hard phases since they get the chance to learn from their past experiences. The knowledge gained from experience can be used as a source of retrievable routines by the firms (Galavotti et al. 2016). Experience enhances the firm's knowledge base and capability, and this allows a firm to carry out its business activities smoothly.

Older business firms' can understand better both the domestic and foreign markets due to their continued presence in the business for many years. This, in turn, helps older firms to understand the demands of their customers better and produce products to fulfil the same. Kowtha and Choon (2001) noted that as the firm acquires experience, it develops better business practices and becomes more sophisticated in business operations. The empirical studies by Kim and Hemmert (2016), Krammer et al.

(2018), and Pattnaik and Elango (2009) found a positive and significant influence of the age of the firm on export performance.

However, the age of the firm may sometimes have a negative effect on the firm's performance. Since older firms have developed their managerial routines long ago, they often lack flexibility or openness to new knowledge produced from the external business environment (Love et al. 2016). The studies by Love et al. (2016) and Paeleman et al. (2017) found a negative effect of the age of the firm on export performance, indicating that younger firms are more export intensive than older ones. Some other studies found a statistically insignificant relationship between the age of the firm and export performance (Mavrogiannis et al. 2008; Maurel 2009).

In the present, based on the findings of the latest empirical studies in the context of developing countries (e.g., Krammer et al. 2018 in the case of Brazil, Russia, India, and China), age of the firms is expected to have a positive impact on the firms' export performance. Hence, it is hypothesized that,

RO2-H2: Age of the firm has a positive impact on the export intensity of food processing firms.

2.3.2.3 Size of the Firm

Size of the firm is one of the important determinants of a firm's export performance. It is believed that firms' size should be larger to become a successful exporter in the global market (Sterlacchini 2001). Larger firms generally have higher export due to their large economies of scale, and easy access to financial and human capital required for exporting. Further, they also have a greater capacity to manage the risks associated with exporting (Wagner, 1995; Lal 2004; Pla-Barber and Alegre 2007).

Singh (2009) noted that export operations include many fixed costs related to market research, redesigning products for global customers, and developing a committed team to manage export activities. Thus, a larger firm can comfortably spend on these fixed costs compared with smaller firms. Further, larger firms can allocate more resources to collect information about the international market and to cover conflicts of foreign markets compared with smaller firms (Singh 2009). According to

Srinivasan and Archana (2011), larger firms can easily spend on entry costs of foreign markets and have less marginal costs, which in turn increase the firm's likelihood of exporting. There are a number of studies that have examined the relationship between firm size and export performance (Wagner 1995; Lal 2004; Majocchi et al. 2005; Senturk and Erdem 2008; Maurel 2009; Singh 2009; Iyer 2010; Kim and Hemmert 2016; Krammer et al. 2018; Paeleman et al. 2017).

Most of the earlier studies have found a positive impact of firm size on export performance. For example, Srinivasan and Archana (2011) examined the determinants of a firm's decision to export in the context of Indian manufacturing firms. The study, that utilized the Probit model, Logit model, and Tobit model, found that firm size had a positive and significant impact on a firm's decision to export as well as on a firm's propensity to export. The study suggested that economy of scale is vital to overcome the initial fixed cost barriers related to collecting information or expenses on marketing activities. Hence, larger firms can export more than smaller firms.

In contrast, some studies found a negative (Iyer 2010) or weak or statistically insignificant impact of firm's size on export performance (Siddharthan and Nollen 2004; Ayan and Percin 2005; Pla-Barber and Alegre 2007; Mavrogiannis et al. 2008). However, based on the findings of most of the previous studies and the findings of Srinivasan and Archana (2011) in the context of India, the present study expects a positive impact of firm size on the export performance of firms. Hence, it is hypothesized that,

RO2-H3: Size of the firm has a positive impact on the export intensity of food processing firms.

2.3.2.4 Capital-Labour Ratio

Capital and labour are the two essential factors that influence the success and growth of any manufacturing firm. The term 'capital-labour ratio' represents the firm's nature of production technique. Empirical studies by Lubatkin and Chatterjee (1994), Athukorala et al. (1995), and Ozcelik and Taymaz (2004) found capital intensity to be important in determining the performance of the firms. Capital intensive firms can

reduce their business risk during economic downturns by avoiding further investment in capital (Lubatkin and Chatterjee 1994). This, in turn, helps firms to avoid additional investment in capital and improves business performance.

In the RBV perspective, human capital/labour and their skills are considered a valuable and not easily imitable resource that leads to increased competitive advantages for a firm. Wright et al. (2001) stated that a highly skilled and motivated workforce has more significant potential to constitute a source of competitive advantage. The uncertainty posed by foreign markets necessitates specialized knowledge and experience of labours (Pucar 2012). The study by Pinho and Martins (2010) noted that a lack of qualified personnel is one of the barriers that hinder a firm's export performance. Cerrato and Piva (2012) stated in their study that human resources possess characteristics of resources that are rare, valuable, and difficult to imitate and substitute. Thus, the adoption of labour-intensive production techniques can give a competitive advantage to a firm desirous of capturing the overseas market. Many of the empirical studies have found a positive relationship between human capital and export performance (Chuang 2000; Cerrato and Piva 2012; Pucar 2012).

The suitability of capital-intensive technique and labour-intensive technique in the context of developing countries is debatable (Stewart, 1972). As mentioned earlier, the food processing sector in India is one of the important sectors in terms of employment generation. Further, since India has abundant labour, firms located in India may have a competitive advantage in terms of costs over other global firms if they adopt labour-intensive technologies (Kumar and Siddharthan 1994). Accordingly, one can argue that firms in the food processing industry in India that invest relatively more on plant and machinery may be at a disadvantage in terms of cost in the export market. Hence, it is hypothesized that,

RO2-H4: Capital-labour ratio has a negative impact on the export intensity of food processing firms.

2.3.2.5 Affiliation

A firm that belongs to a conglomerate (also known as a business house in India) or is a subsidiary of a multinational firm can have extra advantage due to access to resources and knowledge of the parent or other firms in the business house. Firms that are affiliated can also take advantage of the brand names and build contact with customers and suppliers of the affiliates (Bhat and Narayanan 2009). The political connection of affiliated firms facilitates superior access to capital, information, and policies, which in turn allows affiliated firms to undertake timely adaptation (Schneider 2008). The business groups help their affiliated firms to reduce transaction costs and improve market performance by overcoming market imperfections by economies of scale and scope across their different units (Chang and Choi 1988). The firm which is affiliated to a multinational or foreign firm can access superior technical, managerial, and financial resources from their multinational parent firms, which can help them to achieve better performance (Douma 2006). From the RBV perspective also, it can be argued that firms that are affiliated get an opportunity to access the superior and inimitable resources from their parents that aids in improving the performance of the subsidiary firms.

Research studies based on the institutional void (IV) perspective and the entrenchment/exploitation (EE) perspective believe that affiliated firms may behave either as “paragons” or as “parasites” depending on the country, business group, and time period (Khanna and Yafeh, 2007; Carney et al., 2018). In the case of paragons, the affiliated firm is an efficient organization that rises above the hurdles posed by weak infrastructure in terms of communication, trade, contract enforcement, and information disclosure by availing appropriate resources and capabilities from the group (Chang and Choi, 1988; and Khanna and Rivkin, 2001). As paragons, the affiliated firms develop proprietary organizational and technological capabilities and use the networks of their parent firms to compete efficiently in global markets (Carney et al., 2018). Institutions and contract-enforcing mechanisms in developing countries are often weak, which results in high transaction costs. To reduce these transaction costs, affiliated firms enter the global market by affiliating themselves with a larger organization. Further, due to their greater access to parent firms’

financial resources, skilled labour, information about the foreign market, and links with multinational enterprises, affiliated firms are more likely to focus on the export market (Castellacci, 2015).

In the case of parasites, the affiliated firm exploits the group's political powers and relationships to entrench itself (Castellacci, 2015). In parasite groups, the profits earned by affiliates are diverted to their parent firm instead of being reinvested in the affiliated firms. This makes parasite affiliates less export oriented, as they do not develop export capabilities and are not incentivized to invest internationally (Carney et al., 2018). Thus, parasite affiliates tend to focus more on domestic markets due to their strong domestic political and social relations (Castellacci, 2015).

Affiliated firms are likely to flourish in countries like India, Israel, South Africa, and Turkey, where the state of institutional development is intermediate (Carney et al., 2018). These countries often lack efficient institutions and perfect markets for capital, labour, and products. Moreover, studies that have examined the impact of firm's affiliation on its export performance in developing countries have found the impact to be positive and statistically significant (Rasiah, 2003; Yi, 2014; Nguyen and Almodovar, 2018; Tajeddin and Carney, 2018). Hence, based on the findings of previous studies it is hypothesized that,

RO2-H5: Affiliation has a positive impact on the export intensity of food processing firms.

2.2.2.6 Government Intervention

Government intervention in the form of support, assistance, and regulations and policies either may boost or hinder the export performance of firms. The government plays an important role in enhancing export competence of the firms by helping them with their internal production process and providing necessary information about the international market (Mazumder 2012). The government also plays a vital role in shaping the internationalization strategies and behaviours of business firms (Angulo-Ruiz et al. 2018). Further, government intervention in the form of regulations and financial support help the firms to regularly export (Francis and Collins-Dodd 2004).

There are some studies that have examined the effects of government intervention in the form of export promotion programmes and found a positive impact of the intervention on the firm's export performance (Gencturk and Kotabe 2001; Francis and Collins-Dodd 2004; Shamsuddoha et al. 2009; Quaye et al. 2017).

Government intervention may also have an adverse effect on a business firm's performance. Again, the government regulations depend on the political scenario of a particular economy and this can be one of the drawbacks for the development of the economy and industry sectors. Further, government regulations such as taxes often discourage firms to invest, which in turn reduces the production of goods and services. Thus, government intervention in the form of various regulations can also hamper a firm's performance.

As mentioned earlier, the variable 'government intervention' in the present study is represented by firms that manufacture sugar. Although India is one of the largest producers of sugar, India's share in the international market is low compared with other countries like Brazil and Thailand. The global share of India's sugar was just 4.9 per cent in TE2015-16, which is less than the 44.4 per cent and 14.5 per cent of Brazil and Thailand, respectively.[13] One of the reasons for the low level of sugar export is high domestic demand with occasional fluctuations in sugar production (Solomon 2014).

Again, as mentioned earlier, the sugar industry in India is highly regulated and controlled by the government. The export and import of sugar in India depends on domestic availability, demand, and price. Further, international policies such as export ban, financial aids for exporting firms, and import duties vary depending upon domestic demand and supply circumstances. This, in turn, makes it difficult for sugar manufacturing firms to keep a long-term relationship in the global market.[14] Due to these reasons, a firm belonging to the sugar industry may hesitate to enter the export market.

[13] https://cacp.dacnet.nic.in/ViewReports.aspx?Input=2&PageId=41&KeyId=595
[14] https://cacp.dacnet.nic.in/ViewReports.aspx?Input=2&PageId=41&KeyId=595

Thus, government intervention may boost or hinder the export performance of business firms. There are not many studies that have explored the relationship between government intervention and export performance of firms. Thus, the impact of such government interventions on the export performance of food processing firms in the case of developing countries like India is still unclear. Hence it is hypothesized that,

RO2-H6: Government intervention has a statistically significant impact on the export intensity of food processing firms.

The sign on the coefficient of the variable will indicate whether the interventions are favourable or unfavourable to the export performance of the firms in the present study.

2.3.2.7 Research and Development Intensity

According to the endogenous growth theory (Romer 1990), innovation is the primary source of productivity growth. Knowledge-based view (KBV) states that knowledge is a unique resource that is heterogeneous between firms (Grant 1996). Based on KBV and RBV theories, investment in R&D activities can be considered as one of the valuable and inimitable resources as it leads to innovations and develops knowledge capabilities in the firm (Somaya et al. 2007). R&D related activities are intangible and thus, difficult to replicate. This, in turn, gives a competitive advantage to the firm and leads to improvements in the firm's performance (Lome et al. 2016). Innovations through R&D can improve a firm's market position through the introduction of new products or improvements in the firm's existing product range (Roper and Love 2002; Wang 2014). A firm's R&D activities with higher absorptive capacity can not only reduce entry barriers into export markets, but can also improve further export performance (Harris and Li, 2009). Manufacturing firms often invest in R&D activities to become internationally competitive (Parameswaran 2009). Studies by Roper and Love (2002), Bhaduri and Ray (2004), Goldar (2013), and Tyagi and Nauriyal (2017) found a positive association between a firm's R&D investment and export performance. Hence, based on the KBV and RBV perspectives and the findings of many earlier studies, it is hypothesized that,

RO2-H7: Research and development intensity has a positive impact on the export intensity of food processing firms.

2.3.2.8 Import of Raw Material Intensity

The quality of finished products is vital for firms to export more successfully. The import of raw materials of international quality is one source for firms to enhance the quality of their final products. The import intensity improves the export capacity of the firm by importing inputs at low costs and of superior quality, especially when not available in the domestic market (Paul 2014). Firms can produce superior quality products using imported raw materials, which helps them to compete in markets where customers are more quality conscious (Aggarwal 2002). The import of raw materials considered to be embedded with the latest technologies and modern designs helps firms to enhance their production processes and to produce quality products that suit the global market (Vyas et al. 2013).

Some studies have examined the impact of the import of raw materials on export performance (Kumar and Siddharthan 1994; Aggarwal 2002; Bhaduri and Ray 2004; Bhat and Narayanan 2009). These studies have found that the import of raw material impacts export performance positively. For example, the study by Aggarwal (2002) examined the export performance of Indian manufacturing firms using fixed and random effects Tobit model and found that the import of raw material has a positive and significant impact on the export of the firms. The study stated that the import of raw materials from the cheapest possible sources facilitated the firms to achieve cost competitiveness at acceptable quality levels, which in turn enhanced the export intensity of the firms.

Another study by Bhaduri and Ray (2004) examined the impact of technological capability on export performance of two R&D intensive industries, namely, the pharmaceutical and electronics industry in the context of India. The result of the study showed that the import of raw material had a positive impact on export performance of firms belonging to the pharmaceutical industry. The study suggested that the import of high-quality raw materials helped the firms to penetrate quality sensitive markets of the West. Similarly, Bhat and Narayanan (2009) examined the

determinants of export behaviour of firms belonging to the basic chemical industry in India. The study, using the Tobit regression model, found that the import of raw material determined positively both the decision to export and the export intensity of the firms. Hence, based on these findings in the context of India (Bhaduri and Ray 2004; Bhat and Narayanan 2009), it is hypothesized that,

RO2-H8: Import of raw material intensity has a positive impact on the export intensity of food processing firms.

2.3.3 Interactive Variables

The present study also introduced select interactive variables to explore the impact of interactions between two variables on the export performance of food processing firms. Accordingly, the variables *affiliation and government regulation* were interacted with the main variable of interest, that is, *ICT investment intensity*. This helps in understanding the influence of an affiliated firm's ICT investment and government regulated firm's ICT investment on export performance. Similarly, the third interactive variable between *research and development intensity* and *import of raw material intensity* was introduced to understand the impact of import and adapt technology (IAT) strategy in determining the export performance of food processing firms.

2.3.3.1 Affiliated Firm's ICT Investment and Export Performance

The stewardship theory[15] states that managers act like stewards, who are not influenced by individual goals, but act as agents to accomplish organizational goals such as sales and profitability. In other words, a steward (manager) protects and maximizes the shareholders' wealth by enhancing the firm's performance, instead of exploiting the firm for personal gain (Davis et al. 1997). It has been observed that the managers of most of the business group affiliates in India exhibit this feature (Komera et al. 2018). Hence, the managers in affiliated firms are more likely to undertake risky technological investments like investment in ICT that has the potential to enhance business efficiency and thereby, improve the firm's overall performance. Further,

[15] Refer to Davis et al. (1997) for more details on stewardship theory.

affiliated firms have access to financial and other kinds of support from the members of their business groups during periods of distress (Komera et al. 2018), which reduces the risks they undertake. The investment in ICT involves huge investments and risks that all firms cannot afford, especially those operating in developing countries. However, a firm's affiliation with business groups and foreign companies make it easier for these firms to invest in ICT related activities due to their access to necessary funds and technological resources. Thus, the present study believes that affiliated firms that invest in ICT are able to efficiently cater to the needs of the global market, thereby enhancing their export performance. Hence, it is hypothesized that,

RO2-H9: Affiliated firms' ICT investment intensity has a positive impact on the export intensity of food processing firms.

2.3.3.2 Government Intervened Firm's ICT Investment and Export Performance

As explained earlier, government intervention can enable or impede a firm's investment in ICT. As such, government intervention is considered to be important in the adoption of technology like ICT. There are studies that have found government intervention to be important in the adoption of ICT (Scupola 2003; Xu et al. 2004; Seyal et al. 2007). However, the protective regulation may block investments on technological activities since such regulations create an impression that there is no need to be innovative. Further, government regulations are traditionally considered to be an expensive burden that control firms and increase their costs (Van Den Bosch and De Man 1994).

In the present study, the interactive variable between government intervention and ICT intensity is introduced to explore the impact of ICT investment by government intervened firms on the export performance of those firms in the case of food processing industry in India. Hence, it is hypothesized that,

RO2-H10: Government intervened firm's ICT investment has a statistically significant impact on the export intensity of food processing firms.

The sign on the coefficient of the variable would indicate whether the ICT investment of the government intervened firms is favourable or unfavourable to the export performance of the firms in the present study.

2.3.3.3 Import and Adapt Technology Strategy and Export Performance

Import and adapt technology strategy is usually used by firms in developing countries like India (Katrak 1989). The firms in many developing countries import technology and modify them to suit the home country's resources and other conditions (Siddharthan 1992; Narayanan and Bhat 2009). IAT refers to importing of technology and performing R&D to locate, adapt, assimilate, and develop imported technology within the firm's business processes (Narayanan and Bhat 2009). Firms in developing countries have great potential to import and adapt technologies of industrialized countries, which in turn provides competitive advantage to these firms in the global market (Urban and Heydenrych 2015). There is evidence that imported technology can be complementary to the indigenous efforts of the firms in developing countries, which is also favourable for their export performance (Brem and Wolfram). Thus, firms in developing countries seem to import technology from advanced countries to improve their business performance. Hence, it is hypothesized that,

RO2-H11: Import and adapt technology strategy has a positive impact on the export intensity of food processing firms.

2.3.4 Literature Review Support for Research Objective 3

This section gives an overview of the studies that have explicitly used the TOE framework to understand technology adoption in firms. In particular, this section elaborates on the studies that have considered specific components of the technology, and the organizational and environmental contexts of the TOE framework (please refer to Figure 2.4 on page 22).

2.2.4.1 Perceived Relative Advantage

Perceived relative advantage is the degree to which technology adoption is perceived to afford more significant benefits for the firm (Gutierrez et al. 2015). It also indicates

beliefs on obtaining benefits by adopting the technology (Ahmad et al. 2015). It is noted that the adoption of technology like ICT is likely to be more when ICT usage is perceived to provide relative advantages over the organization's current practices (Ramdani et al. 2013). The benefits typically associated with ICT adoption are increase of revenue and profits, improvement in business processes, improvement in growth, reduction in business operating and administrative costs, improvement in customer services, development of new market segments, and the streamline of business operations (Ramdani et al. 2013; Ahmad et al. 2015). Thus, a firm is likely to adopt technology if it believes that the benefits of adoption outweigh the risks. Some of the earlier studies have found that perceived relative advantage is one of the significant factors in determining adoption of ICT and its related technologies (Gibbs and Kraemer 2004; Zhu et al. 2006; Ramdani et al. 2009; Ghobakhloo et al. 2011; Ifinedo 2011; Low et al. 2011; Al-Jabri and Sohail 2012; Ramdani et al. 2013; Oliveira et al. 2014; Admad et al. 2015; Rahayu and Day 2015; Safari et al. 2015; Setiowati et al. 2015; Awa et al. 2016; AlBar and Hoque 2017; Ilin et al. 2017). However, the study by Gutierrez et al. (2015) and Wang et al. (2010) has found that there is no significant impact of relative advantage in the adoption of technology.

2.2.4.2 Perceived Compatibility

Compatibility is the degree to which technology adoption is consistent with a firm's existing values, beliefs, past experiences, needs of potential adopters, previously introduced ideas, and clients' needs for the innovation. The more compatible is the technology the less uncertain it is to the potential adopters and fits more closely with the firm's situations (Rogers 2003). The chance of benefiting from new technology adoption is high when it is easier for the firm to integrate new technology with its existing systems (Leung et al. 2015). The adoption of new technology can bring in essential changes in the firm's work practices, and thus changes must be compatible with the infrastructure, values, and beliefs (Ramdani et al. 2013). If the new technology is incompatible, significant adjustments in the existing processes and significant learning would be required to adopt the technology successfully (Low et al. 2011). Thus, firms are more likely to adopt new technology if the technology is identified as compatible with the infrastructure and the working processes of the firm.

There are some studies that have found a significant impact of compatibility on the adoption of ICT technologies (Zhu et al. 2006; Wang et al. 2010; Ghobakhloo et al. 2011; Al-Jabri and Sohail 2012; Ramdani et al. 2013; Admad et al. 2015; Safari et al. 2015; Setiowati et al. 2015). However, some other studies have found no significant relationship between compatibility and technology adoption (Ramdani et al. 2009; Low et al. 2011; Thiesse et al. 2011; Oliveira et al. 2014; Gutierrez et al. 2015; Rahayu and Day 2015; AlBar and Hoque 2017).

2.2.4.3 Perceived Complexity

Complexity is the degree to which firms perceive that the adoption of technology would be complicated to understand and use. The innovations that are easy to understand and use are adopted more quickly than the innovation that demands the adopter to develop new skills and knowledge (Rogers 2003). The adoption of new technology is inhibited if it is perceived to be complex by the adopters since complex technologies require the adopter to develop new skills and expertise not readily available within the firm (Rogers 2003; Ifinedo 2011; Oliveira et al. 2014).

According to Rogers (2003), new technology adoption may not be difficult if it is easier for the adopter to understand and use. However, it might have been difficult for the very first adopter of the new technology. Thus, complexity may have a negative impact on ICT adoption if the adopter fails to understand and to develop the required skills and knowledge. Some of the previous studies like Zhu et al. (2006), Wang et al. (2010), Ramdani et al. (2013), Gutierrez et al. (2015), and Setiowati et al. (2015) found a significant impact of complexity on the firm's ICT adoption. However, there are also studies that have found no significant impact of complexity on ICT adoption (Ramdani et al. 2009; Al-Jabri and Sohail 2012; Ghobakhloo et al. 2011; Ifinedo 2011; Low et al. 2011; Thiesse et al. 2011; Oliveira et al. 2014; Admad et al. 2015; Rahayu and Day 2015; Safari et al. 2015; AlBar and Hoque, 2017).

2.2.4.4 Top Management Support

Top management support is found to be one of the best predictors of a firm's technology adoption and plays a critical role in creating a supportive environment for

new technology adoption (Ramdani et al. 2013). If the top management has a positive attitude towards technology adoption, it is more likely to initiate technology-related activities. When the top managers understand the importance of technology like ICT, they play a significant role in motivating other members of the firm to adopt technology and allocate necessary resources to the adoption (Ahmad et al. 2015). The role of top management is vital for technology adoption since the process involves the integration of resources and reengineering of business processes (Low et al. 2011). Thus, firms are more likely to adopt technology when the top management understands the significance of technology and encourages adoption. Some of the prior studies have found that top management support plays a significant role in determining the adoption of ICT (Ramdani et al. 2009; Ifinedo 2011; Low et al. 2011; Thiesse et al. 2011; Ramdani et al. 2013; Yeh et al. 2014; AlBar and Hoque 2017; Ilin et al. 2017). In contrast to these studies, there are some other studies like Wang et al. (2010) and Oliveira et al. (2014) that have found no significant role of top management support in explaining ICT adoption.

2.2.4.5 Organizational Readiness

Organizational readiness is the process of assessing whether the firm has the necessary attributes to ensure organizational readiness towards technology adoption (Chaong et al. 2009). It indicates the organization's internal capability to accept technology adoption. The availability of resources, including finance and personnel, may impact organizational readiness. Leung et al. (2015) noted that there are two dimensions of organizational readiness, namely, financial readiness and technological readiness. Financial readiness indicates the financial resources available to install and implement technology, whereas technological readiness indicates the level of sophistication of technology usage and management in a firm. Azadegan and Teich (2010) stated that organizations that adopt new technology generally have the appropriate structure and culture to introduce innovations, technological capabilities, know-how, and personnel skills to implement and use innovation and sufficient finance to purchase and allocate adequate resources to implement. Studies by Zhu et al. (2004); Chong et al. (2009); Ramdani et al. (2009); Ramdani et al. (2013); and Rahayu and Day (2015) have found a significant impact of organizational readiness in

the adoption of ICT related technologies. However, Ifinedo (2011) and Low et al. (2011) found insignificant impact of organizational readiness on technology adoption.

2.2.4.6 Competitors, Customers, and Suppliers

Firms are often forced to adopt a technology due to pressure exerted by various external forces (Leung et al. 2015). These external forces include competitors and trading partners like suppliers and customers (Khoumbati et al. 2006). Competitive pressure is considered as one of the effective motivator for technology adoption, especially for the adoption of technologies like ICT. The adoption and use of ICT is one of the strategies that help firms to compete in the market (Gangwar et al. 2015). Firms that are facing higher degree of competition tend to invest in ICT so as to gain competitive advantage (Anand and Kulshreshtha 2007). If the firms find their competitors to be using ICT, then they are willing to invest more in technologies to gain competitive advantage over their rivals (Rahayu and Day 2015). Further, firms adopt ICT to tackle rapidly and continuously changing competitive environment (Yeh et al. 2014).

Some of the previous studies have found competitive pressure as one of the important external factors in influencing firms' adoption of ICT (Zhu et al. 2003; Zhu et al. 2006; Oliveira and Martins 2010; Wang et al. 2010; Ghobakhloo et al. 2011; Ifinedo 2011; Low et al. 2011; Ramdani et al. 2013; Yeh et al. 2014; Gutierrez et al. 2015; Safari et al. 2015; Setiowati et al. 2015). Yet, there are some other studies, which have found competitive pressure as not important for adoption of ICT (Pan and Jang 2008; Ramdani et al. 2009; Oliveira et al. 2014; Zhu et al. 2014; Rahayu and Day 2015; AlBar and Hoque 2017).

Similarly, pressure from trade partners such as suppliers and customers can also be one of the external factors that determine a firm's technology adoption. This is especially true when the trade partners of the firms adopt compatible technologies (Anand and Kulshreshtha 2007). The fulfilment of suppliers' and customers' expectations by delivering higher-level electronic services and better communication is the major driver for the firms' technology adoption (Ghobakhloo et al. 2011). There are studies that have found significant impact of trade partners such as customers and

suppliers on the adoption of technology (Beckinsale et al. 2006, Zhu et al. 2006, Oliveira and Martins 2010, Wang et al. 2010, Ghobakhloo et al. 2011, Low et al. 2011, Gutierrez et al. 2015, Safari et al. 2015, Ilin et al. 2017). Thus, firms may adopt ICT to connect efficiently with their trading partners. In contrast, studies by Ifinedo (2011) and Rahayu and Day (2015) found no significant importance of trade partners' pressure on technology adoption.

2.2.4.7 Government Support

Government support represents the assistance provided by the government to business enterprises to adopt ICT. Government supports the firms to adopt ICT by facilitating necessary capital, and introducing supportive regulatory and tax laws (Anand and Kulshreshtha 2007). Government support, policies, and regulations play an important role in technology adoption (Gibbs and Kraemer 2004; Ghobakhloo et al. 2011; Ifinedo 2011; Rahayu and Day 2015). Lack of government supportive regulatory environment can hinder ICT adoption. Further, firms adopt ICT, if the government makes it mandatory to use a particular system or technology (Chau and Jim 2002). Government resource support such as consulting, education and financial support, and government regulatory support like transparency and legal support for the firms to purchase over the internet influences the adoption of ICT (Ilin et al. 2017). Studies by Chau and Hui (2001), Chau and Jim (2002), Gibbs and Kraemer (2004), Thatcher et al. (2006), Safari et al. (2015), AlBar and Hoque (2017), and Ilin et al. (2017) found a significant impact of government support and regulatory environment on the adoption of technologies. However, studies by Chau and Hui (2001), Ifinedo (2011), and Oliveira et al. (2014) found insignificant relationship between government support and ICT related technology adoption.

Summary

Chapter 2 presented an overview of the theoretical background of the study and reviews previous studies relevant to the present study. It provided an overview of the theories/paradigm/framework that is used as theoretical base to conduct the present research study. The chapter reviewed relevant literature related to each research objective of the study. It gave detailed literature review on the factors that determines

the investment or adoption of ICT, impact of investment in ICT, and other factors that affect the performance of firms, particularly the export performance of the firms. Further, the chapter reviewed literature of the studies that have used TOE framework to understand the determinants of ICT adoption. Based on the theoretical background and literature review of the study, the chapter also presented theoretical frameworks for each of the three research objectives of the study.

CHAPTER 3

RESEARCH METHODOLOGY

This chapter explains the research methodology followed in the present study, that is, the processes involved in achieving the research objectives. Specifically, the chapter describes the sample of the study, the process of data collection, and the methods used to clean and analyse the data in order to accomplish the research objectives.

3.1 RESEARCH METHODOLOGY FOR RESEARCH OBJECTIVE 1 AND RESEARCH OBJECTIVE 2

This section explains the process of sample and data collection for the quantitative analysis in the present study. It describes how the variables used in the study are defined, along with the descriptive statistics on these variables. Further, it also describes the econometric method used to analyse the data.

3.1.1 Sampling Frame for the Study

The present study is based on firms belonging to the food processing industry operating in India. The researcher initially tried to get a complete list of the food processing firms operating in India by contacting various relevant government offices and organizations.

The researcher tried to get information about the food processing firms from the Ministry of Food Processing Industry (MOFPI) through the Right to Information (RTI) Act. The MOFPI, in response to the researcher's RTI, responded that it does not maintain any data related to food processing firms operating in India.

The researcher then contacted the All India Food Processors' Association (AIFPA) in Delhi, India. However, since the list had only those food processing firms that are members of AIFPA and not a complete list of food processing firms, there was high possibility of selection bias, if this list was used for the present study.

Hence, the researcher finally decided to use the Prowess database, an electronic database provided by the Centre for Monitoring Indian Economy (CMIE) as the

source of data for quantitative analysis. The Prowess database is widely used in India for various firm level empirical studies (Pradhan 2004; Sahu and Narayanan 2011; Sharma 2012; Shaban and Kavida 2013; Gupta et al. 2015; Sasidharan et al. 2015; Mitra et al. 2016; Mathew 2017; Satpathy et al. 2017; Soni et al. 2017; Ghosh and Roy 2018; Paul and Lal 2020). For example, Gupta et al. (2015) used the Prowess database to get a sample of firms belonging to the Indian IT industry to analyse the determinants of the export performance of firms in the IT industry. The study by Mitra et al. (2016) examined the impact of infrastructure and ICT on total factor productivity (TFP) of Indian manufacturing firms using the data from the Prowess database. Similarly, a more recent study by Paul and Lal (2020) used the data from the Prowess database to understand the impact of technology on employment. Thus, the Prowess database is used extensively in India by various research studies.

The Prowess covers data from 1989 and provides information related to the financial aspects of companies such as annual audited profit and loss statement, balance sheet, prices of shares either from the National Stock Exchange or the Bombay Stock Exchange, and quarterly financial statements of listed companies. It provides information of over 50,000 companies, which are both domestic and foreign companies and Indian listed and unlisted companies operating in India. The company's annual reports, stock exchanges, and regulators are the primary sources of data for the Prowess database. The database covers companies operating in India for which the data is available to CMIE without any restrictions of use. It also updates relevant information continuously.

The data covered by the Prowess is prominent since it includes fairly larger proportions of the businesses conducted in India. It includes companies whose total income is about 82% of India's GDP; the value of the output of all manufacturing companies in Prowess is 73% of the value of the output of the manufacturing sector of India during 2016-17. Further companies in Prowess represent half of India's trade, and the corporate tax paid by these companies is 61% of all taxes paid by the enterprises.[16] Therefore, the Prowess database was considered to be an appropriate

[16] https://prowessiq.cmie.com/kommon/bin/sr.php?kall=wprowstat&sectcode=006&ismore=1#

source to get the secondary data required for the first two objectives of the present study.

3.1.2 Sample for the Study

The list of food processing firms operating in India was extracted from the Prowess database based on the National Industrial Classification (NIC) – 2008. NIC is an important statistical standard that develops and maintains a comparable database based on economic activities. The NIC database is used to classify economically active population, statistics on industrial production and distribution, the different fields of labour, and other economic data such as national income. The accessibility of comparable statistics from diverse sources on many aspects of the economy and usability of such data for economic analysis are fundamental for the standardization of a system of classification. NIC – 2008 is the revised version of NIC – 2004. It is developed based on the International Standard Industrial Classification (ISIC)-rev.4, which is recommended by the United Nations Statistical Commission. NIC – 2008 provides the basis for the standardized collection, analysis, and dissemination of industry-wise economic data for India. Further, NIC – 2008 provides a more contemporary industrial classification system. Hence, NIC is primarily used by government agencies, industry associations, and researchers for various administrative, analytical, and research purposes.[17]

The food processing firms, according to NIC – 2008 classification, are categorized under 'Division 10' named as 'Manufacture of Food Products'. There are mainly eight groups that are at the three-digit level under Division 10. Further, there are multiple sub-groups which are at four and five-digit level under these eight groups at the three-digit level. The Prowess database provides NIC – 2008 codes for the firms in the database. A query was run to extract all those firms that are based on NIC – 2008 Division 10 for the period of seven years from 2012 to 2018. This list consisted of 1509 different food processing firms operating in India.

[17] http://mospi.nic.in/sites/default/files/main_menu/national_industrial_classification/nic_2008_17apr09.pdf

Due to the Great Recession from 2007 to 2008, India's total export declined until the year 2010. India's total export started to recover from the year 2011. Hence, the data used in the present study was extracted from the year 2012, once the effect of recession in the world started to reduce. Again, the data for the year 2019 was not completely updated for these food processing firms, and hence, the data was collected only up to the year 2018. The data related to investment in ICT such as net value on software, communication equipment, and computers and IT systems, expenses on software charges, and IT-enabled services charges was collected to create the ICT related variable. The data that represented firm structure such as year of incorporation, ownership group, sales value, expenses on salaries and wages, and net value on plant and machinery was collected. The data related to firms' technological and internationalization activities such as research and development, import of raw materials, export sales, total forex earnings, and total forex spending was also collected. Finally, the data related to other firm specific information like raw material purchase, investment in total assets and net fixed assets along with NIC code and NIC name for each of the observation was also extracted from the Prowess database for the present study.

Once the necessary data for the period from 2012 to 2018 was extracted from the Prowess database, it was further examined to identify any missing or zero values on aspects generally expected to be non-zero for a firm that is active and in food products manufacturing sector. These aspects are sales, net fixed assets, salaries and wages, plant and machinery net, and raw material purchased. Firms that had missing or zero values on these aspects in any of the seven years of the study period from 2012 to 2018 were dropped from the sample. Accordingly, firms that were inactive and/or in hospitality or food products distribution sectors were eliminated. However, for other investment related aspects such as R&D, export, import of raw material, and likewise, the missing values were assumed to be zero, since it is not necessary that all active firms would invest in these activities.

Subsequently, the study adopted a statistical method called Bacon (blocked adaptive computationally efficient outlier nominators) to detect outliers in the sample. The Bacon method was proposed by Billor, Hadi, and Velleman (2000) and provides an

efficient way to detect outliers in multivariate data. It can identify outliers even in large datasets of tens of thousands of observations. The study used STATA 13.0 version software package to run the Bacon method. The food processing firms that were identified as outliers by the Bacon method were also removed from the sample. Thus, the final balanced sample consisted of 175 food processing firms for the period 2012 to 2018.

3.1.3 Econometric Method for Data Analysis

The study used balanced panel data for seven years. In the panel data, the data was collected on the same cross-sectional unit over time. In other words, panel data refers to "pooling of observations on a cross-section of households, countries, firms, etc. over several time periods" (Baltagi 2005). The importance of micro and macro panel data is increasing in numbers with the availability of such data, and the methods used to deal with panel data are in high demand by practitioners (Baltagi 2015). There are several benefits of using panel data. It controls individual heterogeneity and provides data that is more informative, efficient with high variability, with more degrees of freedom, and less collinear. The panel data allows one to study the dynamics of adjustments and to construct and test more complicated behavioural models than only cross-section and time-series data. Thus, the use of panel data is considered to be appropriate to understand individual behaviour over time (Baltagi 2005).

Many researchers are also trying to model the dynamic nature of the data through specialized econometric models. In the present study, both ICT investments and export intensity can be considered to be dynamic in nature. This means that investment in ICT in the current year may be influenced by the investment in ICT over the past few years. During the initial stage of ICT adoption, the firms generally invest in ICT to manage their administrative tasks. Over a period of time, the firm that has a favourable experience with its ICT investment is more likely to increase investments in ICT. The previous experience related to the adoption of information technology reduces the decision maker's uncertainty about the technology adoption consequences (Makhmudov 2004). Thus, the firm's previous experience related to

investment in ICT may have a positive impact on the present year's investment in ICT.

Similarly, the firm's past experiences in the international market may have a significant impact on the firm's current year export performance. The firm's past experience concerning extra-regional expansion and import activity is significant precursors to the firm's positive export behaviour (Ibeh 2003). It is also argued that international experience can be one of the resources, which is difficult to imitate and can thereby, provide a sustainable competitive advantage to the firm (Oura et al. 2016). Thus, firms that have a positive experience with previous year's export performance are more likely to export more in the present year.

Therefore, the present study tries to explore the effect of a firm's previous year's investment in ICT on the present year's investment in ICT and to examine the impact of a firm's previous year's export performance on the present year's export performance. To examine these effects, the lagged values of the investment in ICT and the lagged values of export performance needs to be introduced as explanatory variables in the relevant econometric models. However, the use of lagged dependent variables in the econometric models can lead to biased results, if ordinary least square regression technique is used as the method of estimation (Alam et al. 2019).

The present study also conducted an endogeneity test to check for the presence of endogeneity problems in the model. Endogeneity refers to the "condition in which an explanatory variable correlates with the error term, or if two error terms correlate when dealing with structural equation modelling" (Ullah et al. 2018; pp. 69). Endogeneity in the model can be present due to common-method variance, measurement errors, omitted variables, and simultaneity. The presence of endogeneity results in inconsistent estimates, which lead to wrong interpretation, ambiguous conclusions, and incorrect theoretical explanation (Ullah et al. 2018). Hence, checking for and addressing endogeneity is important to get consistent estimates.

To detect the presence of endogeneity, the study used the Durbin–Wu–Hausman test, a procedure suggested by Ullah et al. (2018). First, each independent variable is regressed as a dependent variable with all the other independent variables using the

OLS method. To test whether the independent variable is endogenous or exogenous, the independent variable is treated as a dependent variable and regressed with other independent variables. In the second step, the residual is estimated for the independent variable. Then, the residual of the independent variable is included as an independent variable in the main model. If the test statistics of the Durbin–Wu–Hausman test is significant for the independent variable residual, it indicates that the independent variable is an endogenous variable. This procedure was followed for each of the independent variables to test for the presence of endogeneity in the proposed model. It was observed from the Durbin–Wu–Hausman test that majority of the variables in the econometric model were endogenous.

To mitigate the problem of endogeneity and to explore the dynamic nature of ICT and export performance variables, the generalized method of moments based estimation techniques proposed by Arellano and Bond (1991) and Blundell and Bond (1998) were used for the dynamic panel data in the present study. The use of GMM in the context of panel data gives consistent results in the presence of endogeneity. The application of GMM removes the panel data endogeneity by transforming the data internally. In other words, it removes the endogeneity by subtracting the past value of the variable from the present value (Ullah et al. 2018). Further, the use of GMM method also addresses the heteroscedasticity and autocorrelation problem that is likely to be present in the datasets (Alam et al. 2019). According to Baltagi (2011; pp. 98), heteroscedasticity occurs when "the disturbances have a varying variance". In other words, heteroscedasticity represents that the variance of the error term is different for different observations (Andren 2007). Autocorrelation represents "sample or population observations or elements that are related to each other across time, space, or other dimensions" (Losh 2010; pp. 51). Autocorrelation occurs when two or more consecutive error terms are correlated (Verbeek 2008). The following is a general dynamic generalized method of moments model proposed by Arellano and Bond (1991) and Blundell and Bond (1998):

$$y_{it} = \partial y_{i,t-1} + \beta x_{it} + Xn_{it} + \mu_{it} + \varepsilon_{it} \quad (1)$$

Where, y_{it} denotes dependent variable, $y_{i,t-1}$ is one period lag of dependent variable, βx_{it} represents explanatory variables, Xn_{it} denotes control variable, μ_{it} is firm-specific fixed effects, and ε_{it} represents the error term.

The GMM method has two kinds of estimators, namely, difference GMM and system GMM. The difference GMM as proposed by Arellano and Bond (1991) corrects for endogeneity by transforming all the regressors by differencing. The system GMM is proposed by Arellano and Bover (1995) and Blundell and Bond (1998). It corrects for endogeneity by introducing more instruments to dramatically improve efficiency. It transforms the instruments to make them uncorrelated (exogenous) with fixed effects. Further, it develops a system of two equations, that is, the original equation and the transformed equation, and hence, is called as system GMM (Roodman 2009).

Shokr and Al-Gasaymeh (2018; pp.1297) refer to Blundell and Bond (1998) and explain that "the lagged levels are weak instruments for the transformed variables and the difference GMM performs weakly when the dependent variable is close to a random walk. It is because the lagged levels transmit little information about future changes". Due to this issue, Arellano and Bover (1995) and Blundell and Bond (1998) developed system GMM, which combines lagged levels and lagged differences. Further, there are two models of system GMM, namely, one-step system GMM and two-step system GMM. The two-step system GMM is considered to be more efficient than the one-step system GMM since it uses finite sample corrected standard errors that give coefficients with lower bias and standard error (Shokr and Al-Gasaymeh 2018). Also, the two-step system GMM is appropriate when the sample consists of a large number of firms and a shorter time span (Teixeira and Queiros, 2016). Furthermore, the use of two-step GMM avoids unnecessary data loss (Ullah et al. 2018). Therefore, the present study uses the two-step system GMM to analyse the data.

There are some conditions that need to be satisfied in order to justify the use of the GMM method in a study. The first condition is that one has to use the Hansen test to check the overall validity of the instruments. It focuses on whether the instruments are specified correctly and is robust to heteroscedasticity (Alam et al. 2019; Saglam

2018). The null hypothesis of the Hansen test is that the instruments are exogenous. Hence, Hansen's statistics should not reject the null hypothesis. The second condition is to test for second-order autocorrelation AR (2) in the econometric specification. This check is for the second-order serial correlation in the first difference residual. Inability to reject the null hypothesis indicates the absence of second-order autocorrelation (Alam et al. 2019; Saglam 2018). Finally, the number of instruments should not be more than the number of groups (Roodman 2009).

3.1.4 Definition of Variables and Descriptive Statistics for Research Objective 1 and Research Objective 2

The variables used in the present study are presented in Table 1. In the present study, ***ICT*** is defined as the sum of net expenses towards computers and IT systems, software, communication equipment, software charges, and IT-enabled service charges, all in millions of rupees. The variable ***ICTI*** is measured as a ratio of ICT to the firm's sales.

Table 3.1: Variables, Symbols, and Definitions used in the Study

Variables	Symbol	Definition
Information and communication technology investment intensity	***ICTI***	Percentage of ICT as a ratio of sales in a given year
Labour intensity	***LABI***	Percentage of salaries and wages to sales in a given year
Capital intensity	***CAPI***	Percentage of plant and machinery net to sales in a given year
Age of the firm	***AGE***	Year of observation - Age of Incorporation
Size of the firm	***SIZE***	Log of sales in millions of rupees
Liquidity	***LIQUI***	Ratio of quick assets to quick liabilities*
Government intervention	***GI***	GR = 1, if a firm belongs to the NIC code 10721 GR = 0 otherwise

International exposure	***IE***	IE = 1, if a firm has either forex earnings and forex spending in a given year IE = 0 otherwise
Export intensity	***EXPI***	Percentage of exports as a ratio of sales*
Capital-labour ratio	***CAPLAB***	Percentage of plant and machinery net to salaries and wages in a given year
Affiliation	***AFF***	AFF = 1, if a firm is affiliated to either business groups or foreign company AFF = 0 otherwise
Research and development intensity	***RDI***	Percentage of research and development expenses to sales in a given year
Import of raw materials intensity	***IRAWI***	Percentage of import of raw material to sales in a given year
Affiliation and ICTI	***AFF×ICTI***	AFF×ICTI is the interaction between firm's affiliation and ICT investment intensity
Government intervention and ICTI	***GI×ICTI***	GR×ICTI is the interaction between government intervention and ICT investment intensity
Import of raw material intensity and research and development intensity	***IRAWI×RDI***	IRAWI×RDI is the interaction between import of raw material intensity and research and development intensity

Note: *The definitions of these variables are directly taken from the Prowess.

In general, a higher level of expenses on salaries and wages indicates presence of higher proportion of managerial, technical, and skilled employees, who are required to use ICT technologies efficiently (Malhotra and Singh, 2007). Hence, labour intensity is measured as a ratio of salaries and wages to sales. The variable 'international exposure' represents whether the firm is active internationally either through import or export. It is measured as a dummy variable where it takes the value 1, if the firm has either forex earnings or forex spending in a given year and takes 0 otherwise.

Here, total forex earnings show the sum total of earnings of the firm in terms of foreign exchange, and total forex spending indicates the total amount spent by the firm in foreign exchange. The variable capital intensity is measured as a ratio of plant and machinery net to sales. Similarly, the variable capital-labour ratio is measured ratio of plant and machinery net to salaries and wages. The variable liquidity is measured as quick ratio which is directly taken from Prowess database.

The variable government policies/regulation is also measured as a dummy variable where the firm takes the value 1, if it belongs to the NIC code 10721 and takes 0 otherwise. Here, the NIC code 10721 is used as a proxy to measure the impact of government policies/regulations on a firm's investment in ICT. As explained in Chapter 2, firms which are into the manufacturing of sugar in India are highly regulated and controlled by the government. Hence, it is believed that NIC code 10721 seems to be an appropriate proxy to capture the impact of government regulations. The other variables in the study such as age of the firm, size of the firm, affiliation, research and development intensity, and import of raw materials intensity are as per the definitions used in other studies.

The descriptive statistics of the variables used in the study are presented in Table 2 and Table 3 for Research Objective 1 and Research Objective 2, respectively. It can be observed from the table that the average ICT investment intensity (***ICTI***) is just around 0.1 (0.09) per cent for the period 2012 - 2018. It gives the impression that processed food firms in the present study are hardly investing in ICT. However, it is observed from the data that there are firms in the sample that are investing more than Rs. 100 million (in real terms) on ICT in almost every year of the study, for example, Mondelez India Foods Pvt. Ltd., Agro Tech Foods Ltd., Tata Global Beverages Ltd., and Britannia Industries Ltd. are leading firms with more than Rs. 100 million investments (in real terms) on ICT in almost every year of the study.

Table 3.2: Descriptive statistics for Research Objective 1

Variables	**Mean**	**Std. Dev.**	**Minimum**	**Maximum**
ICTI	0.096	0.245	0	3.255

LABI	7.257	10.297	0.088	62.5
CAPI	19.935	22.047	0.079	176.435
AGE	35.206	25.443	1	128
SIZE	7.933	1.566	2.528	12.470
LIQUI	0.491	0.538	0	5.1

Note: Number of observations is 1225. In the present study, around 85% and 37% of food processing firms are internationally exposed and intervened by the government, respectively.

Table 3.3: Descriptive statistics for Research Objective 2

Variables	**Mean**	**Std. Dev.**	**Minimum**	**Maximum**
EXPI	9.671	22.933	0	95.46
ICTI	0.096	0.245	0	3.255
AGE	35.206	25.443	1	128
SIZE	7.933	1.566	2.528	12.470
CAPLAB	625.145	736.184	1.075	5714.109
RDI	0.043	0.122	0	1.194
IRAWI	2.812	10.679	0	106.085

Note: Number of observations is 1225. In the present study, around 61% and 37% of food processing firms are affiliated and intervened by the government, respectively.

It can be observed from Table 3, that the average value of export intensity (***EXPI***) is around 9 per cent, which indicates that most of the food processing firms are operating in the domestic market. The mean age of the firms in this industry is around 35 years. It can be observed from the table that on average, the food processing firms seem to more capital intensive even though they traditionally considered labour-intensive. This indicates that food processing firms seem to be investing more in machinery in order to support their investment in ICT and business operations, and hardly in research and development activities. This explains that food processing firms seem to less innovative in the present study. The firms seem to be importing raw materials than investing more in R&D to manufacture quality food products for their customers.

3.2 RESEARCH METHODOLOGY FOR RESEARCH OBJECTIVE 3

The study uses a qualitative research approach to achieve Research Objective 3. According to Creswell (2014: pp.4), qualitative research "is an approach for exploring and understanding the meaning individuals or groups ascribe to a social or human problem". Qualitative research is used to explore new phenomena and to capture an individual's thoughts, feelings, or interpretations of meaning and process. It allows for a complete exploration of a topic of interest in which information is collected through case studies, ethnographic work, and interviews (Harwell, 2011). Qualitative research is preferred in developing countries where reliable secondary data is often scarce (Mpofu and Watkins-Mathys, 2011). One of the most used qualitative methods in technology management research and information systems studies is the case study method (Apulu et al., 2011; Childe, 2011; Agrifoglio et al., 2017; Cragg and McNamara, 2018). The case study method helps the researcher to obtain a rich understanding of the nature and complexity of the phenomenon in its natural context (Campos et al., 2019) and provides in-depth information about the research topic (Cragg and McNamara, 2018). Thus, the case study method is an in-depth examination of a particular case such as an individual, programme, project, work unit, or several cases (Lichtman 2014). The method is especially useful in circumstances where there is limited amount of research available related to the topic. It allows for face-to-face communication and interaction with the managers and experts of firms and thereby, provides an in-depth insight into the case (Govindan et al., 2017). Since limited studies have examined the determinants of ICT investment of food processing firms in the context of India, case study will allow the researcher to understand in detail the perceptions of owners/managers with regard to ICT usage in food processing firms in a developing country like India to achieve the third objective in the present study.

To get in-depth understanding of the ICT investment in the case firms belonging to the food processing industry, the present study uses the semi-structured interview technique, includes a blend of closed- and open-ended questions along with why and how questions (Adams 2015). The general aim of a semi-structured interview is to obtain systematic information about a set central topic and allows exploration when

new issues or topics emerge. The method is used when there is some knowledge related to topics or issues that are under investigation, but further details are still required (Wilson 2014). The semi-structured interview is the most widely used interviewing method of qualitative research, which takes between thirty minutes to several hours to complete either with an individual or groups (Dicicco-Bloom and Crabtree 2006).

3.2.1 Design of the Questionnaire for Semi-Structured Interview

To guide the interviewer during the semi-structured interview process and to conduct the interviews efficiently, a questionnaire was designed. The questionnaire was prepared by referring to previous studies related to the adoption of ICT and related technologies. The questionnaire was initially given to an expert, who is a software developer, to check the clarity of the questions related to ICT. After incorporating the suggestions of the expert, a pilot study was conducted with some of the food processing firms operating in the Baikampady industrial area and the Yeyyadi industrial area of Mangaluru in Karnataka.

A pilot study is a process of either to trial run a research study or a pre-test of a specific research instrument or procedure. It helps to identify the problems before the main research study, which in turn helps to improve the research process to succeed in the main study. It further helps in determining the suitability of the instruments, data collection procedures, and sample population. In the present study, the pilot study was conducted to ensure the validity of the questionnaire. The details of the pilot study are provided in Chapter 4 of the present study.

Thus, based on the pilot study, the initial questionnaire was further modified and improved for the final research study. The final questionnaire had five sections where Section A and Section B were related to the general information about the company and the types of ICT currently being used in the business operations. Section C was related to the TOE factors that influence investment in ICT. Section D was devoted to understanding the impact of investment in ICT on the firm's export activities. Finally, Section E collected information about the respondents. While, the Sections A, B, and E included both open-ended as well as close-ended questions, Sections C and D

included questions that were framed using the 5- point Likert Scale, where 1 indicated "strongly disagree" and 5 indicated "strongly agree". The detailed questionnaire used to conduct the semi-structured interview is presented in Appendix I.

3.2.2 Location for Final Case Studies

To get a list of food processing firms for the case studies, the researcher visited the Department of Industry and Commerce (DIC), Bengaluru, Karnataka, Registrar of Companies (ROC), Bengaluru, Karnataka, and the Karnataka Udyog Mitra (KUM) offices, Bengaluru, Karnataka. The DIC acts as a developer and facilitator for the overall development of industries. However, the researcher could not get any list from these offices.

Further, as the response rate for the pilot study was not encouraging and given the time and cost constraints of the researcher, it was proposed to consider food processing firms operating within Karnataka in the industrial areas in Bengaluru for the final study. Bengaluru is the capital of the state of Karnataka, called as the Silicon Valley of India since it plays a significant role in the export of information technology (IT) from India (Sudhira et al. 2007). Hence, the firms operating in Bengaluru are likely to have easy access to latest information on ICT and favourable attitude towards ICT adoption in their business operations, and perhaps be more willing to participate in the present study.

The initial list of the food processing companies operating in Bengaluru area was taken from the Prowess database used in the secondary data analysis in the present study. There were five food processing firms operating in Bengaluru in the sample extracted from the Prowess database. The study then adopted the snowball sampling technique to get a list of more food processing firms operating in Bengaluru. Snowball sampling is defined as "a technique for gathering research subjects through the identification of an initial subject who is used to provide the names of other actors" (Atkinson and Flint 2004; 1043). It means that "the researcher locates a "good" participant and, at the end of the interview, asks the participant to help with the study by referring the researcher to another person who may like to participate in the study" (Morse 2004). Following this a list of thirty-five (including five firms from

Prowess) food processing firms located in Bengaluru were identified. However, due to lack of response and time constraint, in-depth case studies could be conducted for only three food processing firms operating in Bengaluru, Karnataka.

The researcher first visited the companies to explain the research agenda and to get an appointment for conducting the interview. The actual interview was conducted according to the respondents' convenience in August 2018. The respondents were the owner of Company A, the chief executive officer of Company B, and the information technology manager and export manager of Company C. As per the preference of the respondents, the interview was carried out in either English or the native language (Kannada). The researcher is able to understand and communicate in both these languages. The interview was recorded with prior permission, and essential notes were taken down. Each interview lasted for around 45 to 60 minutes. Then, the responses were transcribed and summarized. Pseudonyms were given to protect the anonymity of the case companies involved in the present study.

Summary

Chapter 3 presents the research methodology followed in the present study. It explains the processes of arriving at the final sample used in the study. It describes the Prowess database, which was the main source used to collect information about the food processing firms. The chapter also explains the process of finalizing the sample based on the NIC-2008 classification in the present study. Then, it explains the econometric method, that is, the generalized method of moments (GMM) used in the present study to analyse the data. Further, the chapter provide the definition for each variable of the study and descriptive statistics for Research Objective 1 and Research Objective 2 of the study. Finally, it explains the methodology adopted to achieve Research Objective 3 and explains the processes of finalizing the questionnaire used for conducting the case study.

CHAPTER 4

RESULTS AND DISCUSSION

The chapter presents the results of the quantitative study, followed by qualitative studies. Accordingly, the results of the two-step system GMM for Research Objective 1 and Research Objective 2 of the study are presented and discussed. This is followed by discussion on the findings of the pilot study and final case studies for Research Objective 3. Finally, the findings of the three objectives are connected and discussion regarding the overall findings of the study is presented. Further instances from the secondary data sample are provided to strengthen the overall understanding of the findings in the context of the food processing industry in India.

4.1 Econometric Model Specifications and Results for Objective 1 and Objective 2

A summary of all the developed hypotheses and the expected signs on the coefficients of the variables for Research Objective 1 and Research Objective 2 is given in Table 4.1 (refer to Chapter 2 for hypothesis development).

Table 4.1: Variables and expected direction of effect

Variables	**Hypotheses with Expected Direction of Effect in brackets**	
	Determinants of investment in ICT	**Impact of ICT and other factors on export performance**
Labour intensity (**LABI**)	**RO1-H1** (Positive)	-
Capital intensity (**CAPI**)	**RO1-H2** (Positive)	-
Age of the firm (**AGE**)	**RO1-H3** (Positive)	**RO2-H2** (Positive)
Size of the firm (**SIZE**)	**RO1-H4** (Positive)	**RO2-H3** (Positive)
Liquidity (**LIQUI**)	**RO1-H5** (Positive)	-
International exposure (**IE**)	**RO1-H6** (Positive)	-
Government intervention (**GI**)	**RO1-H7**	**RO2-H6**

	(Positive/Negative)	(Positive/Negative)
ICT investment intensity (**ICTI**)	-	**RO2-H1** (Positive)
Capital-labour ratio (**CAPLAB**)	-	**RO2-H4** (Negative)
Affiliation (**AFF**)	-	**RO2-H5** (Positive)
Research and development activities (**RDI**)	-	**RO2-H7** (Positive)
Import of raw material intensity (**IRAWI**)	-	**RO2-H8** (Positive)
Interactive variables		
Affiliated firms' ICT investment and export performance (**AFF×ICTI**)	-	**RO2-H9** (Positive)
Government intervened firms' ICT investment and export performance (**GI×ICTI**)	-	**RO2-H10** (Positive/Negative)
Import and adapt technology (IAT) strategy and export performance (**IRAWI×RDI**)	-	**RO2-H11** (Positive)

The correlation metrics, the econometric model specifications, and the results of the two-step system GMM analyses for Research Objective 1 and Research Objective 2 are presented below.

4.1.1 Two-Step System GMM Results for Research Objective 1

The econometric specifications and correlation matrix for the variables are provided here along with the results of the two-step system GMM econometric models to identify the significant factors that determine ICT intensity of the food processing firms.

Based on the first objective of the present study and the hypotheses developed in Chapter 3, the two-step GMM econometric models proposed to analyze Research Objective 1 are as follows:

$$ICTI_{it} = ICTI_{it-1} + LABI_{it} + CAPI_{it} + AGE_{it} + SIZE_{it} + LIQUI_{it} + IE_{it} + GI_{it} + \mu_{it} + \varepsilon_{it}$$

(**M1**)

$$ICTI_{it} = ICTI_{it-1} + LABI_{it} + CAPI_{it} + AGE_{it} + SIZE_{it} + LIQUI_{it} + IE_{it} + GI_{it} + \mu_{it} + \varepsilon_{it}$$

(**M2**)

$$ICTI_{it} = ICTI_{it-1} + LABI_{it} + CAPI_{it} + AGE_{it} + SIZE_{it} + LIQUI_{it} + IE_{it} + GI_{it} + \mu_{it} + \varepsilon_{it}$$

(**M3**)

In the above equations, **M1** is the basic model where only the variable $ICTI_{it-1}$ is considered as an endogenous variable. In equation **M2**, along with the variable $ICTI_{it-1}$, IE is also considered as endogenous variable. In equation **M3**, the variable $LIQUI_{it}$ is also treated as an endogenous variable.

The correlation matrix for the continuous variables used in the econometric specifications is presented in Table 4.2. It can be seen that the correlation coefficient between labour intensity and ICT intensity is positive with statistically significant sign. This suggests that the food processing firms are labour-intensive and have higher ICT intensity. Although, there are other statistically significant correlation coefficients between other variables, the magnitude of the coefficients is not very large. Hence, there may not be any multicollinearity problem among the independent variables that influence ICTI.

Table 4.2: Correlation matrix for ICTI as the dependent variable

Variables	ICTI	LABI	CAPI	AGE	SIZE	LIQUI
ICTI	1.000					
LABI	0.174[a]	1.000				
CAPI	0.024	-0.026	1.000			
AGE	-0.004	0.377[a]	-0.006	1.000		
SIZE	0.028	-0.397[a]	-0.068[b]	-0.049[c]	1.000	

LIQUI	-0.032	0.087[a]	-0.253[a]	0.073[b]	-0.057[b]	1.000

Note: [a, b] and [c] denotes significance level at 1%, 5%, and 10% respectively.

The two-step system GMM results for each of the econometric models to achieve Research Objective 1 are presented in Table 4.3. It can be observed from the table that the primary conditions of the system GMM method are satisfied. The number of instruments is less than the number of groups in all the three econometric models (**M1**, **M2**, and **M3**). The Hansen test statistic, which ought to be statistically insignificant, is statistically significant in the initial model M1; however, it is insignificant in the next two models, namely, **M2 and M3**). The insignificance of the Hansen test indicates that the instruments used are valid in the model. Similarly, the p-value of AR (2) indicates that there is no second-order serial correlation. Hence, the results of the statistical tests are in line with the requirements of the GMM method. Thus, it can be concluded that the model specification and instruments are valid for the econometric models determining the factors that affect ICT intensity in the present study.

Table 4.3: Two-Step system GMM results for determinants of ICTI

Variables	**Two-step GMM Model**		
	M1	**M2**	**M3**
$ICTI_{it-1}$	0.659	0.661	0.669
	(8.71)[a]	(8.33)[a]	(8.81)[a]
LABI	0.002	0.002	0.002
	(1.73)[c]	(1.71)[c]	(1.98)[b]
CAPI	0.0002	0.0004	0.0005
	(1.39)	(2.22)[b]	(2.12)[b]
AGE	-0.0001	-0.00004	-0.0001
	(-0.71)	(-0.25)	(-0.49)
SIZE	0.003	0.005	0.005
	(1.26)	(1.70)[c]	(1.79)[c]
LIQUI	-0.006	-0.008	-0.009
	(-0.99)	(-1.55)	(-1.24)

IE	0.007	0.012	0.017
	(0.98)	(2.17)[b]	(2.56)[b]
GI	-0.012	-0.003	-0.028
	(-1.29)	(-2.29)[b]	(-2.15)[b]
Constant	-0.017	-0.032	-0.038
	(-0.77)	(-1.44)	(-1.68)[c]
No. of Observations	1050	1050	1050
No. of Groups	175	175	175
No. of Instruments	28	53	78
Wald chi^2	115.59[a]	142.88[a]	206.42[a]
Hansen test (p-value)	0.092	0.388	0.298
Arellano–Bond AR (1) (p-value)	0.041	0.042	0.040
Arellano–Bond AR (2) (p-value)	0.538	0.541	0.542
Remarks	**M1** is a basic model with only **L1.ICTI** as endogenous. In model **M2**, **$ICTI_{it-1}$** and **IE** are endogenous, and in model **M3**, **$ICTI_{it-1}$**, **IE,** and **LIQUI** are endogenous.		

Note: a, b, and c denote significance level at 1%, 5%, and 10%, respectively.

The model **M1** in Table 4.2 is the basic model where all the variables of interest are introduced in the analysis. There are two kinds of instrument groups in running a GMM model, namely, *gmmstyle* and *ivstyle*. The *gmmstyle* consists of variables, which are not strictly exogenous. The *ivstyle* includes variables which serve as standard instruments and are strictly exogenous regressors. In the basic model **M1**, only the lagged value of the dependent variable, that is, **$ICTI_{it-1}$** is considered endogenous and introduced in the *gmmstyle*. All the other variables such as **LABI**, **CAPI**, **AGE**, **SIZE**, **LIQUI**, **IE**, and **GI** are treated as strictly exogenous and introduced in *ivstyle*. However, the *p-value* of Hansen's statistics is significant,

which rejects the null hypothesis that the instruments are exogenous. Hence, in the subsequent two models, based on appropriate reasoning, the variable representing international exposure (**IE**) is also introduced as an endogenous variable. In the present era of digitized world, a firm that is desirous of higher international exposure will need to invest higher amounts on ICT. Likewise, the firm that invests higher amounts on ICT will be easily able to connect to suppliers and customers across the world for its global operations. Hence, there is simultaneity between IE and ICTI, suggesting IE to be introduced as endogenous variable. Even the statistical test supports this idea. The introduction of the variable **IE** as an endogenous variable made the Hansen's test insignificant in **M2** and **M3** econometric models, which indicates that the instruments are valid. Again, with appropriate reasoning, the variable **LIQUI** is also introduced as an endogenous variable in **M3**. To invest on various technological activities such as ICT, where the actual budget often overshoots the estimated one, there is need for ready cash in the firm. Similarly, when the firm has more liquid assets, it can easily channelize the same for ICT and related investments. This suggests that the variable **LIQUI** can also be treated as endogenous variable due to simultaneity between liquidity and ICT investments. Accordingly, **LIQUI** is also introduced as an endogenous variable along with **IE** and **L1.ICTI** in **M3**. However, although it made the overall model **M3** more significant compared with models **M1** and **M2**, the coefficient on **LIQUI** remained insignificant in all the three econometric specifications. The following paragraphs give more insight on the results of the econometric analyses.

The variable $\mathbf{ICTI_{it-1}}$ is statistically significant with a positive sign, clearly supporting the idea that investment in ICT is dynamic in nature. In other words, the firm's previous year investment in ICT influences the present year investment in ICT. The firms gain confidence as they invest more and more on ICT and start using it effectively. Previous year's investment in ICT reduces the firm's uncertainty about the process of acquisition of the new ICT tools in the present year. This must be the driving force for the firms to get motivated to invest more in ICT in the present year.

With regard to TOE factors determining ICT investment, the hypotheses **RO1-H1**, **RO1-H2**, **RO1-H4**, **RO1-H6**, and **RO1-H7** are accepted. This implies that larger

size with higher exposure to the international market and less regulation by the government can have a positive influence on ICT intensity. Also, higher labour intensity and capital intensity favourably affects the ICT intensity.

Although ICT is a general-purpose technology, it needs skilled personnel who are qualified in the area of information technology and who can handle intermediate to advanced ICT software and technology tools. The finding for LABI in the present study is similar to the results by Alderete and Gutierrez (2014) and Riddell and Song (2017), who also found human capital to be important for adoption and use of ICT. Similarly, investing in suitable ICT is not possible without setting- up the necessary infrastructure to handle the ICT tools and technologies in a more efficient way. Firms that have created infrastructure to support latest production technologies like plants and machinery also invest on the, often complementary, ICT technologies. Hence, companies that have higher capital intensity (**CAPI**) invest more in ICT.

The result concerning the variable **SIZE** in the present study is similar to the findings of many other studies. For example, studies by Premkumar and Roberts (1999), Giunta and Trivieri (2007), Wang et al. (2010), Ashrafi et al. (2014), and Awa et al. (2016) have also found a positive impact of size of the firm on investment in ICT. In general, large sized firms can allocate dedicated resources and manage risks associated with technological investments like ICT.

The other two organizational variables such as **AGE** and **LIQUI** are found to be insignificant in explaining the food processing firms' investment in ICT. Hence, hypotheses **RO1-H3** and **RO1-H5** are rejected. It seems that in the food processing industry in India, the experience of the firm as well as the amount of liquid assets do not matter for adoption of ICT.

Finally, with regard to environmental factors, the coefficients on **IE** and **GI** variables are statistically significant with a positive and a negative sign, respectively. The result concerning the variable **IE** shows that firms which are exposed to the international market are more ICT investment intensive firms. The firms' international connection, either through export or import, does have a significant effect on their investment in ICT. These business firms connect internationally either to export their products or to

import raw materials, capital goods, and finished products that may be required to operate their business.

The negative coefficient on **GI** indicates that firms which are highly controlled and regulated by the government invest less in ICT compared with firms which are not highly regulated by the government. This is in line with the findings of other empirical studies that have found government intervention to be a barrier to a firm's innovative activities (Hall and Bagchi-Sen 2002, D'Este et al. 2012).

4.1.2 Two-Step System GMM Results for Research Objective 2

Based on the second objective of the present study and the hypotheses developed in Chapter 3, the two-step GMM models proposed to analyse Research Objective 2 are as follows:

$$EXPI_{it} = EXPI_{it-1} + ICTI_{it} + AGE_{it} + SIZE_{it} + \mu_{it} + \varepsilon_{it} \quad \textbf{(M4)}$$

$$EXPI_{it} = EXPI_{it-1} + ICTI_{it} + AGE_{it} + SIZE_{it} + \mu_{it} + \varepsilon_{it} \quad \textbf{(M5)}$$

$$EXPI_{it} = EXPI_{it-1} + EXPI_{it-2} + ICTI_{it} + AGE_{it} + SIZE_{it} + \mu_{it} + \varepsilon_{it} \quad \textbf{(M6)}$$

$$EXPI_{it} = EXPI_{it-1} + EXPI_{it-2} + ICTI_{it} + AGE_{it} + SIZE_{it} + CAPLAB_{it} + \mu_{it} + \varepsilon_{it} \quad \textbf{(M7)}$$

$$EXPI_{it} = EXPI_{it-1} + EXPI_{it-2} + ICTI_{it} + AGE_{it} + SIZE_{it} + CAPLAB_{it} + AFF_{it} + \mu_{it} + \varepsilon_{it} \quad \textbf{(M8)}$$

$$EXPI_{it} = EXPI_{it-1} + EXPI_{it-2} + ICTI_{it} + AGE_{it} + SIZE_{it} + CAPLAB_{it} + AFF_{it} + GI_{it} + \mu_{it} + \varepsilon_{it} \quad \textbf{(M9)}$$

$$EXPI_{it} = EXPI_{it-1} + EXPI_{it-2} + ICTI_{it} + AGE_{it} + SIZE_{it} + CAPLAB_{it} + AFF_{it} + GI_{it} + AFF \times ICTI_{it} + GI \times ICTI_{it} + \mu_{it} + \varepsilon_{it} \quad \textbf{(M10)}$$

$$EXPI_{it} = EXPI_{it-1} + EXPI_{it-2} + ICTI_{it} + AGE_{it} + SIZE_{it} + CAPLAB_{it} + AFF_{it} + GI_{it} + AFF \times ICTI_{it} + GI \times ICTI_{it} + RDI_{it} + IRAWI_{it} + IRAWI \times RDI_{it} + \mu_{it} + \varepsilon_{it} \quad \textbf{(M11)}$$

In the above equations, equation **M4** is a basic model of Research Objective 2 where only the variable $EXPI_{it-1}$ is considered as an endogenous variable. Equation **M5** is similar to **M4**; however the variable $ICTI_{it}$ is treated as an endogenous variable to correct for the Hansen statistics. In equation **M6**, two previous years lagged values of export intensity, that is, $EXPI_{it-1}\ and\ EXPI_{it-2}$ are introduced as endogenous variables to correct for AR (2). In equations **M7**, **M8**, and **M9,** the variables$CAPLAB_{it}$, AFF_{it}, and GI_{it} are introduced one-by-one. In equation **M10,** the interactive variables $AFF \times ICTI_{it}$ and $GI \times ICTI_{it}$ are introduced. Finally, in equation **M11**, the variables RDI_{it}, $IRAWI_{it}$, and $IRAWI \times RDI_{it}$ are introduced.

The correlation matrix for the continuous variables determining the export performance of food processing firms is presented in Table 4.4. It can be observed that ICTI correlated positively with the export intensity of the firms. This means that firms that have high ICT intensity have higher sales in the international market. Other variables like the size of the firm (SIZE) and the import of raw material (IMPI) also positively correlated to EXPI. This indicates that in the present sample, larger firms and firms that are importing raw materials from abroad is more export intensive. Further, it can also be seen from Table 4.4, that capital-labour ratio (CAPLAB) correlated negatively with EXPI, which implies that the food processing firms that are more labour-intensive rather than capital intensive have higher export intensity. On the whole, the magnitudes of the correlation coefficients among the other explanatory variables are not very high, and hence, multicollinearity problem may not be present during the econometric model estimation.

Table 4.4: Correlation matrix for EXPI as the dependent variable

Variables	EXPI	ICTI	AGE	SIZE	CAPLAB	RDI	IRAWI
EXPI	1.000						
ICTI	0.135[a]	1.000					
AGE	-0.021	-0.004	1.000				
SIZE	0.052[c]	0.028	-0.049[c]	1.000			
CAPLAB	-0.082[a]	-0.129[a]	-0.245[a]	0.098[a]	1.000		
RDI	0.045	0.092[a]	0.078[a]	0.114[a]	-0.109[a]	1.000	

IRAWI	0.117[a]	0.008	-0.063[b]	0.204[a]	0.137[a]	0.022	1.000

Note: [a, b] and [c] denotes significance level at 1%, 5%, and 10% respectively.

The two-step system GMM results for Research Objective 2 are presented in Table 4.5. It can be observed that the number of instruments is less than the number of groups in all the eight models. The Hansen test statistic is significant in the base model **M4**; however, as required, in all the subsequent models (**M5**-**M11**), it is statistically insignificant. Thus, the instruments used are valid in these subsequent econometric models. Finally, the p-values of the AR (2) in econometric model **M6** onwards indicate that there is no second-order serial correlation. Hence, the model specification and instruments are valid for the econometric models from **M6** to **M8**.

Table 4.5: Two-Step system GMM results determining impact of ICTI and other variables on EXPI

Variables	**Two-step GMM Model**							
	M4	**M5**	**M6**	**M7**	**M8**	**M9**	**M10**	**M11**
$EXPI_{it-1}$	0.627	0.743	0.676	0.679	0.668	0.663	0.622	0.605
	(2.87)[a]	(6.08)[a]	(6.77)[a]	(6.82)[a]	(6.59)[a]	(6.31)[a]	(6.04)[a]	(5.78)[a]
$EXPI_{it-2}$	-	-	0.211	0.211	0.207	0.205	0.185	0.179
			(2.78)[a]	(2.77)[a]	(2.72)[a]	(2.67)[a]	(2.50)[b]	(0.015)[b]
ICTI	3.811	3.659	4.646	4.903	5.414	5.398	-1.633	-1.023
	(0.98)	(2.18)[b]	(1.44)	(1.46)	(1.55)	(1.56)	(-1.01)	(-0.70)
AGE	-0.011	-0.008	-0.004	-0.005	-0.002	-0.002	-0.017	-0.016
	(-1.05)	(-0.88)	(-0.67)	(-0.69)	(-0.33)	(-0.40)	(-2.29)[b]	(-2.12)[b]
SIZE	-0.242	-0.179	-0.226	-0.218	-0.146	-0.139	-0.191	-0.225
	(-1.11)	(-1.08)	(-2.06)[b]	(-1.99)[b]	(-1.57)	(-1.22)	(-1.35)	(-1.55)
CAPLAB	-	-	-	-0.0002	-0.0002	-0.0002	-0.0004	-0.001
				(-0.75)	(-0.68)	(-0.94)	(-1.51)	(-1.97)[b]
AFF	-	-	-	-	-0.907	-0.889	-1.244	-1.003
					(-1.95)[b]	(-1.89)[b]	(-2.16)[b]	(-1.54)
GI	-	-	-	-	-	-0.092	0.328	0.718

						(-0.13)	(0.55)	(1.46)
AFF×ICTI	-	-	-	-	-	-	10.549	9.281
							(2.17)[b]	(2.36)[b]
GI×ICTI	-	-	-	-	-		-15.996	-16.659
							(-1.64)[c]	(-1.76)[c]
RDI	-	-	-	-	-	-	-	-7.063
								(-2.02)[b]
IRAWI	-	-	-	-	-	-	-	0.083
								(1.21)
RDI×IRAWI	-	-	-	-	-	-	-	1.631
								(2.25)[b]
Constant	3.817	2.365	1.522	1.586	1.527	1.539	3.251	3.719
	(1.42)	(1.02)	(1.57)	(1.46)	(1.34)	(1.40)	(2.44)[b]	(2.35)[b]
No. of observations	1050	1050	1050	875	875	875	875	875
No. of groups	175	175	175	175	175	175	175	175
No. of instruments	24	49	45	46	47	48	94	97
Wald chi^2	160.76[a]	201.21[a]	231.36[a]	297.46[a]	393.33[a]	612.06[a]	748.81[a]	1878.92[a]
Hansen test (p-value)	0.068	0.241	0.454	0.453	0.426	0.420	0.303	0.204
Arellano–Bond AR(1) (p-value)	0.012	0.003	0.010	0.010	0.010	0.010	0.011	0.011
Arellano–Bond AR(2) (p-value)	0.097	0.074	0.682	0.678	0.673	0.669	0.631	0.671
Remarks	In model M4, only $EXPI_{it-1}$ is endogenous; in model M5, ICTI and $EXPI_{it-1}$are endogenous to correct for Hansen test statistics, and in model M6, $EXPI_{it-2}$is introduced to correct for AR (2)							

Note: a, b, and c denote significance level at 1%, 5%, and 10%, respectively.

Model **M4** in Table 4.5 is the basic model, which includes only the variable of interest, that is, **ICTI** along with the control variables **AGE** and **SIZE**. In this model, the one year lagged value of **EXPI** (i.e., $\mathbf{EXPI_{it-1}}$) is treated as endogenous, and hence, it is included in *gmmstyl*e, whereas the variables **ICTI**, **AGE**, and **SIZE** are treated as exogenous and included in *ivstyle*. However, the Hansen test in model **M4** indicates that the instruments are not specified correctly. Hence, with proper reasoning, in model **M5**, the variable **ICTI** is introduced in *gmmstyle* considering it as an endogenous variable. ICT helps the firms to face international competition by connecting the firms directly to their end-users and making the firms to respond quickly to market changes. The use of ICT thus provides a secure and robust link to the international supply chain partners. In other words, firms desirous of higher export intensity may intentionally invest higher amounts on ICT. Thus, there is a possibility of simultaneous relationship between ICTI and EXPI, suggesting ICTI to be treated as an endogenous variable. The Hansen test statistic also supports this, as introducing ICTI as endogenous variable makes the p-value of the Hansen test insignificant. In the proposed model, the coefficient of ICTI took a positive and statistically significant sign, suggesting that ICTI has a favourable effect on export performance of firms in the food processing industry.

However in both **M4** and **M5** models, the AR (2) was not according to the GMM specification. This problem was rectified by introducing the second year lagged values of export intensity (i.e., $\mathbf{EXPI_{it-2}}$) in model **M6**. Thus, all the primary conditions of the GMM model were fulfilled for the econometric models from **M6** to **M11**. Although, due to the introduction of the second year lagged value of export intensity, the overall model fitted in terms of Wald Chi2 increased compared with earlier econometric specifications, and the coefficient on ICTI became statistically insignificant.

The other variables related to firm structure such as **CAPLAB**, **AFF**, and **GI** were then introduced in model **M7**, **M8**, and **M9**, respectively. The coefficient on only **AFF** turned out to be statistically significant with a negative sign, suggesting that unaffiliated firms have better export performance compared with affiliated ones. Since the main variable of interest in the study, that is, **ICTI** became insignificant in

M6, which satisfied all the primary conditions of GMM estimation technique, select interactive variables were introduced to explore whether ICT intensity in specific food processing firms had any significant effect on the export performance of the firms. Accordingly, the interactive term **AFF×ICTI** was introduced in econometric model **M10** to explore whether ICT activities of the affiliated firms was favourable for export performance of those firms. Similarly, to explore the effect of ICT investments on export performance in government intervened firms, another interactive term **GI×ICTI** was also introduced in econometric model **M10.** Since the variable **ICTI** is endogenous in the model, both **AFF×ICTI** and **GI×ICTI** were introduced in *gmmstyle*, treating them also as endogenous variables.

It can be seen from the results of model **M10** in Table 4.5 that both **AFF×ICTI** and **GI×ICTI** are statistically significant in explaining EXPI. These two interactive variables continued to be statistically significant even in the final model **M11**, where the conduct variables **RDI**, **IRAWI**, and **IRAWRDI** were also introduced. The Wald Chi2 value of econometric model **M11** is the largest compared with all the earlier econometric specifications. All the conditions of GMM estimation are also satisfied in **M11**. The following paragraphs further discuss the results of the econometric analyses.

As is visible from the GMM results in Table 4.5, both $\mathbf{EXPI_{it-1}}$ and $\mathbf{EXPI_{it-2}}$ are statistically significant with a positive sign, and it is clear that export performance is also dynamic in nature. In other words, the past two years of experience in the export market affected the export performance in the current year. This is similar to the findings of Tyagi and Nauriyal (2017), who also found a positive impact of past export performance on the present year export performance of the firms in the case of the drug and pharmaceutical industry in India.

Overall, in the present study, hypotheses **RO2-H1**, **RO2-H5,** and **RO2-H6** are rejected. This implies that in general, investment on ICT, affiliation of the firm, and government interventions may not have any effect on the export performance of the firms in the food processing industry. Even the firm's investment in R&D (**RDI**) is found to be statistically significant, but with an unexpected negative sign. Thus, the

hypothesis **RO2-H7** is rejected. The negative coefficient on **RDI** is perhaps because the high R&D efforts of the food processing firms in India are directed to make their products appealing to the domestic market consumers resulting in negative effect on export performance. This finding is not be surprising since India is one of the largest consumers of processed food in the world. Another technology variable, **IRAWI**, is statistically insignificant in explaining the firm's export performance. Thus, the hypothesis **RO2-H8** is also rejected in the present study.

However, the coefficients on all the three interactive terms are statistically significant. Thus, the hypotheses **RO2-H9**, **RO2-H10a**, and **RO2-H11** are accepted. While ICT investments by affiliated firms have a favourable effect on export performance, ICT investments by the firms in regulated product sub-sector has a negative effect on the export performance in the case of the food processing industry in India. Further, it seems that the import and adapt technology strategy is favourable for the export performance of firms, since the interactive term between import of raw materials intensity and R&D intensity is statistically significant with positive sign.

One of the control variables, the age of the firm (**AGE**), is found to be statistically significant with a negative sign in the last two econometric models with higher Wald chi^2 statistics compared with all the other econometric specifications in Table 4.5. Thus, the hypothesis **RO2-H2** is rejected. The negative sign on the variable **AGE** suggests that the younger firms are more export intensive compared with firms that are older and experienced in the food processing industry. This finding is similar to the findings by Love et al. (2016) for UK SMEs and Paeleman et al. (2017) for the manufacturing sector in Belgium, who also found younger firms to be more export intensive. Experienced firms lack flexibility and openness to new knowledge. Again, older firms which have grown-up under protected trade regime may avoid up-gradation and replacement of their technology and obsolete plants making them incompetent in the export market (Bhaduri and Ray, 2004). Some younger firms may start their business operations by exporting (Ayan and Percin 2005), and hence, can be more export intensive than older firms. Again, due to disadvantage in domestic markets in the form of costs and access to resources, younger firms often focus their efforts on overseas markets and thus achieve high export performance (Maurel 2009).

At the same time, as expected, the variable **CAPLAB** is significant with a negative sign in the final econometric specification. Thus, the hypothesis **RO2-H4** is accepted. The result implies that the food processing firms that use labour-intensive rather than capital-intensive processes are more export intensive. This finding is similar to the findings by Cerrato and Piva (2012), Chuang (2000), and Pucar (2012), who also found human capital to be a decisive factor in determining a firm's export performance.

The size of the firm (**SIZE**) is another important control variable used in many of the studies related to determinants of export performance. In the present study, the coefficient on **SIZE** was statistically significant with negative sign only in econometric models **M6** and **M7.** In all the later econometric specifications, the variable was found to be insignificant in explaining the export performance of the food processing firms. Hence, the hypothesis **RO2-H3** is rejected. This result is however, in line with the findings of other studies where the size of the firm had a weak or insignificant relationship with export performance (Ayan and Percin 2005; and Pla-Barber and Alegre 2007).

4.2 FINDINGS FOR RESEARCH OBJECTIVE 3

This section deals with the case studies. It provides the insights gained from the pilot study that was conducted to validate the questionnaire for the semi-structured interview. Further, it also provides detailed findings of the case studies on food processing firms related to Research Objective 3 of the study.

4.2.1 Insights from the Pilot Study

The pilot study was undertaken to first understand the extent of ICT use in the food processing industry in India, and secondly, to get inputs from the food processing firms to improve the questionnaire that was to be used as a guide for conducting the final semi-structured interview based case studies. Accordingly, the initial draft of the questionnaire was prepared based on some of the existing literature (Ifinedo 2011, Thiesse et al., 2011, Pezderka et al., 2012, Oliveira et al., 2014, and Gangwar et al., 2015). This questionnaire was first given to an information technology expert for

evaluation. Then, it was modified based on the suggestions given by the expert. Next, to get industry inputs on the modified questionnaire, the researcher approached the food processing firms operating in the Baikampady industrial area and the Yeyyadi industrial area of Mangaluru in Karnataka, India. The details on the companies were collected from the Department of Industries and Commerce located in Mangaluru, Karnataka. In total, thirty-two food processing companies operating in the above mentioned industrial areas were visited. Out of these thirty-two companies, some declined to participate in the study, a few were inactive, while some were not found at the registered address. Hence, the researcher was finally able to get responses from only six food processing firms for the pilot study. The following paragraphs give a summary of the insights drawn from the pilot study.

Four of the six food processing firms were in business for the past thirty years. Of these, one firm was into primary level of food processing, three into secondary level of food processing, and two into tertiary level of food processing. Further, five out of the six firms were private ownership firms and one firm belonged to a business group. In terms of firm size, except for one firm, five were small sized firms. Three out of six respondents were aged between 20 to 29 years, one was aged between 40-49 years, and the remaining two was over 50 years of age. The respondents for the pilot study were managers and/or owners of the companies. Four of the respondents were postgraduates (like M.B.A. and M.Com.) and the remaining two were graduates.

All six companies had invested in a computer system. Four companies had less than 10 computer systems in their office and the remaining two had around 20 to 30 computer systems. The respondents of all the six food processing companies stated that they had invested in basic ICT like personal computers, office suites, and the internet and further that they used them very often to manage their day-to-day business transactions. Five companies out of the six also mentioned that they were using e-commerce technology to sell their products, apart from the traditional offline channel. A respondent from one of the companies mentioned that their company imported raw materials like raw cashew nuts from Africa and Nigeria and technology like cutting, grading, and sorting machinery from Vietnam and China. The company exported its cashew nuts to countries like the U.S.A., Japan, and Nepal. Similarly,

another respondent also stated that their company imported machinery from Germany and China and exported products such as Namkeen and Jaggery snacks to countries like the U.S.A., Australia, U.A.E., and Europe.

It was further observed that these companies used ICT mainly for information sharing. The respondents stated that they used the ICT to access information quickly from their supply-chain partners, to disseminate information faster to their employees and suppliers, and to improve information quality. Five of the respondents stated that they used ICT to reduce the costs related to communication. Further, four of the respondents indicated that they used ICT to improve sales in the present market, to establish better relationships with their suppliers and customers, to reduce clerical and managerial labour force, and to change the ways of doing business. The respondents also perceived that the use of ICT helped them in improving sales, market share, and the profitability of their business.

Overall, the pilot study indicated that food processing firms in India were investing on basic, intermediate as well as advanced ICT technologies. Further, the food processing firms from India were exporting their products and importing raw materials from abroad. Thus, based on the inputs from the information technology professionals and the pilot study the questionnaire was finalized to conduct the semi-structure interview.

4.2.2 Findings from the Case Studies for Research Objective 3

Here, the findings of the case studies with special focus on the factors related to - (a) technological context, (b) organizational context, and (c) environmental context that influence investment in ICT for Company A, Company B, and Company C, respectively, is discussed.

4.2.2.1 Company A

Company A is a small-sized private limited firm located in the Peenya industrial area of Bengaluru city, Karnataka state, India. The company was established in 2016. Company A is involved in the manufacturing of a wide array of ready- to- cook millet products mix ranging from *Dosa* to *Idli* batter, *Pong*al

to *Bisibelebath* and *Kheer* to *Kesribath*. The processes include cleaning of raw materials, roasting, grinding, sewing, and finally, packaging of the final food products. The business is maintained and controlled by a team of a husband and wife, who are the owners of the company. Both are computer engineering graduates. In the present study, the respondent for the interview was the female owner of the company, and the interview lasted for around forty-five minutes to one hour.

Level of Investment in ICT

Company A has invested in basic ICT like personal computers, laptops, and office suites, including word processing, PowerPoint, and internet connectivity to support their daily business operations. The owner informed that the company has its website, which was developed by a third-party service provider. It is used to provide general information about the company and its products. The company uses ICT regularly in its business operations, and updates its website whenever necessary. According to the respondent, their company sells products with the help of third party e-commerce websites. On verification, the researcher did find that the products of the company were listed on e-commerce websites of BigBasket and Spar India.

Insights Based On TOE Framework

(a) Technological Context

The following paragraphs describe the insights gained through the semi-structured interview on the elements of the technological context, that is, perceived relative advantage, perceived compatibility, and perceived complexity for Company A.

Perceived Relative Advantage: The respondent believes that the use of ICT allows them to manage their business operations efficiently. It helps them to complete specific tasks (such as production planning and product delivery) quickly by providing up-to-date information about the orders they receive from their customers. The respondent stated that the use of ICT has a significant impact on job performance, and acknowledged that ICT played an important role in the business success achieved so far.

The respondent strongly believed that ICT helps them purchase better raw materials and to get information about their competitors. The respondent was well aware about the benefits of using ICT and automated systems in the business against manual working procedures. Nevertheless, at the time of the interview, the company used manual methods for various activities that had scope for automation like adjusting the inventory of the ingredients on the basis of the orders received.

Perceived Compatibility: The basic ICT which Company A was using was compatible with its business operations, corporate culture, and value systems. The company had installed all the required infrastructure and hardware to support basic ICT use at the time of the commencement of the business. The respondent stated that ICT was required even for the basic operations (for example, generating bill), and as such, the company had installed necessary ICT infrastructure like computer system and internet connections at the incorporation stage itself.

Further, the ICT was also compatible with the company's customers and suppliers. The company communicated with its customers and suppliers online to sell its products and to purchase raw materials, respectively. Even receipts and payment transactions were issued using online tools.

Perceived Complexity: According to the respondent, the existing level of ICT was not complex for the company. However, the respondent believed that investing in a higher-level of ICT would become a challenge for them since intermediate ICTs like ERP required substantial investment to develop the necessary infrastructure and involved reengineering of work practices. Further, the respondent suspected that the use of advanced ERP might become difficult for the present employees since they had less knowledge about the use of ICT. According to the respondent, the process would become more complex as the company would be forced to either train their existing employees or recruit new skilled employees to use advanced ICT efficiently. Hence, the firm was not going for further investment in higher-level ICT at any time soon.

(b) Organizational Context

The following paragraphs describe the insights gained through the semi-structured interview for the elements of the organizational context, that is, top management support and organizational readiness for Company A.

Top Management Support: The respondent's educational background helped in believing in the importance of ICT in business operations and supported the use of the same. The respondent also believed that employee training was essential to use ICT. However, the researcher found that the company had not given any formal training to its existing employees on the use of the basic ICT currently being used in the company. The respondent felt that further investment in ICT was risky given the present growth condition of Company A. Hence, at present, the company was concentrating mainly on production to fulfil the orders and further ICT investments did not seem to be a priority.

Organizational Readiness: The researcher observed that the company was not ready for further investment in ICT. Though the respondent showed knowledge about the benefits of using ICT, the management had decided to invest more in ICT only after the company had reached a specific growth level. Since limited finance was available with this small company, it did not maintain any separate funds to invest in ICT. Thus, the company is mainly concentrating on managing its raw materials and production process, and has adopted an approach to invest on ICT only on ad-hoc basis. Furthermore, the company lacked human resources with specialized ICT skills. The current employees had acquired ICT skills through hands-on assistance from the owners themselves.

(c) Environmental Context

The following paragraphs describe the insights gained through the semi-structured interview on the elements of the environmental context, that is, competitors, suppliers, customers, and government support for Company A.

Competitors, Customers and Suppliers: It is evident that the owners of the firm knew very well that in the present era, the adoption of ICT is inevitable for the global operations of any firm. Hence, the company installed basic ICT during its

establishment. The company connects to its customers through offline as well as online (via retail outlets like BigBasket) modes. However, the respondent did mention that the company did not face any pressure from its suppliers and customers to adopt more complex ICT. The company may not be facing high competition in its market segment, namely, millet food product segment. Therefore, perhaps, the company did not feel the need to go for ICT up-gradation in the near future.

Furthermore, the respondent seemed quite clear regarding the ICT adoption strategy for the firm and expressed reluctance in merely copying a competitor's ICT investment strategies. The respondent believed that investment in ICT should be made based on one's business requirements and not by blindly copying other firms. Thus, on the whole, the respondent perceived that imitating the competitor would not be the reason for ICT adoption in the company.

Government Support: Company A has taken support from the Government of India in its marketing efforts. The company, with the support of the Department of Agriculture, has participated in trade fairs, seminars, and meetings with various ministers. This, in turn, had helped the company to build a connection with suppliers and customers, and with the ministers. However, the company had not taken any financial support from the government to invest in ICT. Moreover, the respondent mentioned that they are not ready to take any loans from the government to invest in ICT since they feel that repaying the loan is difficult as they have limited knowledge of financial management. According to the respondent, due to the fear of failure to repay they prefer to use their internal funds to invest in ICT rather than loans provided by any financial institutions or government agencies.

ICT's Impact on Export Performance

The company has recently received two international orders from the U.S.A. and Dubai. Another international order from Australia was in the process. The company exports all types of instant breakfast mixes to both the U.S.A. and Dubai, and the same products are to be exported to Australia soon.

With respect to the impact of ICT on export, the respondent stated that they had not yet noticed any impact on the export business of the firm as the firm had entered into exporting only recently. Further, the respondent mentioned that the firm receives orders from Indian customers who stay abroad such as in the U.S.A., and in the case of Australia, the owner had met the customers in a trade fair held in one of the Gulf countries.

Furthermore, the respondent stated that the company had enough demand for its food products in the domestic and foreign markets. Hence, the company is concentrating on both domestic and foreign markets simultaneously to fulfil the demands. The respondent expected a positive impact of its ICT investments on the export performance.

4.2.2.2 Company B

Company B is a large-sized private limited company located in Hoskote Industrial Area in Bengaluru city of Karnataka, India. The firm started its business in 1991 and has another unit in Telangana, India. The company produces products like wheat flour, *Maida*, *Suji*, *Chakki Atta*, resultant *Atta*, bran, and wheat germ. The process includes tasks like storage, cleaning, conditioning, gristing, milling, and packaging. The company sources its raw material, that is, wheat from various states across India like Rajasthan, Madhya Pradesh, and Uttar Pradesh. It also imports premium quality wheat, namely, Australian Premium White (APW) from Australia. The company caters to wholesale grain markets across the states of Andhra Pradesh, Karnataka, Tamil Nadu, and Kerala. The company has obtained the Food Safety System Certificate (FSSC) 22000, International Organization for Standardization (ISO) 20000:2005, and Halal India certificates. The respondent for the interview was the Chief Executive Officer (CEO) of the unit, who had completed his Diploma from the Central Food Technological Research Institute (CFTRI), Mysuru, Karnataka, India.

Level of Investment in ICT

Company B has invested in basic and intermediate ICTs, including personal computers, internet connections, office suites, Tally software, and custom-built

enterprise resource planning (ERP) system. According to the respondent, the company often uses these ICTs to manage its everyday business operations. It uses the Tally software to maintain its accounts and production-related business transactions. However, the company uses manual procedures to connect to its customers and suppliers and does not use other enterprise-level ICT software like supply chain management software or customer relationship management software. The company has its website, which is mainly used to provide information about the company and its products. Sometimes they receive inquiries through their website. However, the company has no direct online purchase interface. The respondent stated that the company's online business was through third-party online service providers, namely, Grofers and Flipkart.

Insight Based on TOE Framework

(a) Technological Context

The following paragraphs describe the insights gained through the semi-structured interview on the elements of the technological context, that is, perceived relative advantage, perceived compatibility, and perceived complexity for Company B.

Perceived Relative Advantage: The respondent of Company B strongly believes that the use of ICT benefits them in many ways including quick completion of a specific task, time savings on searching for resources, purchase of better raw materials, improvement in job performance, and efficient management of business operations. At the time of the interview, the company had a custom-built ERP system that was developed by a third-party service provider. The company uses it to visualize the data related to customer orders and to prepare the bill accordingly. It also helps the company to dispatch the products at the right time. Moreover, the respondent strongly believes that the use of ERP has reduced communication errors, which used to happen earlier when they communicated through the phone. Thus, information communication has become more comfortable and efficient due to the use of ERP in the company.

Perceived Compatibility: The respondent stated that the ICT employed by the company is, to a large extent, compatible with the current business processes and the

existing hardware infrastructure of the firm. The ERP system was developed as per the prevailing resources and business processes of the company. However, the respondent did mention that there are a few issues with regard to integrating ICT in their current work practices. For example, data updating is a significant challenge as they were not able to feed the data accurately into the ERP system. Further, the respondent is doubtful regarding the benefit realization of ICT adoption in the company as some tasks were still being done manually.

Another major compatibility issue related to ICT use in the company was due to the fact that the company was using equipment supplied by different vendors. Hence, the full integration of ICT into business processes had become a challenge for this unit of the company. The respondent anticipates that this problem will continue with further ICT investment in the Hoskote unit.

Perceived Complexity: According to the respondent, the ERP software was developed with minimal features that were suitable for the company's operation. Hence, the cost of this tailor-made ERP software was affordable for the company. In general, the respondent considers ICT adoption to be a complicated process requiring skilled personnel to handle specific software. The respondent is concerned that the employees of the company might find it challenging to work with the intermediate level ICT as they are not trained to use it.

(b) Organizational Context

The following paragraphs describe the insights gained through the semi-structured interview on the elements of the organizational context, that is, top management support and organizational readiness for Company B.

Top Management Support: The respondent believes that the use of ICT is strategically essential for any company. However, the respondent has reservations about the extent of usage of ICT in the current unit of the company. The top management supports investment in customized ERP software and encourages the employees of the company to use ICT. Further, the management encourages its employees to attend seminars and training related to ICT. However, formal training to handle the in-house ERP system was given to only two graduate employees of the company.

Organizational Readiness: Company B does not allocate or maintain any separate funds to invest in ICT or to manage the changes brought about by ICT investments. The management invests in ICT on ad-hoc basis. The company has two engineering graduates, who look after every business transaction carried out using ICT.

(c) Environmental Context

The following paragraphs describe the insights gained through the semi-structured interview on the elements of the environmental context, that is, competitors, suppliers and customers, and government support for Company B.

Competitors, Customers and Suppliers: The respondent is aware that the use of ICT is essential for business, and therefore the firm is using the internet, email, and other ICT in its business. Further, the respondent notes that the company's customers (third party retailers) have begun to use their mobile app to place orders for the products. Hence, ICT has become necessary for the company's business operations. The respondent strongly believes that the company had invested in ICT, not because of any pressure from its competitors, but to improve its own business operations.

Government Support: The respondent states that the company has not received any help from the government to adopt ICT in the business. The company invested in ICT using its internal funds and is likely to continue to invest from the same source in the future too. However, the respondent did welcome the idea of getting financial support from the government to invest in ICT. Nevertheless, the respondent is confident that there will not be any issue, even if the company did not get any financial support from the government as the company is financially strong to invest in further ICT, if required.

ICT's Impact on Export Performance

The company does not directly export in the international market even though the management of the company was aware that some of the final consumers of their products are from outside the country. The company sells its products to private traders, who then export the products.

Thus, the ICT currently employed by the company is used to manage the domestic business transactions. The respondent believes that the use of ICT should help the company to export directly; however, is unsure with regard to the effect of ICT investment on export performance. The management has no plan for direct export in the near future, and the company is happy catering to the needs of the domestic customers.

4.2.2.3 Company C

Company C is operating in Bengaluru, Karnataka. It was established in 2004. The company was initially set- up as a subsidiary of a foreign company, but later was taken over by a consortium of private investors. It is a medium-sized firm involved in the tertiary level of the processing of foods. The company is into manufacturing of cookies with different ingredients such as cocoa and nuts. The process of preparing cookies involves various stages like raw material purchase planning, quality check, raw material weighing, mixing, forming wire cut, baking, cooling, and packaging. In the case of Company C, there were two respondents for the interview. The first (Respondent 1) was an IT manager and the second (Respondent 2) was the export manager of the company.

Level of ICT investment

The company has invested in basic to intermediate level ICT such as personal computers, office suites, internet, electronic data interchange, enterprise resource planning, sales force automation (SFA), and AutoCAD software. Respondent 1 claims that the company uses ERP, SFA, and AutoCAD software more often to perform daily business operations. It uses the software to perform business operations related to purchasing, store, sales, production, and warehouse. It is used to connect the entire office, factory, and other offices located across India. The company also had its own website, which is mainly used to provide details about the company, products, and other company-related information. It is noted that the company is not involved in direct e-commerce sales. Its products are sold online through third-party online services such as Amazon, BigBasket, Flipkart, Grofers, Spencer’s, and Paytm Mall.

Insights Based on the TOE Framework

(a) Technological Context

The following paragraphs describe the insights gained through the semi-structured interview on the elements of the technological context, that is, perceived relative advantage, perceived compatibility, and perceived complexity for Company C.

Perceived Relative Advantage: Respondent 1 perceives that the use of ICT helps to efficiently manage the business, to quickly complete tasks, to purchase better products and services, to collect necessary information about the competitors, and to get right information to make the right decision in the business. The respondent perceives that there is more scope for transparency in the data exchange due to the use ERP against manual business processes. Overall, Respondent 1 believes that the use of ICT helps to improve their business performance.

The ERP system is fully integrated into the company. The company uses this software at every stage of its production process, from the procurement of raw materials to the manufacturing and marketing of the final products. The ICT also helps the company to analyse the demand for the products in different states across India. Thus, the firm can identify fast-moving and slow-moving products in various locations. This, in turn, helps the company to properly plan the production and distribution of its products.

The company had thus automated its manual business processes with the help of ICT. The respondent mentioned that transition from manual to automation helped the company to reduce transaction costs by around 20 to 30 per cent. Further, the use of ICT helped the firm to quickly collect information about the orders and in the timely delivery of the orders. Respondent 1 believes that the use of ICT has not only reduced the transaction costs, but also saved time, improved employees' efficiency, improved process efficiency, allowed faster communication, and allowed transparency in the data exchange. Overall, Respondent 1 strongly believes that the use of ICT has helped in improving the business performance of the company.

Perceived Compatibility: Respondent 1 believes that the use of ICT is compatible with the company's culture, values, existing business operations, and existing

hardware and software. The respondent believes that the use of ICT involves continuous changes, improvement, and optimization of business processes, and mentions that the company purchased readily available ERP software and customized it as per requirement. The company did evaluate the suitability of the software prior to purchase and customization. Overall, the respondent perceives that the current ICT is compatible with the company's business processes.

Perceived Complexity: Respondent 1 perceives that the integration of ICT in the work practices is not difficult for the company, and mentions that the cost of installing and maintaining ICT is not high. Further, the existing ICT is not difficult for the employees to use as the company has provided the necessary training towards this end. The cost of training the employees was not very high for the company. Overall, as per the respondent, the installation and use of ICT was never a problem for the company.

(b) Organizational Context

The following paragraphs describe the insights gained through the semi-structured interview on the elements of the organizational context, that is, top management support and organizational readiness for Company C.

Top Management Support: Respondent 1 believes that the use of ICT is strategically important for the success of any business, and observes that running a business without ICT is difficult in the modern business environment. The use of ICT is mandatory for business. According to the respondent, the top management of the company encourages the use of ICT and is willing to face any challenges for its successful adoption. The respondent believes that the management supports and motivates its employees to use ICT and trains them to use it efficiently.

Organizational Readiness: According to the respondent, the company did have a practice of maintaining separate funds for ICT investments and to manage the problems or changes caused by ICT adoption. The respondent mentions that the company has a policy of technology migration every three years and that a separate IT department is in place to deal with the task of keeping the ICT up-to-date. The company also has the necessary skilled employees to work with ICT efficiently. The

company provides both in-house and external ICT training to its employees whenever necessary. Further, the company is financially strong to invest in ICT regularly. Overall, the respondent perceives that the company is quite ready and keen on adopting and using the latest ICT for its business.

(c) Environmental Context

The following paragraphs describe the insights gained through the semi-structured interview on the elements of the environmental context, that is, competitors, suppliers and customers, and government support for Company C.

Competitors, Customers, and Suppliers: The respondent believes that there is no pressure from customers, suppliers, or competitors to use ICT, and states that the company uses ICT to run the business in an integrated way and to have data in a centralized place. The company follows the automated system. Hence, the business process runs without intervention from any employee. Thus, according to Respondent 1, the decision to use ICT is not driven by any external forces; rather, it is a decision taken by the management of the company for its betterment. Further, the respondent believes that the company is into the manufacturing of unique products and hence, faces less competition in the cookies market.

However, the respondent did state that the company's market-analyst regularly uses ICT and analytical tools to gather and analyse information related to the market and competitors to monitor the business market environment. The company also uses ICT for advertising their products on social media like Facebook, Twitter, and Instagram.

Thus, although the respondent likes to believe that there is no competitor pressure for the adoption of ICT in the company, the fact seems to be that Company C uses ICT, and perhaps even upgrades it regularly, to have a competitive edge over its rivals/potential rivals in the cookies business. In other words, there is perceived competitor pressure for ICT adoption.

Government Support: The respondent notes that the company has no pressure and took no support from government agencies to use ICT. The respondent perceives that the use of ICT is a requirement for any company in the present era, and hence the

company uses its own funds to adopt ICT in its business and did not approach the government with funding requests.

ICT's Impact on Export Performance

The respondents mentioned that the company's cookies had a huge demand not only in the domestic market, but also in the international market. The company exports its products to over 15 countries across the world including those located in North America, the Gulf, and South-East Asia. The company also has retail/supermarket chains in these countries. The company manufactures specific products for over six private retailers across the world.

Similar to Respondent 1's perception, Respondent 2, an export manager of the company, also perceives that the company has adopted ICT since the technology is inevitable for the business. According to Respondent 2, the primary purpose of using ICT is to ensure the smooth running of the business and not merely to export. The company, via email, collects feedback from its foreign customers. The respondent perceives that without ICT like the internet and email, it is not possible to connect with both domestic and international customers. He adds that all customers are registered in the company's ERP, and each customer is coded accordingly. Similarly, each vendor is also registered and coded in the ERP. The respondent states that ICT helps to track every business activity like orders, location of sales personnel, number of products sold, amount of cash received, etc.

However, Respondent 2 does believe that the use of ICT will not provide a competitive advantage to the company over its rival companies. This was because, ICT is a basic set -up to connect with the international market. Further, the company is using ICT, not because of competitors, but for the requirement of the business. However, the respondent did mention that ICT helps the company in getting information about its competitors in the foreign market.

Earlier, the company had its own e-commerce website through which it used to sell its products online directly to the customers. However, at the time of the interview, the company had stopped using its e-commerce interface and was selling its products

online through third-party e-commerce websites. The main reason for this switchover, according to Respondent 2, was that the company noticed that most of the customers preferred to purchase their products through third-party e-commerce websites such as Amazon and BigBasket.

The respondent mentioned that the company sells the same products in both domestic and foreign markets. However, in the case of foreign countries, sometimes depending on geographical condition and the taste and preference of the customers, the company customizes the products. The company is certified by the British Retail Consortium (BRC), a must for exporting to countries like the UK, Australia, and the USA. The company also has Hazard Analysis and Critical Control Points (HACCP) and Halal certificates. Perhaps, these certificates, apart from ICT technology, help the company to improve its export performance.

The company maintains separate funds related to export in the yearly budget, which includes export manager's salary, travel expenses, geographical promotion expenses, on-store promotion activities, etc. Respondent 2 believes that there is competition from large companies within India and abroad. The respondent believes that the company can compete against large competitors in both the markets, and states that although the company's product has high demand overseas, it is focusing more on the Indian market since the company has large domestic market share compared with the international market.

Table 4.6 presents the comparative analysis of the above three case studies for a quick understanding of the case studies' findings.

Table 4.6: A comparative analysis of the findings of the three case studies

Name of the Company	**Company A**	**Company B**	**Company C**
Profile	Small-sized private limited. Manufacturer of ready-to-cook millet	Large-sized private limited. Manufacturer of wheat related products.	Medium-sized private firms. Manufacturer of cookies.

		products mix.		
Level of Investment in ICT		Invested in basic level ICT.	Invested in basic and intermediate level ICTs.	Invested in basic to intermediate level ICTs.
TOE Framework	**Technological Context**	**PRA:** The use of ICT helps the firm to manage business operations efficiently and to complete the tasks quickly. **PC1:** The present ICT is compatible with business operations since the necessary ICT infrastructures are installed at the incorporation stage. **PC2:** The present level of ICT is not complex to understand and	**PRA:** The use of ICT has benefited the firm in several ways. It also reduced communication errors which used to happen through the phone. **PC1:** The present ICT is compatible with the current business processes and hardware infrastructure. The company uses customised ICT as per the prevailing resources and business processes of the	**PRA:** ICT provided more scope for transparency in the data exchange against manual business processes. ICT helped the company to properly plan the production and distribution of its products. Reduced company's transaction costs by around 20 to 30 per cent. **PC1:** Purchased readily available ERP software and

		use. However, using a higher-level of ICT would be a challenge for the company.	company. However, there is a compatibility issue as the respondent stated that the company facing a significant challenge to feed the data accurately into the ERP system. **PC2:** The cost of ICT investment is not high as the company uses a customized ICT. However, there is a complexity issue since the use of ICT like intermediate ICTs requires highly skilled labours which the company does not have at present.	customized it as per requirement. Hence, it is compatible with the company's business operations and existing infrastructures. **PC2:** The cost of installing and maintaining ICT is not high for the company. There is no complexity of ICT use as necessary training was given to the employees.

	Organizational Context	**TMS:** The respondent is well aware of the importance of ICT use in business operations and employee training benefits to use ICT efficiently. However, the company has not provided any formal training to its existing employees. **OR:** The company is not ready for further investment in ICT. Decided to invest more in ICT only after the company had reached a specific growth level.	**TMS:** The top management supports investment in customized ERP and encourages employees to use ICT and to attend seminars and training related to ICT. **OR:** The company has no separate funds to invest and maintain ICT. Invests in ICT on ad-hoc basis. It has two skilled employees who manage every business transactions with ICT.	**TMS:** The top management encourages the use of ICT. Running a business without ICT is difficult in the modern business environment. The management is willing to face any challenges for its successful adoption. **OR:** Maintains separate funds to invest in ICT and manage problems or changes caused by ICT adoption. Has separate IT department to manage the task

		Adopted an approach to invest in ICT on an ad-hoc basis.		of keeping the ICT up-to-date.
	Environmental Context	**CCS:** The company has no pressure from its suppliers and customers to adopt more complex ICT. Investment in ICT should be made based on one's business requirement and not by blindly copying other firms. **GS:** The company has taken support from the Government of India in its marketing efforts. The company has received no	**CCS:** The use of ICT is essential for business. Invested in ICT to improve its own business operations and not because of any pressure from its competitors, suppliers and customers. **GS:** The company has not received any help from the government to adopt ICT in the business. Financially strong to invest in ICT using its internal funds.	**CCS:** There is no pressure from competitors, customers, and suppliers to use ICT. The company uses ICT to run the business in an integrated way and to have data in a centralized place. However, there is perceived competitors pressure for ICT adoption since the company uses ICT and analytical tools gather

		financial support from the government to invest in ICT. The company is not ready to take any government loans due to limited knowledge of financial management.		information related to the market and competitors. **GS:** The company has no pressure and took no support from government agencies to use ICT. It uses its own funds to adopt ICT since it is the requirement for the business operations.
ICT's Impact on Export Performance		The company exports all types of instant breakfast mixes to U.S.A. and Dubai. The company has not yet noticed any impact of ICT on the export business.	Not directly involved in export. It sells its products to private traders, who then export the products. The company has no plan for direct export in	Exports its products to over 15 countries. Perceived that without ICT, it is not possible to connect with both domestic and international customers.

	However, expected a positive impact of ICT on the export performance in the future.	the near future since it is happy catering to the needs of the domestic customers.	The ICT helps the company in getting information about its competitors in the foreign market. It customizes the products according to the taste and preferences of its foreign customers. The company maintains separate funds to manage export related activities.

Note: PRA: Perceived Relative Advantage; **PC1**: Perceived Compatibility; **PC2**: Perceived Complexity; **TMS**: Top Management Support; **OR**: Organizational Readiness; **CCS**: Competitors, Customers, and Suppliers; **GS**: Government Support.

4.3. FURTHER DISCUSSIONS AND SUPPORTING CASES FROM SECONDARY DATA

The results of the two-step system GMM indicate that the firm's previous year investment in ICT, labour intensity, capital intensity, size of the firm, international exposure, and government intervention are significant factors in determining the food processing firms' investment in ICT. The coefficient on **LABI** is statistically

significant with positive sign in determining the firm's investment in ICT. Thus, the quantitative study supports the idea that firms require more skilled labour to invest and efficiently use ICT. This view is also supported by the in-depth case studies. All the respondents perceived that skilled labour is necessary to use ICT efficiently. Hence, Company B and Company C have trained their employees to use ICT in their business. However, due to financial constraints, Company A has not provided any formal training to its employees.

Further, there are instances in the secondary data sample that support this idea. For example, Rossell India Limited is one of the high labour-intensive firms in the secondary data sample that has invested in computer hardware and software to manage its business operations.[18] It is mentioned in the company's annual report that the company has invested on ICT to shift from two different points of sale software to integrated software. This has resulted in workforce efficiency in the output. The investment in technology and software has resulted in overall improvement in product quality and labour productivity, which has led to economies in cost. Thus, labour and their skills are necessary for the effective use of ICT in the firms.

The positive and statistically significant sign on the coefficient of **CAPI** in the econometric models explaining ICTI suggests that adequate capital investment is required to use ICT technologies. Often companies that have invested on automated production technologies have to invest on other complementary technologies like ICT software and services. Even from the case studies it is clear that Company C has invested in necessary infrastructure to make ICT compatible with its business operations. Company C has state-of-the-art-technology, namely, wire-cut technology, which helps the company to produce superior quality products for its consumers. Similarly, in the secondary data, Lotte India Corporation Limited (LICL), a capital intensive firm has used ERP software and provided necessary training to its employees to use the software productively.[19] According to the company's annual report, the investment in ERP software has helped the company to establish a connection between the head office, factory, and the zonal offices.

[18] http://www.rossellindia.com/2019/Annual%20Report%202018-2019.pdf
[19] https://lotteindia.com/pdf/Annual-Reports/AnnualReport_2010-11.pdf

In the case of variables representing organizational context, **SIZE** is the only variable whose coefficient is statistically significant with a positive sign in determining investment in ICT. This implies that larger firms favourably invest in ICT. Investment in ICT usually is accompanied by radical changes in business operations, which can be easily managed by large firms with experienced managers. Again, the impact of ICT investment is uncertain. It may affect the business operations of the firm favourably or adversely. Hence, due to uncertainty about investment in ICT, it can be risky for smaller firms to invest in it. However, larger firms can manage the risks associated with investment in ICT due to their strong financial position. Hence, larger firms can invest more in ICT compared with smaller firms.

This finding is also supported by the case studies in the present study. For example, Company A, which is a small firm, has invested only in basic ICT like computer systems and the internet. The owner is aware of the importance of ICT and is keen to invest in ICT, but finds it difficult to invest more in ICT due to the financial constraints. However, Company B and Company C are able to invest in intermediate level ICT like ERP along with basic level ICT due to their strong financial capability. Another example from the secondary data sample of the study is Britannia Industries Limited (BIL). BIL is a large sized firm with large ICT intensity. The company has invested in software like SAP to have efficient connections throughout the business processes. The company has automated its entire business processes.[20] [21] It has also provided online training to enable its employees to learn ICT at their own learning pace.[22] From these examples, one can understand that large food processing firms can support larger investment in ICT.

In the present study, **IE** has a positive effect on ICTI, which clearly suggests that internationally oriented firms in the food processing industry try to reduce their international transaction costs and distance barriers by connecting to their overseas supplier and customers through digital networks. Due to this, the use of ICT is considered as a basis for doing business around the clock across the world (Welge and Borghoff 2009).

[20] http://britannia.co.in/pdfs/annual_report/Annual-Report-2018-19.pdf
[21] http://britannia.co.in/pdfs/annual_report/Britannia_Annual_Report_2016-17.pdf
[22] http://britannia.co.in/pdfs/annual_report/Annual-Report-Britannia-2018.pdf

In the secondary data sample of this study, Global Green Company Ltd. (GGCL) of Avantha Group, an internationally active firm, uses customized decision support software for forecasting in its agribusiness (Ray, 2011). Even in the in-depth case studies, Company B has invested in advanced ICT compared with the other two food processing companies because the respondent of Company B perceive the use of ICT as necessary to have a business connection not only in the domestic market, but also in the international market.

The variable **GI** was another environmental context variable in the GMM method that was found to have a negative effect on ICTI. Thus, food processing firms that are producing sugar, a product sector that is regulated by the government, are less ICT intensive compared with other food processing firms. This suggests that firms may be reluctant to invest on ICT under controlled policy regimes.

With respect to the determinants of export performance, in line with the findings of some of the recent studies (for example Tyagi and Nauriyal, 2017), the present study also finds that the export behaviour of a firm is dynamic in nature. This implies that the previous experience of the firm in export business helps it to gain knowledge about the export market and better understanding of the international market and customer's demands. This builds confidence in exporting firms in the upcoming years. In the secondary data sample of the present study, there are firms like Bambino Agro Industries Limited, Global Green Company, Lotte India Corporation Limited, and Vippy Industries Ltd. that showed increasing trend in their export intensity.

The GMM results also show that investment in ICT, affiliation, government regulation, and import of raw materials are insignificant in determining the export performance of food processing firms. In fact, investment in R&D has a negative effect on export performance. However, introduction of additional interactive variables in the econometric models give specific insights with regard to the determinants of export performance in the food processing industry in India.

For example, although **ICTI** shows insignificant impact on the export performance of the firms, the interaction of **ICTI** with affiliation (**AFF×ICTI)** is found to be significant with a positive sign in explaining the export performance of food

processing firms. The positive sign on the coefficient of **AFF×ICTI** implies that higher ICT intensity in firms, which are affiliated to either multinationals or business groups result in better export intensity. The affiliated firms generally benefit from their parent firm's production technologies, marketing knowledge, R&D, and reputation in the capital market. This improves the ability of the affiliated firms to invest in technological activities like ICT. Further, as explained earlier, managers of affiliated firms often act as stewards who work towards the success of the organization and undertake risky technological investments that give high returns to the firms, if successful (Komera et al., 2017). Thus, the present study supports the view that affiliated firms, due to their access to abundant resources and stewardship behaviour of managers, invest better in ICT and perform better in the international market.

In the case of Company C, the importance of past affiliation to foreign firm was still evident. The firm was a subsidiary of a foreign firm when the state-of-the-art technology of the firm was set-up by its foreign parent firm. Even today, the company regularly invests in ICT to run its business efficiently. The firm has a separate IT department to manage IT-related activities. The company still believes that the digital platform is one of the effective ways to build relationships with customers. The company, with the help of ICT, is efficiently connecting to international customers and exporting its products to more than fifteen countries. Both the respondents of Company C perceived that the use of ICT has helped the company to achieve success in both the domestic and the international market.

Another example from the secondary data sample is of the Andrew Yule & Co. Ltd., an affiliated firm, which is into tea manufacturing business. The company has invested in the necessary IT systems and software to manage daily business activities and trained its employees for the efficient use of IT systems and software. The company has an online buying facility on its website, where consumers can directly buy their choice of tea. The company is exporting its varied tea products to Eastern Europe, United States, and the Commonwealth of Independent States (CIS).[23] Thus,

[23] http://www.andrewyule.com/rti/Annual_Report_2018_19.pdf

affiliated firms can be more ICT investment intensive as it can help achieve better export performance.

Similarly, the interaction between **ICTI** and **GI,** that is, **GI×ICTI** is also statistically significant, albeit with a negative sign. This implies that firms operating in government intervened food processing sectors not only have lower ICT investments, but also that whatever ICT investments are undertaken are likely to be focused more on domestic market expansion rather than on international market expansion. As mentioned earlier in the present study, government intervention is represented by the proxy dummy variable, namely, sugar manufacturing firms, since the supply chain activities of the sugar sector is highly intervened and regulated by the government in India. The decision concerning the export of sugar depends on domestic availability and prices. Also, international policies like the export ban on sugar vary as per the situations in the domestic market. There is also restriction on the quantity that sugar manufacturing firms can export into the international market. Due to these government interventions and regulations, sugar manufacturing firms are unable to enter and operate in the export market freely. Therefore, these firms may focus more on the large domestic market rather than the export market. For example, there are very few sugar manufacturing firms like Bannari Amman Sugars Ltd., D C M Shriram Inds. Ltd., Dalmia Bharat Sugar & Inds. Ltd., Dhampur Sugar Mills Ltd., and Shree Renuka Sugars Ltd. that are regularly exporting for the past seven years in the sample of the present study. Thus, it can be understood from the results that in the present study, that firms which are operating in the product sector that are highly intervened and regulated by the government are not only reluctant to invest on technologies like ICT, but are also less likely to export.

Among the common control variables, age of the firm (**AGE**) is found to be significant in determining the export performance of the firm. The negative sign on **AGE** indicates that younger food processing firms are more export intensive than older firms. Younger firms may find the domestic market to be over-crowded, and hence explore vast overseas market as a strategy to survive. Furthermore, the plant and machinery of younger firms are naturally closer to state- of- the- art, which is an added benefit against older firms to attract overseas clients (Bhaduri and Ray 2004).

Hence, younger firms can export better than older firms, and the same is confirmed in the present study too.

It is evident from the GMM results for the **CAPLAB** variable that the labour-intensive food processing firms are more export intensive compared with capital-intensive ones. The labour and their skills are an important resource of the firms, which provide a competitive advantage and cannot be easily imitated by the competitors. Firms need to have specialized skilled labour to manage the presence of uncertainties in the international market. As such, food processing firms in a labour-abundant country like India prefer to use labour-intensive technologies to have lower operating costs. Hence, the adoption of labour-intensive production techniques allows these firms to perform better in the export market by enhancing their ability to offer products at competitive prices. Of course, the firms also need to analyse the global markets and changing global customer demands, which only employees with appropriate skills can do. Hence, the labour and their skills are essential for firms to export in the international market.

Unlike earlier empirical studies on export performance of firms, in the present study, in-house R&D intensity (**RDI)** was statistically significant with a negative sign in explaining the export intensity of food processing firms. This indicates that food processing firms that have invested in innovative activities like R&D are less export intensive and seem to be more domestic market oriented. However, as the variable **IRAW×IRDI** is significant with a positive sign on its coefficient, there is some indication that food processing firms might be using the IAT strategy to successfully export their food products in the international market. In the IAT strategy in the present study, the firms seem to be importing technology in the form of raw materials and then investing in some adaptive R&D. The IAT strategy is commonly used in developing countries like India. Although, three decades earlier, Siddharthan (1992) stated that very few firms in India undertake innovative activities to create new products and processes, nevertheless it is possible that food processing firms import raw materials and adapt their processes to produce products that meet the quality of the international market. Perhaps the firms are putting in efforts to produce innovative

products that suit the needs of the time constrained and health conscious customers in the international market.

In the secondary data sample of the present study, food processing firms like A D F Foods Ltd., Andrew Yule & Co. Ltd., Britannia Industries Ltd., and Goodricke Group Ltd. are some of the firms that have invested in innovative research activities and imported raw materials to cater to the needs of their clients all over the world. A D F Foods Ltd. is into the manufacturing of a variety of pickles and ready-to-eat products that appeal to the taste of Indians, the Non-resident Indians (NRIs) and other global consumers.[24] The company performs R&D activities to develop new recipes, new products, enhance food quality, and improve and standardize the packaging of the products. Edible oil, especially olive oil, is one of the important raw materials for the firm. A D F Foods Ltd. imports olive oil from other countries, apart from sourcing from within India. The company exports its products to over 52 countries like North America, Europe, Middle East, South Africa, Australia, New Zeland, and Asia. The company believes that investment in R&D activities has resulted in improved customer satisfaction, introduction of new brands and products, adherence to international quality norms, improvement of exports, and reduced costs on packing. Thus, there is evidence that firms in this industry import raw materials and supply finished products all over the world.

Summary

Chapter 4 presents the results of the present study. The results of Research Objective 1 and Research Objective 2 of the study, which are based on secondary data and use the two-step system GMM technique, are presented first. This is followed by the insights gained from the qualitative study, that is, the findings of the case studies for Research Objective 3. In the final section, the study discusses the findings of the study based on quantitative and qualitative techniques and provides some more evidences from the secondary data to understand the factors that determine ICT investments and the export performance of firms in the food processing industry in India.

[24] https://www.adf-foods.com/wp-content/uploads/2019/08/29th-Annual-Report-2018-19.pdf

CHAPTER 5

CONCLUSIONS AND IMPLICATIONS

5.1 SUMMARY OF THE FINDINGS AND CONCLUSIONS

The section summarizes the findings of the present study with respect to the factors determining investment in ICT and its impact on the export performance of food processing firms in India. The chapter also gives the contributions of the study, policy suggestions, limitation of the study, and future research directions.

Information and communication technology has become an integral part of business due to its rapid development. Many researchers from developed and developing countries concur that the use of ICT helps firms to manage business operations smoothly. Business firms can use ICT as one of the strategies to survive and compete in the present globalized world. They can manage their resources with the help of ICT and thereby, perform the operations quickly and accurately. However, there are limited studies on factors affecting ICT investment and its effect on the performance of firms in the context of developing countries. Hence, there was an impending need to understand the importance of ICT use and its impact on firm performance, particularly in the context of the food processing industry in developing countries such as India.

Therefore, the present study was undertaken to fill the first gap identified in the literature. The study used both quantitative and qualitative techniques to study ICT investments and its impact on export competitiveness in the case of a low-tech but priority sector industry in India, the food processing industry. Accordingly, the objectives of the present study were to identify the factors that determine the investment in ICT and its impact on the export performance of food processing firms in India using quantitative research method. To supplement the findings of the quantitative study, the present study also employed qualitative research method and tried to understand the perceptions of the owners/managers regarding ICT investments in the food processing industry.

The study used three important paradigms/theories/frameworks, namely, structure-conduct-performance (SCP) paradigm, technology-organization-environment (TOE) framework, and resource-based view (RBV) as theoretical background of the study. Although there are limited studies on the determinants of ICT and its effects on the performance of firms in the context of India, the present study carried out an extensive literature review of related studies in other countries and industries to identify explanatory variables for the present study. Thus, the present study tried to fill the second research gap by including some rare and unconventional variables like the firm's liquidity position, international exposure, and government intervention along with commonly used variables in the econometric specifications related to the first two objectives.

To achieve the research objectives of the present study, data was collected from the Prowess database for the period from 2012 to 2018. The study adopted the generalized method of moments (GMM) econometric technique to analyse the data for Objectives 1 and 2. The statistical results of the system GMM techniques clearly indicated the dynamic aspect in ICT investment behaviour and export performance. Thus, the present study filled the third research gap and confirmed that both ICT investments and export performance are influenced by the past experiences of the firm. While in the case of ICT investment, the experience in the previous year was relevant, in the case of export performance, the experiences in the past two years influenced the current export behaviour of the food processing firms in India. Even the case studies suggested that in general, firms are willing to invest more and more on latest ICT when their past experiences with ICT investments are encouraging.

The study tried to bridge the fourth research gap in the existing literature by specifically introducing ICT intensity and its interactive terms in the econometric models determining export performance of the food processing firms in India. Furthermore, the present study also conducted case studies to understand the perceptions of the owners/managers of the food processing firms regarding the role of ICT in the industry and its relevance for improving the performance in the food processing firms. Thus, the study addressed the fifth gap in the existing literature and

used in-depth case studies to add to the literature on the relevance of ICT to the food processing industry in India.

Based on the results of the System GMM method concerning Research Objective 1 and the insights drawn from the qualitative studies, the present study concluded that most of the variables considered in the present study turned out to be important in determining the ICT intensity of the firms. Both the factors proposed under technological context, namely, labour intensity and capital intensity are important in favourably determining ICT investments in firms. Among the factors considered under organizational context, only size of the firm was relevant to some extent in determining ICT investments. Both the variables under environmental context, namely, international exposure and government intervention were statistically significant, but with opposite effects in determining ICT intensity of the firms.

Thus, the study supports the view that investment in ICT generally demands skilled labour and infrastructure support to use the technology efficiently in the business processes. As such, firms that recruit and pay well their trained skilled employees invest higher amounts on ICT related technologies. Likewise, firms that invest on various plants and machinery to automate their production process invest on complementary general purpose technologies like ICT that can increase the efficiency of the firm's operations. Again, the study supports the view that only a large firm will be in a position to afford investments on various complementary infrastructures like electrical connections and buildings that are needed to support ICT investments. In the present era of globalization and digitalization, it is not surprising that firms that connect to their overseas suppliers and customers are more ICT intensive. Further, excessive government regulations and interventions can make the investment scenario uncertain for the firms, resulting in relatively lower investments on general purpose technology such as ICT. On the whole, past ICT investment experience has a direct influence on current ICT investment behaviour of the firms in this industry.

Based on the results of the system GMM method concerning Research Objective 2 and the insights drawn from the qualitative studies, the present study concluded that as such ICT investments has no significant effect on the export performance of firms

belonging to the food processing industry in India. However, affiliated firms, with the support of their parent firms, seem to be investing on risky technological activities like investment in ICT, which must be helping the affiliated firms to achieve better export performance. Further, the present study supports the view that ICT enables firms to build and sustain their association with their suppliers and clients all over the world, sometimes even after breaking away from a large conglomerate. In contrast, in the food processing product sector, where the government regularly intervenes to control the prices and export behaviour, the firms make use of the ICT investments to expand their business in the domestic market itself. Some of the other structure and conduct variables that have turned out to be statistically significant in affecting the export performance of the food processing firms in the present study are age of the firm, capital-labour ratio, and R&D intensity. The study supports the view that younger firms may find it difficult to penetrate the stronghold of well-established food product brands in India and find foreign markets to be more lucrative. Furthermore, by using more labour intensive production technology, food processing firms from India are able to provide global quality products at competitive prices in the overseas markets.

The unexpected finding in this study is that food processing firms that have significantly invested in R&D activities are less export-intensive. It is possible that food processing firms are investing on R&D to fulfil the changing food preferences and demands of their customers in India. These customers could either be the final consumers of the food products in India or, as is evident from the case studies, the customers could be intermediate e-commerce businesses and other large food companies that procure products from these firms and sell them all over the world. Hence, although the R&D undertaken is to make the food products at par with the global standards, the sales are higher in the domestic market through business-to-business mode of transactions. However, food processing firms that are carrying out in-house R&D with high investment on imported raw materials are found to be export intensive in the study. These food processing firms are perhaps following the import and adapt strategy to efficiently cater to the demands of the international market. Thus, food processing firms in India import raw materials of international quality and

create innovative products that are appealing to consumers in the overseas markets. Again, the past experiences of the firms in the overseas market have significant effect on the current export performance confirming the dynamic nature of export behaviour.

With respect to Research Objective 3 of the study, the following conclusions can be drawn. Food processing firms are using ICT to manage their daily business operations like production planning, product delivery, purchase, store, sales, and warehouse. ICT is also being used to collect information about the market, competitors, and customers and to interact with their trade partners, often other domestic firms. Advanced ICT software like ERP systems are either completely developed in-house or customized from generic ones to suit the needs of the firm's business operations.

Nevertheless, firms are dependent on third-party e-commerce giants like Amazon, Flipkart, BigBasket, and Grofers to sell their food products via online mode. Third-party e-commerce websites that have strong logistic and distribution networks act as food product aggregators and are able to sell the food products online to customers all over the world in a cost effective way.

With respect to factors that may negatively affect ICT adoption, poor management of finance is a possible deterrence to ICT investments in younger small firms like Company A, and lack of flexibility can be a hindrance for advanced ICT investments in older large firms like Company B. In younger firms, due to financial constraints, the firms may not be willing to give formal training to employees, which is essential for advanced ICT tools. Hence, only financially stable companies like Company C with dedicated departments and budget allocation for various business activities and strong network connections can afford to invest on regular procurement of advanced ICT as well as training of its employees for successful ICT adoption.

The environment context of the firm, especially with regard to competitors and trade partners, has an influence on the decision of the firms to adopt ICT. Hence, the respondents invariably perceived that the use of ICT is essential to efficiently manage the business activities in the firm. However, the firms have not asked for any support from the Government of India to invest on ICT or for ICT related employee training.

In fact, the respondents have no awareness about the schemes related to ICT adoption such as the Promotion of Information & Communication Technology (ICT) in Indian MSME, which was introduced by the Government of India. This shows a lack of connection between food processing firms and the Government of India, which needs to be addressed.

5.2 CONTRIBUTION OF THE STUDY

The present study contributes to the ICT adoption literature and export literature, specifically in developing countries. The study examines the determinants of investment in ICT and its impact on firms' export performance in the context of India. Moreover, the study focused on India's important sector: the food processing industry, which is ignored largely in earlier research. The present study's findings support that ICT adoption is important across different countries and different industry sectors. The study also examines firms' dynamic behavior about investment in ICT and export performance, which has less consideration in the earlier research study. Thereby, the present study's findings highlight the significance of the dynamic behavior of the firm's investment in ICT and export performance.

The study used three theories, namely, the SCP paradigm, TOE framework, and RBV theory. Many previous studies have adopted the RBV theory at the firm-level. However, very few studies have considered the other two theories: the SCP paradigm and TOE framework at firm-level studies, particularly in India's context. The use of these theories helps to understand the impact of structural variables (technological, organizational, and environmental) on the firm's conduct variable (investment in ICT) and its impact on the firm's performance variable (export).

The present study used qualitative and quantitative techniques to produce a richer and more comprehensive understanding of the research area. The use of combined research methodology in the present study helped to understand the manager's perception regarding investment in ICT and the purpose of using ICT in food processing firms' business operations. Further, the study used a generalized method of moments (GMM) econometric method, which is adopted less in developing countries in technology management research. The GMM method addresses the endogeneity,

heteroscedasticity, and autocorrelation problem that is likely to be present in the datasets. The method also helps to understand the dynamic behavior of the investment in ICT and export performance of the firms.

5.3 POLICY IMPLICATIONS OF THE STUDY

To the best of the researcher's knowledge, there are no studies in the context of the food processing industry in India that has analysed ICT adoption and its effect on export performance by utilizing both quantitative and qualitative techniques. Further, the study supports the idea that managers in the affiliated food processing firms, as against the ones in unaffiliated firms, act as stewards and are motivated towards the achievement of the firm's goals rather than individual goals. Hence, the managers of affiliated food processing firms support investments in risky ICT investments to improve the export performance of the firms. This is evident in both the quantitative and the qualitative analyses.

Overall, it is evident that small firms are less ICT investment intensive as they have limited resources to build necessary IT infrastructure and to have skilled labour for successful ICT adoption. These firms are unaware of the ICT adoption related scheme, namely, the Promotion of Information & Communication Technology (ICT) in Indian MSME and reluctant to take support from the Government of India for ICT adoption. Though there are schemes by the Government of India to aid the food processing firms in upgrading production technology, there are hardly any schemes targeted at the adoption of ICT in the food processing firms. However, as various studies in other countries have found that ICT adoption has benefited even food processing firms, food processing firms in India should also take advantage of the latest ICT tools to produce quality products through efficient processes. The government can help in this regard by promoting policies and schemes that encourage small and younger food processing firms to invest in ICT and become globally competitive. The support could be monetary to encourage purchase of new ICT tools or could be provision of training facilities to acquire relevant ICT as well as other managerial skills or could be joint R&D efforts with ICT professionals to develop customized software for the food processing industry. With the help of appropriate

support, the export oriented young food processing firms can export higher volumes of quality food products at competitive prices in the international market.

ICT involves continuous changes and up-gradations, and hence there is need to retrain employees regularly to work comfortably with ICT. The case studies in the present research work revealed the need to educate the owners and managers of food processing firms, especially the smaller ones, regarding the importance of formal training to enhance the ICT skills of their employees. The Government of India and IT professionals can organize workshops and seminars specifically aimed at managers and owners of food processing firms to help them understand the process of integrating latest ICT with their automated production technologies more efficiently and effectively.

There is evidence that government interventions and controls can hamper the adoption of ICT as well as the export performance in the food processing industry. The sugar manufacturing subsector in India is highly intervened and regulated by the government. Often there are quantity restrictions on sugar exports invariably imposed by the government based on domestic demand and supply of sugar. Due to these reasons, the Indian sugar manufacturing firms are not only investing less on ICT, but are also unable to export much in the international market. Hence, government intervention and control needs to be reduced in this sector to encourage ICT adoption and to enhance export performance in this subsector.

Innovation in the food processing industry is important to meet the ever-changing demands of customers. Further, innovation in the food processing industry enhances the quality, shelf life, and safety of the food products. However, the present study shows that R&D intensive food processing firms have failed to achieve better export performance. It is not easy for every food processing firm, particularly in developing countries, to fulfil the demands of the international market. This can be due to the high cost associated with meeting the food standards of the international market. Further, the food standards often involve continuous changes due to improved food processing technologies and scientific knowledge with regard to health hazards

(Athukorala and Jayasuriya 2003). Hence, food processing firms in developing countries like India may find it challenging to meet international food standards.

Rahmat et al. (2016) noted that in developing countries the food processing industry should try to identify the food safety standard that suits the production techniques prevailing in their own country and the country where the food products can be exported. The findings of the present study suggest that the import and adapt technology strategy can be relevant in this context. The food processing firms in India can try to identify a suitable overseas market with quality standards at par with quality standards achievable in India. Then, using appropriate R&D on the imported raw materials, the companies can provide products that are suited to the taste and preferences of the consumers in the destination countries.

Again, the findings in the present study highlight the need for the government to increase its efforts towards creating awareness about its policies and schemes among potential beneficiaries. The government can frequently conduct training programmes and seminars, perhaps in collaboration with other suitable government funded agencies, to disseminate information among the food processing firms. The government can also put in efforts to advertise its schemes and policies during the trade fairs and other such events where large numbers of small and young food processing firms gather.

Finally, with digital technologies getting integrated into dining experiences (Spence and Piqueras-Fiszman, 2013), and big data technology gaining importance in the food and agriculture sector (Bronson and Knezevic, 2016), there is an impending need to organize more workshops and training programmes for food processing firms in developing countries like India to create awareness and impart skills for successful adoption of fourth generation ICT tools and to sustain global competitiveness.

5.4 LIMITATIONS AND FURTHER RESEARCH

The result of the present study is based on a sample extracted from a secondary source, namely, the Prowess database. Although the database is considered as an indispensable source to understand the performance of active business enterprises in

India, some companies, especially the micro and small ones, are not part of the Prowess database. The present study adopted the TOE framework; however not all TOE factors are included due to lack of availability of the required data. Due to lack of favourable response, the present study could conduct in-depth case studies in only three food processing firms.

Future research can replicate and/or extend the present study in the context of food processing firms in other developing countries. To have a holistic understanding of the effects of ICT investments on the overall performance of food processing firms, other performance indicators like domestic sales and profits can also be included along with export performance in future research.

REFERENCE

Abri, A. G. and Mahmoudzadeh, M. (2015). "Impact of information technology on productivity and efficiency in Iranian manufacturing industries." *Journal of Industrial Engineering International*, 11(1), 143-157.

Acquaah, M. and Chi, T. (2007). "A longitudinal analysis of the impact of firm resources and industry characteristics on firm-specific profitability." *Journal of Management & Governance*, 11(3), 179-213.

Adams, W. C. (2015). "Conducting semi-structured interviews." *Handbook of practical program evaluation*, K. E. Newcomer, H. P. Hatry, and J. S. Wholey, John Wiley & Sons, USA, 492-505.

Aggarwal, A. (2002). "Liberalisation, multinational enterprises and export performance: evidence from Indian manufacturing." *Journal of Development Studies*, 38(3), 119-137.

Aggarwal, R. and Zong, S. (2002). "Internal cash flows and corporate investment decision." *Innovations in Investments and Corporate Finance*, 73-92.

Aghaei, M. and Rezagholizadeh, M. (2017). "The impact of information and communication technology (ICT) on economic growth in the OIC countries." *Economic and Environmental Studies*, 17(2), 255-276.

Agrifoglio, R., Cannavale, C., Laurenza, E. and Metallo, C. (2017). "How emerging digital technologies affect operations management through co-creation: empirical evidence from the maritime industry." *Production Planning & Control*, 28(16), 1298-1306.

Ahmad, S. Z., Abu Bakar, A. R., Faziharudean, T. M. and Mohamad Zaki, K. A. (2015). "An empirical study of factors affecting e-commerce adoption among small- and medium-sized enterprises in a developing country: evidence from Malaysia." *Information Technology for Development*, 21(4), 555-572.

Akkerman, R. and Donk, D. P. V. (2008). "Development and application of a decision support tool for reduction of product losses in the food-processing industry." *Journal of Cleaner Production*, 16, 335-342.

Alam, A., Uddin, M. and Yazdifar, H. (2019). "Institutional determinants of R&D investment: evidence from emerging markets." *Technological Forecasting & Social Change*, 138, 34-44.

Albadvi, A., Keramati, A. and Razmi, J. (2007). "Assessing the impact of information technology on firm performance considering the role of intervening variables:

organizational infrastructures and business processes reengineering." *International Journal of Production Research*, 45(12), 2697-2734.

AlBar, A. M. and Hoque, M. R. (2017). "Factors affecting the adoption of information and communication technology in small and medium enterprises: a perspective from rural Saudi Arabia." *Information Technology for Development*, 25(4), 715-738.

Alderete, M. V. and Gutiérrez, L. H. (2014). "Drivers of information and communication technologies adoption in Colombian services firms." *International Journal of Business Information Systems*, 17(4), 373-397.

Al-Gharbi, K. and Ashrafi, R. (2010). "Factors Contribute To Slow Internet Adoption in Omani Private Sector Organizations." *Communications of the IBIMA*, 2010, 698412, IBIMA Publishing.

Ali, J. and Kumar, S. (2011). "Information and communication technologies (ICTs) and farmers' decision-making across the agricultural supply chain." *International Journal of Information Management*, 31, 149-159.

Al-Jabri, I. M. and Sohail, M. S. (2012). "Mobile banking adoption: application of diffusion of innovation theory." *Journal of Electronic Commerce Research*, 13(4), 379-391.

Anand, A. and Kulshreshtha, S. (2007). "The B2C adoption in retail firms in India." *Second International Conference on Systems (ICONS'07), IEEE*, Martinique, France, 46-46.

Andersen, T. J. and Segars, A. H. (2001). "The impact of IT on decision structure and firm performance: evidence from the textile and apparel industry." *Information & Management*, 39, 85-100.

Andren, T. (2007). *Econometrics*. Thomas Andren & Ventus Publishing ApS.

Angulo-Ruiz, F., Pergelova, A. and Wei, W. X. (2018). "How does home government influence the internationalization of emerging market firms? the mediating role of strategic intents to internationalize." *International Journal of Emerging Markets*, 14(1), 187-206.

Apulu, I., Latham, A. and Moreton, R. (2011). "Factors affecting the effective utilisation and adoption of sophisticated ICT solutions: case studies of SMEs in Lagos, Nigeria." *Journal of Systems and Information Technology*, 13(2), 125-143.

Arellano, M. and Bond, S. (1991). "Some tests for specification for panel data: Monte Carlo evidence and an application to employment equations." *The Review of Economic Studies*, 58(2), 277-297.

Arellano, M. and Bover, O. (1995). “Another look at the instrumental variable estimation of error-components models.” *Journal of Econometrics*, 68(1), 29-51.

Arpanutud, P., Keeratipibul, S., Charoensupaya, A. and Taylor, E. (2009). “Factors influencing food safety management system adoption in Thai food-manufacturing firms: model development and testing.” *British Food Journal*, 111(4), 364-375.

Arvanitis, S. and Ley, M. (2013). “Factors determining the adoption of energy-saving technologies in Swiss firms: an analysis based on micro data.” *Environmental and Resource Economics*, 54, 389-417.

Ashrafi, R., Sharma, K. S., Al-Badi, A. and Al-Gharbi, K. (2014). “Achieving business success through information and communication technologies adoption by small and medium enterprises in Oman.” *Middle-East Journal of Scientific Research*, 22(1), 138-146.

Athukorala, P. C. and Jayasuriya, S. (2003). “Food safety issues, trade and WTO rules: a developing country perspective.” *World Economy*, 26(9), 1395-1416.

Athukorala, P., Jayasuriya, S. and Oczkowski, E. (1995). “Multinational firms and export performance in developing countries: some analytical issues and new empirical evidence.” *Journal of Development Economics*, 46(1), 109-122.

Atkinson, R. and Flint, J. (2004). “Snowball sampling.” *The SAGE encyclopedia of social science research methods*, M.S. Lewis-Beck, A. Bryman, and T.F. Liao, SAGE Publications, Inc., California, 1043-1044.

Avgerou, C. (1998). “How can IT enable economic growth in developing countries?” *Information Technology for Development*, 8(1), 15-28.

Awa, H. O. and Ojiabo, O. U. (2016). “A model of adoption determinants of ERP within T-O-E framework.” *Information Technology & People*, 29(4), 901-930.

Awa, H. O., Ojiabo, O. U. and Emecheta, B. C. (2015). “Integrating TAM, TPB and TOE frameworks and expanding their characteristic constructs for e-commerce adoption by SMEs.” *Journal of Science & Technology Policy Management*, 6(1), 76-94.

Awa, H. O., Ojiabo, O. U. and Orokor, L. E. (2017). “Integrated technology-organization-environment (TOE) taxonomies for technology adoption. *Journal of Enterprise Information Management*, 30(6), 893-921.

Awa, H. O., Ukoha, O. and Emecheta, B. C. (2016). “Using T-O-E theoretical framework to study the adoption of ERP solution.” *Cogent Business & Management*, 3(1), 1-23.

Ayan, T. Y. and Percin, S. (2005). “A structural analysis of the determinants of export performance: evidence from Turkey.” *Innovative Marketing,* 1(2), 106-120.

Azadegan, A. and Teich, J. (2010). “Effective benchmarking of innovation adoptions: a theoretical framework for e-procurement technologies.” *Benchmarking: An International Journal*, 17(4), 472-490.

Azam, M. S. (2015). “Diffusion of ICT and SME performance.” *E-services adoption: Processes by firms in developing nations, Advances in business marketing and purchasing*, Emerald Group Publishing Limited, 23(A), 7-290.

Bagale, G. S. (2014). “Determinants of E-commerce in Indian MSME sector: a conceptual research model based on TOE framework.” *Universal Journal of Management,* 2(3), 105-115.

Bahrini, R., and Qaffas, A. A. (2019). “Impact of information and communication technology on economic growth: evidence from developing countries.” *Economies*, 7(1), 1-13.

Bain, J. S. (1951). “Relation of profit rate to industry concentration: American manufacturing, 1936–1940.” *The Quarterly Journal of Economics*, 65(3), 293-324.

Baker, J. (2012). “The technology-organization-environment framework.” *Information Systems Theory*, Springer, New York, 231-245.

Baldwin, J. R., Sabourin, D. and Smith, D. (2004). “Firm performance in the Canadian food processing sector: the interaction between ICT, advanced technology use and human resource competencies.” *The economic impact of ICT: Measurement, evidence and implications*, Organisation for Economic Co-operation and Development (OECD), 153-81.

Baltagi, B. (2005). *Econometric analysis of panel data*, John Wiley & Sons, England.

Baltagi, B. H. (2011). *Econometrics*. Springer, Berlin, Heidelberg.

Baltagi, B. H. (2015). *The Oxford handbook of panel data*. Oxford Handbooks, New York.

Barney, J. (1991). “Firm resources and sustained competitive advantage.” *Journal of Management,* 17(1), 99–120.

Basu, S. and Fernald, J. (2004). “Information and communications technology as a general-purpose technology: evidence from US industry data.” *German Economic Review*, 8(2), 146-173.

Bayo-Moriones, A., Billon, M. and Lera-Lopez, F. (2013). “Perceived performance effects of ICT in manufacturing SMEs.” *Industrial Management & Data Systems*, 113(1), 117-135.

Beckinsale, M., Levy, M. and Powell, P. (2006). “Exploring internet adoption drivers in SMEs.” *Electronics Markets*, 16(4), 361-370.

Benitez, J., Chen, Y., Teo, T. S. H. and Ajamieh, A. (2018). “Evolution of the impact of e-business technology on operational competence and firm profitability: a panel data investigation.” *Information & Management*, 55, 120-130.

Bhaduri, S. and Ray, A. S. (2004). “Exporting through technological capability: econometric evidence from India's pharmaceutical and electrical/electronics firms.” *Oxford Development Studies*, 32(1), 87-100.

Bhagwat, R. and Sharma, M. K. (2007). “Information system architecture: a framework for a cluster of small- and medium-sized enterprises (SMEs).” *Production Planning & Control*, 18(4), 283-296.

Bharadwaj, A. S. (2000). “A resource-based perspective on information technology capability and firm performance: an empirical investigation.” *MIS Quarterly*, 24(1), 169-196.

Bhardwaj, S. (2013). “The dynamics of food processing industries in India: an economic investigation.” Master of Science thesis, Indian Agricultural Research Institute, New Delhi, India.

Bhaskaran, S. and Gligorovska, E. (2009). “Information communication technology adoption by small-to-medium-sized food enterprises in Australia.” *International Journal of Enterprise Network Management*, 3(4), 332-346.

Bhat, S. and Narayanan, K. (2009). “Technological efforts, firm size and exports in the basic chemical industry in India.” *Oxford Development Studies*, 37(2), 145-169.

Bhat, S. and Narayanan, K. (2011). “Technology sourcing and outward FDI: comparison of chemicals and IT industries in India.” *Transnational Corporations Review*, 3(2), 50-64.

Bhatt, G. D. and Grover, V. (2005). “Types of information technology capabilities and their role in competitive advantage: an empirical study.” *Journal of Management Information Systems*, 22(2), 253-277.

Bianchi, C. and Mathews, S. (2016). “Internet marketing and export market growth in Chile.” *Journal of Business Research*, 69(2), 426-434.

Billor, N., Hadi, A. S. and Velleman, P. F. (2000). "BACON: blocked adaptive computationally efficient outlier nominators." *Computational Statistics & Data Analysis*, 34(3), 279-298.

Blind, K., Petersen, S. S. and Riillo, C. A. F. (2017). "The impact of standards and regulation on innovation in uncertain markets." *Research Policy*, 46, 249-264.

Blundell, R. and Bond, S. (1998). "Initial conditions and moment restrictions in dynamic panel data models." *Journal of Econometrics*, 87(1), 115-143.

Bocquet, R. and Brossard, O. (2007). "The variety of ICT adopters in the intra-firm diffusion process: theoretical arguments and empirical evidence." *Structural Change and Economic Dynamics*, 18(4), 409-437.

Bocquet, R., Brossard, O. and Sabatier, M. (2007). "Complementarities in organizational design and the diffusion of information technologies: an empirical analysis." *Research Policy*, 36(3), 367-386.

Boothby, D., Dufour, A. and Tang, J. (2010). "Technology adoption, training and productivity performance." *Research Policy*, 39(5), 650–661.

Boyle, G. W. and Guthrie, G. A. (2003). "Investment, uncertainty, and liquidity." *The Journal of Finance*, 58(5), 2143-2166.

Brem, A. and Wolfram, P. (2014). "Research and development from the bottom up-introduction of terminologies for new product development in emerging markets." *Journal of Innovation and Entrepreneurship*, 3(9), 1-22.

Brigham, E. F. and Houston, J. F. (2015). *Fundamentals of financial management*, Cengage Learning, USA.

Bronson, K. and Knezevic, I. (2016). "Big data in food and agriculture." *Big Data & Society*, 3(1),

Bruque, S. and Moyano, J. (2007). "Organisational determinants of information technology adoption and implementation in SMEs: the case of family and cooperative firms." *Technovation*, 27, 241-253.

Campo, S., Rubio, N. and Yague, M. J. (2010). "Information technology use and firm's perceived performance in supply chain management." *Journal of Business-to-Business Marketing*, 17(4), 336-364.

Campos, P. F., Trucco, P. and Huatuco, L. H. (2019). "Managing structural and dynamic complexity in supply chains: insights from four case studies." *Production, Planning & Control*, 30(8), 611-623.

Canepa, A. and Stoneman, P. (2005). “Financing constraints in the inter firm diffusion of new process technologies.” *The Journal of Technology Transfer*, 30(1-2), 159-169.

Cao, Q., Jones, D. R. and Sheng, H. (2014). “Contained nomadic information environments: Technology, organization, and environment influences on adoption of hospital RFID patient tracking.” *Information & Management*, 51(2), 225-239.

Capasso, A., Gallucci, C. and Rossi, M. (2015). “Standing the test of time. Does firm performance improve with age? an analysis of the wine industry.” *Business History*, 57(7), 1037-1053.

Carney, M., Van Essen, M., Estrin, S. and Shapiro, D. (2018). “Business Groups reconsidered: beyond paragons and parasites.” *Academy of Management Perspectives*, 32(4), 493-516.

Castellacci, F. (2015). “Group Affiliation and Firms' Export Intensity: a Cross-Country Study.” *Review of Economics & Institutions*, *6*(1), 1-22.

Castiglione, C. and Infante, D. (2013). “ICT as general purpose technologies: a micro-econometric investigation on Italian firms.” *International Journal of Trade and Global Markets*, 6(3), 225-241.

Cecchini, S., and Scott, C. (2003). “Can information and communications technology applications contribute to poverty reduction? lessons from rural India.” *Information Technology for Development*, 10, 73-94.

Cerrato, D. and Piva, M. (2012). “The internationalization of small and medium-sized enterprises: the effect of family management, human capital and foreign ownership.” *Journal of Management & Governance*, 16(4), 617-644.

Cetin, B., Akpınar, A. and Ozsayın, D. (2004). “The use of information and communication technologies as a critical success factor for marketing in Turkish agri-food companies.” *Food Reviews International*, 20(3), 221-228.

Chang, S. J. and Choi, U. (1988). “Strategy, structure and performance of Korean business groups: a transactions cost approach.” *The Journal of Industrial Economics*, 37(2), 141-158.

Chau, P. Y. K. and Hui, K. L. (2001). “Determinants of small business EDI adoption: an empirical investigation.” *Journal of Organizational Computing and Electronic Commerce*, 11(4), 229-252.

Chau, P. Y. K. and Jim, C. C. F. (2002). “Adoption of electronic data interchange in small and medium-sized enterprises.” *Journal of Global Information Management*, 10(4), 61-85.

Chege, S. M., Wang, D. and Suntu, S. L. (2019). “Impact of information technology innovation on firm performance in Kenya.” *Information Technology for Development*, 1-31.

Childe, S. J. (2011). “Case studies in operations management.” *Production Planning & Control*, 22(2), 107-107.

Choi, J. Y., Kim, Y., Jun, Y. and Kim, Y. (2011). “A Bayesian multivariate probit analysis of Korean firms' information system adoption.” *Industrial Management & Data Systems*, 111(9), 1465-1480.

Chong, A. Y. L., Lin, B., Ooi, K. B. and Raman, M. (2009). “Factors affecting the adoption level of c-commerce: an empirical study.” *Journal of Computer Information Systems*, 50(2), 13-22.

Chowdhury, S. K. (2006). “Investments in ICT-capital and economic performance of small and medium scale enterprises in East Africa.” *Journal of International Development*, 18(4), 533-552.

Chuang, Y. C. (2000). “Human capital, exports, and economic growth: a causality analysis for Taiwan, 1952–1995.” *Review of international economics*, 8(4), 712-720.

Chun, H., Kim, J. W. and Lee, J. (2015). “How does information technology improve aggregate productivity? a new channel of productivity dispersion and reallocation.” *Research Policy*, 44(5), 999–1016.

Chung, S.H. and Snyder, C.A. (2000). “ERP adoption: a technological evolution approach.” *International Journal of Agile Management Systems*, 2(1), 24-32.

CII (2019). *Indian food processing sector: trends and opportunities*, Confederation of Indian Industry, New Delhi, India.

Cleary, S. (1999). “The relationship between firm investment and financial status.” *The Journal of Finance*, 54(2), 673-692.

Cline, M. K. and Guynes, C. S. (2001). “A study of the impact of information technology investments on firms performance.” *Journal of Computer Information Systems*, 41(3), 15-19.

Confederation of Indian Industry (CII) (2015). *Importance of food processing sector in India*, Confederation of Indian Industry, New Delhi, India.

Corso, M., Dogan, S. F., Mogre, R. and Perego, A. (2010). “The role of knowledge management in supply chains: evidence from the Italian food industry.” *International Journal of Networking and Virtual Organisations*, 7(2/3), 163-183.

Cragg, T. and McNamara, T. (2018). “An ICT-based framework to improve global supply chain integration for final assembly SMEs.” *Journal of Enterprise Information Management*, 31(5), 634-657.

Creswell, J. W. (2014). *Research Design: qualitative, quantitative, and mixed methods approaches*, SAGE Publications, Inc, California.

Crisostomo, V. L., Lopez-Iturriaga, F. J. and Vallelado, E. (2011). “Financial constraints for innovation in Brazil.” *Latin American Business Review*, 12(3), 165-185.

D’Este, P., Iammarino, S., Savona, M. and von Tunzelmann, N. (2012). “What hampers innovation? revealed barriers versus deterring barriers.” *Research Policy*, 41(2), 482-488.

Das, A., Khan, S. and Chowdhury, M. (2016). “Effects of ICT development on economic growth in emerging Asian countries.” *ICTs in Developing Countries: research, practices, and policy implications*, B. Dey, K. Sorour, and R. Filieri, Palgrave Macmillan, London, 141-159.

Davis, J. H., Schoorman, F. D. and Donaldson, L. (1997). “Toward a stewardship theory of management.” *Academy of Management Review*, 22(1), 20-47.

Dedrick, J., Kraemer, K. L., and Shih, E. (2013). “Information technology and productivity in developed and developing countries.” *Journal of Management Information Systems*, 30(1), 97-122.

Department of Agriculture, Cooperation & Farmers Welfare (DACFW) (2019). *Annual report 2018-19*, Department of Agriculture, Cooperation & Farmers Welfare, Ministry of Agriculture & Farmers Welfare, Government of India, New Delhi.

Dhanaraj, C. and Beamish, P. W. (2003). “A resource-based approach to the study of export performance.” *Journal of Small Business Management*, 41(3), 242–261.

DiCicco-Bloom, B. and Crabtree, B. F. (2006). “The qualitative research interview.” *Medical Education*, 40(4), 314-321.

Dimelis, S. P. and Papaioannou, S. K. (2010). “FDI and ICT effects on productivity growth: a comparative analysis of developing and developed countries.” *European Journal of Development Research*, 22, 79-96.

Ding, J., Chen, P. and Lyu, J. J. (2011). “Evolutionary strategy to apply information and communication technology: a case study in the apparel industry.” *Production Planning & Control*, 22(3), 282-297.

Dlodlo, N. and Kalezhi, J. (2015). "The internet of things in agriculture for sustainable rural development." *International Conference on Emerging Trends in Networks and Computer Communications (ETNCC)*, IEEE, 13-18.

Douma, S., George, R. and Kabir, R. (2006). "Foreign and domestic ownership, business groups, and firm performance: evidence from a large emerging market." *Strategic Management Journal*, 27(7), 637-657.

Dunne, T. (1994). "Plant Age and Technology use in U. S. Manufacturing Industries." *The RAND Journal of Economics*, 25(3), 488-499.

Erumban, A. A., and Das, D. K. (2016). "Information and communication technology and economic growth in India." *Telecommunications Policy*, 40, 412-431.

Esselaar, S., Stork, C., Ndiwalana, A. and Deen-Swarray, M. (2006). "ICT usage and its impact on profitability of SMEs in 13 African countries." *International Conference on Information and Communication Technologies and Development*, IEEE, 40-47.

Fabiani, S., Schivardi, F. and Trento, S. (2005). "ICT adoption in Italian manufacturing: firm-level evidence." *Industrial and Corporate Change*, 14(2), 225-249.

Falk, M. (2005). "ICT-linked firm reorganisation and productivity gains." *Technovation*, 25, 1229-1250.

Fatima, S. T. (2017). "Globalization and technology adoption: evidence from emerging economies." *The Journal of International Trade & Economic Development*, 26(6), 724-758.

Ferguson, P. R. and Ferguson, G. J. (1994). *Industrial economics: issues and perspectives*, New York University Press, New York.

Francis, J. and Collins-Dodd, C. (2004). "Impact of export promotion programs on firm competencies, strategies and performance." *International Marketing Review*, 21(4/5), 474-495.

Franco, M. and Garcia, M. (2018). "Drivers of ICT acceptance and implementation in micro-firms in the estate agent sector: influence on organizational performance." *Information Technology for Development*, 24(4), 658-680.

Galavotti, L., Cerrato, D. and Depperu, D. (2016). "Experience and cross-border acquisitions: an organizational learning perspective." *European Management Review*, 14(2), 119-131.

Galbreath, J. and Galvin, P. (2008). “Firm factors, industry structure and performance variation: new empirical evidence to a classic debate.” *Journal of business research*, 61(2), 109-117.

Gangwar, H., Date, H. and Ramaswamy, R. (2015). “Developing a cloud-computing adoption framework.” *Global Business Review*, 16(4), 632-651.

Gangwar, H., Date, H. and Raoot, A. D. (2014). “Review on IT adoption: insights from recent technologies.” *Journal of Enterprise Information Management*, 27(4), 488-502.

Garcia, M. J. (2019). “The impact of information and communication technologies on economic growth in Mexico.” *International Journal of Business and Social Research*, 9(2), 11-22.

Gbadegeshin, S. A., Oyelere, S. S., Olaleye, S. A., Sanusi, I. T., Ukpabi, D. C., Olawumi, O., and Adegbite, A. (2019). “Application of information and communication technology for internationalization of Nigerian small- and medium-sized enterprises.” *The Electronic Journal of Information Systems in Developing Countries*, 85(1), 1-17.

Gençtürk, E. F. and Kotabe, M. (2001). “The effect of export assistance program usage on export performance: a contingency explanation.” *Journal of International Marketing*, 9(2), 51-72.

Gërguri-Rashiti, S., Ramadani, V., Abazi-Alili, H., Dana, L. P. and Ratten, V. (2017). “ICT, innovation and firm performance: the transition economies context.” *Thunderbird International Business Review*, *59*(1), 93-102.

Ghalandari, K. (2013). “The effect of information and communication technology on export performance of Iranian firms.” *Research Journal of Applied Sciences, Engineering and Technology*, 5(17), 4367-4372.

Ghobakhloo, M., Arias-Aranda, D. and Benitez-Amado, J. (2011). “Adoption of e-commerce applications in SMEs.” *Industrial Management & Data Systems*, 111(8), 1238-1269.

Ghosh, M. and Roy, S. S. (2018). “Foreign direct investment, firm heterogeneity, and exports: an analysis of Indian manufacturing.” *Asian Development Review*, 35(1), 27-51.

Gibbs, J.L. and Kraemer, K.L. (2004). “A cross-country investigation of the determinants of scope of e-commerce use: an institutional approach.” *Electronic markets*, 14(2), 124-137.

Gill, A., Mand, H. S., Obradovich, J. D. and Mathur, N. (2018). "The impact of financial support from non-resident family members on the financial performance of newer agribusiness firms in India." *Journal of Agribusiness in Developing and Emerging Economies*, 8(2), 303-319.

Giunta, A. and Trivieri, F. (2007). "Understanding the determinants of information technology adoption: evidence from Italian manufacturing firms." *Applied economics*, 39(10), 1325-1334.

Goldar, B. (2013). "R&D intensity and exports: a study of India pharmaceutical firms." *Innovation and Development*, 3(2), 151-167.

Gomez, J. and Vargas, P. (2012). "Intangible resources and technology adoption in manufacturing firms." *Research Policy*, 41, 1607-1619.

Govindan, K., Mangla, S. K. and Luthra, S. (2017). "Prioritising indicators in improving supply chain performance using fuzzy AHP: insights from the case example of four Indian manufacturing companies." *Production Planning & Control*, 28(6-8), 552-573.

Grant, R. M. (1996). "Toward a knowledge-based theory of the firm." *Strategic Management Journal*, 17(S2), 109-122.

Grazzi, M. and Jung, J. (2016). "Information and Communication technologies, Innovation, and productivity: evidence from Firms in Latin america and the Caribbean." *Firm innovation and productivity in Latin America and the Caribbean*, Palgrave Macmillan, New York, 103-135.

Gudoshnikov, S., Jolly, L. and Spence, D. (2004). *The world sugar market*, Woodhead Publishing Limited, England.

Guerrieri, P., Luciani, M., and Meliciani, V. (2011). "The determinants of investment in information and communication technologies." *Economics of Innovation and New Technology*, 20(4), 387-403.

Gupta, G. and Mahakud, J. (2019). "Alternative measure of financial development and investment-cash flow sensitivity: evidence from an emerging economy." *Financial Innovation*, 1-28.

Gupta, S. D., Raychaudhuri, A. and Haldar, S. K. (2015). "Determinants of exports of information technology in India: an empirical analysis." *South Asia Economic Journal*, 16(1), 64-81.

Gutierrez, A., Boukrami, E. and Lumsden, R. (2015). "Technological, organisational and environmental factors influencing managers' decision to adopt cloud computing in the UK." *Journal of Enterprise Information Management*, 28(6), 788-807.

Haftu, G. G. (2019). "Information communications technology and economic growth in Sub-Saharan Africa: a panel data approach." *Telecommunications Policy*, 43, 88-99.

Hagsten, E. and Kotnik, P. (2017). "ICT as facilitator of internationalisation in small- and medium-sized firms." *Small Business Economics*, 48, 431-446.

Hall, L. A. and Bagchi-Sen, S. (2002). "A study of R&D, innovation, and business performance in the Canadian biotechnology industry." *Technovation*, 22(4), 231-244.

Haller, S. A. and Siedschlag, I. (2011). "Determinants of ICT adoption: Evidence from firm-level data." *Applied Economics*, 43(26), 3775-3788.

Harris, R. and Li, Q. C. (2009). "Exporting, R&D, and absorptive capacity in UK establishments." *Oxford Economic Papers*, 61, 74-103.

Harwell, M. R. (2011). "Research design in qualitative/quantitative/mixed methods." *The sage handbook for research in education*, C.F. Conrad, and R.C. Serlin, SAGE Publications, Inc, California, 147-164.

Hasan, R. (2002). "The impact of imported and domestic technologies on the productivity of firms: panel data evidence from Indian manufacturing firms." *Journal of Development Economics*, 69(1), 23-49.

Heldman, D. R. and Hartel, R. W. (1997). *Principles of food processing*, Chapman & Hall, New York.

Higon, D. A. (2011). "The Impact of ICT on Innovation Activities: evidence for UK SMEs." *International Small Business Journal*, 30(6), 684-699.

Hill, C. A. and Scudder, G. D. (2002). "The use of electronic data interchange for supply chain coordination in the food industry." *Journal of Operations Management*, 20, 375-387.

Hinton, C. M. and Kaye, G. R. (1996). "The hidden investments in information technology: the role of organisational context and system dependency." *International Journal of Information Management*, 16(6), 413-427.

Hollenstein, H. (2004). "Determinants of the adoption of Information and Communication Technologies (ICT): an empirical analysis based on firm-level data for the Swiss business sector." *Structural Change and Economic Dynamics*, 15(3), 315-342.

Hollenstein, H. and Woerter, M. (2008). “Inter-and intra-firm diffusion of technology: the example of E-commerce: an analysis based on Swiss firm-level data.” *Research Policy*, 37(3), 545-564.

Ibeh, K. I. N. (2003). “On the internal drivers of export performance among Nigerian firms: empirical findings and implications.” *Management Decision*, 41(3), 217-225.

Ifinedo, P. (2011). “An empirical analysis of factors influencing internet/e-business technologies adoption by SMEs in Canada.” *International Journal of Information Technology & Decision Making*, 10(4), 731-766.

Ilin, V., Ivetic, J. and Simic, D. (2017). “Understanding the determinants of e-business adoption in ERP-enabled firms and non-ERP-enabled firms: a case study of the Western Balkan Peninsula.” *Technological Forecasting and Social Change*, 125, 206-223.

Iyer, K. (2010). “The determinants of firm-level export intensity in New Zealand agriculture and forestry.” *Economic analysis and Policy*, 40(1), 75-86.

Jeon, B. N., Han, K. S. and Lee, M. J. (2006). “Determining factors for the adoption of e-business: the case of SMEs in Korea.” *Applied Economics*, 38(16), 1905-1916.

Jin, S. and Cho, C. M. (2015). “Is ICT a new essential for national economic growth in an information society?” *Government Information Quarterly*, 32(3), 253-260.

Jorgenson, D. W. and Motohashi, K. (2005). “Information technology and the Japanese economy.” *Journal of the Japanese and International Economies*, 19(4), 460-481.

Jorgenson, D. W., and Vu, K. M. (2016). “The ICT revolution, world economic growth, and policy issues.” *Telecommunications Policy*, 40, 383-397.

Kahiya, E. T. and Dean, D. L. (2014). “Export performance: multiple predictors and multiple measures approach.” *Asia Pacific Journal of Marketing and Logistics*, 26(3), 378-407.

Kandukuri, R. (2016). “Role of I.T. in pharmaceutical industry in India.” *Anveshana’s International Journal of Research in Regional Studies, Law, Social Science, Journalism and Management Practices*, 1(8), 61-65.

Kannabiran, G. and Dharmalingam, P. (2012). “Enablers and inhibitors of advanced information technologies adoption by SMEs.” *Journal of Enterprise Information Management*, 25(2), 186-209.

Kanungo, R. P. (2004). “E-Commerce in the pharmaceutical industry: threshold of innovation.” *Management Research News*, 27(8/9), 98-108.

Katrak, H. (1985). “Imported technology, enterprise size and R&D in a newly industrializing country: the Indian experience.” *Oxford Bulletin of Economics and Statistics*, 47(3), 213-229.

Khalifa, A. B. (2016). “Determinants of information and communication technologies adoption by Tunisian firms.” *Journal of Innovation Economics Management*, 2, 151-177.

Khan, M. Y. and Jain, P. K. (2005). *Basic financial management*, Tata McGraw-Hill Publishing Company Limited, New Delhi.

Khanna, T. and Rivkin, J. W. (2001). “Estimating the performance effects of business groups in emerging markets.” *Strategic Management Journal*, 22(1), 45-74.

Khanna, T. and Yafeh, Y. (2007). “Business groups in emerging markets: Paragons or parasites?” *Journal of Economic Literature*, 45(2), 331-372.

Khoumbati, K., Themistocleous, M. and Irani, Z. (2006). “Evaluating the adoption of enterprise application integration in health-care organizations.” *Journal of Management Information Systems*, 22(4), 69-108.

Kim, J. J. and Hemmert, M. (2016). “What drives the export performance of small and medium-sized subcontracting firms? a study of Korean manufacturers.” *International Business Review*, 25(2), 511-521.

Komera, S., Lukose, P. J. and Sasidharan, S. (2018). “Does business group affiliation encourage R&D activities? evidence from India.” *Asia Pacific Journal of Management*, 35(4), 887-917.

Kowtha, N. R. and Choon, T. W. I. (2001). “Determinants of website development: a study of electronic commerce in Singapore.” *Information & Management*, 39(3), 227-242.

Kraemer, K. L., Gibbs, J. and Dedrick, J. (2005). “Impacts of globalization on e-commerce use and firm performance: a cross-country investigation.” *The Information Society*, 21(5), 323-340.

Krammer, S. M., Strange, R. and Lashitew, A. (2018). “The export performance of emerging economy firms: the influence of firm capabilities and institutional environments.” *International Business Review*, 27(1), 218-230.

Kumar, N. and Siddharthan, N. S. (1994). “Technology, firm size and export behaviour in developing countries: the case of Indian enterprises.” *The Journal of Development Studies*, 31(2), 289-309.

Kumar, P. (2010). “Structure and Performance of Food Processing Industry in India.” *Journal of Indian School of Political Economy*, 22(1-4), 127-163.

Kumar, R. R., Stauvermann, P. J. and Samitas, A. (2016). “The effects of ICT on output per worker: a study of Chinese economy.” *Telecommunications Policy*, 40(2-3), 102-115.

Kyobe, M. (2011). “Investigating the key factors influencing ICT adoption in South Africa.” *Journal of Systems and Information Technology*, 13(3), 255-267.

Laitsou, E., Kargas, A. and Varoutas, D. (2017). “The impact of ICT on economic growth of Greece and EU-28 under economic crisis.” *Internet of Things Business Models, Users, and Networks*, IEEE, 1-6.

Lal, K. (1996). “Information technology, international orientation and performance: a case study of electrical and electronic goods manufacturing firms in India.” *Information Economics and Policy*, 8, 269-280.

Lal, K. (1999). “Determinants of the adoption of information technology: a case study of electrical and electronic goods manufacturing firms in India.” *Research policy*, 28(7), 667-680.

Lal, K. (2002). “E-business and manufacturing sector: a study of small and medium-sized enterprises in India.” *Research Policy*, 31, 1199-1211.

Lal, K. (2004). “E-business and export behavior: evidence from Indian firms.” *World Development*, 32(3), 505-517.

Lal, K. (2005). “Determinants of the adoption of e-business technologies.” *Telematics and Informatics*, 22, 181-199.

Lee, H., Choi, H., Lee, J., Min, J. and Lee, H. (2016). “Impact of IT investment on firm performance based on technology IT architecture.” *Procedia Computer Science*, 91, 652-661.

Lee, J. (2009). “Does size matter in firm performance? Evidence from US public firms.” I*nternational Journal of the Economics of Business*, 16(2), 189-203.

Lee, M. and Choi, M. (2015). “The determinants of research and development investment in the pharmaceutical industry: focus on financial structures.” *Osong Public Health and Research Perspectives*, 6(5), 302-309.

Lefebvre, L. A., Lefebvre, E., Elia, E. and Boeck, H. (2005). “Exploring B-to-B e-commerce adoption trajectories in manufacturing SMEs.” *Technovation*, 25(12), 1443-1456.

Leung, D., Lo, A., Fong, L. H. N. and Law, R. (2015). "Applying the Technology-Organization-Environment framework to explore ICT initial and continued adoption: an exploratory study of an independent hotel in Hong Kong." *Tourism recreation research*, 40(3), 391-406.

Liao, H., Wang, B., Li, B., and Weyman-Jones, T. (2016). "ICT as a general-purpose technology: the productivity of ICT in the United State revisited." *Information Economics and Policy*, 36, 10-35.

Lichtman, M. (2014). *Qualitative research for the social sciences*, SAGE publications, Inc., California.

Liu, L., Miao, R. and Li, C. (2007). "The impacts of enterprise resource planning systems on firm performance: an empirical analysis of Chinese chemical firms." *Research and Practical Issues of Enterprise Information Systems II*, 579-587, Springer, Boston, MA.

Loderer, C. F. and Waelchli, U. (2010). "Firm age and performance." Available at SSRN: https://ssrn.com/abstract=1342248 or http://dx.doi.org/10.2139/ssrn.1342248.

Lome, O., Heggeseth, A. G. and Moen, Ø. (2016). "The effect of R&D on performance: do R&D-intensive firms handle a financial crisis better?" *The Journal of High Technology Management Research*, 27(1), 65-77.

Lopez Rodriguez, J. and Garcia Rodriguez, R. M. (2005). "Technology and export behaviour: a resource-based view approach." *International Business Review*, 14(5), 539–557.

Losh, S. C. (2010). "Autocorrelation." *Encyclopedia of Research Design Volume 1*, N.J. Salkind, SAGE Publications, Inc., Calofornia, 76-80.

Love, J. H., Roper, S. and Zhou, Y. (2016). "Experience, age and exporting performance in UK SMEs." *International Business Review*, 25(4), 806-819.

Love, P. E., Irani, Z., Standing, C., Lin, C. and Burn, J. M. (2005). "The enigma of evaluation: benefits, costs and risks of IT in Australian small–medium-sized enterprises." *Information & Management*, 42(7), 947-964.

Low, C., Chen, Y. and Wu, M. (2011). "Understanding the determinants of cloud computing adoption." *Industrial Management & Data Systems*, 111(7), 1006-1023.

Lu, J. W. and Beamish, P. W. (2001). "The internationalization and performance of SMEs." *Strategic Management Journal*, 22(6-7), 565-586.

Lu, V. N. and Julian, C. C. (2007). "The internet and export marketing performance: the empirical link in export market ventures." *Asian Pacific Journal of Marketing and Logistics*, 19(2), 127-144.

Lubatkin, M. and Chatterjee, S. (1994). "Extending modern portfolio theory into the domain of corporate diversification: does it apply?" *Academy of Management Journal*, 37(1), 109-136.

Majeed, M. T., and Ayub, T. (2018). "Information and communication technology (ICT) and economic growth nexus: a comparative global analysis." *Pakistan Journal of Commerce and Social Science*, 12(2), 443-476.

Majocchi, A., Bacchiocchi, E. and Mayrhofer, U. (2005). "Firm size, business experience and export intensity in SMEs: a longitudinal approach to complex relationships." *International Business Review*, 14(6), 719-738.

Makanyeza, C. and Ndlovu, A. (2016). "ICT usage and its effect on export performance: empirical evidence from small and medium enterprises in the manufacturing sector in Zimbabew." *Botswana Journal of Business*, 9(1), 21-36.

Makhmudov, N. (2004). Adoption process and impacts of information and communication technologies in small and medium size enterprises in Central Asia: evidence from Uzbekistan. Cuvillier Verlag, Gottingen.

Malhotra, P. and Singh, B. (2007). "Determinants of internet banking adoption by banks in India." *Internet Research*, 17(3), 323-339.

Mansfield, E. (1963). "Intrafirm rates of diffusion of an innovation." *The Review of Economics and Statistics*, 45(4), 348-359.

Martins, M. F. O. and Oliveira, T. (2008). "Determinants of information technology diffusion: a study at the firm level for Portugal." *Electronic Journal of Information Systems Evaluation*, 11(1), 27-34.

Mathew, N. (2017). "Drivers of firm growth: micro-evidence from Indian manufacturing." *Journal of Evolutionary Economics*, 27, 585-611.

Matopoulos, A., Vlachopoulou, M. and Manthou, V. (2007). "Exploring the impact of e-business adoption on logistics processes: empirical evidence from the food industry." *International Journal of Logistics*, 10(2), 109-122.

Maumbe, B. M. and Okello, J. J. (2013). "Uses of Information and Communication Technology (ICT) in agriculture and rural development in sub-Saharan Africa: Experiences from South Africa and Kenya." *Technology, Sustainability, and Rural Development in Africa*, 113-134, IGI Global.

Maurel, C. (2009). "Determinants of export performance in French wine SMEs." *International Journal of Wine Business Research*, 21(2), 118-142.

Mavrogiannis, M., Bourlakis, M. A., Dawson, P. J. and Ness, M. R. (2008). "Assessing export performance in the Greek food and beverage industry." *British Food Journal*, 110(7), 638-654.

Mazumder, K (2012). "Small and Medium-size firms: government support, local strength and export performance: experience from Bangladeshi manufacturing firms." Master thesis, University of Agder, Norway.

Mendonca, M. A. A. D., Freitas, F. and Souza, J. M. D. (2008). "Information technology and productivity: evidence for Brazilian industry from firm-level data." *Information Technology for Development*, 14(2), 136-153.

Ministry of Food Processing Industry (MOFPI) (2017). *Annual report 2016-17*, Ministry of Food Processing Industry, Government of India, New Delhi, India.

Mitra, A., Sharma, C. and Veganzones-Varoudakis, M. A. (2016). "Infrastructure, information & communication technology and firms' productive performance of the Indian manufacturing." *Journal of Policy Modeling*, 38(2), 353-371.

Moen, O., Madsen, T. K. and Aspelund, A. (2008). "The importance of the internet in international business-to-business markets." *International Marketing Review*, 25(5), 487-503.

MOFPI (2019). *Annual report 2018-19*, Ministry of Food Processing Industry, Government of India, New Delhi, India.

MoFPI, Ernst & Young LLP (EY) and Confederation of Indian Industry (2017). *High-Growth Segments of Indian Food and Beverage Industry*, Ernst & Young LLP (EY) and Confederation of Indian Industry.

Morse, J. M. (2004). "Purposive sampling." *The SAGE encyclopedia of social science research methods*, M.S. Lewis-Beck, A. Bryman, and T. F.,Liao, SAGE Publications, Inc., California, 884-885.

Mpofu, K. C. and Watkins-Mathys, L. (2011). "Understanding ICT adoption in the small firm sector in Southern Africa." *Journal of Systems and Information Technology*, 13(2), 179-199.

Naidoo, I. P. and Hoque, M. (2018). "Impact of information technology on innovation in determining firm performance." *African Journal of Science, Technology, Innovation and Development*, 10(6), 643-653.

Narayanan, K. and Bhat, S. (2009). "Technology sourcing and its determinants: A study of Basic Chemical industry in India." *Technovation*, 29(8), 562-573.

Narayanan, K. and Bhat, S. (2011). "Technology sourcing and outward FDI: a study of IT industry in India." *Technovation*, 31(4), 177-184.

National Manufacturing Competitiveness Council (NMCC) (2010). *A Roadmap to Enhance ICT Adoption in the Indian Manufacturing Sector*, National Association of Software and Service Companies (NASSCOM), New Delhi, India.

Ng, Y. C. and Chang, M. K. (2003). "Impact of computerization on firm performance: a case of Shanghai manufacturing enterprises." *The Journal of the Operational Research Society*, 54(10), 1029-1037.

Nguyen, Q. T. and Almodovar, P. (2018). "Export intensity of foreign subsidiaries of multinational enterprises: the role of trade finance availability." *International Business Review*, 27(1), 231-245.

Nguyen, T. H. (2009). "Information technology adoption in SMEs: an integrated framework. *International Journal of Entrepreneurial Behavior & Research*, 15(2), 162-186.

Nguyen, T. H., Newby, M. and Macaulay, M. J. (2013). "Information technology adoption in small business: Confirmation of a proposed framework." *Journal of Small Business Management*, 53(1), 207-227.

Nguyen, T. H., Newby, M. and Macaulay, M. J. (2015). "Information technology adoption in small business: Confirmation of a proposed framework." *Journal of Small Business Management*, 53(1), 207-227.

Niebel, T. (2018). "ICT and economic growth – comparing developing, emerging and developed countries." *World Development*, 104, 197-211.

Njoh, A. J. (2018). "The relationship between modern information and communications technologies (ICTs) and development in Africa." *Utilities Policy*, 50, 83-90.

Nurmilaakso, J. (2009). "ICT solutions and labor productivity: evidence from firm-level data." *Electronic Commerce Research*, 9, 173-181.

OECD (2007). Sugar policy reform in the European Union and in world sugar markets, Organization for Economic Co-operation and Development (OECD) Publications Service, France.

OECD/ Indian Council for Research on International Economic Relations (ICRIER) (2018). *Agricultural Policies in India*, OECD Food and Agricultural Reviews,

Organisation for Economic Co-operation and Development (OECD) Publishing, Paris.

Oliveira, T., Thomas, M. and Espadanal, M. (2014). "Assessing the determinants of cloud computing adoption: an analysis of the manufacturing and services sectors." *Information & Management*, 51(5), 497-510.

Ollo-Lopez, A., and Aramendia-Muneta, M. E. (2012). "ICT impact on competitiveness, innovation and environment." *Telematics and Informatics*, 29(2), 204-210.

Organisation for Economic Co-operation and Development (OECD) (2004). *The economic impact of ICT: measurement, evidence and implications*, Organisation for Economic Co-operation and Development (OECD) Publications Service, France.

Oura, M. M., Zilber, S. N. and Lopes, E. L. (2016). "Innovation capacity, international experience and export performance of SMEs in Brazil." *International Business Review*, 25, 921-932.

Oyelere, P., Laswad, F. and Fisher, R. (2003). "Determinants of internet financial reporting by New Zealand companies." *Journal of International Financial Management and Accounting*, 14(1), 26-63.

Ozcelik, E. and Taymaz, E. (2004). "Does innovativeness matter for international competitiveness in developing countries?: the case of Turkish manufacturing industries." *Research Policy*, 33(3), 409-424.

Ozilgen, S. and Ozilgen, M. (2016). "General Template for the FMEA Applications in Primary Food Processing." *Measurement, Modeling and Automation in Advanced Food Processing*, Springer, Cham, 29-69.

Pachouri, A. and Sharma, S. (2016). "Barriers to innovation in Indian small and medium-sized enterprises." *ADBI Working Paper 588*, Asian Development Bank Institute, Tokyo.

Paeleman, I., Fuss, C. and Vanacker, T. (2017). "Untangling the multiple effects of slack resources on firms' exporting behavior." *Journal of World Business*, 52(6), 769-781.

Pan, M. and Jang, W. (2008). "Determinants of the adoption of enterprise resource planning within the technology-organization-environment framework: Taiwan's communications industry." *Journal of Computer Information Systems*, 48(3), 94-102.

Panayiotou, N. A. and Katimertzoglou, P. K. (2015). "Micro firms internet adoption patterns: the case of the Greek jewellery industry." *Journal of Enterprise Information Management*, 28(4), 508-530.

Papaioannou, S. K., and Dimelis, S. P. (2007). "Information technology as a factor of economic development: evidence from developed and developing countries." *Economics of Innovation and New Technology*, 16(3); 179-194.

Parameswaran, M. (2009). "International trade, R&D spillovers and productivity: evidence from Indian manufacturing industry." *Journal of Development Studies*, 45(8), 1249-1266.

Pattnaik, C. and Elango, B. (2009). "The impact of firm resources on the internationalization and performance relationship: a study of Indian manufacturing firms." *Multinational Business Review*, 17(2), 69–88.

Paul, M. (2014). *Import intensity and its impact on exports, output and employment*, ISID 167, Institute for Studies in Industrial Development, New Delhi, India.

Paul, S. and Lal, K. (2020). "Technology intensity and employment in the Indian economy." *Arthaniti: Journal of Economic Theory and Practice*, 1-19.

Penrose, E. T. (2009). *The Theory of the Growth of the Firm*, Oxford University Press.

Pezderka, N., Sinkovics, R. R. and Jean, R. J. B. (2012). "Do born global SMEs reap more benefits from ICT use than other internationalizing small firms." *Handbook of Research on Born Globals*, 185-213.

Piget, P. and Kossaï, M. (2013). "The relationship between information and communication technology use and firm performance in developing countries: a case study of electrical and electronic goods manufacturing SMEs in Tunisia." *African Development Review*, 25(3), 330-343.

Pinho, J. C. and Martins, L. (2010). "Exporting barriers: Insights from Portuguese small-and medium-sized exporters and non-exporters." *Journal of international Entrepreneurship*, 8(3), 254-272.

Pispa, J. and Eriksson, I. V. (2003). "Aligning organizations and their information technology infrastructure: how to make information technology support business." *Production Planning & Control*, 14(2), 193-200.

Pla-Barber, J. and Alegre, J. (2007). "Analysing the link between export intensity, innovation and firm size in a science-based industry." *International Business Review*, 16(3), 275-293.

Policepatil, A. G. (2018). *Cost-benefit analysis of sugar industry in Gulbarga district*, Lulu Publication, United States.

Pradhan, J. P. (2004). "The determinants of outward foreign direct investment: a firm-level analysis of Indian manufacturing." *Oxford Development Studies*, 32(4), 619-639.

Pradhan, J. P. (2011). "R&D strategy of small and medium enterprises in India." *Science, Technology and Society*, 16(3), 373-395.

Pradhan, R. P., Arvin, M. B., and Norman, N. R. (2015). "The dynamics of information and communications technologies infrastructure, economic growth, and financial development: evidence from Asian countries." *Technology in Society*, 42, 135-149.

Pradhan, R. P., Mallik, G. and Bagchi, T. P. (2018). "Information communication technology (ICT) infrastructure and economic growth: a causality evinced by cross-country panel data." *IIMB Management Review*, 30, 91-103.

Premkumar, G. and Roberts, M. (1999). "Adoption of new information technologies in rural small businesses." *Omega, the International Journal of Management Science*, 27, 467-484.

Pucar, S. (2012). "The influence of intellectual capital on export performance." *Journal of Intellectual Capital*, 13(2), 248-261.

Quaye, D. M., Sekyere, K. N. and Acheampong, G. (2017). "Export promotion programmes and export performance." *Review of International Business and Strategy*, 27(4), 466-483.

Racela, O. C. and Thoumrungroje, A. (2019). "Enhancing export performance through proactive export market development capabilities and ICT utilization." *Journal of Global Marketing*, 33(1), 46-63.

Rahayu, R. and Day, J. (2015). "Determinant factors of e-commerce adoption by SMEs in developing country: evidence from Indonesia." *Procedia-Social and Behavioral Sciences*, 195, 142-150.

Rahmat, S., Cheong, C. B. and Hamid, M. S. R. B. (2016). "Challenges of developing countries in complying quality and enhancing standards in food industries." *Procedia–Social and Behavioral Science*, 224, 445-451.

Rais, M., Acharya, S. and Sharma, N. (2013). "Food processing industry in India: S&T capability, skills and employment opportunities." *Journal of Rural Development,* 32(4), 451–480.

Ralston, P. M., Blackhurst, J., Cantor, D. E. and Crum, M. R. (2015). "A structure–conduct–performance perspective of how strategic supply chain integration affects firm performance." *Journal of Supply Chain Management*, 51(2), 47-64.

Ramdani, B., Chevers, D. and Williams, D. A. (2013). "SMEs' adoption of enterprise applications: a technology-organisation-environment model." *Journal of Small Business and Enterprise Development*, 20(4), 735-753.

Ramdani, B., Kawalek, P. and Lorenzo, O. (2009). "Predicting SMEs' adoption of enterprise systems." *Journal of Enterprise Information Management*, 22(1/2), 10-24.

Rasiah, R. (2003). "Foreign ownership, technology and electronics exports from Malaysia and Thailand." *Journal of Asian Economics*, 14(5), 785-811.

Ravichandran, T., Lertwongsatien, C. and Lertwongsatien, C. (2005). "Effect of information systems resources and capabilities on firm performance: a resource-based perspective." *Journal of Management Information Systems*, 21(4), 237-276.

Ray, R. (2011). "Enterprise resource planning." *Tata McGraw Hill Education Private Limited*, New Delhi.

Riddell, W. C. and Song, X. (2017). "The role of education in technology use and adoption: Evidence from the Canadian workplace and employee survey." *ILR Review*, 70(5), 219-1253.

Roberts, N. and Grover, V. (2012). "Leveraging information technology infrastructure to facilitate a firm's customer agility and competitive activity: an empirical investigation." *Journal of Management Information Systems*, 28(4), 231-269.

Rogers, E. M. (2003). *The diffusion of innovation*, Free Press, New York.

Romer, P. M. (1990). "Endogenous technological change." *Journal of Political Economy*, 98(5/2), S71-S102.

Roodman, D. (2009). "How to do xtabond2: an introduction to difference and system GMM in Stata." *The Stata Journal*, 9(1), 86-136.

Roper, S. and Love, J. H. (2002). "Innovation and export performance: evidence from the UK and German manufacturing plants." *Research policy*, 31(7), 1087-1102.

Safari, F., Safari, N., Hasanzadeh, A. and Ghatari, A. R. (2015). "Factors affecting the adoption of cloud computing in small and medium enterprises." *International Journal of Business Information Systems*, 20(1), 116-137.

Saglam, B. B. (2018). "ICT diffusion, R&D intensity, and economic growth: a dynamic panel data approach." *Journal of the Knowledge Economy*, 9, 636-648.

Sahu, S. K. and Narayanan, K. (2011). “Determinants of energy intensity in Indian manufacturing industries: a firm level analysis.” *Eurasian Journal of Business and Economics,* 4(8), 13-30.

Sasidharan, S., Lukose, P. J. J. and Komera, S. (2015). “Financing constraints and investments in R&D: evidence from Indian manufacturing firms.” *The Quarterly Review of Economics and Finance,* 55, 28-39.

Satpathy, L. D., Chatterjee, B. and Mahakud, J. (2017). “Firm characteristics and total factor productivity: evidence from Indian manufacturing firms.” *Margin – The Journal of Applied Economic Research,* 11(1), 77-98.

Schimmenti, E., Asciuto, A., Borsellino, V. and Galati, A. (2013). “The role of information and communication technologies and logistics organisation in the economic performance of Sicilian fruit and vegetable enterprises.” *International Journal of Business and Globalisation, 10*(2), 185-193.

Schneider, B. R. (2008). “Economic liberalization and corporate governance: the resilience of business groups in Latin America.” *Comparative politics,* 40(4), 379-397.

Scupola, A. (2006). “Government intervention in SMEs' e-commerce adoption: an institutional approach.” *Global Electronic Business Research: Opportunities and Directions,* 158-178, IGI Global.

Senturk, İ. and Erdem, C. (2008). “Determinants of export propensity and intensity of SMEs in developing countries: an empirical analysis of Turkish firms.” *The Empirical Economics Letters,* 7(2), 171-179.

Sepehrdoust, H. (2018). “Impact of information and communication technology and financial development on economic growth of OPEC developing economies.” *Kasetsart Journal of Social Sciences,* 1-6.

Setiowati, R., Daryanto, H. K. and Arifin, B. (2015). “The effects of ICT adoption on marketing capabilities and business performance of Indonesian SMEs in the fashion industry.” *Journal of Business and Retail Management Research,* 10(1). 100-115.

Seyal, A. H., Rahman, M. N. A. and Mohammad, H. A. Y. H. A. (2007). “A quantitative analysis of factors contributing electronic data interchange adoption among Bruneian SMEs.” *Business Process Management Journal,* 13(5), 728-746.

Shaban, M. (2013). “Intellectual capital, financial performance and market valuation: an empirical investigation of information technology industry in India.” *Asia-Pacific Journal of Management,* 9(1), 55-62.

Shaharudin, M. R., Omar, M. W., Elias, S. J., Ismail, M., Ali, S. M. and Fadzil, M. I. (2012). "Determinants of electronic commerce adoption in Malaysian SMEs' furniture industry." *African Journal of Business Management*, 6(10), 3648-3661.

Shahiduzzaman, M., and Alam, K. (2014). "Information technology and its changing roles to economic growth and productivity in Australia." *Telecommunications Policy*, 38, 125-135.

Shamsudddoha, A. K., Ali, M. Y. and Ndubisi, N. O. (2009). "Impact of government export assistance on internationalization of SMEs from developing nations." *Journal of Enterprise Information Management*, 22(4), 408-422.

Sharma, C. (2012). "R&D and firm performance: evidence from the Indian pharmaceutical industry." *Journal of the Asia Pacific Economy*, 17(2), 332-342.

Shokr, M. A. and Al-Gasaymeh, A. (2018). "Bank lending channel and banking sector efficiency: panel data of Egypt." *International Journal of Emerging Markets*, 13(5), 1291-1310.

Siddharthan, N. S. (1992). "Transaction costs, technology transfer, and in-house R&D: a study of the Indian private corporate sector." *Journal of Economic Behavior & Organization*, 18(2), 265-271.

Siddharthan, N. S. and Nollen, S. (2004). "MNE affiliation, firm size and exports revisited: A study of information technology firms in India." *Journal of Development Studies*, 40(6), 146-168.

Singh, D. A. (2009). "Export performance of emerging market firms." *International Business Review*, 18(4), 321-330.

Sojoodi, S. (2016). "The impact of information and communication technology (ICT) on the firms' export behavior in manufacturing firms of Iran using Tobit and Heckman method." *International Business Management*, 10(6), 908-916.

Solomon, S. (2014). "Sugarcane agriculture and sugar industry in India: at a glance." *Sugar Tech*, 16(2), 113-124.

Somaya, D., Williamson, I. O. and Zhang, X. (2007). "Combining patent law expertise with R&D for patenting performance." *Organization Science*, 18(6), 922-937.

Soni, A., Mittal, A. and Kapshe, M. (2017). "Energy intensity analysis of Indian manufacturing industries." *Resource-Efficient Technologies*, 3, 353-357.

Sousa, C. M., Martínez-López, F. J. and Coelho, F. (2008). "The determinants of export performance: a review of the research in the literature between 1998 and 2005." *International Journal of Management Reviews*, 10(4), 343-374.

Spence, C. and Piqueras-Fiszman, B. (2013). "Technology at the dining table." *Flavour*, 2(1), 16.

Srinivasan, T. N. and Archana, V. (2011). "Determinants of export decision of firms." *Economic and Political Weekly*, 46(7), 49-58.

Statt, D. A. (2004). *The Routledge dictionary of business management*, Routledge, London.

Sterlacchini, A. (2001). "The determinants of export performance: a firm-level study of Italian manufacturing." *Review of World Economics*, 137(3), 450-472.

Stewart, F. (1972). "Choice of technique in developing countries." *The Journal of Development Studies*, 9(1), 99-121.

Sudhira, H. S., Ramachandra, T. V. and Subrahmanya, M. B. (2007). "Bangalore." *Cities*, 24(5), 379-390.

Tajeddin, M. and Carney, M. (2018). "African business groups: how does group affiliation improve SMEs' export intensity?" *Entrepreneurship Theory and Practice*, 43(6), 1194-1222.

Tang, C., Huang, T. C. and Wang, S. (2018). "The impact of internet of things implementation on firm performance." *Telematics and Informatics*, 35, 2038-2053.

Teixeira, A. A. and Queiros, A. S. (2016). "Economic growth, human capital and structural change: a dynamic panel data analysis." *Research Policy*, 45(8), 1636-1648.

Teo, T. S. and Tan, M. (1998). "An empirical study of adoptors and non-adopters of the Internet in Singapore." *Information & Management*, 34(6), 339-345.

Teo, T. S., Tan, M. and Buk, W. K. (1997). "A contingency model of Internet adoption in Singapore." *International Journal of Electronic Commerce*, 2(2), 95-118.

Thatcher, S. M. B., Foster, W. and Zhu, L. (2006). "B2B e-commerce adoption decisions in Taiwan: the interaction of cultural and other institutional factors." *Electronic Commerce Research and Applications*, 5, 92-104.

Thiesse, F., Staake, T., Schmitt, P. and Fleisch, E. (2011). "The rise of the "next-generation bar code": an international RFID adoption study." *Supply Chain Management: An International Journal*, 16(5), 328-345.

Tiago, M. T. B., Couto, J. P., Natario, M. M. D. S., and Braga, A. M. M. (2007). "The adoption of communication and information technologies and the local development." *Journal of Business Economics and Management,* 8(2), 111-117.

Tornatzky, L. G. and Fleischer, M. (1990). *The processes of technological innovation,* Lexington, MA: Lexington Books.

Tyagi, S. and Nauriyal, D. K. (2017). "Do innovative activities matter to Indian drug and pharmaceutical firms? an application to export performance." *Journal of Generic Medicines,* 13(4), 193-205.

Ullah, S., Akhtar, P. and Zaefarian, G. (2018). "Dealing with endogeneity bias: the generalized method of moments (GMM) for panel data." *Industrial Marketing Management,* 71, 69-78.

Urban, B. and Heydenrych, J. (2015). "Technology orientation and effectuation-links to firm performance in the renewable energy sector of South Africa." *South African Journal of Industrial Engineering,* 26(3), 125-136.

Van Den Bosch, F. A. and De Man, A. P. (1994). "Government's impact on the business environment and strategic management." *Journal of General Management,* 19(3), 50-59.

Verbeek, M. (2008). "A guide to modern econometrics." John Wiley & Sons, Ltd., England.

Vishwasrao, S. and Bosshardt, W. (2001). "Foreign ownership and technology adoption: evidence from Indian firms." *Journal of Development Economics,* 65, 367-387.

Vu, K. M. (2011). "ICT as a source of economic growth in the information age: empirical evidence from the 1996-2005 period." *Telecommunications Policy,* 35, 357-372.

Vyas, V., Narayanan, K. and Ramanathan, A. (2013). "Mergers and acquisitions, technological efforts and exports: a study of pharmaceutical sector in India." *Innovation and Development,* 3(2), 169-186.

Wagner, J. (1995). "Exports, firm size, and firm dynamics." *Small Business Economics,* 7(1), 29-39.

Walker, J. H., Saffu, K. and Mazurek, M. (2016). "An empirical study of factors influencing E-Commerce adoption/non-adoption in Slovakian SMEs." *Journal of Internet Commerce,* 15(3), 189-213.

Wang, F. (2014). “Complementarities between R&D investment and exporting—Evidence from China.” *China Economic Review*, 31, 217-227.

Wang, Y., Wang, Y. and Yang, Y. (2010). “Understanding the determinants of RFID adoption in the manufacturing industry.” *Technological Forecasting & Social Change*, 77, 803-815.

Ward, M. R. and Zheng, S. (2016). “Mobile telecommunications service and economic growth: evidence from China.” *Telecommunications Policy,* 40(2-3), 89-101.

Welge, M. K. and Borghoff, T. (2009). “The contribution of information and communication technologies (ICT) to the globalization process of firms.” *Management der Internationalisierung,* Gabler, 203-231.

Wernerfelt, B. (1984). “A resources-based view of the firm.” *Strategic Management Journal,* 5(2), 171-180.

Wilson, C. (2014). “Semi-structured interviews.” *Interview techniques for UX practitioners,* 1, 23-41.

Winklhofer, H., Houghton, K. and Chesney, T. (2007). “How advanced are websites of SME exporters? An investigation into drivers and inhibitors.” *International Marketing Research: Opportunities and Challenges in the 21st Century, Advances in International Marketing*, 17, 395-426.

Wright, P. M., Dunford, B. B. and Snell, S. A. (2001). “Human resources and the resource based view of the firm.” *Journal of management*, 27(6), 701-721.

Wu, J., Zhong, W. and Mei, S. (2011). “Application capability of e-business, e-business success, and organizational performance: empirical evidence from China.” *Technological Forecasting & Social Change,* 78, 1412-1425.

Xu, S., Zhu, K. and Gibbs, J. (2004). “Global technology, local adoption: a Cross-Country investigation of internet adoption by companies in the united states and china.” *Electronic markets,* 14(1), 13-24.

Yeh, C. H., Lee, G. G. and Pai, J. C. (2014). “Using a technology-organization-environment framework to investigate the factors influencing e-business information technology capabilities.” *Information Development,* 31(5), 435-450.

Yi, J. (2014). “Firm heterogeneity, sunk costs, spatial characteristics and export market participation: evidence from China.” *The Journal of International Trade & Economic Development,* 23(3), 361-386.

Yin, R. K. (2018). “Case study research and applications: design and methods.” Sage Publications.

Yousefi, A. (2011). “The impact of information and communication technology on economic growth: evidence from developed and developing countries.” *Economics of Innovation and New Technology*, 26(6), 581-596.

Yunis, M., Tarhini, A. and Kassar, A. (2018). “The role of ICT and innovation in enhancing organizational performance: the catalysing effect of corporate entrepreneurship.” *Journal of Business Research*, 88, 344-356.

Zawislak, P. A. and Fracasso, E. M. (2018). “Technological intensity and innovation capability in industrial firms.” *Innovation & Management Review*, 15(2), 189-207.

Zehir, C., Muceldili, B., Akyuz, B. and Celep, A. (2010). “The impact of information technology investments on firm performance in national and multinational companies.” *Journal of Global Strategic Management*, 4(1), 143-154.

Zhang, C., Cui, L., Huang, L. and Zhang, C. (2007). “Exploring the Role of Government in Information Technology Diffusion.” *IFIP International Working Conference on Organizational Dynamics of Technology-Based Innovation*, 393-407, Springer, Boston, MA.

Zhu, K., Dong, S., Xu, S. X. and Kraemer, K. L. (2006). “Innovation diffusion in global contexts: determinants of post-adoption digital transformation of European companies.” *European Journal of Information Systems*, 15(6), 601-616.

Zhu, K., Kraemer, K. and Xu, S. (2003). “Electronic business adoption by European firms: a cross-country assessment of the facilitators and inhibitors.” *European journal of information systems*, 12(4), 251-268.

Zhu, K., Kraemer, K. L. and Dedrick, J. (2004). “Information technology payoff in e-business environments: an international perspective on value creation of e-business in the financial services industry.” *Journal of management information systems*, 21(1), 17-54.

Zia, M. (2016). “Consumer of processed food in India: barriers and possibilities.” *Journal of Agricultural Engineering and Food Technology*, 3(4), 285-290.

List of Publications based on PhD Research Work

Sl. No.	Title of the paper	**Authors** (in the same order as in the paper Underline the Research Scholar's name)	Name of the Journal/Conference/Symposium, Vol., No. Pages	Month & Year of Publication	Category *
1	The Determinants of Export Behaviour: A Study of Food Processing Industry in India	G. R. Navyashree Savita Bhat	Journal of Global Business Advancement	Accepted: 30th June 2019	1. Journal paper, full paper reviewed
2	Drivers of ICT Investment in Bakery and Sugar Confectionery Processed Food Sub-Sector in India	Navyashree G. R. Savita Bhat	Journal of Agribusiness in Developing and Emerging Economies	Published: 22 April, 2020	1. Journal paper, full paper reviewed
3	Determinants of ICT Investment Intensity: A Study of Food Processing Industry in India	Navyashree G. R. Savita Bhat	International Seminar on "Creation and Diffusion of Technology"	18th March 2016	3.Conference/Symposium paper, full paper reviewed
4	ICT Investments and Growth of Small and Medium Firms: A Study of Food Processing Industry in India	Navyashree G. R. Savita Bhat	11th International Conference on Globalization of Technology and Development	3-5 December 2016	3.Conference/Symposium paper, full paper reviewed

*Category: 1. Journal paper, full paper reviewed
2. Journal paper, Abstract reviewed
3. Conference/Symposium paper, full paper reviewed
4. Conference/Symposium paper, abstract reviewed
5. Others (including papers in Workshops, NITK Research Bulletins, Short notes etc.)

(if the paper has been accepted for publication but yet to be published, the supporting documents must be attached.)

Navyashree 13.01.2021
(NAVYASHREE · G · R)

Research Scholar
Name & Signature, with Date

Research Guide
Name & Signature, with Date

APPENDIX I

QUESTIONNAIRE

Information and Communication Technology (ICT) Investment and Performance of Firms: A Study of Food Processing Firms in India

Name of the company:

Address:

Website:

Firm Size:

Section-A

1. Does your firm use ICT?

Yes	
No	

If the answer is **Yes**, continue answering next question
If the answer is **No**, go to question number **12**

2. Please indicate which of the following ICT has been installed in your firm and the extent to which they are being used in your firm.

Type of ICT installed and usage	Not at all	Very little	Sometimes	Often	Very often
Personal computers/Laptops					
Office suits (word processing, spreadsheet, power point)					
Internet					

Electronic data interchange (EDI)					
Enterprise resource planning (ERP)					
Decision support system (DSS)					
Customer relationship management system (CRM)					
Supply chain management system (SCM)					
e-commerce					
Any other ICTs , if your firm has installed					

Section-B

3. In which year your company started its business?

4. Please explain the type of products that manufacture by your firm?

5. Please indicate the level of food processing that your firm belongs to.

Primary food processing	
Secondary food processing	
Tertiary food processing	

6. Please explain the stages involved in manufacturing of your firm products from processing of raw food to finished food products.

7. Does your firm export to international market?

Yes	
No	

If the answer is **Yes**, continue answering next question

If the answer is **No**, go to question number **9**

8. Please specify the type of food products and the country to which your firm exports.

Type of food products	Name of the countries

9. Please explain the reason for not exporting food products to an international market.

Section-C

The t*echnological*, *organizational* and *environmental* factors influencing firm's ICT investment

10. On the basis of your experience, please give your opinion on the following aspects by marking tick only in one box using the scale below: 1= strongly disagree, 2= disagree, 3= neither agree nor disagree, 4= agree, 5= strongly agree.

Statements	1	2	3	4	5
Technology Context					
Relative advantage					
The use of ICT allows us to manage business operations in an efficient way					
ICT allows us to accomplish specific tasks more quickly					
ICT allows us to save time in searching for resources					
ICT allows us to improve our job performance					
ICT allows us to purchase products and services for the business					
ICT allows us to learn more about our competitors					
ICT allows for better advertising and marketing					
ICT provides timely information for decision making purpose					
ICT use increases business performance					
Compatibility					
The use of ICT is fully compatible with current business operations					
The use of ICT is compatible with our firm's corporate culture and value system					
The use of ICT is compatible with our existing hardware and software					
The changes created by ICT usage are compatible with our business					
The ICT is compatible with our customers and suppliers					
Complexity					
Integrating ICT in our current work practices will be a challenge					

The cost of installing and maintaining ICT is high					
The skills needed to adopt ICT are too complex for employees of the firm					
The cost for training and reengineering work practices are very high					
Organization Context					
Top Management Support					
Our top management considers adoption of ICT as strategically important					
Our top management is willing to take risks involved in adopting ICT					
Our top management encourages firm's human resources to use ICT and provide proper training for the same					
Our top management maintains sufficient cash to meet short-term responsibilities of a firm					
Our parent firm encourages us to use ICT in the business transaction					
Our firm gets sufficient financial and human resources from parent firm to invest and use ICT					
Our top management is well experienced to invest better on ICT					
Organization Readiness					
Our firm allocated sufficient resources including fund to install and use ICT					
Our firm allocates sufficient resources and funds to manage the changes caused by ICT investment					
Being old, keep on modifying existing technology would be difficult for our firm					
As our firm grow older and older, we will be willing to invest more on ICT					

Our firm's younger employees are very comfortable working with ICT whereas old employees reluctant to work ICT					
Our firm has abundant human resource who supports the use of ICT					
Our firm has highly skilled and knowledgeable human resource to use ICT more efficiently					
Our firm has employed expert trainer to train employees to use ICT in more productive way					
Our firm invests on new machineries and equipment to improve production process					
Our firm has state-of-the-art-machinery in production to fulfill the demands of the customers					
Our firm has invested on necessary computer systems and related hardware to support the use of ICT					
Our firm is always keen to invest on new and modern ICT					
Our firm is financially strong to invest on technology related activities					
Our firm is financially strong to invest more on ICT regularly					
Global Exposure					
Our firm has invested on ICT to enter into international market					
Our firm use ICT to compete with competitors in international market					
Our firm use ICT to communicate easily with international customers					
Our firm invested on ICT to connect with suppliers in the global market					

Our firm invested on ICT to connect with our subsidiaries abroad					
Industry Specific (Processing Level)					
Our firm's food processing procedure demands the use of ICT					
Our firm has invested on ICT to automate completely the manufacturing process					
The use of automated ICT helps us in processing the food faster					
Environment Context					
External Pressure					
Our firm is under pressure from customers and suppliers to use ICT					
Our firm is under pressure from competitors to use ICT					
Our firm is under pressure from some government agencies to adopt ICT technology					
The government is providing us with incentives to adopt ICT technologies (tax benefits, loan grants, etc.)					

Section-D

The impact of information and communication technology (ICT) on export performance

11. On the basis of your experience, please give your opinion on the following aspects by marking tick only in one box using the scale below: 1= strongly disagree, 2= disagree, 3= neither agree nor disagree, 4= agree, 5= strongly agree

Statement	1	2	3	4	5
The ICT enables us to overcome difficulties in reading, speaking and understanding the languages of potential foreign export markets					
The ICT has helped us to gain useful feedback about our products from foreign customers					
The ICT improves our ability to create relationship with customers in our target foreign markets					
The ICT helps us to reach more potential foreign customers					
Using the ICT to target foreign customers gives our company a competitive edge over our rivals					
The ICT allows us to gather business knowledge about foreign markets					
Using ICT to market our products and services internationally lowers our overall marketing costs					
Overall, ICT investment helps us to improve our firm's export performance					
Other aspects on export performance					
Our firm is able to allocate necessary resources to compete strongly in the global market					
Our firm is able to take risk involved in competing in global market					
We allocate little resources once we enter into the global market					
As we grow older, we are able to get know more about global market					
As we grow older, we are able to export more in the global market					
Our firm has state-of-the-art-machinery which has					

the capacity to work of many employees					
We require less number on human resources and their skill due to state-of-the-art-machinery					
We are able to find better customers for our products due to our parent firm supports and brand image					
The kind of products our firm manufactures has huge demand in the global market					

12. Please indicate what are the ***barriers*** for ICT adoption?

    On the basis of your experience, please give your opinion on the following aspects by marking tick only in one box using the scale below: 1= strongly disagree, 2= disagree, 3= neither agree nor disagree, 4= agree, 5= strongly agree.

Statements	**1**	**2**	**3**	**4**	**5**
Lack of ICT infrastructure					
Lack of ICT expertise/technical know-how					
Lack of ICT budget					
Lack of appropriate service provider (system integrators, value added resellers)					
Lack of awareness about ICT benefits					
Lack of awareness of the financial and technical assistance provided by government and private sector					
Lack of security and trust					
Others (Please specify)					

Section-E: Information about Respondents

13. What is your current position in your firm? Please indicate the relevant option given below. ☐ Owner ☐ Chief Executive Officer ☐ Senior manager ☐ Manger ☐ Other (Please specify) _____ _	14. Please indicate your gender. ☐ Male ☐ Female
15. Please indicate your age range. ☐ 20-29 ☐ 30-39 ☐ 40-49 ☐ Above 50	16. Please indicate your level of education ☐ High school ☐ Pre-university ☐ Degree ☐ Post-graduate ☐ Above post graduate

Bio-Data

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Educational Background

Degree	Institute	Place	Stream	Year of Passing	Results
M.Com	Mangalore University	Mangalore, Karnataka	M.Com	2012	62.25%
B.Com	Sri Bhuvanendra College	Karkala, Udupi, Karnataka	B.Com	2010	67.94%
Pre-University	Besant Girls Pre-University College	Mangalore, Karnataka	Commerce	2007	72.5%
SSLC	The Ryots Education High School	Hanakere, Mandya, Karnataka	-	2005	65.92%

Workshop attended

- Participated in the workshop on “Data Analytics for Research in Management and Social Sciences” from October 30 – November 1, 2014 at Centre for Distance Education, Anna University, Chennai.
- Participated in the Short-Term Course on ‘Time Series and Panel Data analysis using EViews and STATA’ held from January 25-30, 2016 at National Institute of Technology, Tiruchirappalli-15.
- Participated in One Week National Level Workshop cum Conference on “Panel Data Econometrics” from 12-18 August, 2016 organized by Department of Studies in Economics and Co-operation, Manasagangothri, Mysuru, University of Mysore.
- Participated in One Week Faculty Development Programme on Econometrics for Management Research, held at IIM Kozhikode during December 5-9, 2016.
- Participated in the Faculty Development Program on "Structural Equation Modelling using Rstudio-Enrich your Publications" on 16th and 17th December, 2016 at T.A. Pai Management Institute (TAPMI), Manipal, Karnataka.