Geography, Linkages and Capabilities: Innovation in the Agricultural Coffee Production in Latin America

by

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Abstract

The main contribution of this work is the proposal of a conceptual framework that integrates internal (to the firm) conditions with external influences at two geographical proximity levels, local and non-local, with respect to four types of innovation performance: product innovation, process innovation, managerial/organisational innovation and marketing innovation. This is quantitatively evaluated in a sample of 186 coffee farmers from Latin America.

Following the Resource-Based View of the Firm (RBV), the internal conditions include two firm capabilities: technological capabilities and marketing capabilities. The external influences incorporates the evaluation of horizontal and vertical linkages with purposes of innovation at the local level (cluster geographical context) and non-local level (extra-cluster geographical context). The tests are controlled by the variable *country of origin*, which is not much relevant in these evaluations, as well as the variable for size, which is mostly significant although with a negative impact.

The results suggest that internal conditions seem to be the most relevant factors related to innovation performance in this sample, whilst extra-cluster linkages are the external conditions with the highest relative importance in the explored models. This last outcome suggests the predominance of global value chains and its dynamics in relation to the innovative results of companies located in primary industries from developing countries. This seem to be the case even in the case of highly clustered activities within a region, such as the agricultural coffee production in Latin America.

Geography, Linkages and Capabilities: Innovation in the Agricultural Coffee Production in Latin America

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Geography, Linkages and Capabilities: Innovation in the Agricultural Coffee Production in Latin America

Author's Statement of Originality

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Geography, Linkages and Capabilities: Innovation in the Agricultural Coffee Production in Latin America

Table of Contents

List of Tables……viii

List of Figures……xiv

List of Acronyms and Abbreviations……xv

Chapter 1. Introduction……1

1.1. Areas of Study 5
1.2. Aim and Objectives of this Research 5
1.3. Research Questions 6
1.3.1. Part 1: Firm Capabilities and Innovation Performance in the Agricultural Coffee Production in Latin America 6
1.3.2. Part 2: The Cluster Effects: Local Influences and the Building of Internal Capabilities in the Latin American Coffee Farms 7
1.3.3. Part 3: Localisation versus Globalisation: External Linkages for Capability Building in the Latin America's Coffee Production 7
1.4. The International Coffee Market and Latin America. Rationale for the Selection of the Coffee Industry in this Research 8

Chapter 2. Methodology ……12

2.1. Sampling 12
2.1.1. Target Population and Unit of Analysis 12
2.1.2. Sample and Data Collection 12
2.2. Measures 17
2.2.1. Innovation Performance 17
2.2.2. Technological Capabilities 19
2.2.3. Marketing Capabilities 21
2.2.4. Cluster (Local) Linkages for Innovation Purposes 22
2.2.5. Extra-Cluster (Non-Local) Linkages for Innovation Purposes 23
2.2.6. Moderating Variables 23
2.2.7. Evaluation of Potential Moderating Variable 1: Absorptive capacity 24
2.2.8. Evaluation of Potential Moderating Variable 2: Collective efficiency 24

2.2.9. Evaluation of Potential Moderating Variable 3: Local Horizontal Linkages with Supporting Institutions 25
2.3. Control Variables 25
2.4. Validity and Reliability 26
2.4.1. Measurement validity 27
2.4.2. Statistical validity 28
2.4.3. Internal validity 29
2.4.4. External validity 30
2.4.5. Reliability 30
2.4.6. Validity and Reliability Conclusions 32
2.5. Data Transformations and Standardization 32
2.6. Normality Test for the Dependent Variables 32
2.7. Common Method Variance 34
2.8. Econometric Models 35
2.9. Regression Diagnostics 42
2.9.1. Linearity of Variables 43
2.9.2. Normality of Residuals 43
2.9.3. Heteroscedasticity 44
2.9.4. Multicollinearity 45
2.10. General Dominance Analysis (Relative Importance) 47

Chapter 3. Firm Capabilities and Innovation Performance in the Agricultural Coffee Production in Latin America 48

3.1. Chapter Introduction 49
3.2. Literature Review 52
3.2.1. The Resource-Based View (RBV) and Firm Capabilities 52
3.2.2. Innovation Performance 54
3.2.3. Firm Capabilities and Innovation Performance 56
3.2.4. Conceptual Framework 57
3.2.5. Research Hypotheses 59
3.3. Methodology 61
3.3.1. Target Population and Unit of Analysis 62
3.3.2. Sample and Data Collection 62
3.3.3. Measures 64
3.3.4. Econometric Models 65
3.3.5 Control Variables 68
3.3.6. Validity and Reliability 69
3.3.7. Data Transformations and Standardisation 69
3.4. Data Analysis 70
3.4.1. Descriptive Statistics 71
3.4.2. Correlations 73
3.4.3. Regression Analysis 74
3.5. Results 84

3.6. Discussion 86

Chapter 4. The Cluster Effects: Local Influences and the Building of Internal Capabilities in the Latin American Coffee Farms……..90

4.1. Chapter Introduction 91
4.2. Literature Review..... 94
4.2.1. Clusters and Local Linkages 94
4.2.2. Clusters and Firm Capabilities 98
4.2.3. Conceptual Framework 99
4.2.4. Research Hypotheses..... 100
4.3. Methodology 105
4.3.1. Target Population and Unit of Analysis 105
4.3.2. Sample and Data Collection..... 105
4.3.3. Measures 106
4.3.4. Econometric Models..... 108
4.3.5. Control Variables..... 110
4.3.6. Validity and Reliability 111
4.3.7. Data Transformations and Standardisation 111
4.4. Data Analysis..... 112
4.4.1. Descriptive Statistics and Correlations..... 112
4.4.2. Regression Analysis..... 113
4.4.2.2. Marketing Capabilities and Local Linkages 116

4.5. Results..... 119
4.6. Discussion 123

Chapter 5. Localisation versus Globalisation: External Linkages for Capability Building in the Latin America's Coffee Production 126

5.1. Chapter Introduction 127
5.2. Literature Review..... 130
5.2.1. Business Clusters and Technological Capabilities..... 131
5.2.2. Global Networks and Technological Capabilities 132
5.2.3. Localisation versus Globalisation: The Simultaneous Influences of Clusters and Global Networks on Capability Building 134
5.2.4. Conceptual Framework 134
5.2.5. Research Hypotheses..... 136
5.3. Methodology 140
5.3.1. Target Population and Unit of Analysis 140
5.3.2. Sample and Data Collection..... 140

5.3.3. Measures 141
5.3.4. Econometric Models 143
5.3.5. Control Variables 145
5.3.6. Validity and Reliability 146
5.3.7. Data Transformations and Standardisation 146
5.4. Data Analysis 147
5.4.1. Descriptive Statistics and Correlations 147
5.4.2. Regression Analysis 148
5.5. Results 158
5.6. Discussion 162

Chapter 6. Conclusions and Future Implications……..165

6.1. Main Findings and Discussion of Research Questions 165
6.2. Research Contributions 171
6.3. Future Research Agenda 173
6.4. Research Limitations 174

Appendix A. Survey instrument……176

Appendix B. Photos of data collection……188

References……..199

Geography, Linkages and Capabilities: Innovation in the Agricultural Coffee Production in Latin America

List of Tables

TABLE 1. DATA COLLECTION IN COSTA RICA. WORKSHOPS 15
TABLE 2. COFFEE FARMERS BY COUNTRY OF ORIGIN 16
TABLE 3. COFFEE PRODUCERS BY SIZE 16
TABLE 4. COFFEE PRODUCERS BY YEARS IN THE COFFEE BUSINESS 17
TABLE 5. INNOVATION PERFORMANCE 19
TABLE 6. TECHNOLOGICAL CAPABILITIES - INDEX AND SUBCATEGORIES 21
TABLE 7. MARKETING CAPABILITIES 22
TABLE 8. LOCAL LINKAGES FOR INNOVATION PURPOSES 23
TABLE 9. EXTRA-CLUSTER (NON-LOCAL) LINKAGES FOR INNOVATION PURPOSES 23
TABLE 10. ABSORPTIVE CAPACITY 24
TABLE 11. COLLECTIVE EFFICIENCY 25
TABLE 12. RELIABILITY MEASURES APPLIED IN THIS RESEARCH 31
TABLE 13. CRONBACH'S ALPHAS TEST 31
TABLE 14. SKEWNESS AND KURTOSIS TESTS FOR NORMALITY 33
TABLE 15. COMMON METHOD VARIANCE ANALYSIS 35
TABLE 16. MODEL SET 1: INNOVATION PERFORMANCE AND FIRM CAPABILITIES 37
TABLE 17. MODEL SET 2: FIRM CAPABILITIES AND LOCAL INFLUENCES 39
TABLE 18. MODEL SET 3: FIRM CAPABILITIES AND NON-LOCAL LINKAGES 40

TABLE 19. MODEL SET 4: FIRM CAPABILITIES AND EXTERNAL (LOCAL AND NON-LOCAL) LINKAGES ……42

TABLE 20. NORMALITY OF RESIDUALS: SHAPIRO-WILK TEST 44

TABLE 21. HETEROSCEDASTICITY: BREUSCH-PAGAN/COOK TEST 45

TABLE 22. MULTICOLLINEARITY: VARIATION INFLATION FACTOR (VIF) 46

TABLE 23. COFFEE FARMERS BY COUNTRY 64

TABLE 24. COFFEE FARMERS BY SIZE 64

TABLE 25. PROPOSED ECONOMETRIC MODELS FOR THE REGRESSION ANALYSIS 68

TABLE 26. PRODUCT INNOVATION – TABULATION 71

TABLE 27. PROCESS INNOVATION – TABULATION 72

TABLE 28. MANAGERIAL AND ORGANISATIONAL INNOVATION – TABULATION 72

TABLE 29. MARKETING INNOVATION – TABULATION 72

TABLE 30. FIRM CAPABILITIES - DESCRIPTIVE STATISTICS 73

TABLE 31. SPEARMAN CORRELATIONS 74

TABLE 32. MODEL SET 1.1. LINEAR OLS (ROBUST) REGRESSIONS: INNOVATION PERFORMANCE (INDEX) AND FIRM CAPABILITIES 75

TABLE 33. GENERAL DOMINANCE ANALYSIS (STANDARDIZED WEIGHTS AND RANKINGS): INNOVATION PERFORMANCE (INDEX) AND FIRM CAPABILITIES 77

TABLE 34. MODEL SET 1.2. ORDERED PROBIT REGRESSIONS: PRODUCT INNOVATION AND FIRM CAPABILITIES 78

TABLE 35. GENERAL DOMINANCE ANALYSIS (STANDARDIZED WEIGHTS AND RANKINGS): PRODUCT INNOVATION AND FIRM CAPABILITIES 79

TABLE 36. MODEL SET 1.3. ORDERED PROBIT REGRESSIONS: PROCESS INNOVATION AND FIRM CAPABILITIES 79

TABLE 37. GENERAL DOMINANCE ANALYSIS (STANDARDIZED WEIGHTS AND RANKINGS): PROCESS INNOVATION AND FIRM CAPABILITIES 80

TABLE 38. MODEL SET 1.4. ORDERED PROBIT REGRESSIONS: MANAGERIAL INNOVATION AND FIRM CAPABILITIES 81

TABLE 39. GENERAL DOMINANCE ANALYSIS (STANDARDIZED WEIGHTS AND RANKINGS): MANAGERIAL INNOVATION AND FIRM CAPABILITIES 82

TABLE 40. MODEL SET 1.5. ORDERED PROBIT REGRESSIONS: MARKETING INNOVATION AND FIRM CAPABILITIES 83

TABLE 41. GENERAL DOMINANCE ANALYSIS (STANDARDIZED WEIGHTS AND RANKINGS): MARKETING INNOVATION AND FIRM CAPABILITIES 83

TABLE 42. RESULTS OF REGRESSION ANALYSIS (ORDERED PROBIT): FIRM CAPABILITIES AND TYPES OF INNOVATION PERFORMANCE 84

TABLE 43. RESULTS OF RELATIVE IMPORTANCE: FIRM CAPABILITIES AND TYPES OF INNOVATION PERFORMANCE 85

TABLE 44. RESULTS OF RELATIVE IMPORTANCE: TECHNOLOGICAL CAPABILITIES (SUBCATEGORIES) AND TYPES OF INNOVATION PERFORMANCE 86

TABLE 45. COFFEE FARMERS BY COUNTRY 106

TABLE 46. COFFEE FARMERS BY SIZE 106

TABLE 47. PROPOSED MODELS FOR THE REGRESSION ANALYSIS 109

TABLE 48. DESCRIPTIVE STATISTICS 113

TABLE 49. SPEARMAN CORRELATIONS 113

TABLE 50. MODEL SET 2.1. LINEAR OLS (ROBUST) REGRESSIONS: TECHNOLOGICAL CAPABILITIES AND LOCAL LINKAGES 115

TABLE 51. GENERAL DOMINANCE ANALYSIS (STANDARDIZED WEIGHTS AND RANKINGS): TECHNOLOGICAL CAPABILITIES AND LOCAL LINKAGES 115

TABLE 52. MODERATION TEST: TECHNOLOGICAL CAPABILITIES, LOCAL LINKAGES AND MODERATING VARIABLES 116

TABLE 53. MODEL SET 2.2. LINEAR OLS (ROBUST) REGRESSIONS: MARKETING CAPABILITIES AND LOCAL LINKAGES 117

TABLE 54. GENERAL DOMINANCE ANALYSIS (STANDARDIZED WEIGHTS AND RANKINGS): MARKETING CAPABILITIES AND LOCAL LINKAGES 118

TABLE 55. MODERATION TEST: MARKETING CAPABILITIES, LOCAL LINKAGES AND MODERATING VARIABLES 118

TABLE 56. RESULTS OF REGRESSION ANALYSIS (OLS): FIRM CAPABILITIES AND LOCAL LINKAGES 120

TABLE 57. RESULTS OF RELATIVE IMPORTANCE: LOCAL LINKAGES, FIRM CAPABILITIES AND OTHER VARIABLES 121

TABLE 58. RESULTS OF MODERATION TEST: TECHNOLOGICAL CAPABILITIES (INDEX), LOCAL LINKAGES AND MODERATING VARIABLES 122

TABLE 59. RESULTS OF MODERATION TEST: MARKETING CAPABILITIES, LOCAL LINKAGES AND MODERATING VARIABLES 122

TABLE 60. COFFEE FARMERS BY COUNTRY 141

TABLE 61. COFFEE FARMERS BY SIZE 141

TABLE 62. PROPOSED ECONOMETRIC MODELS FOR THE REGRESSION ANALYSIS 144

TABLE 63. DESCRIPTIVE STATISTICS 147

TABLE 64. SPEARMAN CORRELATIONS 148

TABLE 65. MODEL SET 3.1. LINEAR OLS (ROBUST) REGRESSIONS: TECHNOLOGICAL CAPABILITIES AND EXTRA-CLUSTER LINKAGES 150

TABLE 66. GENERAL DOMINANCE ANALYSIS (STANDARDIZED WEIGHTS AND RANKINGS): TECHNOLOGICAL CAPABILITIES AND EXTRA-CLUSTER LINKAGES 151

TABLE 67. MODERATION: TECHNOLOGICAL CAPABILITIES, EXTRA-CLUSTER LINKAGES AND MODERATORS 151

TABLE 68. MODEL SET 3.2. LINEAR OLS (ROBUST) REGRESSIONS: MARKETING CAPABILITIES AND EXTRA-CLUSTER LINKAGES 152

TABLE 69. GENERAL DOMINANCE ANALYSIS (RANKINGS): MARKETING CAPABILITIES AND EXTRA-CLUSTER LINKAGES 152

TABLE 70. MODERATION: MARKETING CAPABILITIES, EXTRA-CLUSTER LINKAGES AND MODERATORS 153

TABLE 71. MODEL SET 4.1. LINEAR OLS (ROBUST) REGRESSIONS: TECHNOLOGICAL CAPABILITIES, LOCAL LINKAGES AND EXTRA-CLUSTER LINKAGES 155

TABLE 72. GENERAL DOMINANCE ANALYSIS (STANDARDIZED WEIGHTS AND RANKINGS): TECHNOLOGICAL CAPABILITIES, LOCAL LINKAGES AND EXTRA-CLUSTER LINKAGES 156

TABLE 73. MODEL SET 4.2. LINEAR OLS (ROBUST) REGRESSIONS: MARKETING CAPABILITIES, LOCAL LINKAGES AND EXTRA-CLUSTER LINKAGES 157

TABLE 74. GENERAL DOMINANCE ANALYSIS (STANDARDIZED WEIGHTS AND RANKINGS): MARKETING CAPABILITIES, LOCAL LINKAGES AND EXTRA-CLUSTER LINKAGES 158

TABLE 75. RESULTS OF REGRESSION ANALYSIS (OLS): EXTRA-CLUSTER LINKAGES AND FIRM CAPABILITIES 159

TABLE 76. RESULTS OF RELATIVE IMPORTANCE: EXTRA-CLUSTER LINKAGES AND FIRM CAPABILITIES 160

TABLE 77. MODERATION: TECHNOLOGICAL CAPABILITIES, EXTRA-CLUSTER LINKAGES AND MODERATORS 160

TABLE 78. MODERATION: MARKETING CAPABILITIES, EXTRA-CLUSTER LINKAGES AND MODERATORS 161

TABLE 79. RESULTS OF RELATIVE IMPORTANCE: LOCAL AND EXTRA-CLUSTER LINKAGES (INDEXES) AND FIRM CAPABILITIES 161

Geography, Linkages and Capabilities: Innovation in the Agricultural Coffee Production in Latin America

List of Figures

FIGURE 1. FIRM CAPABILITIES AND INNOVATION PERFORMANCE.....58

FIGURE 2.TECHNOLOGICAL CAPABILITIES' SUBCATEGORIES AND INNOVATION PERFORMANCE.....59

FIGURE 3. LOCAL LINKAGES AND FIRM CAPABILITIES.....99

FIGURE 4. EXTRA-CLUSTER LINKAGES AND FIRM CAPABILITIES.....135

Geography, Linkages and Capabilities: Innovation in the Agricultural Coffee Production in Latin America

List of Acronyms and Abbreviations

ACAP: Absorptive capacity.

ANACAFE: Asociación Nacional del Café (National Association of Coffee. Guatemala).

CATIE: Centro Agronómico Tropical de Investigación y Enseñanza (The Tropical Agricultural Research and Higher Education Center)

CLACDS: Centro Latinoamericano para la Competitividad y el Desarrollo Sostenible (The Latin American Center for Competitiveness and Sustainable Development).

GVC: Global value chains.

ICAFE: Instituto Costarricense del Café (The Costa Rican Institute of Coffee).

ICO: International Coffee Organization.

INCAE: Instituto Centroamericano de Administración de Empresas (The Central American Institute of Business Administration).

ITC: International Trade Center.

OECD: Organisation for Economic Co-operation and Development

OLS: Ordinary least square.

R&D: Research and development.

RBV: The Resource-Based View theory.

SIB: Superintendencia de Bancos (Superintendency of Banks, Guatemala).

VIF: Variance inflation factor.

Geography, Linkages and Capabilities: Innovation in the Agricultural Coffee Production in Latin America

Chapter 1. Introduction

The purpose of the present work is to build on the research stream of the Resource-Based View of the Firm theory (RBV) (Wernerfelt, 1984; Prahalad & Hamel, 1990; Barney, 1991, 2001), borrowing concepts from the innovation management theory. It deals with the mutual potential relationships among internal (to the firm) conditions, such as the innovation performance and the firm capabilities, and some selected external influences, such as the external local and non-local networking and linkage factors and environments. Its general objective is to contribute on previous quantitative studies extending the evaluations of innovation performance to the case of a mature and low-tech industry located in developing countries. More specifically, this study is based on an evaluation of the traditional agricultural coffee production in Latin American countries.

A selection of 186 coffee farmers from several Latin American coffee-exporting countries are being included in the sample. Indeed, coffee growers from Colombia, Mexico, Peru, and all six Central American countries have been considered in this work, in an attempt to accomplish a comparative approach. Nonetheless, due to the author's financial resource limitations, most of the sample is focused only on two important exporting countries: Costa Rica and Guatemala.

The Resource-Based View of the Firm (RBV) proposes that differences in business performances could be explained by differences in the resources that these firms owns or controls (Wernerfelt, 1984; Prahalad & Hamel, 1990; Peteref, 1993; Barney, 1991, 2001). According to the RBV, these resources could represent a source of sustainable competitive

advantage if they are valuable, rare and hard to be imitated or substituted by other companies (Dierickx & Cool, 1989; Prahalad & Hamel, 1990; Barney, 1991; Hoopes et al., 2003).

Firm capabilities, a definition derived from the RBV theory, may be defined as the conjunction of assets and competences that generate value for customers (Afuah, 2003). In other words, capabilities are the efficiency in which firms can transform inputs in outputs (Dutta et al., 2005). In the literature, several types of firm capabilities are explored in relation to their impact on business and innovation performance. This includes firm capabilities such as technological capabilities (Lall, 1992, 1995; Shan & Jolly, 2012), marketing capabilities (Vorhies & Morgan, 2005; Vorhies, Morgan, & Autry, 2009; Eng & Spickett-Jones, 2009), innovation capabilities (Yam et al., 2011), and dynamic capabilities (Teece, Pisano & Shuen, 1997; Rothaermel, & Hess, 2007), among others (Zawislak et al., 2013). This research only focuses on two of these types of firm capabilities: technological capabilities and marketing capabilities, and their potential complementary effects is an issue of particular interest in this thesis.

Previous theoretical studies suggest the existence of complementary effects among different types of firm capabilities (Amit & Schoemaker, 1993; Song et al., 2005; Prasnikar et al., 2008; Eng & Okten, 2011). However, according to Prasnikar et al. (2008), these complementary effects have not been sufficiently corroborated quantitatively in previous studies. This scarcity of quantitative evidence of complementarities among firm capabilities seems to be clearer in the case of primary activities in developing countries, such as the agricultural coffee production in Latin America. As a consequence, the quantitative evaluation of individual and complementary effects in the relationships among technological capabilities, marketing capabilities and innovation performance, in the case of

an agricultural activity in developing countries, may be considered a modest contribution of this work to the literature.

The firm's innovation performance, defined as the firm's degree of achievement or accomplishment on "*the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations"* (OECD, 2005, p. 46), is an important variable to be considered in this research. Indeed, four types of innovation performance are evaluated: product innovation, process innovation, managerial/organisational innovation and marketing innovation, arguably the most commonly considered types of innovation in the management innovation literature.

A positive relationship between firm capabilities and business performance has been suggested in the literature (e.g. Isobe et al., 2008; Eng & Spickett-Jones 2009; Merrilees et al., 2010; Nah et al., 2010). A positive relationship can also be proposed between firm capabilities and innovation performance (Cohen & Levinthal, 1990; Zhou & Wu, 2010). However, most previous studies put special emphasis on evaluating innovation performance in general or product innovation. Much less frequently, process innovation is also considered, but the potential mutual influences of firm capabilities and other types of innovation performance, such as managerial/organisational innovation or marketing innovation, remains relatively unexplored. Taking in consideration the previous information, the evaluation of the mutual influences of firm capabilities with managerial/organisational innovation and marketing innovation may be considered another contribution of this work.

The relevance of geographical proximity is another issue that it tries to be examined in this research (Porter, 1990; Krugman, 1991; Boschma, 2005; Silvestre & Dalcol, 2009). Indeed, the influences of external linkages with other companies and organizations for

innovation purposes, at the local and extra-cluster level, are considered as potential external conditions for innovation performance and capability building in this study. Therefore, three levels of analysis are been evaluated in this research: a) internal to the firm level, as it explores firm capabilities and their complementary effects in relation to firm's innovation performance; b) external local/regional level, as it considers the influences of local linkages and other cluster externalities on firm capabilities; and c) external extra-cluster level, as it also includes the examination of external linkages with entities located beyond the local/regional context of these examined coffee producers.

Finally, globalisation and a fierce international rivalry from global low-cost producers and large-scale exporters from Asia, as well as from other regions in the world, have been contracting the profitability of several Latin American commodity's exporting activities (Gereffi, 1999, 2003; Hausmann et al., 2007). This challenging situation also impact the agriculture sector, an activity where poverty and other social and economic limitations are particularly concerning in most Latin American countries (Flores et al., 2002; Cafaggi et al., 2012).

Innovating to more valuable, differentiated and profitable products may be a necessity for many of these Latin American companies in order to grow their business or, perhaps most commonly, even to survive (Whitford, 2001). Innovation in conjunction with differentiation strategies may be an urgently required action for many of these Latin American coffee farmers (Hausmann et al., 2007). Thus, an eventually better understanding of the most relevant internal and external drivers for innovation and how they mutually interact, in the case of these coffee farmers, could be useful for the design of more effective actions and policies.

This thesis incorporates six (6) different chapters. The first chapter is this introduction. The second chapter explains the methodological considerations followed by this work. Then, the chapters 3, 4 and 5 present the three close-related studies that conform the body of this thesis. Finally, the chapter 6 offers some conclusions, potential policy recommendations, as well as other information that may be considered as useful.

1.1. Areas of Study

This research is based on the theories of the resource-based view of the firm (RBV), business clusters and global value chains (GVC), adapted to the study of innovation management.

1.2. Aim and Objectives of this Research

The aim of this research is to evaluate the mutual relationships among the firm's internal conditions, the potential environmental influences (at two geographical contexts), and its innovation results, in the case of the agricultural coffee producers in Latin America.

The following are the specific research objectives:

Objective 1: Evaluate the importance of technological capabilities and marketing capabilities for the firm's performance in regard to four specific types of innovation.

Objective 2: Understand the potential individual and combined effects of environmental influences at two geographical levels: the cluster level (local context) and the extra-cluster level (non-local context).

Objective 3: Quantify the relative importance of each element in relation to the observable results for innovation performance and capability building.

Objective 4: Propose a model that explores the interrelations among innovation performances and capability building, incorporating three levels into the analysis: a) firm's internal conditions, b) local cluster effects and c) extra-cluster linkages.

This work is presented in three close-related studies (chapters), which in conjunction will be the body of a doctoral thesis, as a requirement for the Ph.D. degree in Entrepreneurship and Innovation at the Essex Business School, University of Essex, United Kingdom.

1.3. Research Questions

The following are the research questions proposed for each of the three close-related studies included in this work:

1.3.1. Part 1: Firm Capabilities and Innovation Performance in the Agricultural Coffee Production in Latin America

1. What is the relationship between innovation performance and technological capabilities in the case of a mature low-tech industry (agricultural coffee sector) in Latin America?
2. Given their differences in the social, economic and institutional current situations, is this relationship stronger for Costa Rica´s coffee growers than for Guatemala´s?

1.3.2. Part 2: The Cluster Effects: Local Influences and the Building of Internal Capabilities in the Latin American Coffee Farms

3. What is the mutual impact of local linkages and firm capabilities in the case of a mature low-tech industry (agricultural coffee production) in Latin America?
4. Does absorptive capacity (ACAP) have a moderating effect on this relationship between local linkages and firm capabilities?
5. Does collective efficiency have a moderating effect on this relationship between local linkages and firm capabilities?

1.3.3. Part 3: Localisation versus Globalisation: External Linkages for Capability Building in the Latin America's Coffee Production

6. What is the mutual impact of extra-cluster linkages for innovation purposes and firm capabilities in the case of a mature and low-tech industry (coffee agricultural production) in Latin America?
7. Does absorptive capacity (ACAP) have a moderating effect on the correlation between extra-cluster linkages and firm capabilities?
8. Does local horizontal linkages with supporting institutions have a moderating effect on the correlation between extra-cluster linkages and firm capabilities?
9. What is the relationship among cluster influences, extra-cluster linkages and internal capability building in agricultural coffee producers of Latin America?
10. Does absorptive capacity (ACAP) have a moderating effect on the correlation between local linkages, extra-cluster linkages and technological capabilities?

1.4. The International Coffee Market and Latin America. Rationale for the Selection of the Coffee Industry in this Research

Coffee is a traditional commodity produced in more than 50 countries in the tropical areas. It is a traditional agricultural product that is particularly important for Latin American countries. In this region, coffee production represents a 58% of the world's total, whilst Asia and Africa accounts 30% and 12%, respectively (ICO, 2011; ITC, 2011). Coffee is the second-largest traded commodity in the world, and the leading coffee-exporting countries are Brazil, Vietnam, Colombia and Indonesia. The largest coffee markets in the world are European Union (66%), United States of America (22%) and Japan (7%) (ICO, 2011).

The main characteristics of the agricultural coffee sector in Latin America can be presented as follows: a) the informal and social interactions among coffee producers are crucial for business development and improvements; b) high dependency in the governance of global buyers in the coffee's global value chain (GVC), and the agricultural producers are focused on low value-added and basic products. More than 90% of the global coffee production is conventional and non-differentiated coffee; c) high level of local support due to high political leverage of these coffee producers through strong and well organized coffee producer associations and coffee industry chambers; d) important differences in the local institutional support framework: "free" trade in some countries, such as in the cases of Guatemala and El Salvador, versus a more direct and intense governmental and legal interventionism with heavy public subsidies, such as in the cases of Costa Rica and Colombia; e) huge number of coffee producers. The exact number is unknown but for sure they total millions of people; f) lack of detailed information and

publicly available about the coffee farmers (Varingis et al, 2002; Deugd, 2003; Cafaggi et al, 2012).

The international prices for agricultural commodities, such as coffee, are particularly volatile. Supply shocks are common, mostly caused by unexpected variations in the outputs from large producers, such as Brazil and Vietnam. These shocks could promote huge price volatility. After passing through a recent profound low-price crisis, the global coffee industry is experiencing a more suitable situation (ICO, 2011). Nonetheless, another price crisis is always a possible scenario in the coffee industry and, precisely for that reason, to innovate and develop better or more differentiated products may be particularly crucial for the success, or even the survival, of these coffee farmers in the long term (González, 1998; Castro et al., 2004, Damiani, 2004). Indeed, according to some coffee producers and experts, during price crisis, the price premiums obtained by producing and selling more sophisticated products, such as certified coffees or specialty coffees, could be the difference between to make a profits and to lose money at the farm level. This is one of the main reason why the coffee sector has been considered an interesting selection for this study about innovation management.

However, the rationale to study innovation management in the case of the Latin American agricultural coffee producers also includes other considerations. Firstly, there is a relative scarcity of previous studies about firm's innovation performance in Latin American countries, and this situation is even scarcer for agricultural activities such as coffee. Secondly, the Latin American coffee sector is focused on selling their products in developed countries, where customers are particularly demanding and where innovation could be much more appreciated (ICO, 2011; ITC, 2011). Thirdly, coffee may have a huge potential and opportunities for the implementation of business initiatives related to promote

product innovation and process innovation, but also managerial/organisational innovation and marketing innovation as, to date, most of the Latin American coffee is traditionally exported as a low value-added and basic commodity (González, 1998, Damiani, 2004). Lastly, as the coffee business is still an important economic activity in many Latin American countries, they have a very high political leverage that allows them to receive a heavy public institutional support, beyond the normal levels on other agricultural activities or in other sectors, such as manufacturing or services (ICAFE, 2009; SIB, 2011). A better understanding of the innovation phenomena in this sector could help to design better public policies that may improve the social and economic situation of many people in this region.

This research focuses in two important Latin American coffee-exporting countries: Costa Rica and Guatemala. However, the general differences between these two countries are significant, not only in regards of social, educational and economic development, but also in relation to the legal and institutional framework that rules the coffee activity in each country. On the one hand, Costa Rica enforces a strict regulation on its coffee activity by law (Castro et al., 2004). This regulation forces a clear separation of functions inside the value chain, under a scheme of profit sharing and social solidarity (Asamblea Legislativa, 1961). In fact, in Costa Rica, by law, the international commercialization of coffee is almost exclusively performed by other local trade-specialized companies and not by the farms themselves. As a consequence, the coffee growers in this country may not require of a high level of marketing skills in order to export their products efficiently. On the other hand, Guatemala presents coffee farmers with a higher degree of freedom for doing business. The Guatemala's legislation could allow a heavy public interventions in the coffee sector, however that rarely happens. Due to the profound structural differences between these two

countries, a comparative analysis, considering a variable for country of origin, is a task proposed within this research.

Geography, Linkages and Capabilities: Innovation in the Agricultural Coffee Production in Latin America

Chapter 2. Methodology

This chapter presents the research methodology that have been followed in this work. This presentation includes the sampling and other procedures for the data collection, the applied statistical methods and data analysis, the definition of variables with the evaluation of their validity, as well as other considerations related to the regressions diagnostics.

2.1. Sampling

2.1.1. Target Population and Unit of Analysis

The target population of this research are the coffee farms located in countries of Latin America. The unit of analysis is the owners (or managers) of these coffee farms. In this study, coffee producers of all sizes are considered. The total population of coffee producers in Central America has been estimate in a number close to 300,000 farmers (Flores et al., 2002, p. 29). The total for coffee producers in Latin America is unknown; nevertheless, that number must certainly be measured in millions, as Brazil and Colombia are two of the larger coffee producers in the world. The majority of this population is composed by small farmers, i.e. farmers with a production area of 20 hectares or less. Accordingly, small farmers are expected to be the predominant type of coffee producer within the sample.

2.1.2. Sample and Data Collection

The sampling process for this research relies on the use of data sources obtained from electronic sources such as websites, electronic databases and electronic contact lists

from coffee's business associations, as well as from local supporting institutions and international organizations related to the coffee sector in these countries. Nonetheless, the utility of using these electronic databases probed to be of a limited utility for this research, as they only include a relatively small number of coffee producers, and most coffee producers in Latin America are not much reachable by electronic means, in particular by electronic mail (e-mail). Indeed, the total number of coffee producers with e-mail that could be identified through the consulted electronic data sources is estimated in around 1,200 people. The exact number of the coffee producers contacted is unknown due to some supporting organizations agreed to share this research's questionnaire themselves, without revealing the identity or quantity of their members to the author.

The data collection relies on a self-reporting questionnaire that is presented in the Appendix A of this thesis. This questionnaire is deployed through the implementation of two strategies. The first strategy was based on an Internet survey conducted through Survey Monkey (www.surveymonkey.com), a specialized website to apply online surveys. However, a very low response rate was expected for this first strategy. The second strategy was a field survey, applied either through personal interviews or during the celebration of training workshops offered by governmental supporting institutions. Most of this research's data was obtained through this second strategy.

The feasibility of applying a random sample in this research was considered as unreachable for the author. The cost of reaching randomly a sample in a population of hundreds of thousand people coffee farmers is well beyond the availability of financial resources and time of the author of this research. Therefore, the sample of this research is not a probabilistic sample, instead it is a convenience sample (Frankfort-Nachmias & Nachmias, 1996). This fact represents one important limitation in this research.

Nevertheless, according to Simon & Burstein (1985), the implementation of non-random samples may be justified when the cost of implementation of random selection is considered too high, as it is the case in this research.

For the first strategy of the Internet survey, the coffee producers that could be found through the electronic databases were around 1,200 people, and all of them were included in this survey. Around 30% of the producers included in the electronic databases could not be reached, presumably due to mistakes in the available information. Other producers just probably ignored the survey that was delivered to them by e-mail. As a result, the Internet survey failed in reaching by electronic means most of these Latin American coffee producers. However, 46 valid responses were obtained through the Internet survey: 9 from Costa Rica, 17 from Guatemala and 20 from other countries. A few Internet responses were discarded because they were mostly null. The response of the Internet survey is close to 4%. The second strategy, a physical survey on the field, achieved much better results than the Internet survey, The idea was to identify training and informational workshops for coffee farmers that may be organized by local supporting institutions, and to attend these activities (granted a previous formal authorization by the supporting institution) to share a self-reporting questionnaire to the maximum number of coffee producers among the attendees. In Costa Rica, the author participated in four workshops in three of the main coffee producing regions of that country: Tarrazú, Grecia and Atenas, according to the schedule shown in Table 1. In Guatemala, personal interviews with coffee producers in several important producing areas were conducted. The Apendix B presents a selection of the photographs that were taken by the author during these four workshops in Costa Rica in July and August, 2012.

Table 1. Data Collection in Costa Rica. Workshops

Workshop	Location	City/Province	Date/Time
Workshop 1	Coopeatenas	Atenas, Alajuela	July 19th, 2012 8:30 a.m.
Workshop 2	Salón Parroquial	Frailes de Desamparados, Tarrazú, San José	July 19th, 2012 2:00 p.m.
Workshop 3	Típico La Sabana	San Marcos de Tarrazú, San José	July 26th, 2012 2:00 p.m.
Workshop 4	Coopevictoria	Grecia, Alajuela	August 9th, 2012 8:30 a.m.

Following this second strategy, a total of 140 additional valid responses were collected: 86 from Costa Rica, 53 from Guatemala and 1 from Mexico (one coffee producer at the border with Guatemala). Therefore, considering both the Internet survey and the survey conducted on the field, the data analysis of this study includes a total of 186 valid responses: 95 from Costa Rica, 70 from Guatemala and 21 from other Latin American countries (see Table 2). Small producers (20 hectares or less) are the larger group in the sample representing a 58% of the total (see Table 3). Also, most of the surveyed coffee producers (67%) have been working in this activity for more than 20 years (see Table 4).

The Appendix B of this document includes photos of the data collection process.

Table 2. Coffee Farmers by Country of Origin

Country	Internet Survey	Field Survey	Total	%
Costa Rica	9	86	95	51
Guatemala	17	53	70	38
Colombia	5	0	5	3
Panama	5	0	5	3
El Salvador	3	0	3	2
Nicaragua	3	0	3	2
Mexico	2	1	3	2
Peru	2	0	2	1
Total	46	140	186	100

Table 3. Coffee Producers by Size

Country	Frequency	%
Up to 5 hectares	51	29.3
6 to 20 hectares	50	28.7
More than 20 hectares	73	42.0
No response	12	-
Total	186	100

In regard to the sample collection of this research, several considerations should be stated. Firstly, Central American coffee producers are sparsely distributed in isolated rural areas, make them difficult to be accessed in many cases. Secondly, low levels of formal education, particularly in small farmers, can be an obstacle for deploying successfully a self-reporting questionnaire. Thirdly, time and budget restrains for the author made even more challenging the goal of reaching a higher number of coffee producers. Therefore, the sample size and sample composition obtained for this research probably is the best result that it could be achieved under those circumstances.

Similarly as in the case of the Internet survey, a random sample selection was not considered as feasible for the survey on the field. As aforementioned before, these coffee producers are sparsely distributed in different regions over extended rural areas, and due to financial and time limitations, it was not possible for the author to reach these coffee growers randomly.

Table 4. Coffee Producers by Years in the Coffee Business

Country	Frequency	%
Up to 5 years	7	4
6 to 10 years	14	8
11 to 15 years	16	9
16 to 20 years	17	9
More than 20 years	127	68
No response	5	3
Total	186	100

2.2. Measures

The measures implemented in this study are explained in this section. These measures are mainly based on adaptations of previous scales found in the literature. The next section details the items used to measure technological capabilities, marketing capabilities, local linkages for innovation purposes, and extra-cluster linkages for innovation purposes. Additionally, the measures for three evaluated potential moderating variables, absorptive capacity, collective efficiency and local horizontal linkages with supporting institutions, are included.

2.2.1. Innovation Performance

The firm's innovation performance is defined in this research as the firm's degree of achievement or accomplishment on "*the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations"* (OECD, 2005, p. 46). This variable is measured through a self-reporting scale, applying a five-point Likert scale, obtained in a questionnaire to coffee farmers.

In the applied questionnaire, the following direct sentences are presented to the coffee farmers, asking them to evaluate this sentences using 5-point Likert scale, from 1 (totally disagree) to 5 (totally agree):

a. **Product innovation:** Your farm or company is stronger than other coffee producers in the region in terms of product innovation.
b. **Process innovation:** Your farm or company is stronger than other coffee producers in the region in terms of process innovation.
c. **Managerial and organisational innovation:** Your farm or company is stronger than other coffee producers in the region in terms of managerial/organisational innovation.
d. **Marketing innovation:** Your farm or company is stronger than other coffee producers in the region in terms of marketing innovation.

Therefore, using this approach, four types of innovation performance are being considered in this study: product innovation, process innovation, managerial/organisational innovation and marketing innovation. Also, a general innovation performance indicator (index) is constructed as an average value of the four previous indicators for innovation performance (see Table 5).

Table 5. Innovation Performance

Variables	Scale
Innovation Performance (Index)	(Simple Average)
Product innovation: Your farm or company is stronger than other coffee producers in the region in terms of product innovation.	Likert 1 to 5
Process innovation: Your farm or company is stronger than other coffee producers in the region in terms of process innovation.	Likert 1 to 5
Managerial and organisational innovation: Your farm or company is stronger than other coffee producers in the region in terms of managerial and organisational innovation.	Likert 1 to 5
Marketing Innovation: Your farm or company is stronger than other coffee producers in the region in terms of marketing innovation.	Likert 1 to 5

Evaluated using a Likert scale from 1: totally disagree to 5: totally agree

2.2.2. Technological Capabilities

In social science research some variables cannot be observed or measured directly (Borsboom et al., 2003; Brahma, 2009). These variables include elements of human emotions and thoughts that can only be inferred thought indirect means: intelligence, satisfaction, confidence, anxiety and fears (Arvey, 1992). In the literature, these types of variables are called latent variables, hypothetical variables, latent constructs or, simply, constructs (Dunn et al., 1994; Bollen, 2002; Netemeyer et al., 2003; Brahma, 2009).

It is a difficult task to measure and quantify latent constructs, such as the broad and multi-dimensional latent construct of technological capabilities (Coombs & Bierly, 2006). Technological capabilities can be defined as the “information and skills – technical, organisational and institutional – that allow productive enterprises to utilise equipment and information efficiently” (Lall, 1995, p. 261). It also can be described as the effectiveness for creating, adapting or assimilating new technological knowledge and skills to create new and more valuable products, services and processes within a particular firm (Wu et al., 2008; Krasnikov & Jayachandran, 2008).

Indeed, previous studies suggest to measure latent constructs through the use of observable proxies, and in the specific case of the measuring of technological capabilities, proxies related to inputs and outputs have been proposed (Armstrong & Shimizu, 2007). Proxies related to inputs include research and development (R&D) expenditures both in absolute magnitudes (in US$) as well as in relative terms (in % of sales) (Aw & Batra, 1998; Ruiz Ortega, 2010). Similarly, proxies related to outputs consider the use of number of patents released and the citations, among others (Renko, Carsrud & Brannback, 2009).

Each of these proxies has their operational limitations, especially considering the business environment conditions in Latin America. In this region, R&D expenditures are rarely monitored or published by the companies themselves. Moreover, the use of patents in Latin America is not as common as it is in developed countries, probably due to a lack of confidence on the rule-of-law for intellectual property rights. Considering these limitations, a feasible alternative to measure technological capabilities may be the use of qualitative scales based on manager's perceptions (e.g. Isobe et al., 2008; Shan & Jolly, 2012).

Indeed, Shan & Jolly (2012) implement this qualitative approach, using the three subcategories proposed by Lall (1992): investment capabilities, production capabilities and linkage capabilities. They develop these three subcategories through the implementation of a multi-item scale applied in their quantitative study over the tech-based companies in China. Similarly, this research measures technological capabilities following the three categories proposed by Lall (1992), using multi-item information obtained through a self-reporting 5-point Likert scales questionnaire, performing an adaptation of the multi-item scale implemented by Shan & Jolly (2012). All the items used to build the technological capability indicators are shown below in Table 6.

Table 6. Technological Capabilities - Index and Subcategories

Variable: Technological Capabilities (Index)		
Subcategories	**Items**	**Scale**
Investment Capabilities (6 items)	In-house R&D	Likert 1 to 5
	Outsourced R&D	Likert 1 to 5
	Investment in tangible technology (machinery/equipment)	Likert 1 to 5
	Investment in intangible technology (patents, licenses, know-how)	Likert 1 to 5
	Marketing of new or improved products	Likert 1 to 5
	Staff training in topics related to innovation	Likert 1 to 5
Production Capabilities (7 items)	Improvement and adaptation of production processes	Likert 1 to 5
	Improvement of product quality	Likert 1 to 5
	Design of changes in how the production is organized	Likert 1 to 5
	Imitation of technologies brought in by competitors	Likert 1 to 5
	Imitation of innovation in products developed by competitors	Likert 1 to 5
	Development of own technology (machinery, processes, etc.)	Likert 1 to 5
	Design of new products	Likert 1 to 5
Linkage Capabilities (6 items)	External relations with suppliers	Likert 1 to 5
	External relations with buyers	Likert 1 to 5
	External relations with competitors	Likert 1 to 5
	External relations with private consultants	Likert 1 to 5
	External relations with academic institutions	Likert 1 to 5
	External relations with public research organization	Likert 1 to 5

Source: Adapted from Lall (1992), Flor & Oltra (2005) and Shan & Jolly (2012, pp. 8-9)

2.2.3. Marketing Capabilities

Another important firm capabilities widely evaluated in the literature is marketing capabilities (Day, 1994; Morgan, Vorhies & Manson, 2009; Day, 2011). According to Nath et al. (2010), a definition of marketing capabilities can be stated as “the integrative process, in which a firm uses its tangible and intangible resources to understand complex consumer specific needs, achieve product differentiation relative to competition, and achieve superior brand equity” (p. 319).

In this research, a simplified scale to measure marketing capabilities is applied, following Vorhies, Morgan & Autry (2009). The simplified scale incorporates eleven 5-point Likert-scale items, adapted from the main categories suggested by Vorhies & Morgan (2005), and by Eng & Spicket-Jones (2009). This simplified scale is shown in the Table 7.

Table 7. Marketing Capabilities

Variables	Items	Scale
Marketing Capabilities (11 items)	Price determination and administration	Likert 1 to 5
	New product development	Likert 1 to 5
	Channel management	Likert 1 to 5
	Marketing communication and promotions	Likert 1 to 5
	Public Relations	Likert 1 to 5
	Branding	Likert 1 to 5
	Selling	Likert 1 to 5
	Use of Internet in marketing activities	Likert 1 to 5
	Acquisition and implementation of market information	Likert 1 to 5
	Marketing planning and strategy	Likert 1 to 5
	Marketing implementation	Likert 1 to 5

Source: Adapted from Vorhies & Morgan (2005, p .92); Eng & Spicket-Jones (2009); Vorhies, Morgan & Autry (2009)

2.2.4. Cluster (Local) Linkages for Innovation Purposes

Local linkages are measured through a self-reporting 5-point Likert scale applied in a questionnaire distributed among the coffee producers in the sample. The relevant local (or regional) horizontal and vertical linkages for innovation with other companies and institutions are introduced. The specific categories adapted in this research combine local competitors (other local coffee producers), local suppliers, local buyers (or customers), local research and academic institutions, local financial institutions and other local institutions (see Table 8).

Table 8. Local Linkages for Innovation Purposes

Variables	Scale
Local horizontal linkages with other coffee producers	Likert 1 to 5
Local horizontal linkages with supporting institutions	
Local linkages with research and academic institutions	Likert 1 to 5
Local linkages with financial institutions	Likert 1 to 5
Local linkages with other institutions	Likert 1 to 5
Local vertical linkages with suppliers and buyers	
Local linkages with suppliers	Likert 1 to 5
Local linkages with buyers	Likert 1 to 5

Source: Adapted from Flor & Oltra (2005)

2.2.5. Extra-Cluster (Non-Local) Linkages for Innovation Purposes

Similarly as local linkages, non-local linkages are evaluated following a self-reporting questionnaire with 5-point Likert-scale questions applied to the coffee growers in the sample (see Table 9). The included categories for these external linkages are the same ones previously established for the local linkages but, obviously, this time only non-local companies and institutions are considered into the evaluations.

Table 9. Extra-Cluster (Non-Local) Linkages for Innovation Purposes

Variables	Scale
Non-Local linkages with other coffee producers	Likert 1 to 5
Non-Local horizontal linkages with supporting institutions	
Non-Local linkages with research and academic institutions	Likert 1 to 5
Non-Local linkages with financial institutions	Likert 1 to 5
Non-Local linkages with other institutions	Likert 1 to 5
Non-Local vertical linkages with suppliers and buyers	
Non-Local linkages with suppliers	Likert 1 to 5
Non-Local linkages with buyers	Likert 1 to 5

Source: Adapted from Flor & Oltra (2005)

2.2.6. Moderating Variables

A selection of potential moderating effects are tested in this research, and this is implemented following the standard statistical methodology suggested in the literature

(Baron & Kenny, 1986). Three potential moderators are being evaluated in this study: absorptive capacity, collective efficiency and local linkages with supporting institutions.

2.2.7. Evaluation of Potential Moderating Variable 1: Absorptive capacity

Absorptive capacity can be defined as the capacity of a firm to identify the utility of new external knowledge, incorporate it and use it for commercial purposes (Cohen & Levinthal, 1990; Zahra & George, 2002; Flatten, Greve & Brettel, 2011). In this research, absorptive capacity is being considered as a potential moderator in the relationship among local linkages and firm capabilities. This variable is calculated as the simple average of the five items related to human resources (excluding temporary labor) that are being presented in Table 10.

Table 10. Absorptive Capacity

Variables	Scale
Human resources (permanent staff)	
Equipped with excellent professional/technical skills.	Likert 1 to 5
Can acquire quickly and thoroughly new knowledge required by their duties.	Likert 1 to 5
Has better working skills than the staff of your competitors.	Likert 1 to 5
Has higher educational qualifications than the staff of your competitors.	Likert 1 to 5
Has the ability to use and organize the acquired knowledge.	Likert 1 to 5

Source: Adapted from Liao, Fei & Chen (2007)

2.2.8. Evaluation of Potential Moderating Variable 2: Collective efficiency

According to Schmitz (1995), the external economies than can be generated by clusters may not be sufficient for the firms to gain competitive advantage. He suggest that these firms may also need to be linked with other firms and organizations in the same cluster and to perform explicit collective tasks, called as joint actions. The combination of both external economies and joint actions working together is what Schmitz calls collective efficiency, and this variable is also considered a potential moderator in the relationship among local linkages and firm capabilities (Schmitz, 1995, 1997, 2004).

In this research, the collective efficiency construct is measure through the calculation of the simple average of two multi-item variables: local conditions (a proxy for external economies) and joint actions, as shown in Table 11.

Table 11. Collective Efficiency

Variables	Scale
Local conditions	
Specialized labor market at your local area/region.	Likert 1 to 5
Availability of inputs at your local area/region.	Likert 1 to 5
Market information available at your local area/region.	Likert 1 to 5
Technical information available at your local area/region.	Likert 1 to 5
Access to markets from your local area/region.	Likert 1 to 5
Joint actions	
Local linkages with local competitors for innovation purposes	Likert 1 to 5
Local linkages with local suppliers for innovation purposes	Likert 1 to 5
Local linkages with local buyers for innovation purposes	Likert 1 to 5
Local linkages with academic and research institutions for innovation purposes	Likert 1 to 5
Local linkages with financial institutions for innovation purposes	Likert 1 to 5
Local linkages with other institutions for innovation purposes	Likert 1 to 5

Source: Adapted from Giuliani, Pietrobelli and Rabellotti (2005)

2.2.9. Evaluation of Potential Moderating Variable 3: Local Horizontal Linkages with Supporting Institutions

A third potential moderator to be tested is the local horizontal linkages with supporting institutions. This types of local linkages have been identified as a crucial condition to achieve a superior business and innovation performance in companies (Pietrobelli & Rabellotti, 2004, 2006; Oliver, Garrigos & Porta, 2008).

2.3. Control Variables

The implementation of control variables are useful to identify potential differences among subsamples according to specific special conditions (Judd, Smith & Kidder, 1991). These special conditions may include geographical location, demographical variables such as age, race, religion, or any other distinction that the research may find useful to examine

their data in a more exhaustive way. In this research, two control variables have been selected: a) country of origin, and b) size.

The inclusion of these two control variables follows previous studies where *size* has been identified as a significant variable in order to explain technological capability differences (Ianmarino et al., 2008). Likewise, country of origin may be considered also an interesting control variable to be included as there are significant differences among the Latin American countries in terms of their institutional, social and economic environments in the general context situation, but also and particularly in regard to the national conditions for the coffee industry in each of these countries. These two control variables are included in the proposed econometrical models as dummy variables, according to the following criteria:

a. **Country of origin (dcr, dgu):** This variable is incorporated through dummy variables that values “1” for coffee farmers from the respective country of origin as follows: Costa Rica (dcr) or Guatemala (dgu). It values “0” for farmers from other Latin American countries.
b. **Small producers (dsmall):** This is a dummy variable that values “1” for small coffee farmers, or coffee farmers with a production area of 20 hectares or less. It values “0” for farmers with a production area that is larger than 20 hectares.

2.4. Validity and Reliability

In social science research, certain types of variables cannot be observed or measured directly (Borsboom et al., 2003; Brahma, 2009). There are conditions of human behaviour, thoughts and emotions that can only be inferred indirectly. Some examples of these variables are intelligence, level of customer satisfaction and trust (Arvey, 1992). This

type of variables are called in the literature as latent variables, hypothetical variable, latent construct or, simply, construct (Dunn et al., 1994; Bollen, 2002; Netemeyer et al., 2003; Brahma, 2009). In this work, the term latent construct is the one that it is being implemented.

The conceptual definition of validity is applied in various contexts in social science research. Nevertheless, validity is normally referred to “the correctness of an inference” (Herzog, 1996:161). Validity is considered important in every kind of research, but it is absolutely crucial when a research is assessing a latent construct (Carmines & Zeller, 1979, Garson, 2013). As latent constructs are not observable, it is necessary to be sure that the proposed indicators are measuring something that actually exists (and not something else) and that it is measuring it adequately, if this two conditions are accomplished, the indicator can be considered as a valid one (Borsboom et al., 2004).

This section presents an analysis of the validity and reliability measures of this research (Carmines & Zeller, 1979, Garson, 2013). Nonetheless, first it may be useful to propose a definition of validity. The broad meaning of validity addresses the level of “the correctness of an inference” (Herzog, 1996:161). There are four types of validity: measurement validity, statistical validity, internal validity and external validity (Bryman, 2001; Herzog 1996; Roe & Just, 2009). In this section, these four types of validity will be considered.

2.4.1. Measurement validity

Measurement validity tests if an indicator represents the theoretical construct that it is intentioned to measure (Neuman, 2006). In the literature, four types of measurement validity are mentioned: face validity, content validity, criterion validity and construct validity (Herzog, 1996).

The measurement validity of this research is based on the judgmental approaches of face validity and content validity that may be considered less rigorous than the empirical approaches of criterion and construct validity (Herzog, 1996). Nevertheless, it may still be a reasonable level of measurement validity.

Face validity is achieved through the review of the survey with a group of coffee experts, academics and practitioners. All the constructs and items were checked with the valuable help of industry experts and coffee producers through personal and electronic interviews. As a consequence of these revisions, some changes and adjustments were incorporated to the final version of the questionnaire applied in the survey. Moreover, the research also adapts the scales used on previous closed-related studies.

Content validity expresses the indicator's degree of achievement to measure the construct in its different components and dimensions (Cronbach & Meehl, 1955; Neuman, 2006). The content validity of this research is increased as most of the variables are built through multi-items complex scales. These three measures may be enough to assure a reasonable level of measurement validity on the inferences and results of this study.

2.4.2. Statistical validity

Statistical validity tests the appropriateness of the statistical methods and calculations to support the research conclusions (Neuman, 2006). This research is based on statistical methods and procedures implemented in previous studies. Moreover, it is following a protocol of PhD research established by The University of Essex, as well as the supervision of two highly experienced professors. Also, a review of the research's instrument and a pilot test was performed, and the survey was considered as an appropriate instrument. Statistical tests (e.g. common method variance) were also performed on the data with satisfactory results; therefore, it may be expected a reasonable

level of statistical validity in the instrument as well as in the quantitative procedures and inferences.

2.4.3. Internal validity

Internal validity examines the level of casual relationships between the variables included in a model (Bryman, 2001; Roe & Just, 2009). In other words, internal validity is achieved when changes in the dependent variable are mainly explained by changes in the independent variables, and not by other reasons. Control variables are commonly applied to increase internal validity and reliability in social science research (Bryman, 2001). This research applies control variables in order to increase its internal validity, which is consistent with the literature.

The literature states a long list of threats to internal validity (Bryman, 2001; Creswell, 2013; Neuman, 2006). Many of these threats may be considered as not much relevant to social science research, but others certainly are. The following is an analysis of the potential threats for the internal validity of this research.

The first and more important threat for the internal validity of this research is the “selection bias” (Neuman, 2006), as it uses a convenience sample. However, some other measures have been implemented to improve the internal validity of this study. For instance, the threat of “pretesting learning effect” (Bryman, 2001) is controlled by excluding, from the main survey, the coffee farmers that have been selected for the pilot study. Also, the threat of the “diffusion of treatment or contamination” (Neuman, 2006) can be considered as a low risk for this study due to the implementation of the following measure. Although the coffee farmers may be aware of other coffee producers participating in the survey; this instrument has been applied simultaneously in the same room to all participating coffee producers, under the surveillance of the author of this research.

2.4.4. External validity

External validity shows the possibilities for generalization of the relationships of the variables in other situations and contexts, including other people, places and times (Calder et al., 1982; Roe & Just, 2009).

There are also several threats to external validity (Bryman, 2001; Neuman, 2006; Creswell, 2013). Nevertheless, it seems not much feasible to secure a high external validity in a single PhD research. The time and resources are so limited for PhD students, that it seems unfeasible that they could test their instruments in different people, places and periods in order to gain external validity in their investigations. PhD research needs to be very narrowly focused in a specific context in order to secure a sufficient level of internal and construct validity, although losing much of its external validity in that process. However, this may be an understandable and common limitation in business administration and innovation PhD researches.

2.4.5. Reliability

Reliability is a concept closely related to validity. It can be defined as the level of consistency of a test results when conducted several times in other contexts but under similar conditions (Neuman, 2006). Reliability is a necessary condition to validity, but it is not a sufficient one: A test could be reliable, but not necessarily valid. Nonetheless, if a test is valid, must be reliable (Bryman, 2001).

Neuman (2006) suggests four recommendations to improve the reliability of a research. These recommendations are: 1) Establishing a precise conceptualization of every construct utilized; 2) detailed grade of measurement; 3) using of several indicators to express each construct; 4) relying on pilot tests and previous studies. This research follows all four Neuman´s recommendations, as it is presented in Table 12.

Table 12. Reliability Measures Applied in this Research

Recommendations for Reliability (Neuman, 2006)	This Research (Figueroa, forthcoming 2015)
Precise construct conceptualization	Construct conceptual definitions based on expert opinions and previous studies.
Detailed grade of measurement	Use of 5 point Likert scales in the questionnaire.
Several indicators measuring one construct	Most constructs are built by multi-items scales.
Pilot tests	Pilot study to evaluate the questionnaire.

Sources: Neuman (2006)

According to Bryman (2001), the Cronbach's α test is a common procedure for evaluating the level of reliability in a data set. The Cronbach's α results obtained in the data analysis show a good internal consistency reliability for the multi-item constructs that have been implemented in this study. Indeed, all of the Cronbach's alphas indicators obtained are higher than the critical value of 0.8 (see Table 13). This high level of reliability should be expected due to the fact that this study includes all four Neuman's recommendations in the research design.

Table 13. Cronbach's Alphas Test

	Items	Cronbach's alphas
Technological Capabilities	3	0.8740
Investment Capabilities	6	0.8898
Production Capabilities	7	0.8811
Linkage Capabilities	6	0.8650
Marketing Capabilities	11	0.9381
Local Linkages	6	0.8787
Local Horizontal Linkages with Competitors	1	
Local Horizontal Linkages with Supporting Inst.	3	
Local Vertical Linkages with Suppliers and Buyers	2	
Non-Local Linkages	6	0.9051
Non-Local Horizontal Linkages with Competitors	1	
Non-Local Horizontal Linkages with Supporting Inst.	3	
Non-Local Vertical Linkages with Suppliers and Buyers	2	
Absorptive Capacity	5	0.8608
Collective Efficiency	11	0.8858

2.4.6. Validity and Reliability Conclusions

This study presents a reasonable level of reasonable level of measurement validity and internal validity and, according to the levels of Conbrach's α, a solid reliability. The Internal validity is appropriate addressed in this research design and procedures, as several measures that may prevent the common threats to internal validity are established. On the other hand, the level of external validity is low in this research, although this may be an expected and normal limitation in most PhD thesis in business administration.

2.5. Data Transformations and Standardization

The data set obtained through the survey was reviewed and adjusted in order to make it compatible with standard econometric software. Therefore, all the qualitative description of the responses in the scales have been transformed into numeric values using a standardized scale. For instance, in all the questions using Likert scales, the values were transformed from 1 to 5, according to the 5 levels of the scale.

With respect to the missed values, all of them were replaced by "0". For all calculation and estimation purposes, the "0" values were ignored by the STATA econometric software. The numeric transformations by the author were performed twice in order to spot potential mistakes in the conversion process. However, no mistakes in the data were identified in any of the two transformation processes.

2.6. Normality Test for the Dependent Variables

In order to obtain a good estimation using Linear OLS regressions, it is required a statistical condition of normality in the considered dependent variables (Gujarati, 2003). Therefore, to test this necessary condition of Linear OLS regression, a normality test is conducted. The Skewness and Kurtosis normality test is performed for all the dependent

variables evaluated in this research. This includes the dependent variables proposed for the first study, related to innovation results: innovation performance (index), product innovation, process innovation, managerial/organisational innovation and marketing innovation; as well as the dependent variables related to firm capabilities variables proposed for the second and third parts of this research: technological capabilities and marketing capabilities.

According to the results of the Skewness and Kurtosis normality test in this study, the null hypothesis of normality of the variables: technological capabilities, marketing capabilities, innovation performance (index), product innovation, and marketing innovation, cannot be rejected, as the Prob>Chi2 is higher than 0.05 (5%) (see Table 14). Thus, the normality of these dependent variables can be assumed. The rest of the dependent variables, process innovation and managerial/organisational innovation cannot be assumed as normal, because their results of the Skewness and Kurtosis normality test are below 5%. In any case, in all econometrical procedures and calculations, this research is assuming that all four categorical dependent variables: product innovation, process innovation, managerial/organisational innovation and marketing innovation, are not normal.

Table 14. Skewness and Kurtosis Tests for Normality

Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	Adj. Chi2(2)	Prob>Chi2
Innovation performance (Index)	157	0.0258	0.9727	4.99	0.0824
Product innovation	148	0.0321	0.6325	4.86	0.0879
Process innovation	147	0.0082	0.7907	6.64	0.0361
Manag/Org innovation	135	0.0058	0.7728	7.13	0.0283
Marketing innovation	132	0.0506	0.9939	3.90	0.1425
Tech. capabilities	182	0.1202	0.3449	3.35	0.1874
Marketing capabilities	177	0.0616	0.2433	4.91	0.0859

The aforementioned assumption means that linear ordinary least square (OLS) regressions are applied for the models including the following dependent variables:

innovation performance (index), technological capabilities and marketing capabilities; whilst ordered probit regressions is implemented for the models which the dependent variables are: product innovation, process innovation, managerial/organisational innovation and marketing innovation.

2.7. Common Method Variance

The common method variance test is considered as a necessary statistical evaluation when a self-reporting questionnaire is implemented (Podsakoff et al., 2003). This test tries to identify the potential influence of common method bias which is normally associated to this kind of instruments in the data collection process. Therefore, a common method variance test is applied, following the factor analysis methodology proposed by Podsakoff el at. (2003).

Firstly, the 30 Likert-scale items specifically applied to measure firm capabilities are evaluated. These are 19 Likert-scale items for technological capabilities, and 11 Likert-scale items for marketing capabilities. A high correlation between these items are detected. In fact, when these 30 items are considered together in only one factor (factor 1), the variance is explained in a 61.68% by this factor alone (see Table 15). This result is higher than the recommendation of less than 50% proposed in the literature. According to this result, the applied instrument potentially may have a problem of common method bias, at least in the case of the variables for measuring firm capabilities.

Secondly, a new evaluation is performed considering all 63 Likert-scale items included in all the variables measured through the instrument. In this case, the percentage of the variance explained by the first factor alone decreases to 33.31% (0.3331), which may be

regarded as an acceptable value that allows to disregard serious problems of Common Method Variance in this research (see Table 15).

Table 15. Common Method Variance Analysis

	Obs	Retained Factors	Number of Parameters (Items)	Eigen Value	Proportion
Factor 1 Likert-scale items for firm capabilities constructs	74	1	30	15.11272	0.6168
Factor 1 Likert-scale Items for all variables included in the survey	46	1	63	20.98327	0.3331

2.8. Econometric Models

This research considers two types of regression analysis. Firstly, the linear ordinary least square (OLS) regressions are applied where the selected dependent variables can be assumed as linear variables, as well as following a normal distribution (Green, 2003; Guajarati, 2003; Dougherty, 2011). This situation is the case for the models explaining innovation performance (index), technological capabilities and marketing capabilities. Secondly, the ordered probit regressions are implemented where the dependent variables are categorical hierarchical variables, as in the case for the four types of innovation performance considered in this thesis: product innovation, process innovation, managerial/organisational innovation and marketing innovation (Long & Freese, 2006). The following tables presents a brief description of the econometric models proposed for this study (see Tables 16, 17, 18 and 19).

The first set of econometric models (Model Set 1) is referred to the relationship among innovation performance and firm capabilities (See Table 16). For example:

InnoP = $\alpha + \beta 1 dcr + \beta 2 dgu + \beta 3 dsmall + \varepsilon$

InnoP = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4Markcap + \beta 5Techcap + \varepsilon$

InnoP = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4Markcap + \beta 5Investcap + \beta 6Prodcap + \beta 7Linkcap + \varepsilon$

Where:

InnoP: Innovation performance (index)

dcr: Dummy variable for coffee producer from Costa Rica

dgu: Dummy variable for coffee producer from Guatemala

dsmall: Dummy variable for small coffee producer (20 hectares or less)

Markcap: Marketing capabilities

Techcap: Technological capabilities

Investcap: Investment capabilities

Prodcap: Production capabilities

Linkcap: Linkage capabilities

Table 16. Model Set 1: Innovation Performance and Firm Capabilities

Proposed Models	Type of Regressions	Dependent Variables	Independent Variables
Model Sub-Set 1.1.	Linear OLS (robust)	Innovation performance (index)	Control variables Technological capabilities (index and subcategories) Marketing capabilities
Model Sub-Set 1.2.	Ordered Probit	Product innovation	Control variables Technological capabilities (index and subcategories) Marketing capabilities
Model Sub-Set 1.3.	Ordered Probit	Process innovation	Control variables Technological capabilities (index and subcategories) Marketing capabilities
Model Sub-Set 1.4.	Ordered Probit	Managerial/organisational innovation	Control variables Technological capabilities (index and subcategories) Marketing capabilities
Model Sub-Set 1.5.	Ordered Probit	Marketing innovation	Control variables Technological capabilities (index and subcategories) Marketing capabilities

The second set of econometric models (Model Set 2) deals with the relationship among firm capabilities and local influences (See Table 17).

Techcap = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \varepsilon$

Techcap =

$\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4Localcomp + \beta 5Localhor + \beta 6Localver + \varepsilon$

Techcap =

$$\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4Localcomp + \beta 5Localhor + \beta 6Localver + \beta 7Acap + \beta 8CollE + \varepsilon$$

Markcap = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \varepsilon$

Markcap =

$$\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4Localcomp + \beta 5Localhor + \beta 6Localver + \varepsilon$$

Markcap =

$$\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4Localcomp + \beta 5Localhor + \beta 6Localver + \beta 7Acap + \beta 8CollE + \varepsilon$$

Where:

Techcap: Technological capabilities

Markcap: Marketing capabilities

dcr: Dummy variable for coffee producer from Costa Rica

dgu: Dummy variable for coffee producer from Guatemala

dsmall: Dummy variable for small coffee producer (20 hectares or less)

Localcomp: Local horizontal links with competitors for innovation

Localhor: Local horizontal links with supporting institutions for innovation

Localver: Local vertical links with suppliers and buyers for innovation

Acap: Absorptive Capacity

CollE: Collective Efficiency

Table 17. Model Set 2: Firm Capabilities and Local Influences

Proposed Models	Type of Regressions	Dependent Variables	Independent Variables
Model Sub-Set 2.1	Linear OLS (robust)	Technological capabilities	Control variables Local linkages Absorptive capacity Collective efficiency
Model Sub-Set 2.2.	Linear OLS (robust)	Marketing capabilities	Control variables Local linkages Absorptive capacity Collective efficiency

The third set of econometric models (Model Set 3) tests the relationship among firm capabilities and non-local influences (See Table 18).

Techcap = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \varepsilon$

Techcap = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4NonLocalhor + \beta 5NonLocalver + \varepsilon$

Techcap = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4NonLocalhor + \beta 5NonLocalver + \beta 6Acap + \beta 7Localhor + \varepsilon$

Markcap = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \varepsilon$

Markcap = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4NonLocalhor + \beta 5NonLocalver + \varepsilon$

Markcap = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4NonLocalhor + \beta 5NonLocalver + \beta 6Acap + \beta 7Localhor + \varepsilon$

Where:

Techcap: Technological capabilities

Markcap: Marketing capabilities

dcr: Dummy variable for coffee producer from Costa Rica

dgu: Dummy variable for coffee producer from Guatemala

dsmall: Dummy variable for small coffee producer (20 hectares or less)

NonLocalhor: Non-Local horizontal links with supporting institutions for innovation

NonLocalver: Non-Local vertical links with suppliers and buyers for innovation

Acap: Absorptive Capacity

Localhor: Local horizontal links with supporting institutions for innovation

Table 18. Model Set 3: Firm Capabilities and Non-Local Linkages

Proposed Models	Type of Regressions	Dependent Variables	Independent Variables
Model Sub-Set 3.1	Linear OLS (robust)	Technological capabilities	Control variables Non-Local linkages Absorptive capacity Local horizontal links with supporting institutions
Model Sub-Set 3.2.	Linear OLS (robust)	Marketing capabilities	Control variables Non-Local linkages Absorptive capacity Local horizontal links with supporting institutions

The fourth set of econometric models (Model Set 4) evaluates the relationship among firm capabilities, local influences and non-local influences (See Table 19).

Techcap = $\alpha + \beta 1 dcr + \beta 2 dgu + \beta 3 dsmall + \varepsilon$

Techcap = $\alpha + \beta 1 dcr + \beta 2 dgu + \beta 3 dsmall + \beta 4 Local + \beta 5 NonLocal + \varepsilon$

Techcap =

$$\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4Localcomp + \beta 5Localhor + \beta 6Localver + \beta 7NonLocalcomp + \beta 8NonLocalhor + \beta 9NonLocalver + \varepsilon$$

Markcap = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \varepsilon$

Markcap = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4Local + \beta 5NonLocal + \varepsilon$

Markcap =

$$\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4Localcomp + \beta 5Localhor + \beta 6Localver + \beta 7NonLocalcomp + \beta 8NonLocalhor + \beta 9NonLocalver + \varepsilon$$

Where:

Techcap: Technological capabilities

Markcap: Marketing capabilities

dcr: Dummy variable for coffee producer from Costa Rica

dgu: Dummy variable for coffee producer from Guatemala

dsmall: Dummy variable for small coffee producer (20 hectares or less)

Local: Local linkages (index) for innovation

NonLocal: Non-Local linkages (index) for innovation

Localcomp: Local horizontal links with competitors for innovation

Localhor: Local horizontal links with supporting institutions for innovation

Localver: Local vertical links with suppliers and buyers for innovation

NonLocalcomp: Non-Local horizontal links with competitors for innovation

NonLocalhor: Non-Local horizontal links with supporting institutions for innovation

NonLocalver: Non-Local vertical links with suppliers and buyers for innovation

Table 19. Model Set 4: Firm Capabilities and External (Local and Non-Local) Linkages

Proposed Models	Type of Regressions	Dependent Variables	Independent Variables
Model Sub-Set 4.1	Linear OLS (robust)	Technological capabilities	Control variables Local linkages Non-Local linkages
Model Sub-Set 4.2.	Linear OLS (robust)	Marketing capabilities	Control variables Local linkages Non-Local linkages

All the statistical and econometrical procedures, technical tests and other evaluations, as well as the inferences performed in this research have been implemented with the assistance of the statistical software STATA IC 13 (Pevalin & Robson 2009; Acock, 2012; Kohler & Kreuter, 2012).

In order to be able to apply statistical regression analysis, this research proposes a classification of dependent and independent variables. Nevertheless, this study cannot assume a causality relationship among these variables, as the use of instrumental variables was not considered achievable. Consequently, the presented results need to be interpreted just as correlations and not necessarily as a cause-effect relationship.

2.9. Regression Diagnostics

The regression diagnostics is performed with the assistance of the statistical software STATA IC 13 (Pevalin & Robson 2009; Acock, 2012; Kohler & Kreuter, 2012). Four (4) main tests are implemented for the regression diagnostics in the following model sets. These four tests are: a) Linearity of variables, b) Normality of residuals, c) Heterocedasticity and d) Multicollinearity.

2.9.1. Linearity of Variables

Using a visual examination, the graphical plotted dependent variables seem to fit well a linear function in all the proposed econometric models. Therefore, the assumption of linearity of the dependent variables can be accepted as a reasonable one. However, as stated before, only the dependent variables innovation performance (index), technological capabilities and marketing capabilities are assumed as normal variables in the proposed models.

2.9.2. Normality of Residuals

The Shapiro-Wilk test is implemented to evaluate the normality of the residuals (Shapiro & Wilk, 1965). This statistical procedure is implemented with the assistance of the econometrics software STATA IC 13 (Pevalin & Robson 2009; Acock, 2012; Kohler & Kreuter, 2012).

The Shapiro-Wilk test proposes a null hypothesis stating that the residuals follow a normal distribution (Shapiro & Wilk, 1965). According to the methodology suggested by this test, the null hypothesis needs to be rejected if the results shows a probability of r > z lower than 0.05.

The results of the Shapiro-Wilk test obtained for the current data of this research suggest that the null hypothesis of normality of the residuals can be accepted in most of the cases, as the probability r > z is higher than 0.05 in all cases except one (see Table 20).

Table 20. Normality of Residuals: Shapiro-Wilk Test

Proposed Models	Dependent Variables	Independent Variables	Shapiro-Wilk Prob. r > z
Model Sub-Set 1.1.	Innovation performance	Control variables Technological capabilities Marketing capabilities	0.08055
Model Sub-Set 2.1.	Technological capabilities	Control variables Local linkages	0.08156
Model Sub-Set 2.2.	Marketing capabilities	Control variables Local linkages	0.04627 (*)
Model Sub-Set 3.1.	Technological capabilities	Control variables Non-Local linkages	0.74319
Model Sub-Set 3.2.	Marketing capabilities	Control variables Non-Local linkages	0.18454
Model Sub-Set 4.1.	Technological capabilities	Control variables Local Linkages Non-Local linkages	0.79664
Model Sub-Set 4.2.	Marketing capabilities	Control variables Local linkages Non-Local linkages	0.23826

* Potential problem of violation of normality of residuals.

2.9.3. Heteroscedasticity

A heteroscedasticity problem happens when the variance of the errors is not constant across the observations (Guajarati, 2003; Greene, 2003). The Breusch-Pagan / Cook-Weisberg test for heteroscedasticity is performed in order to evaluate the potential violation of the assumption of homocedasticity in the proposed models.

The Breusch-Pagan/Cook-Weisberg test results indicate that heteroscedasticity may be a problem only in the models where marketing capabilities are included, either as a dependent variable or as an independent variables. In these cases, the probability > chi2 is lower than 0.05 (see Table 21). Or the rest of the models, there are not motives for concern in regard to potential problems of heteroscedasticity. Nevertheless, in all of the cases of linear OLS regressions, they estimation are being implemented selecting the robust option. This statistical procedure can be considered as a measure to reduce the potential problems of heteroscedasticity that have been detected in a few of the proposed models.

Table 21. Heteroscedasticity: Breusch-Pagan/Cook Test

Proposed Models	Dependent Variables	Independent Variables	Breusch-Pagan/Cook-Weisberg Prob > chi2
Model Sub-Set 1.1.	Innovation performance	Control variables Technological capabilities Marketing capabilities	0.0012 (*)
Model Sub-Set 2.1.	Technological capabilities	Control variables Local linkages	0.6673
Model Sub-Set 2.2.	Marketing capabilities	Control variables Local linkages	0.1781
Model Sub-Set 3.1.	Technological capabilities	Control variables Non-Local linkages	0.6273
Model Sub-Set 3.2.	Marketing capabilities	Control variables Non-Local linkages	0.0122 (*)
Model Sub-Set 4.1.	Technological capabilities	Control variables Local Linkages Non-Local linkages	0.7493
Model Sub-Set 4.2.	Marketing capabilities	Control variables Local linkages Non-Local linkages	0.0173 (*)

* Potential problem of heteroscedasticity.

2.9.4. Multicollinearity

As some of the independent variables are correlated, a problem of high multicollinearity is considered a risk in the present research (Greene, 2003). Therefore, the Variance

Inflation Factor (VIF) test for multicollinearity is performed to evaluate potential high levels of multicollinearity in the evaluated models.

According to the literature, a VIF higher than 5 (or 10) should be considered as an indication of high multicollinearity in a model (Guajarati, 2003). In this research, the Variance Inflation Factor (VIF) is much lower than 5 in all the proposed models (see Table 22). Therefore, multicollinearity most probably is not an important problem to be concerned about in the proposed models.

Table 22. Multicollinearity: Variation Inflation Factor (VIF)

Proposed Models	Dependent Variables	Independent Variables	Variance Inflation Factor (VIF)
Model Sub-Set 1.1.	Innovation performance	Control variables Technological capabilities Marketing capabilities	dcr = 4.14 dgu = 3.34 dsmall = 1.60 Tech cap = 2.13 Mark cap = 2.15
Model Sub-Set 2.1.	Technological capabilities	Control variables Local linkages	dcr = 3.44 dgu = 2.86 dsmall = 1.44 Local links = 1.03
Model Sub-Set 2.2.	Marketing capabilities	Control variables Local linkages	dcr = 3.37 dgu = 2.79 dsmall = 1.45 Local links = 1.03
Model Sub-Set 3.1.	Technological capabilities	Control variables Non-Local linkages	dcr = 3.21 dgu = 2.62 dsmall = 1.40 Non-Local links = 1.06
Model Sub-Set 3.2.	Marketing capabilities	Control variables Non-Local linkages	dcr = 3.12 dgu = 2.54 dsmall = 1.41 Non-Local links = 1.06
Model Sub-Set 4.1.	Technological capabilities	Control variables Local Linkages Non-Local linkages	dcr = 3.19 dgu = 2.62 dsmall = 1.40 Local links = 1.44 Non-Local links = 1.49
Model Sub-Set 4.2.	Marketing capabilities	Control variables Local linkages Non-Local linkages	dcr = 3.10 dgu = 2.54 dsmall = 1.40 Local links = 1.46 Non-Local links = 1.50

2.10. General Dominance Analysis (Relative Importance)

A general dominance analysis is applied to check the relative importance of the selected independent variables in each proposed model (Azen & Budescu, 2003; Tonidandel & LeBreton, 2011).

The general dominance analysis allow to separate the individual effect of each predictor on the variance of the model. This statistical procedure is implemented with the help of the econometric software STATA IC 13, through the using of the command: “domin”.

Geography, Linkages and Capabilities: Innovation in the Agricultural Coffee Production in Latin America

Chapter 3. Firm Capabilities and Innovation Performance in the Agricultural Coffee Production in Latin America

Abstract: The first part of this doctoral research evaluates the mutual relationships between two firm capabilities, technological capabilities and marketing capabilities, and four types of innovation performance: product innovation, process innovation, managerial/organisational innovation and marketing innovation, in a context that has been scarcely explored in the literature: the agricultural coffee production in Latin America. The results suggest a general positive relationship between firm capabilities and innovation performance; however, the relative importance of each firm capability varies according to the type of innovation performance that may be considered.

Keywords: Technological capabilities, marketing capabilities, resource-based view, product innovation, process innovation, managerial innovation, organisational innovation, marketing innovation, Latin America, coffee.

Geography, Linkages and Capabilities: Innovation in the Agricultural Coffee Production in Latin America

Chapter 3. Firm Capabilities and Innovation Performance in the Agricultural Coffee Production in Latin America

3.1. Chapter Introduction

This study follows the research stream of the resource-based view theory (RBV) applied to innovation management (Barney, 1991; Wernerfelt, 1984). This is the first part on a series of three closely related chapters (Chapters 3, 4 and 5 in this document) that, grouped together, constitute a doctoral thesis opting for the PhD degree in Innovation and Entrepreneurship of the University of Essex, United Kingdom. The first part of this work explores the potential relationship between the firm's internal conditions and several indicators of innovation performances, evaluated in a sample of agricultural coffee producers located in Latin America.

The internal conditions included in this research are two specific firm capabilities: a) technological capabilities and b) marketing capabilities. According to the literature, technological capabilities are a crucial element to explain firm's competitive advantage and innovation performance (Anderson & Tushman, 1990; Cohen & Levinthal, 1990; Primo & DuBois, 2012; Ju et al., 2013). However, firm's innovation performance depends not only on its technological capacities, but also on other types of firm capabilities that might be complementary for innovation purposes, such as the firm's marketing capabilities (Yam et al., 2004; Wang et al., 2008). In fact, in previous studies, technological capabilities and marketing capabilities have been considered as complementary for innovation performance and general business performance as well (Su et al., 2013).

Four types of innovation performances are considered in this research: a) product innovation, b) process innovation, c) managerial/organisational innovation and d) marketing innovation. Most of previous studies are mainly focused on product innovation and process innovation, leaving other types of innovation performances, such as managerial/organisational innovation and marketing innovation, much less explored (Krasnikov & Jayachandran, 2008).

The main contribution of the first part of this doctoral research relies on the study of the individual influences of three subcategories of technological capabilities: investment capabilities, production capabilities and linkage capabilities, on the innovation performance of agricultural firms located in developing countries. A better understanding of the individual impact of these three subcategories, how they interrelates among each other, and how they are related to different types of innovation performances, may be a helpful information to promote innovation among coffee producers. This is particularly important in the case of developing countries, where innovation achievements are most needed due to stronger international competitive pressures (Hausmann, Hwang & Rodrik, 2007).

A second contribution of this research is referred to its consideration of two less explored types of innovation performances: managerial/organisational innovation and marketing innovation. Indeed, a positive relationship between the firm's technological capabilities and the firm's innovation performance has been suggested in the literature (Anderson and Tushman, 1990; Cohen & Levinthal, 1990; Kylaheiko et al., 2011; Primo & DuBois, 2012). However, this positive relationship have been established mainly for product innovation and process innovation (eg. Krasnikov & Jayachandran, 2008; Ju et al., 2013). The exploration of the relationship between firm capabilities and other types of innovation performances arguably calls for further research, particularly with respect to

quantitative evaluations. Therefore, another contribution of this study is the incorporation of these two less explored types of innovation performances into the analysis: managerial/organisational innovation and marketing innovation.

Finally, the study of the relationship between innovation performance and firm capabilities in the case of an agricultural activity in developing countries is a less explored phenomenon, with a few exceptions (eg. Gebreeyesus & Sonobe, 2012; or Whitfield, 2012); therefore, the focus of this research on the study of an agricultural activity located in developing countries could also be considered a modest contribution to a better understanding of the internal conditions that may facilitate innovation performance in these types of firms.

The document is organized in six sections. The first section presents this introduction. The next part presents the literature review, the hypotheses and the proposed conceptual framework. Then, the research methodology is explained. The fourth and fifth section shares the data analysis and the obtained results. The sixth and final section discusses the main findings and conclusions.

3.2. Literature Review

The following is a review of the studies considered as the most relevant for the main objectives of the research endeavor that is being undertaken in this document.

3.2.1. The Resource-Based View (RBV) and Firm Capabilities

The resource-based view (RBV) studies the potential effects of the firm's internal conditions on its performance (Liu et al., 2009). According to this theory, differences in business performances may be explained by differences in the resources that companies own and control (Barney, 1991; Wernerfelt, 1984). The RBV states that a firm's resources can be a factor for sustainable competitive advantage only if they are valuable, rare and hard to be imitated or substituted (Barney, 1991; Dierickx & Cool, 1989; Hoopes et al., 2003; Prahalad & Hamel, 1990; Teece, Pisano & Shuen, 1997).

Firm capabilities, a concept derived from the RBV, can be defined as the combination of assets and competences that companies use to produce and deliver value to customers (Afuah, 2003). Firm capabilities can also be represented as the efficiency in which firms transform inputs into outputs (Dutta et al., 2005). In the literature, there are several types of firm capabilities; nevertheless, two of the most often mentioned types of firm capabilities are technological capabilities (Lall, 1995) and marketing capabilities (Vorhies & Morgan, 2005). As stated by Bortagaray (2007), a better understanding of the role of firm capabilities, it is a necessary element within the innovation management's research stream; consequently, this research focuses on the evaluation of firm capabilities and innovation performance at the firm level.

Following Lall (1995), technological capabilities are "the information and skills – technical, organisational and institutional – that allow productive enterprises to utilise

equipment and information efficiently" (p. 261). Another definition proposes technological capabilities as a company's effectiveness for creating, adapting or assimilating new technologies with the purpose to create new and more valuable products, services and processes (Wu et al., 2008; Krasnikov & Jayachandran, 2008).

Technological capabilities are normally developed through specific stages of different degree of technology assimilation. That process of building technological capability is complex and takes time (Bell & Pavitt, 1997; Bessant et al., 2012). Indeed, the literature proposes that the firm's competitive advantage relies on the speed of how firms build new technological capabilities in the near future and not necessarily in their current levels of these capabilities (Helfat, 1997; Combs & Bierly, 2006). Also, according to previous studies, profitable innovation can be reached by the investment of unused levels of technological capabilities that may be available within the firm (Kylaheiko et al., 2011).

Lall (1992) proposes three subcategories for technological capabilities: a) investment capabilities, b) production capabilities, and c) linkage capabilities. According to Lall, investment capabilities are all the efforts that a firm needs to do in order to achieve the implementation of new technologies: selection, evaluation, preparation, design, acquisition and staff training. Also, production capabilities are the developed abilities for a better production process, including adaptations and improvements. Lastly, linkage capabilities are related to the formal or informal alliances and cooperation with other companies and institutions in order to enhance its technological capacities. These three subcategories are widely accepted among academics (eg. Dahlman & Westphal, 1987; Lall, 1992; Shan & Jolly, 2012).

Marketing capabilities can be defined as "the integrative process, in which a firm uses its tangible and intangible resources to understand complex consumer specific needs,

achieve product differentiation relative to competition, and achieve superior brand equity" (Nath et al., 2010, p. 319). Vorhies & Morgan (2005) suggest eight categories of marketing capabilities. These categories are: a) pricing; b) product development; c) channel management; d) marketing communication; e) selling; f) market information management; g) marketing planning; and h) marketing implementation. Nevertheless, Eng & Spicket-Jones (2009) suggest an additional ninth category: the use of IT technologies. Indeed, the implementation of Internet and other IT technologies normally are a useful tool for the successful commercialization of agricultural products, such as coffee, in the international markets.

Finally, another important firm capability found in the literature is dynamic capability. According to Teece, Pisano & Shuen (1997), a definition of dynamic capability can be stated as "the firm's ability to integrate, build, and reconfigure intemal and extemal competences to address rapidly changing environments" (p. 516). It may be necessary to explain that although the concept of dynamic capability has been widely used in innovation previous studies, particularly in the case of fast-cycle markets and rapid-changing productive sectors, such as high-tech manufacturing (Combs & Bierly, 2006), this conceptual framework may be considered as not as much appropriate for these types of evaluations in the case of a more traditional and less dynamic activity, such as the agricultural coffee production in Latin America. That is the reason why dynamic capabilities are not included among the firm capabilities considered in this research.

3.2.2. Innovation Performance

There is not a unique definition of innovation universally accepted among the scholars, but several different conceptualizations have been proposed in the literature. For instance, according to Dundon (2002), innovation is "the profitable implementation of

strategic creativity" (p. 5). Trott (2005) provides a more detailed definition, stating that "innovation is the management of all activities involved in the process of idea generation, technology development, manufacturing and marketing of a new (or improved) product or manufacturing process or equipment" (p.15).

In the literature, several types of innovation can be found. This research is focused in four of these types: product innovation; process innovation; managerial/organisational innovation; and marketing innovation. The following are the conceptual definitions offered by the Oslo Manual of Innovation for each of this four types of innovation (OECD, 2005):

- **Product innovation** is "the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics". (OECD, 2005, p. 48).
- **Process innovation** is "the implementation of a new or significantly improved production or delivery method. This includes significant changes in techniques, equipment and/or software" (OECD, 2005, p. 49).
- **Managerial innovation and organisational innovation.** Organisational innovation is "the implementation of a new organisational method in the firm's business practices, workplace organisation or external relations". (OECD, 2005, p. 51). Managerial innovation is "the invention and implementation of a management practice, process structure or technique that is new to the state of the art and is intended to the further organizational goals" (Birkinshaw et al., 2008, p. 825).

- **Marketing innovation** “the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing” (OECD, 2005, p. 49).

In this part of this document, it may be also useful to emphasise the differences between managerial/organisational innovation and innovation management. As stated before, managerial/organisational innovation is referred to the implementation of a new organisational method within the company, whilst innovation management describes the way a company manages its processes and implementations of all types of innovation.

All of these four types of innovation may be relevant for the Latin American coffee sector. For instance, product innovation may be crucial to achieve a higher level of differentiation and profitability, especially in an international market where coffee is traded mostly as a basic commodity. In a similar way, process innovation can be observed when coffee farms generate or adopt technological changes to increase their agricultural yields, to reduce the negative effects of pests, or to achieve more competitive production costs.

3.2.3. Firm Capabilities and Innovation Performance

A positive relationship between firm capabilities and business and innovation performance has been suggested in the literature (Cohen & Levinthal, 1990; Isobe et al., 2008; Zhou & Wu, 2010). Nevertheless, further conceptual and quantitative exploration of certain types of innovation, such as managerial or organisational innovation, as well as marketing innovation, arguably is still needed (Damanpour & Aravind, 2012). This is also relevant in the case of evaluations of the potential effects of firm capabilities on these less studied types of innovation, and even more advisable in the case of agricultural activities, due to the relative scarcity of innovation management research on this specific areas.

Technological capabilities are suggested as a crucial element to explain firm's competitive advantage (Anderson & Tushman, 1990; Cohen & Levinthal, 1990; Primo & DuBois, 2012; Ju, Zhou, Gao & Lu, 2013). In the literature, there is plenty of evidence that technological capabilities and product innovation are positively correlated (Day, 1994; Song et al., 2005; Zahra et al., 2007; Ho et al., 2011). According to Li & Geng (2012), firms with low levels of technological capabilities struggle to achieve innovation by themselves. They usually have to rely more profoundly on the acquisition of technologies from abroad for innovation purposes (Li, 2011).

Renko, Carsrud & Brännback (2009) suggest that technological capabilities, marketing orientation and entrepreneurial orientation are important conditions for the improvement of firm's innovation and general performance. Indeed, marketing and commercialization capacities are essential for firm's innovation performance (Malmberg & Power, 2005).

Although technological capabilities have been identified as a significant condition for innovation performance, they, by themselves, are not considered as a sufficient condition to guarantee to achieve innovation in a firm (Guan & Ma, 2003; Yam, et al., 2011; Zawislak et al., 2013). Indeed, companies may require other types of capabilities or "complementary assets" to gain competitive advantages in the markets (Teece, 1986). One of these complementary assets is the type of firm capabilities called marketing capabilities (Teece, 1986; Afuah, 2003).

3.2.4. Conceptual Framework

The conceptual framework of the first part of this doctoral research explores the mutual relationships between firm capabilities and innovation performance. As explained before, two types of firm capabilities are included in the analysis: technological capabilities

and marketing capabilities. Arguably, these are two of the main firm capabilities that can be found in the innovation management literature. Also, four types of innovation performance are incorporated: product innovation, process innovation, managerial/organisational innovation and marketing innovation.

A general positive relationship between firm capabilities and innovation performance has been established in the literature (Primo & DuBois, 2012). However, the relevance of technological capabilities or marketing capabilities to explain the positive correlation between firm capabilities and innovation performance may vary according to the specific type of innovation performance that it is evaluated.

Following Afuah (2003) and his explanation of the importance of complementary assets to achieve innovation performance, this conceptual framework also expects a high degree of complementarity between technological capabilities and marketing capabilities to explain innovation performance (see Figure 1).

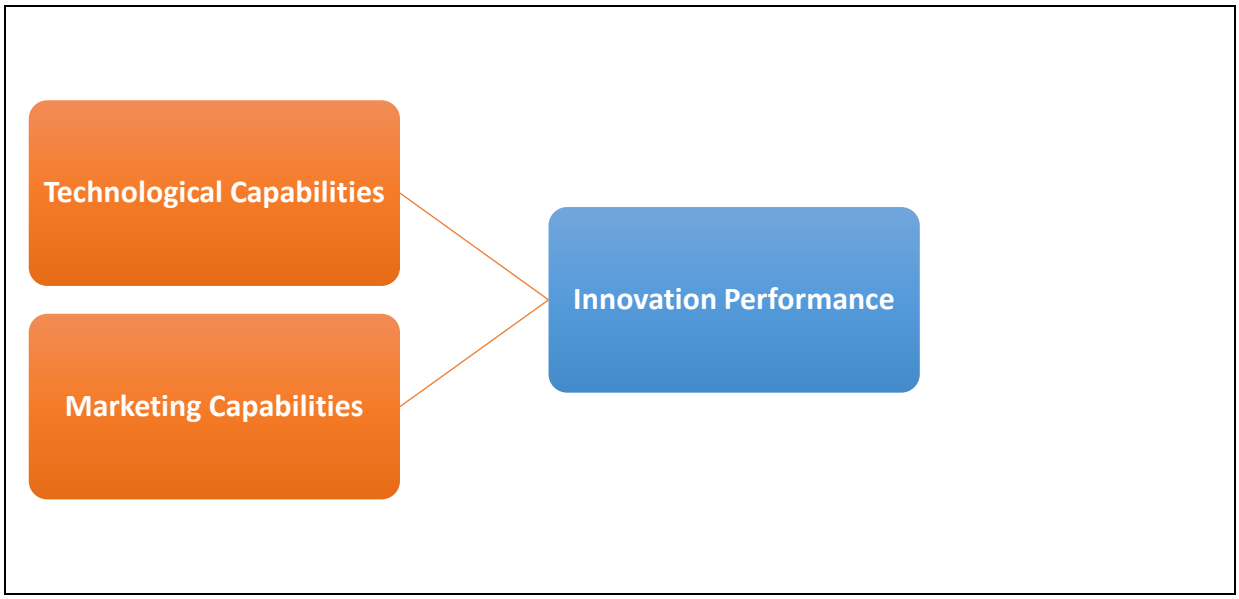


Figure 1. Firm Capabilities and Innovation Performance

Finally, technological capabilities can be classified in three different subcategories: investment capabilities, production capabilities and linkage capabilities (Lall, 1992). This conceptual framework incorporates these three subcategories of technological capabilities into the conducted analysis, and evaluates the relative importance (Azen & Budescu, 2003; Tonidandel & LeBreton, 2011) of each one to explain innovation performance (see Figure 2).

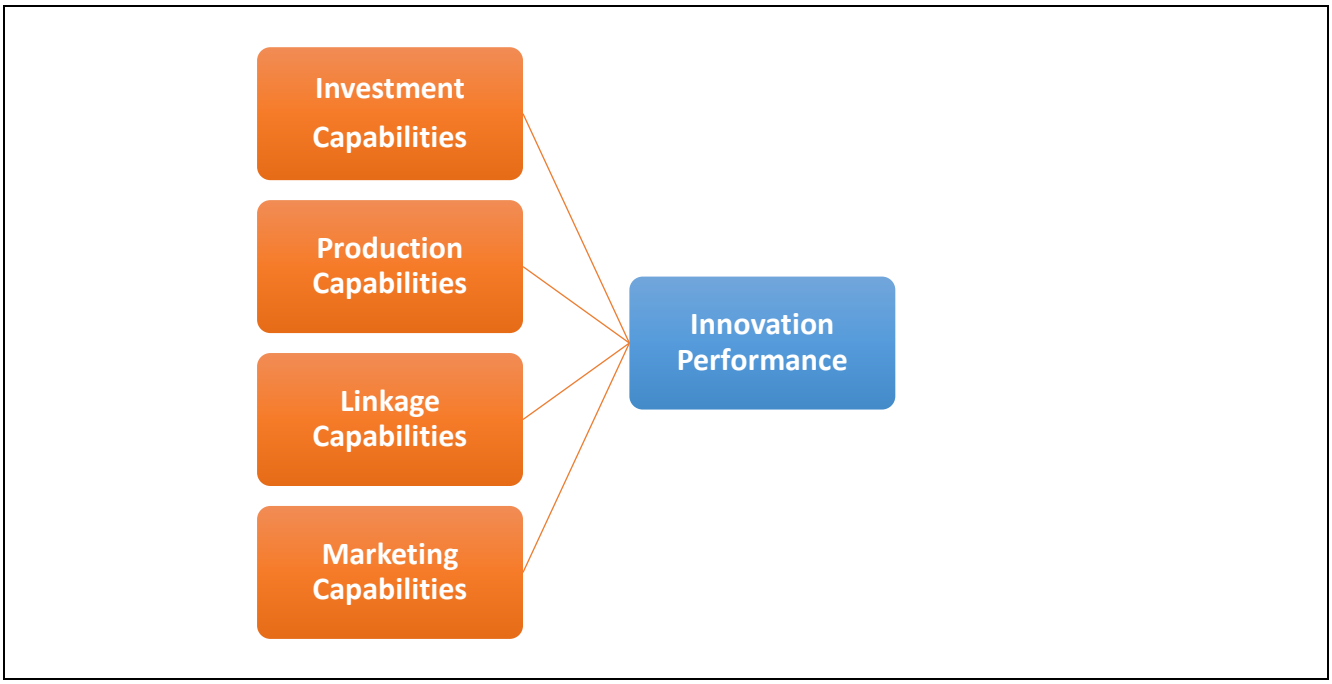


Figure 2.Technological Capabilities' Subcategories and Innovation Performance

3.2.5. Research Hypotheses

Technological capabilities are a key element for the achievement of a better innovation performance (Lee; Lee & Pennings, 2001). Similarly, marketing and commercialization capacities are essential for firm's innovation (Malmberg & Power, 2005; Arunachalam et al., 2013). Then, these two firm capabilities seems to be both crucial to

explain innovation and competitiveness at the firm level, as previous studies have identified a relationship of complementarity between these two types of firm capabilities (Song et al., 2005; Prasnikar et al., 2008). For instance, Renko et al. (2009) suggest that technological capabilities, marketing orientation and entrepreneurial orientation are important conditions for the improvement of the firm's innovation and business performance. However, arguably these previous propositions have been scarcely tested in the case of agricultural activities in developing countries. Therefore, the first two hypotheses of this research tries to validate these propositions in the case of the coffee farmers located in Latin America:

- **Hypothesis 1.1a:** There is a positive relationship between technological capabilities and innovation performance of the agricultural coffee producers in Latin America.
- **Hypothesis 1.1b:** There is a positive relationship between marketing capabilities and innovation performance of the agricultural coffee producers in Latin America.

As stated before, technological capabilities are an important condition for firm's innovation. However, previous studies also aware that this type of firm capabilities may not be enough, by itself, to increase firm's technological and innovative performance in order to gain competitive advantages in the markets. Companies may also need of other types of complementary firm capabilities (or complementary assets) to achieve a better innovation performance and competitive advantage (Combs & Bierly, 2006; Su et al., 2013). Indeed, innovation results depend not only on technological capabilities, but also on other types of firm capabilities, such as marketing capabilities (Yam et al., 2004; Renko et al., 2009). Therefore, in this research, it is expected a complementary effect of technological capabilities and marketing capabilities with respect to their correlations with each type of

innovation performance that it is evaluated. Therefore, due to the mentioned complementary effect expected in these two firm capabilities, the following hypothesis is suggested:

- **Hypothesis 1.2:** Technological capabilities and marketing capabilities are both highly important factors in the relationship between firm capabilities and innovation performance.

In the literature, some previous studies have been interested in the evaluation of the specific subcomponents of technological capabilities, such as investment capabilities, production capabilities and linkage capabilities, with respect to their potential relationship with the firm's business and innovation performance (Flor & Oltra, 2005; Wu, Gu & Zhang 2008; Shan & Jolly, 2012). This research proposes to study the relative importance of these three subcomponents with respect to the correlations between firm capabilities and four different types of innovation performance. Therefore, an evaluation of the next hypothesis is proposed next:

- **Hypothesis 1.3:** Investment capabilities, production capabilities and linkage capabilities are highly important factors in the correlation between firm capabilities and innovation performance.

3.3. Methodology

A short explanation of the main methodological topics of this research are offered next. However, a more complete presentation of the methodological issues are presented in the Chapter 2 of this document.

3.3.1. Target Population and Unit of Analysis

The target population of this study is the coffee farms located in coffee-exporting countries of Latin America, but with a special emphasis on two specific Central American countries: Costa Rica and Guatemala. The unit of analysis is the owners/managers of these selected Latin American coffee farms.

In this research, agricultural coffee producers of all sizes are considered, including small producers, medium producers and large producers. However, the majority of this population is composed by small farmers, i.e. farmers with a production area of 20 hectares or less. Accordingly, the category of small farmers was expected to be, and actually is, the predominant group in this sample.

3.3.2. Sample and Data Collection

The sampling is facilitated by data sources of coffee producers obtained from several websites, electronic databases and other contact lists from business associations and other supporting institutions related to the coffee sector in these countries, as well as from several international organizations. Nevertheless, these databases include only a relatively small number of coffee producers, and they were not completely accessible. The total population of coffee producers in Latin America is unknown but this number most certainly may be in the order of the hundreds of thousands. The exact total number of coffee producers with e-mail that could be identified through the consulted data sources is unknown because some organizations agreed to share the self-reporting questionnaire by themselves, without revealing the identity or the quantity of their reached members. Nevertheless, a total number of 1,200 coffee producers contacted by this research may be considered a conservative and realistic estimation.

A self-reporting questionnaire is designed for the data collection of this research. After some pilot tests with coffee experts and coffee producers, this self-reporting questionnaire was deployed through two strategies. The first strategy is an Internet survey based in a website called Survey Monkey (www.surveymonkey.com). In this first strategy, a very low response rate was expected. The second strategy is a survey applied in the field, implemented either through personal interviews or in workshops offered by local supporting institutions in Costa Rica and Guatemala. Subsequently, this is a convenience sample and not a probabilistic one, which represents one of the limitations of this work.

In the case of the survey conducted in the field, a random sample selection was not considered as feasible either. Coffee producers are sparsely distributed in different regions over extended rural areas, and due to the financial and time limitations of this research project, it was not possible to reach these coffee farmers in a random way. The chosen strategy instead was to identify training and informational workshops organized by local supporting institutions, and to attend these activities (made possible by a formal authorization by the supporting institution) to share a self-reporting questionnaire to the maximum number of coffee producers among the attendees. In Costa Rica, the author participated in four workshops in three of the main coffee producing regions: Tarrazú, Grecia and Atenas. In Guatemala, personal interviews with coffee producers in several important producing areas were conducted.

Considering both the Internet survey and the survey conducted in the field, this research includes a total sample of 186 responses: 95 from Costa Rica, 70 from Guatemala and 21 from other countries (see Table 23). Moreover, as expected, small producers (20 hectares or less) are the larger group in the sample representing a 58% of the total (see Table 24).

Table 23. Coffee Farmers by Country

Country	Frequency	%
Costa Rica	95	51.1
Guatemala	70	37.6
Other Latin American countries	21	11.3
Total	186	100

Table 24. Coffee Farmers by Size

Country	Frequency	%
Up to 5 hectares	51	29.3
6 to 20 hectares	50	28.7
More than 20 hectares	73	42.0
No response	12	-
Total	186	100

3.3.3. Measures

The measures applied in this research are explained next. These measures are adaptations of scales used in previous relevant studies.

a) Dependent Variable: Innovation Performance

The first part of this research proposes innovation performance as the dependent variable. Innovation performance is measured through a self-reporting scale, using a five-point Likert scale, obtained through a questionnaire applied to a sample of coffee farmers in Latin America. Following this approach, four types of innovation performance are considered: a) product innovation, b) process innovation, c) managerial/organisational innovation and d) marketing innovation. Also, a general innovation performance indicator (index) is built as an average value of the four previously mentioned variables for innovation performance.

b) *Technological Capabilities*

Technological capabilities is a broad and multi-dimensional latent construct; therefore, its quantification can be considered a challenging task (Coombs & Bierly, 2006). In the

literature, one of the choices to measure technological capabilities is through the application of qualitative scales based on manager's perceptions (e.g. Isobe et al., 2008 and Shan & Jolly, 2012). In this research, technological capabilities are measured as an index variable composed by three indicators derived from the three subcategories suggested by Lall (1992), following an adaptation of the multi-item qualitative scale implemented by Shan & Jolly (2012). Following Voudouris (et al., 2012), this research applies a seven-point Likert scale to measure technological capabilities.

c) Marketing Capabilities

Marketing capabilities are measured in this research following a simplified scale as the one implemented by Vorhies, Morgan & Autry (2009). This simplified scale incorporates eleven 5-point Likert-scale items, adapted from the main categories suggested by Vorhies & Morgan (2005) and Eng & Spicket-Jones (2009).

3.3.4. Econometric Models

The first part of this doctoral research evaluates the following three regression models where innovation performance is the dependent variables and firm capabilities are the main independent variables. Also, two selected control variables related to size and country of origin are included (see Table 25).

The first regression model (see Table 25, model 1) considers only the two control variables: the dummy variables for country of origin (Costa Rica and Guatemala) and size (small producer, area of 20 hectares or less):

InnoP = $\alpha + \beta 1 dcr + \beta 2 dgu + \beta 3 dsmall + \varepsilon$

Where:

InnoP: Innovation performance (index)

dcr: Dummy variable for coffee producer from Costa Rica

dgu: Dummy variable for coffee producer from Guatemala

dsmall: Dummy variable for small coffee producer (20 hectares or less)

The second regression model (see Table 25, model 2) incorporates, to the previous evaluation, the two firm capabilities considered in this study: technological capabilities and marketing capabilities:

InnoP = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4Markcap + \beta 5Techcap + \varepsilon$

Where:

InnoP: Innovation performance (index)

dcr: Dummy variable for coffee producer from Costa Rica

dgu: Dummy variable for coffee producer from Guatemala

dsmall: Dummy variable for small coffee producer (20 hectares or less)

Markcap: Marketing capabilities

Techcap: Technological capabilities

The third regression model (see Table 25, model 3) includes control variables and firm capabilities, but disaggregating technological capabilities into the three subcategories suggested by Lall (1992): investment capabilities, production capabilities and linkage capabilities:

InnoP =

$\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4Markcap + \beta 5Investcap + \beta 6Prodcap + \beta 7Linkcap + \varepsilon$

Where:

InnoP: Innovation performance (index)

dcr: Dummy variable for coffee producer from Costa Rica

dgu: Dummy variable for coffee producer from Guatemala

dsmall: Dummy variable for small coffee producer (20 hectares or less)

Markcap: Marketing capabilities

Investcap: Investment capabilities

Prodcap: Production capabilities

Linkcap: Linkage capabilities

Table 25. Proposed Econometric Models for the Regression Analysis

	Dependent Variables: Innovation Performance		
Independent Variables:	**Model 1**	**Model 2**	**Model 3**
Control Variables			
Country of Origin	X	X	X
Size	X	X	X
Technological Capabilities (Index)		X	
Investment Capabilities			X
Production Capabilities			X
Linkage Capabilities			X
Marketing Capabilities		X	X

Regression analysis requires a classification of dependent variables and independent variables. Nonetheless, this research cannot assure a relationship of causality among these variables, as the use of instrumental variables was not considered achievable. Consequently, the presented results should be interpreted just as correlations and not as cause-effect relationships.

Also a general dominance analysis (relative importance analysis or relative weight analysis) is performed to identify the individual impact of each included variable in the proposed models.

3.3.5 Control Variables

The study includes two control variables: country of origin and size. This follows previous studies where size is a significant variable that explains technological capabilities (Ianmarino et al., 2008). These two control variables are included in the proposed models as dummy variables according to the following criteria:

a. Country of origin (dcr, dgu): This variable is incorporated through dummy variables that values “1” for coffee farmers from the respective country: Costa Rica (dcr) or Guatemala (dgu). It values “0” for farmers from other countries.

b. Small producers (dsmall): This is a dummy variable that values “1” for coffee farmers with a production area of 20 hectares or less. It values “0” for farmers with a production area that is larger than 20 hectares.

3.3.6. Validity and Reliability

The validity of this work relies mainly in face validity (Carmines & Zeller, 1979, Garson, 2013). All the constructs and items used by this research are adaptations of previous scales and constructs implemented in other studies, also they were reviewed by a small group of academics, experts, and coffee producers through personal and electronic interviews. As a consequence of these revisions, some changes and adjustments were incorporated to the final version of the instrument applied in the survey.

Reliability is checked using the Cronbach’s alpha test (Bryman, 2001). With respect to reliability, the Cronbach’s alpha test suggests a good internal consistency reliability for the multi-item constructs implemented in this research. Indeed, all Cronbach’s alpha’s results obtained in this data are higher than the critical value of 0.8 established in the literature. For further details, please refer to Chapter 2.

3.3.7. Data Transformations and Standardisation

All the obtained data was reviewed and numerically standardized in order to make it compatible with the econometric software STATA. All the responses were transformed to numeric values using a standardized scale. The following is an example that illustrates this transformation in the case of the question related to the area of production.

The question number 5 in the questionnaire asks: What is the current area of your coffee production? (hectares). Seven choices are offered to the respondent:

a) Up to 5 hectares
b) 6 to 10 hectares

c) 11 to 20 hectares
d) 21 to 50 hectares
e) 51 to 100 hectares
f) More than 100 hectares
g) Don’t know / No answer

Each of these choices are transformed to numeric values, as follows:

a) Up to 5 hectares, transformed to 1
b) 6 to 10 hectares, transformed to 2
c) 11 to 20 hectares, transformed to 3
d) 21 to 50 hectares, transformed to 4
e) 51 to 100 hectares, transformed to 5
f) More than 100 hectares, transformed to 6
g) Don’t know / No answer, transformed to 0

(Note: In all the performed econometrical analysis, cero values are ignored).

Similarly, for the questions using Likert scales, the values were transformed from 1 to 5. The missed values presented in the data were replaced by 0. Nevertheless, again the 0 values were ignored in all the performed econometric calculations. Moreover, all the transformations were performed twice in order to detect potential mistakes in the conversion process. Nonetheless, no mistakes could be identified.

3.4. Data Analysis

The data analysis and econometrical results are presented in this section. These evaluations are obtained through the implementation of statistical and econometrical procedures with the assistance of a specialized econometrical software package called STATA IC 13.

3.4.1. Descriptive Statistics

The following is a presentation of the descriptive statistics and tabulation results for the four main dependent variables used in the first part of this research. For product innovation, Table 26 shows that a majority of 76 respondents (51%) agree (i.e. Likert-scale values of 4 or 5) with the proposition: “Your farm or company is stronger than other coffee producers in the region in terms of product innovation”, whilst 21 respondents (14%) disagree (i.e. Likert-scale values of 1 or 2).

Table 26. Product Innovation – Tabulation

Likert-scale value	Freq.	%	Cum.
1	8	5.41	5.41
2	13	8.78	14.19
3	51	34.46	48.65
4	46	31.08	79.73
5	30	20.27	100.00
Total	148	100.00	

Note: the variable has a value range between 1 and 5

With respect to process innovation, Table 27 presents a similar situation than the one obtained for product innovation. The majority of 76 respondents (51%) agree (i.e. Likert-scale values of 4 or 5) with the proposition: “Your farm or company is stronger than other coffee producers in the region in terms of process innovation”, whilst 19 respondents (13%) disagree (i.e. Likert-scale values of 1 or 2).

Table 27. Process Innovation – Tabulation

Likert-scale value	Freq.	%	Cum.
1	10	6.80	6.80
2	9	6.12	12.93
3	52	35.37	48.30
4	49	33.33	81.63
5	27	18.37	100.00
Total	147	100.00	

Note: the variable has a value range between 1 and 5

For managerial and organisational innovation and for marketing innovation, the situation seems to be similar to the two first cases (product innovation and process innovation) in relation to the responses to the following propositions: “Your farm or company is stronger than other coffee producers in the region in terms of managerial and organisational innovation innovation” (see Table 28), and “Your farm or company is stronger than other coffee producers in the region in terms of marketing innovation” (see Table 29).

Table 28. Managerial and Organisational innovation – Tabulation

Likert-scale value	Freq.	%	Cum.
1	8	5.93	5.93
2	15	11.11	17.04
3	35	25.93	42.96
4	54	40.00	82.96
5	23	17.04	100.00
Total	135	100.00	

Note: the variable has a value range between 1 and 5

Table 29. Marketing Innovation – Tabulation

Likert-scale value	Freq.	%	Cum.
1	7	5.30	5.30
2	13	9.85	15.15
3	48	36.36	51.52
4	45	34.09	85.61
5	19	14.39	100.00
Total	132	100.00	

Note: the variable has a value range between 1 and 5

The descriptive statistics for the independent variables measuring firm capabilities and local linkages are presented in the next table (see Table 30). The information for the total sample, including all countries, are shown, but also specific information for each country of origin: Costa Rica, Guatemala and other Latin American countries.

Table 30. Firm Capabilities - Descriptive Statistics

Variables		All Countries	Costa Rica	Guatemala	Others
Technological Capabilities (Index)	Mean	2.94	2.87	3.02	2.92
	Std. Dev.	0.75	0.88	0.57	0.62
	Obs.	182	93	70	19
Investment Capabilities	Mean	2.78	2.73	2.87	2.68
	Std. Dev.	0.87	0.97	0.74	0.85
	Obs.	178	90	69	19
Production Capabilities	Mean	3.08	3.06	3.10	3.11
	Std. Dev.	0.74	0.82	0.63	0.73
	Obs.	173	87	67	19
Linkage Capabilities	Mean	2.96	2.85	3.11	2.95
	Std. Dev.	0.85	1.01	0.61	0.69
	Obs.	173	86	69	18
Marketing Capabilities	Mean	2.93	2.80	3.06	3.06
	Std. Dev.	0.89	1.00	0.81	0.58
	Obs.	177	86	70	21

Note: each variable has a value range between 1 and 5

3.4.2. Correlations

The following table presents the Spearman correlations for all of the main variables incorporated in this study (see Table 31). There are significant and positive high correlations among the variables related to innovation performance. This may be considered as expectable, because a coffee producer with a high level of sophistication and firm capabilities that allows him/her to obtain a better innovative behavior in one type of innovation, most probably it would be in a position to achieve a good performance with respect to other types of innovation as well.

For the two other variables, technological capabilities and marketing capabilities, the correlations are still positive, but not as high as the one presented for innovation performance variables (see Table 31).

Table 31. Spearman Correlations

	Variables	1	2	3	4	5	6
1	Product Innovation	1.0000					
2	Process Innovation	0.7468	1.0000				
3	Managerial innovation	0.7196	0.7235	1.0000			
4	Marketing Innovation	0.6616	0.5876	0.7516	1.0000		
5	Technological Capabilities	0.5397	0.4733	0.4615	0.4655	1.0000	
6	Marketing Capabilities	0.4805	0.3905	0.4072	0.5046	0.6509	1.0000

3.4.3. Regression Analysis

The mutual relationships between firm capabilities and several indicators of innovation performance are tested through regression analysis. Five innovation indicators are considered in this research a dependent variables: a) product innovation, b) process innovation, c) managerial/organisational innovation and d) marketing innovation, as well as an innovation performance index build by the average of the four previously mentioned innovation indicators. The two main independent variables included in this evaluation are: technological capabilities and marketing capabilities. Moreover, as mentioned before, two control variables: country of origin (Costa Rica, Guatemala and other Latin American countries) and being a small producer (<20 hectares) are also incorporated into the analysis.

Ordered probit regressions are implemented in the case of the four types of innovation performances as these variables are ordinal categorical dependent variables. Nevertheless, ordinary lest square regression is performed in the case of the general

innovation performance indicator (index) because this index variable behaves as a normal variable.

It is important to notice that although a classification of independent and dependent variables are proposed in this work, it cannot be assured a relationship of casualty among these variables. Therefore, the regression results should be interpreted just as correlations and not necessarily as a cause-effect relationship.

3.4.3.1. Innovation Performance and Firm Capabilities

The following models evaluates the mutual relationships among firm capabilities, selected control variables and general innovation performance (Index). The analysis of control variables shows a significant negative impact of being a small producer on the general level of innovation performance (see Table 32, model 1). Also, the control variable for country of origin Guatemala seems to have a negative effect on this relationship (see Table 32, model 2).

Table 32. Model Set 1.1. Linear OLS (Robust) Regressions: Innovation Performance (Index) and Firm Capabilities

Independent Variables:	Dependent Variables:		
	Innovation Performance (Index)	Innovation Performance (Index)	Innovation Performance (Index)
	Model 1	Model 2	Model 3
Control Variables			
Country of Origin: Costa Rica	0.0175	-0.229	-0.253
Country of Origin: Guatemala	-0.495	-0.552**	-0.559**
Size: Small Producer	-0.520**	-0.238	-0.197
Technological Cap. (Index)		0.558**	
Investment Capabilities			0.266*
Production Capabilities			0.176
Linkage Capabilities			0.160
Marketing Capabilities		0.185	0.154
Constant	3.945***	1.667***	1.650***
N	148	141	135
R-sq	0.0808	0.3591	0.3712
AIC	399.4114	333.1638	318.3045
BIC	411.4002	350.8564	341.5467

*p<0.05, **p<0.01, ***p<0.001

As expected, the goodness of fit of the model 1 is low, presenting a R-sq of 0.0808. This is expected as it only considers the control variables (see Table 32, model 1). When the main independent variables, technological capabilities and marketing capabilities, are included, the goodness of fit improves significantly with a R-sq of 0.3591 (see Table 32, model 2). Finally, when the three subcategories of technological capabilities: investment capabilities, production capabilities and linkage capabilities, are incorporated in replacement of the index variable, the goodness of fit improves a little further reflecting a R-sq of 0.3712 (see Table 32, model 3). Therefore, the proposed model that better explains the interrelations between innovation performance index and firm capabilities is the third one (see Table 32, model 3).

The following table shows the results for the general dominance (relative importance) analysis. These results suggest that technological capabilities has the highest relative importance explaining the relationship between firm capabilities and general innovation performance (see Table 33, model 2). Moreover, investment capabilities seems to be the most relevant subcategory of technological capabilities in regard to the same relationship (see Table 33, model 3).

Table 33. General Dominance Analysis (Standardized Weights and Rankings): Innovation Performance (Index) and Firm Capabilities

Independent Variables:	Dependent Variables:		
	Innovation Performance (Index)	Innovation Performance (Index)	Innovation Performance (Index)
	Model 1	Model 2	Model 3
Control Variables			
Country of Origin: Costa Rica	0.1178 (3)	0.0199 (5)	0.0181 (7)
Country of Origin: Guatemala	0.3454 (2)	0.0699 (3)	0.0690 (5)
Size: Small Producer	0.5368 (1)	0.0659 (4)	0.0448 (6)
Technological Cap. (Index)		0.5061 (1)	
Investment Capabilities			0.2625 (1)
Production Capabilities			0.2307 (2)
Linkage Capabilities			0.1689 (4)
Marketing Capabilities		0.3382 (2)	0.2060 (3)
Total	1.0000	1.0000	1.0000

The next sections present a similar analysis for each of the four types of innovation performance that are considered in this work. This includes the regression analysis for the variables: product innovation, process innovation, managerial innovation and marketing innovation.

a) *Product Innovation and Firm Capabilities*

Technological capabilities has a significant and positive correlation with product innovation (see Table 34, model 2). With respect to the control variables, once again, small producers and producers from Guatemala seems to have a weaker positive correlation between these variables (see Table 34, model 1).

Table 34. Model Set 1.2. Ordered Probit Regressions: Product Innovation and Firm Capabilities

Independent Variables:	Dependent Variables:		
	Product Innovation	Product Innovation	Product Innovation
	Model 1	Model 2	Model 3
Control Variables			
Country of Origin: Costa Rica	-0.159	-0.502	-0.523
Country of Origin: Guatemala	-0.690*	-0.925**	-0.955**
Size: Small Producer	-0.468*	-0.184	-0.130
Technological Cap. (Index)		0.784***	
Investment Capabilities			0.313
Production Capabilities			0.142
Linkage Capabilities			0.341
Marketing Capabilities		0.165	0.173
N	139	136	131
Pseudo R-sq	0.0262	0.1318	0.1334
AIC	397.6923	353.4918	345.0068
BIC	418.2336	379.7056	376.634

*p<0.05, **p<0.01, ***p<0.001

When the relative importance analysis is considered, the variable for technological capabilities has the highest relative importance in the relationship between firm capabilities and product innovation (see Table 35, model 2).

Table 35. General Dominance Analysis (Standardized Weights and Rankings): Product Innovation and Firm Capabilities

Independent Variables:	Dependent Variables:		
	Product Innovation	Product Innovation	Product Innovation
	Model 1	Model 2	Model 3
Control Variables			
Country of Origin: Costa Rica	0.1504 (3)	0.0378 (5)	0.0347 (6)
Country of Origin: Guatemala	0.4662 (1)	0.1287 (3)	0.1311 (5)
Size: Small Producer	0.3834 (2)	0.0416 (4)	0.0297 (7)
Technological Cap. (Index)		0.4933 (1)	
Investment Capabilities			0.2186 (1)
Production Capabilities			0.2163 (2)
Linkage Capabilities			0.1875 (3)
Marketing Capabilities		0.2987 (2)	0.1821 (4)
Total	1.0000	1.0000	1.0000

b) *Process Innovation and Firm Capabilities*

Technological capabilities shows a positive correlation in regard to process innovation (see Table 36, model 2), whilst the selected control variables seems not to be significant in this evaluation.

Table 36. Model Set 1.3. Ordered Probit Regressions: Process Innovation and Firm Capabilities

Independent Variables:	Dependent Variables:		
	Process Innovation	Process Innovation	Process Innovation
	Model 1	Model 2	Model 3
Control Variables			
Country of Origin: Costa Rica	-0.0182	-0.292	-0.364
Country of Origin: Guatemala	-0.451	-0.609	-0.665
Size: Small Producer	-0.408	-0.201	-0.141
Technological Cap. (Index)		0.677***	
Investment Capabilities			0.541*
Production Capabilities			0.112
Linkage Capabilities			0.112
Marketing Capabilities		0.0323	-0.0341
N	138	133	127
Pseudo R-sq	0.0152	0.0795	0.0924
AIC	394.2246	362.3883	343.7765
BIC	414.7153	388.4014	375.0626

*p<0.05, **p<0.01, ***p<0.001

In regard to relative importance, technological capabilities presents the highest relative importance in the relationship between firm capabilities and process innovation (see Table 37, model 2).

Table 37. General Dominance Analysis (Standardized Weights and Rankings): Process Innovation and Firm Capabilities

Independent Variables:	Dependent Variables:		
	Process Innovation	Process Innovation	Process Innovation
	Model 1	Model 2	Model 3
Control Variables			
Country of Origin: Costa Rica	0.1530 (3)	0.0333 (5)	0.0289 (7)
Country of Origin: Guatemala	0.4172 (2)	0.1143 (3)	0.1067 (5)
Size: Small Producer	0.4298 (1)	0.0622 (4)	0.0356 (6)
Technological Cap. (Index)		0.5633 (1)	
Investment Capabilities			0.3624 (1)
Production Capabilities			0.2231 (2)
Linkage Capabilities			0.1291 (3)
Marketing Capabilities		0.2269 (2)	0.1142 (4)
Total	1.0000	1.0000	1.0000

c) *Managerial and Organisational Innovation and Firm Capabilities*

Managerial and organisational innovation is positively correlated to technological capabilities (see Table 38, model 2), whilst marketing capabilities are not significant in the same model.

Table 38. Model Set 1.4. Ordered Probit Regressions: Managerial and Organisational Innovation and Firm Capabilities

Independent Variables:	Dependent Variables:		
	Managerial and Organisational innovation	Managerial and Organisational innovation	Managerial and Organisational innovation
	Model 1	Model 2	Model 3
Control Variables			
Country of Origin: Costa Rica	0.155	-0.0727	-0.136
Country of Origin: Guatemala	-0.393	-0.577	-0.547
Size: Small Producer	-0.401	-0.156	-0.135
Technological Cap. (Index)		0.720***	
Investment Capabilities			0.371
Production Capabilities			0.261
Linkage Capabilities			0.0979
Marketing Capabilities		0.213	0.160
N	126	121	117
Pseudo R-sq	0.0166	0.1178	0.1087
AIC	367.8833	325.1113	320.8789
BIC	387.7373	350.2734	351.2628

*p<0.05, **p<0.01, ***p<0.001

The general dominance analysis reveals that both technological capabilities and marketing capabilities have a significant relative importance in the relationship between firm capabilities and managerial/organisational innovation (see Table 39, model 2). Nonetheless, the relative importance of technological capabilities is much higher than the relative importance of marketing capabilities, contrary as expected.

Table 39. General Dominance Analysis (Standardized Weights and Rankings): Managerial and Organisational Innovation and Firm Capabilities

Independent Variables:	Dependent Variables:		
	Organisational Innovation	Organisational Innovation	Organisational Innovation
	Model 1	Model 2	Model 3
Control Variables			
Country of Origin: Costa Rica	0.2271 (3)	0.0344 (4)	0.0237 (6)
Country of Origin: Guatemala	0.4525 (1)	0.0979 (3)	0.0883 (5)
Size: Small Producer	0.3204 (2)	0.0265 (5)	0.0226 (7)
Technological Cap. (Index)		0.5061 (1)	
Investment Capabilities			0.2747 (1)
Production Capabilities			0.2743 (2)
Linkage Capabilities			0.1048 (4)
Marketing Capabilities		0.3351 (2)	0.2117 (3)
Total	1.0000	1.0000	1.0000

d) *Marketing Innovation and Firm Capabilities*

As expected, marketing innovation is significantly and positively correlated with the two types of firm capabilities included in this research: technological capabilities and marketing capabilities (see Table 40, model 2). Moreover, the highest magnitude of this positive impact is related to marketing capabilities, as it was expected as well.

Table 40. Model Set 1.5. Ordered Probit Regressions: Marketing Innovation and Firm Capabilities

Independent Variables:	Dependent Variables:		
	Marketing Innovation	Marketing Innovation	Marketing Innovation
	Model 1	Model 2	Model 3
Control Variables			
Country of Origin: Costa Rica	0.145	0.0257	0.0939
Country of Origin: Guatemala	-0.628	-0.798*	-0.845*
Size: Small Producer	-0.764**	-0.587*	-0.504
Technological Cap. (Index)		0.499*	
Investment Capabilities			0.0103
Production Capabilities			0.0765
Linkage Capabilities			0.418*
Marketing Capabilities		0.585***	0.680***
N	123	122	118
Pseudo R-sq	0.0390	0.1842	0.2012
AIC	344.5992	297.0078	286.3751
BIC	364.2844	322.244	316.8526

*p<0.05, **p<0.01, ***p<0.001

In the relationship between firm capabilities and marketing innovation, the subcategory of technological capabilities with the highest relative importance seems to be the variable production capabilities, and not the variable for linkage capabilities as it was expected (see Table 41, model 3).

Table 41. General Dominance Analysis (Standardized Weights and Rankings): Marketing Innovation and Firm Capabilities

Independent Variables:	Dependent Variables:		
	Marketing Innovation	Marketing Innovation	Marketing Innovation
	Model 1	Model 2	Model 3
Control Variables			
Country of Origin: Costa Rica	0.1257 (3)	0.0346 (5)	0.0380 (7)
Country of Origin: Guatemala	0.3631 (2)	0.1097 (3)	0.1188 (5)
Size: Small Producer	0.5112 (1)	0.0737 (4)	0.0580 (6)
Technological Cap. (Index)		0.3206 (2)	
Investment Capabilities			0.1334 (4)
Production Capabilities			0.1521 (2)
Linkage Capabilities			0.1430 (3)
Marketing Capabilities		0.4614 (1)	0.3566 (1)
Total	1.0000	1.0000	1.0000

3.5. Results

This section includes the data results obtained in this study. These results will be exposed through the consideration of each hypothesis that have been proposed in a previous section.

- **Hypothesis 1.1a:** There is a positive relationship between technological capabilities and innovation performance of the agricultural coffee producers in Latin America.

The results suggest that technological capabilities are significantly and positively correlated to the four types of innovation performance considered in this research. Therefore, the hypothesis 1.1a is accepted (see Table 42).

Table 42. Results of Regression Analysis (Ordered Probit): Firm Capabilities and Types of Innovation Performance

Independent Variables:	Dependent Variables:			
	Product Innovation	Process Innovation	Managerial/ Organisational innovation	Marketing Innovation
Control Variables				
Country of Origin: Costa Rica	-0.502	-0.292	-0.0727	0.0257
Country of Origin: Guatemala	-0.925**	-0.609	-0.577	-0.798*
Size: Small Producer	-0.184	-0.201	-0.156	-0.587*
Technological Cap. (Index)	0.784***	0.677***	0.720***	0.499*
Marketing Capabilities	0.165	0.0323	0.213	0.585***
N	136	133	121	122
Pseudo R-sq	0.1318	0.0795	0.1178	0.1842
AIC	353.4918	362.3883	325.1113	297.0078
BIC	379.7056	388.4014	350.2734	322.244

*p<0.05, **p<0.01, ***p<0.001

- **Hypothesis 1.1b:** There is a positive relationship between marketing capabilities and innovation performance of the agricultural coffee producers in Latin America.

Marketing capabilities are positively correlated with the four types of innovation performances that have been evaluated (see Table 42). However, in the proposed models,

the coefficients for marketing capabilities are significant only in the case of marketing innovation (see Table 42). The hypothesis 1.1b is also accepted.

- **Hypothesis 1.2:** Technological capabilities and marketing capabilities are both highly important factors in the relationship between firm capabilities and innovation performance.

Technological capabilities seems to have a significantly higher relative importance than marketing capabilities in the evaluations for product innovation, process innovation and managerial/organisational innovation (see Table 43). Thus, the hypothesis 1.2 is rejected for those three types of innovation performances.

Nevertheless, in the evaluation of marketing innovation, it can be considered that both technological capabilities and marketing capabilities have a similar relative importance (see Table 43). In this only case, the relative importance for marketing capabilities are slightly higher than the one for technological capabilities (see Table 43).

Table 43. Results of Relative Importance: Firm Capabilities and Types of Innovation Performance

Independent Variables:	Dependent Variables:				
	Innovation Performance (Index)	Product Innovation	Process Innovation	Managerial/ Organisational innovation	Marketing Innovation
Control Variables	0.1557 (3)	0.2080 (3)	0.2098 (3)	0.1588 (3)	0.2180 (3)
Tech. Cap.(Index)	0.5061 (1)	**0.4933 (1)**	**0.5633 (1)**	**0.5061 (1)**	0.3206 (2)
Marketing Capabilities	0.3382 (2)	0.2987 (2)	0.2269 (2)	0.3351 (2)	**0.4614 (1)**
Total	1.0000	1.0000	1.0000	1.0000	1.0000

- **Hypothesis 1.3:** The three subcategories of technological capabilities: investment capabilities, production capabilities and linkage capabilities, are highly important factors in the relationship between firm capabilities and innovation performance.

The hypothesis 1.3 is rejected in the case of two types of innovation performances: process innovation and managerial/organisational innovation. In this two cases, the relative

importance of linkage capabilities seems to be significantly lower than the ones for the other two subcategories: investment capabilities and production capabilities (see Table 44). However, this hypothesis 1.3 is accepted for the two other types of innovation performance: product innovation and marketing innovation, as the relative importance of each of the three subcategories can be considered as similar (see Table 44).

Table 44. Results of Relative Importance: Technological Capabilities (Subcategories) and Types of Innovation Performance

Independent Variables:	Dependent Variables:				
	Innovation Performance (Index)	Product Innovation	Process Innovation	Managerial/ Organisational innovation	Marketing Innovation
Control Variables	0.1319 (5)	0.1955 (3)	0.1712 (3)	0.1345 (4)	0.2149 (2)
Investment Cap.	0.2625 (1)	0.2186 (1)	0.3624 (1)	0.2747 (1)	0.1334 (5)
Production Cap.	0.2307 (2)	0.2163 (2)	0.2231 (2)	0.2743 (2)	0.1521 (3)
Linkage Capabilities	0.1689 (4)	0.1875 (4)	0.1291 (4)	0.1048 (5)	0.1430 (4)
Marketing Capabilities	0.2060 (3)	0.1821 (5)	0.1142 (5)	0.2117 (3)	0.3566 (1)
Total	1.0000	1.0000	1.0000	1.0000	1.0000

3.6. Discussion

In this study of agricultural coffee producers in Latin America, four types of innovation are evaluated. Two of them have been widely tested in previous literature: product innovation and process innovation. However, two other types of innovation have not received the same level of interest from most academic researchers: managerial/organisational innovation and marketing innovation (Krasnikov & Jayachandran, 2008; Ju et al., 2013).

In regard to the first two types of innovation, product innovation and process innovation, technological capabilities present a clear, positive and significant relationship with two types of innovation performances: product innovation and process innovation. These two types of innovation performances normally require of more technological

knowledge to be achieved in comparison to other types of innovation performance such as managerial/organisational innovation and marketing innovation. This finding should not be considered a surprise, as this situation has been confirmed for other economic activities, in particular for manufacturing industries, by previous studies (Malmberg & Power, 2005; Renko et al., 2009; Arunachalam et al., 2013).

However, with respect to one of the other two types of innovation, managerial/organisational innovation, the strong positive and significant relationship between technological capabilities and managerial/organisational innovation, as well as the high relative importance of technological capabilities to explain managerial/organisational innovation, was not expected, as few previous studies have suggested that relationship before.

Marketing capabilities have been suggested in the literature as an important complementary condition to facilitate firm's technological change and innovation (Afuah, 2000; Song et al., 2005; Hsu et al., 2008), there is a relative scarcity of quantitative evidence for the opposite case, i.e. the consideration that technological capabilities may be also important to explain firm's good marketing endeavours. Moreover, some authors suggest that in certain circumstances the over specialization of firm capabilities can be a detrimental factor for product innovation, for instance (e.g. Haeussler et al., 2012).

The results obtained in this research suggest that technological capabilities is positively correlated with marketing innovation and explain an important part of this relationship. According to the data, marketing capabilities are the highest positive influence to explain marketing innovation; nevertheless, technological capabilities also seems to have an important positive influence on marketing innovation as well.

In this research, technological capabilities and marketing capabilities presents a certain degree of complementarity. Indeed, according to the performed general dominance statistical analysis, these two firm capabilities are both relatively important to explain the four evaluated types of innovation performance considered in this research. Therefore, policies designed to support innovation in the agricultural coffee production should take in consideration both types of firm capabilities to promote any of these types of innovation among the coffee agricultural producers.

The literature suggest propose three subcategories to explain technological capabilities: investment capabilities, production capabilities and linkage capabilities (Lall, 1992). Nonetheless, the analysis of these three subcomponents of technological capabilities, and their potential influence on innovation, suggests that these three elements do not have the same relative importance in most of the evaluated cases. Indeed, investment capabilities has a much higher relative importance in regard to product innovation, process innovation and managerial/organisational innovation than the other two subcomponents. However, this high relative importance of investment capabilities is diminished in the case of marketing innovation, where marketing capabilities takes the first place of relative importance, and investment capabilities are just as important as the other two subcomponents.

The lack of financial resources and limited access to formal credit are usual obstacles for business operations, including innovation achievements, for agricultural SMEs in Latin America and other developing regions of the world. Most of the small coffee farmers in Latin America do not have the financial capacities to deploy any investment, included the kind of investments needed for technological capability building. Therefore, the obtained general dominance result of a higher relative importance for investment

capabilities reflects a normal although challenging situation within this industry. A first step to promote innovation in the coffee sector, it may be to increase the investment capabilities of these farmers, as this capability proves to be the most important for them in order to perform activities related to innovation purposes.

Geography, Linkages and Capabilities: Innovation in the Agricultural Coffee Production in Latin America

Chapter 4. The Cluster Effects: Local Influences and the Building of Internal Capabilities in the Latin American Coffee Farms

Abstract: The second part of this doctoral research tests the mutual influences among different types of local (cluster) linkages and firm capabilities in a sample of coffee farms located in Latin America. The results suggest a significant positive relationship between local linkages and firm capabilities, although the relevant types of local linkages may be different according to the type of innovation performances that may be evaluated.

Keywords: Technological capabilities, marketing capabilities, absorptive capacity, resource-based view, local linkages, clusters, Latin America, Coffee.

Geography, Linkages and Capabilities: Innovation in the Agricultural Coffee Production in Latin America

Chapter 4. The Cluster Effects: Local Influences and the Building of Internal Capabilities in the Latin American Coffee Farms

4.1. Chapter Introduction

The second part of this doctoral research proposes an integration of elements borrowed from the resource-based view theory (RBV) (Wernerfelt, 1984; Barney, 1991, 2001) into the research stream on economic geography and business clusters (Krugman, 1991; Porter, 1990; Giuliani, Pietrobelli, & Rabellotti, 2005). Specifically, this study tests the reciprocal influences between the firm's internal conditions and its external linkages for innovation purposes at the local level, in the case of the agricultural coffee production in Latin American countries.

The internal conditions considered in this chapter are two widely studied types of firm capabilities: a) technological capabilities (Lall, 1992; Combs & Bierly, 2006; Isobe et al., 2008; Zhou & Wu, 2010), and b) marketing capabilities (Day, 1994; Morgan, Vorhies & Manson, 2009; Day, 2011). Similarly, the local linkages that are being considered in this study include three categories: a) local horizontal linkages with competitors, b) local horizontal linkages with supporting institutions, and c) local vertical linkages with suppliers and buyers. These three categories are an adaptation of the relevant external linkages proposed by previous literature (e.g. Freel, 2000; Shu, Wong & Lee, 2005)

A positive correlation between technological capabilities and local linkages have been suggested in the literature (Ianmarino et al., 2012). Indeed, previous studies states that the firm's technological capabilities tends to improve within clusters due to the

environment of more intensive local linkages among companies and other institutions embedded within that cluster (Riain, 2006; Ciravegna, 2011). For instance, previous research on ICT clusters shows the high importance of informal interactions of engineers, technicians and other related people to enhance technological capabilities and innovation on those firms (Saxenian & Hsu, 2001; Ciravegna; 2011). However, this research tests these relationships in a context that has been scarcely explored in previous studies: an agricultural activity in developing countries, in particular the primary coffee production in Latin America. The objective of this research is to evaluate if these types of local social dynamics may promote in the Latin American coffee farms the same positive results that have been observed in companies from other sectors.

Previous studies suggest that governmental supporting institutions located within clusters facilitate improvements in the performance of local companies (Primo & DuBois, 2012). Moreover, as agricultural coffee production is an activity with a high political leverage in Latin America, this political influence has promoted an intense governmental involvement and sectorial regulations with respect to this activity, as well as a generous amount of subsidies, including high investments in specialized public research and supporting institutions.

Arguably, most previous Resource-Based View (RBV) studies focus on the internal elements of firm capabilities, without considering the potential impacts of network and other external conditions, such as the influence of shared resources and other cluster capabilities (Li & Geng, 2012; Voudouris et al., 2012). This study follows the research stream that explores the potential relationship between firm capabilities and cluster externalities. Its potential contribution is referred to the consideration of technological capabilities and marketing capabilities acting complementary together in relation to different types of local

linkages, including horizontal and vertical local linkages in a less explored context, an agricultural activity located in developing countries.

This chapter is structured in six sections. The first section includes this brief introduction. The second part exposes the closely related literature and the conceptual framework developed for this work. Next, the research methodology is explained. The fourth and fifth section show the data analysis, followed by the presentation of the results. Finally, the last section shares the main findings of this research and offers some conclusions and discussions.

4.2. Literature Review

The following is a review of the literature that is closely related to these two internal and external conditions for capability building and innovation.

4.2.1. Clusters and Local Linkages

The potential economic advantages of geographical agglomerations have been explored for decades. Since the industrial districts identified by Marshal (1920), our understanding about this phenomenon, its characteristics and limitations, have grown substantially, thanks to the work of many prestigious academics worldwide (De Langen, 2002; Krugman, 1991; McCormick, 1999; Porter, 1990).

Michael Porter (1990) proposes a new name, “cluster”, for this geographical agglomerations creating a renewed interest on this topic, although not without academic controversy. Porter defines clusters as a “geographic concentration of interconnected companies and institutions in a particular field” (Porter, 1998, p.78). According to Porter (2000), it is advantageous for companies to be embedded within a cluster as this improves their productivity and their innovation performance.

These advantages of being embedded in business clusters are called agglomeration economies or external economies (Krugman, 1991; Duranton et al., 2010). Two different types of agglomeration economies are suggested in the literature: localization economies and urbanization economies. The localization economies are generated in agglomerations of companies in one particular industry in a limited geographical area. The urbanization economies are related to the physical agglomeration per se of different economic activities and people in large cities (Hollar, 2006; Duranton et al., 2010). This research focuses only

on localization economies as this is the type of agglomeration more closely related to the business cluster studies.

The literature identifies five main sources of agglomeration economies: a) access to customers, b) specialized inputs and services, c) specialized infrastructure, d) specialized labor markets, and e) knowledge spillovers as a result of frequent social or informal people's interrelationship promoted and facilitated by the geographical agglomeration (Marshal, 1920; Porter, 1990; Krugman, 1991; McCormick, 1999; De Langen, 2002). The agglomeration economies may improve the business performance through lower transaction costs, economies of scale and a more frequent sharing of tacit knowledge among people in a cluster (Teece, 1998).

Cluster capabilities are defined as the shared resources, institutional provisions and other agglomeration's positive influences available to firms inside a cluster. (Maskell & Malmberg, 1999; Hervas-Oliver & Albors-Garrigos, 2007; Li & Geng, 2012). Indeed, the literature suggests a positive relationship between being located within a clusters and better business and innovation performances (Audretsch & Feldman, 1996; Baptista & Swann, 1998; Breschi & Lissoni, 2001; Silvestre & Dacol, 2010), although this conclusion is not unanimous among academics (Duranton et al., 2010).

The argument about the supposed superiority of firms embedded in clusters in relation to their business and innovation performance has been controversial due to the contradictory results of previous research on that topic. (Karlsson & Klaesson, 2000, Camisón, 2004; Diez-Vial, 2011; Camisón & Villar-Lopez, 2012). Indeed, Camisón & Villar-Lopez (2012) shows that the fact of being located in a cluster, it is not necessary an immediate advantage for the embedded firms, unless they possess a high level of technological capabilities in order to take advantage of the potential external economies

that may be available within the cluster. In any case, some academics argue that most cluster studies seem to focus more on productivity impact and not on innovation performance (Silvestre & Dalcol, 2010).

Schmitz (1995) suggests that the cluster's external economies may not be sufficient to achieve competitive advantage. Companies in clusters may also need to be linked with other firms and organizations in the same cluster and to perform explicit collective tasks. Schmitz calls these collective efforts as "joint actions". According to him, the real competitive advantage of being located within a cluster, or, as he calls it, "collective efficiency", it is the result of the combination of both external economies and joint actions working together.

Geographical proximity encourages knowledge sharing and improvements in technological capabilities (Primo & DuBois, 2012). For instance, in their study about textile-based companies located in export processing zone in Mauritius, Peerally & Cantwell (2011) identifies a positive impact of local linkages with suppliers on their level of innovative technological capabilities in local firms and global subsidiaries in that country.

Pietrobelli & Rabellotti (2004) suggest that local linkages with other companies and institutions are crucial for a firm's business and innovation results. According to them, the actions to improve the local linkages may include encouraging mutual trust, promoting collective projects, strengthening business associations, developing a better local supply of financial and other local services, and enhancing local innovation, as well as the opening of channels of communication or linkages to other companies and institutions outside the cluster.

The literature suggests a positive relationship between high levels of collective efficiency and better business and innovation performances in companies (Caniels &

Romijn; 2003; Hervas-Oliver & Albors-Garrigos, 2007; Hervas-Oliver et al., 2009). This could be explained as the lower transaction costs may liberate additional resources for research and development (R&D) investment, for example. Also, the acquisition and sharing of tacit knowledge from competitors, local suppliers, and other local institutions, facilitated for the geographical proximity, may improve the innovation results of all involved firms (Porter, 1990; Caniels & Romijn, 2003). Nonetheless, as suggested by Li & Geng (2012), the quantitative evidence in previous studies is not yet conclusive, some scholars suggest the necessity of further empirical research to strengthening the understanding of the correlation between cluster capabilities and a firm's innovation performance.

Nevertheless, the advantages of clusters are not equally exploited by the companies. Different levels of firm capabilities may produce a significant difference in the degree of advantages that firms assimilate from the cluster's shared resources (Hervas-Oliver et al., 2009). Therefore, it may be expected that firms with higher levels of firm capabilities should be more capable of taking advantage of the cluster's benefits that may be available in their local areas.

Finally, innovation networks in developing countries are normally not highly developed due to the presence of weak linkages among local companies and local supporting institutions (Bell & Albu, 1999; Giuliani & Bell, 2005; Dantas & Bell, 2009; Figueiredo, 2010; Yoruk, 2011). In fact, clusters in countries from Latin America may be profoundly different to clusters in developed countries, such as Italy, France, and Spain. Indeed, some academics seem to share a kind of pessimistic evaluation about Latin American clusters, due to observed limitations such as: a) non-homogenous base skills and capacities with different levels of success in international market integration; b) lack of specialization; c) lack of trust and cooperation; and d) low dynamics on innovation

(Altenburg & Meyer-Stamer, 1999; Albaladejo, 2001). Therefore, for the Latin American coffee growers considered in this research, it may be considered as an issue of interest to test the net effect of the relationship between technological capabilities and local conditions.

4.2.2. Clusters and Firm Capabilities

There is abundant evidence in the literature about the positive relationship between knowledge spillovers (and other cluster and local conditions) and firm capabilities (Frost, 2001; Gilbert, McDougall & Audretsch, 2008; Ianmarino et al., 2012). Indeed, technological capabilities improves within clusters due to the environment of more intensive local linkages among companies and other institutions embedded within that cluster (Riain, 2006; Ciravegna, 2011).

Geographical proximity encourages knowledge sharing and improvements in technological capabilities (Primo & DuBois, 2012). For instance, in their study about textile-based companies located in export processing zone in Mauritius, Peerally & Cantwell (2011) identifies a positive impact of local linkages with suppliers on their level of innovative technological capabilities in local firms and global subsidiaries in that country.

Also, technological capabilities are positively correlated to the formation of innovation networks (Wu, Gu & Zhang, 2008). Local linkages with research and other supporting institutions are also important for technological capability building (Ianmarino et al., 2012).

Clusters externalities are important for technological capability building and innovation (Camison & Villar-Lopez, 2012; Wang & Zhou, 2013). Silvestre & Dalcol (2010) suggest a positive relationship between technological capabilities, geographical proximity, local interactions and innovation results of firms located within clusters. Nonetheless,

previous studies suggest that cluster externalities are harder to be assimilated by local companies if they lack of a high level of technological capabilities (Sajarattanochote & Poon, 2009).

4.2.3. Conceptual Framework

This second part of the conceptual framework, explores the potential relationship between local linkages and firm capabilities. In this sense, three categories of local linkages are tested: local horizontal links with competitors, local horizontal links with supporting institutions and local vertical links with suppliers and buyers.

It is expected that local horizontal links with supporting institutions and local vertical link with suppliers and buyers are more important to explain the correlation between local linkages and firm capabilities, whilst local horizontal links with competitors may be much less relevant in this relationship (see Figure 3).

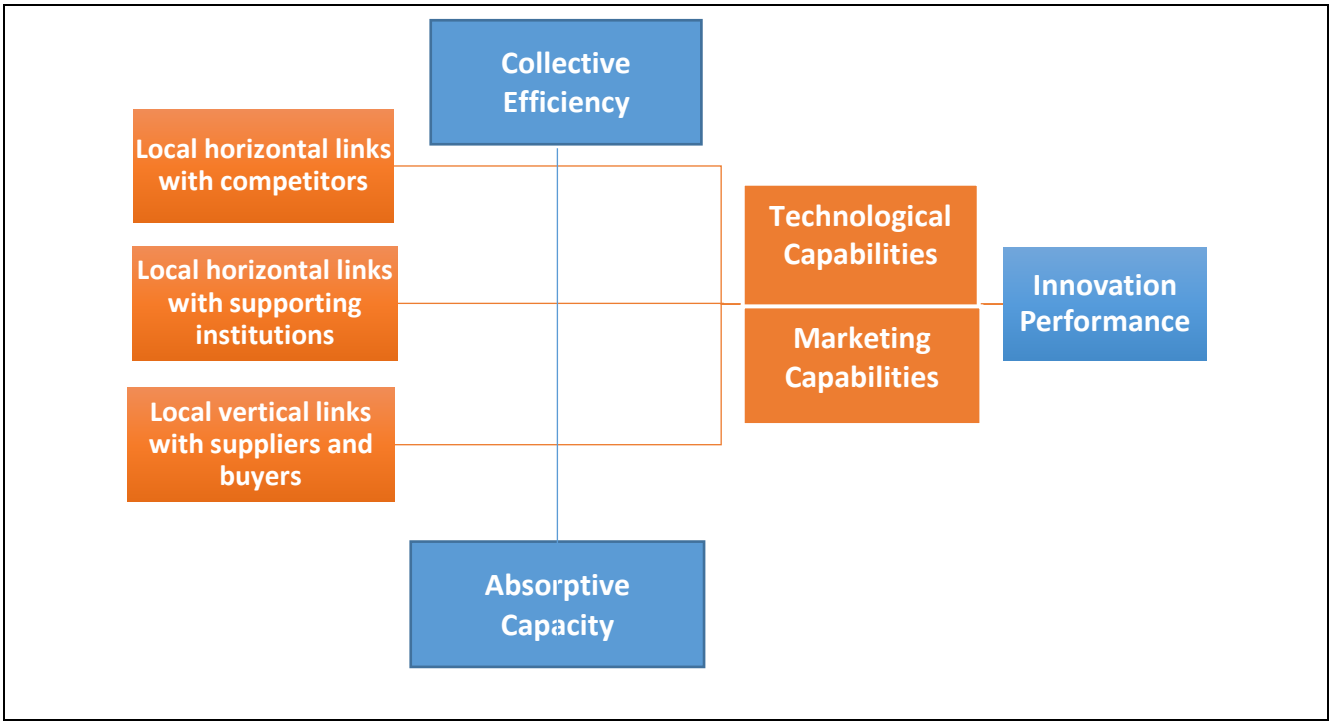


Figure 3. Local Linkages and Firm Capabilities

In this relationship among local linkages and firm capabilities, a potential moderating effect of two variables are expected. Firstly, the impact of cluster externalities, in particular the collective efficiency (Schmitz, 1995), may be a potential moderator that should be evaluated. Secondly, other internal to the firm conditions, such as in the case of absorptive capacity (Cohen & Levinthal, 1990; Zahra & George, 2002), is expected. In this sense, a higher degree of collective efficiency or absorptive capacity may increase the positive correlation expected between local linkages and firm capabilities (see Figure 3).

4.2.4. Research Hypotheses

There is plenty evidence in the literature about the positive relationship between knowledge spillovers in clusters and technological capabilities (Frost, 2001; Gilbert, McDougall & Audretsch, 2008). In fact, within clusters, knowledge and information can be transmitted in a more efficient way among companies embedded due to the personal interactions facilitated by their geographical and cultural proximity (Breschi & Malerba, 2007). Technological capabilities improves within clusters due to the environment of more intensive local linkages among companies and other institutions embedded within that cluster (Lee, Lee & Pennings, 2001; Riain, 2006; Ciravegna, 2011; Ianmarino et al., 2012). Therefore, the following two hypotheses are proposed:

- **Hypothesis 2.1a:** There is a positive relationship between local linkages and technological capabilities.
- **Hypothesis 2.1b:** There is a positive relationship between local linkages and marketing capabilities.

According to Hervas-Oliver & Albors-Garrigos (2008), firm capabilities and external linkages are both important conditions for a better firm performance, and this is confirmed by previous studies (e.g. Maskell & Malmberg, 1999; Lee et al., 2001; Giuliani, 2007). Similarly, more recent studies have found a positive simultaneous influence among technological capabilities, local linkages with buyers and product innovation performance at the firm level (Hsu et al., 2008).

Indeed, vertical linkages with local suppliers and local buyers play an important role in the process of capability building for firms located within clusters (Cooke & Ehret, 2009; Brown, McNaughton & Bell, 2010). Moreover, local linkages with research institutions and other supporting organizations are also important for the building of technological capabilities among companies embedded in clusters (Ianmarino et al., 2012).

In the specific case of the coffee sector, there are two situations that may be worthy to mention. On the one hand, governmental supporting institutions and NGOs offer free technical and marketing assistance to coffee producers in order to increase their capabilities in agricultural production and commercialization. On the other hand, there may be an interest of local suppliers to sell their more sophisticated products to the coffee producers, as well as the intentions of the buyers to improve the producer's capacities to achieve better and more profitable coffee products (González, 1998; Giuliani, Pietrobelli, & Rabellotti, 2005). Exploring these potential situations in the Latin American coffee sector, two additional hypotheses are proposed:

- **Hypothesis 2.2a:** Local horizontal links with supporting institutions and Local vertical links with suppliers and buyers are both significant factors in regard to the correlations between local linkages and technological capabilities.

- **Hypothesis 2.2b:** Local horizontal links with supporting institutions and Local vertical links with suppliers and buyers are both significant factors in regard to the correlations between local linkages and marketing capabilities.

Horizontal linkages with competitors may enhance firm's cooperation that allows to take advantage of certain economies of scale, such as joint production and acquisition of specialized services, among other joint activities (Humphrey, 2005; Pietrobelli, 2007). However, although in the literature, it is suggested that external sources, such as the competitors, could be a positive influence for firm competitiveness (St. John & Pouder, 2006; Baark et al., 2011). In fact, the horizontal linkages with competitors may not be as relevant for enhancing firm's innovation performance and technological capabilities as rivalry and lack of trust may be a strong obstacle for mutual cooperation among local agricultural farms (Iammarino et al., 2012). For that reason, it is expected that linkages with other local coffee farmers may not be much relevant in the relationship between local links and firm capabilities. The next hypothesis is presented:

- **Hypothesis 2.3:** Local horizontal links with competitors are not a significant factor in the correlations between local linkages and firm capabilities.

Absorptive capacity (ACAP) is "the ability of a firm to recognize the value of new external information, assimilate it and apply it to commercial ends" (Cohen & Levinthal, 1990, p.128). In other words, ACAP is the company's ability to assimilate external knowledge for its own benefit. Indeed, a high level of absorptive capacity (ACAP) is likely to facilitate the effective transfer of external knowledge from the local environment (business

cluster) into the firm (Cohen & Levinthal, 1990; Zahra & George, 2002; Hervas Oliver, Albors & De Miguel Molina, 2009).

Previous studies have intended to demonstrate a potential moderating effect of ACAP on the relationship between external linkages and innovation performance; nevertheless, this task has probed to be a difficult endeavor. For instance, Shu et al., 2005 only finds partial evidence of a positive influence of a high level of ACAP over the positive relationship between external linkages (with R&D institutions) and product innovation, although not a formal moderating effect. In the same way, Terstriep & Luthje (2009) could not find a statistical moderating effect of ACAP on the relationship between clusters effects and innovation results.

Zahra & George (2002) suggest that ACAP is “a dynamic capability that influences the creation of other organizational competencies” (p. 186), in other words ACAP is the firm’s ability to create other firm capabilities as a consequence of learning from external sources. According to this, it is likely to be present a moderating effect of ACAP on the relationship between local external linkages and capability building, although the statistical demonstration of this moderating effect could be as difficult to detect as the one for innovation performance previously mentioned.

Understanding the difficulties and limitations for detecting and measuring the moderating effect, the present doctoral research is intended to test the potential ACAP’s moderating effect on the relationship between local external linkages and capability building, as theoretically it may be considered as likely to happen. Therefore, a new hypothesis is presented below:

- **Hypothesis 2.4:** Absorptive capacity moderates the relationship between local links and firm capabilities.

High levels of collective efficiency within a business cluster should be a positive local environment that favors the competitive advantage of embedded firms (Schmitz, 1995). This competitive advantage may include better business results in areas such as a higher degree of capability building and a superior innovation performance (Bell, 2005; Arikan, 2009). However, this cluster's positive effect should not be considered as an automatic procedure, as the firm capabilities plays a role on this assimilation of cluster's advantages (Camison & Villar-Lopez, 2012).

The literature have established a potential positive relationship among local linkages, firm capabilities and collective efficiency. As it may be likely to expect a greater importance of local linkages on capability building within a cluster with a higher level of collective efficiency, the next hypothesis proposes a potential moderating effect of these cluster's effects (or collective efficiency) on the relationship between local external linkages and capability building. Therefore, the last hypothesis is stated as:

- **Hypothesis 2.5:** Collective efficiency moderates the relationship between local links and firm capabilities.

4.3. Methodology

This section shows a brief presentation of the main methodological issues taken in consideration for this research. A more extended and complete explanation of the followed methodology is offered in the Chapter 2 of this thesis.

4.3.1. Target Population and Unit of Analysis

The target population of this research is Latin American coffee farms. The unit of analysis is the owners/managers of these selected coffee farms. Coffee producers of all sizes are considered, although there is a particular interest on small producers, i.e. farmers with a production area of 20 hectares or less.

4.3.2. Sample and Data Collection

The total population of coffee producers in Latin America is unknown but this number most certainly is in the order of the hundreds of thousands. The sample was built with the help of data sources from websites, databases and contact lists of different related organizations. However, the main source of coffee producers for the sample was a survey conducted in the field, applied either through personal interviews or in workshops offered by local supporting institutions. Consequently, this is not a probabilistic sample but a convenience one, which is one of the limitations of this research.

The total number of coffee producers that could be identified to be included in the sample through these sources is estimated in 1,200. The exact number is unknown due to some organizations agreed to share the questionnaire themselves, without revealing the identity or quantity of their members to the author.

The data collection relies on a self-reporting questionnaire. In Costa Rica, the author participated in four workshops in three of the main coffee producing regions: Tarrazú,

Grecia and Atenas. In Guatemala, personal interviews with coffee producers in several important producing areas were conducted. A total of 186 valid responses were obtained for the sample. 95 from Costa Rica, 70 from Guatemala and 21 from other Latin America countries (see Table 45). Most of them are small producers (20 hectares or less) which represents a 58% of the total sample (see Table 46).

Table 45. Coffee Farmers by Country

Country	Frequency	%
Costa Rica	95	51.1
Guatemala	70	37.6
Other Latin American countries	21	11.3
Total	186	100

Table 46. Coffee Farmers by Size

Country	Frequency	%
Up to 5 hectares	51	29.3
6 to 20 hectares	50	28.7
More than 20 hectares	73	42.0
No response	12	-
Total	186	100

4.3.3. Measures

The following are the measures proposed for this study. These measures are based on adaptations of scales found in the literature.

4.3.3.1. Dependent Variable: Technological Capabilities

Technological capabilities are a broad and multi-dimensional latent construct; therefore, its operationalization is a challenging task (Coombs & Bierly, 2006). In the literature, one of the choices for measuring technological capabilities is the implementation of qualitative scales based on manager's perceptions (e.g. Isobe et al., 2008; Shan & Jolly, 2012). Indeed, Shan & Jolly (2012) implement this qualitative approach, using the three categories proposed by Lall (1992) in a multi-item scale in their quantitative research about tech-

based companies in China. In the present research, technological capabilities are measure as an index variable composed by three sub-index multi-item variables (self-reporting 5-point Likert scales) in the three categories proposed by Lall (1992), following an adaptation of the multi-item scale implemented by Shan & Jolly (2012).

4.3.3.2. Dependent Variable: Marketing Capabilities

In this research, marketing capabilities are measured, following Vorhies, Morgan & Autry (2009), through a simplified scale. This simplified scale is applied in order to avoid a too long questionnaire, as this could represent a serious problem for a self-reported survey. The simplified scale incorporates eleven 5-point Likert-scale items, adapted from the categories suggested by Vorhies & Morgan (2005) and Eng & Spicket-Jones (2009).

4.3.3.3. Local Linkages for Innovation Purposes

Similarly as other previous studies (e.g. Flor & Oltra, 2005), the importance of several types of local linkages for the coffee farms is measured through the use of a qualitative Likert scale applied in a questionnaire, and distributed among the coffee producers selected in the sample. The relevant local (or regional) horizontal and vertical linkages for innovation with other companies and institutions are introduced. The specific categories adapted in this research combine local competitors (other local coffee producers), local suppliers, local buyers (or customers), local research and academic institutions, local financial institutions and other local institutions.

4.3.3.4. Absorptive Capacity

Absorptive capacity is the firm's ability to identify, incorporate, and exploit new external knowledge for commercial purposes (Cohen & Levinthal, 1990; Zahra & George, 2002; Flatten, Greve & Brettel, 2011). As previously presented in Chapter 2, the items considered to measure absorptive capacity in this research are centered on variables

related to the quality of the human resources (only considering permanent staff). These items are: a) human resources are equipped with excellent professional/technical skills; b) human resources can acquire quickly and thoroughly new knowledge required by their duties; c) human resources has better working skills than the staff of your competitors; d) human resources Has higher educational qualifications than the staff of your competitors; e) human resources has the ability to use and organize the acquired knowledge.

4.3.3.5. Collective Efficiency

Schmitz (1995, 1997, 2004) defines collective efficiency as the conjunction of the cluster's externalities (external economies) that may be present in a region, and the joint actions performed by a group of companies. The specific items used to measure collective efficiency in this research are also shown in Chapter 2.

4.3.4. Econometric Models

The next table presents a brief description of the econometric models proposed for the second part of this research, where technological capabilities and marketing capabilities are being proposed as dependent variables, whilst local linkages are included as the main independent variables (see Table 47). Other potential moderating variables, absorptive capacity and collective efficiency, are also included in the models to examine the influence of that inclusion in the general results of these models.

Table 47. Proposed Models for the Regression Analysis

Independent Variables:	Dependent Variables: Firm Capabilities		
	Model 1	Model 2	Model 3
Control Variables			
Country of Origin	X	X	X
Small Size	X	X	X
Main Independent Variables			
Local Horizontal Links with Competitors		X	X
Local Horizontal Links with Supporting Institutions		X	X
Local Vertical Links with Suppliers and Buyers		X	X
Moderating Variables			
Absorptive Capacity			X
Collective Efficiency			X

The specifications for the proposed econometric models to be estimated are presented as follows:

Techcap = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \varepsilon$

Techcap =

$\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4Localcomp + \beta 5Localhor + \beta 6Localver + \varepsilon$

Techcap =

$\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4Localcomp + \beta 5Localhor + \beta 6Localver +$

$\beta 7Acap + \beta 8CollE + \varepsilon$

Markcap = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \varepsilon$

Markcap =

$\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4Localcomp + \beta 5Localhor + \beta 6Localver + \varepsilon$

Markcap =

$\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4Localcomp + \beta 5Localhor + \beta 6Localver +$

$\beta 7Acap + \beta 8CollE + \varepsilon$

Where:

Techcap: Technological capabilities

Markcap: Marketing capabilities

dcr: Dummy variable for coffee producer from Costa Rica

dgu: Dummy variable for coffee producer from Guatemala

dsmall: Dummy variable for small coffee producer (20 hectares or less)

Localcomp: Local horizontal links with competitors for innovation

Localhor: Local horizontal links with supporting institutions for innovation

Localver: Local vertical links with suppliers and buyers for innovation

Acap: Absorptive Capacity

CollE: Collective Efficiency

In order to perform regression analysis, this research proposes a classification of dependent and independent variables. Nevertheless, this study cannot assume a causality relationship among these variables, as the use of instrumental variables was not considered achievable. Consequently, the presented results need to be interpreted just as correlations and not as cause-effect relationships.

4.3.5. Control Variables

Two control variables are proposed for this study, country of origin and small size. This follows previous studies where size is a significant variable that explains technological capabilities (Ianmarino et al., 2008).These two control variables are included in the models as dummy variables.

a. Country of origin (dcr, dgu): This variable is incorporated through dummy variables that values “1” for coffee farmers from the respective country: Costa Rica (dcr) or Guatemala (dgu). It values “0” for farmers from other countries.
b. Small producers (dsmall): This is a dummy variable that values “1” for coffee farmers with a production area of 20 hectares or less. It values “0” for farmers with a production area that is larger than 20 hectares.

4.3.6. Validity and Reliability

In this research, the measurement validity and construct validity relies in the use of adaptations of scales and constructs used in previous studies (Carmines & Zeller, 1979, Garson, 2013). Moreover, face validity was tested, as all the constructs and items were checked with the valuable help of industry experts in the field and coffee producers through personal and electronic interviews. As a consequence of these revisions, some changes and adjustments were incorporated to the final version of the questionnaire applied in the survey.

The Cronbach’s alpha test is a common procedure for evaluating reliability in any data (Bryman, 2001). The Cronbach’s alphas results show a good internal consistency reliability for the multi-item constructs used in this research, as all Cronbach’s alphas are higher than the critical value of 0.8.

4.3.7. Data Transformations and Standardisation

The data set obtained through the survey was reviewed and adjusted in order to make it compatible with standard econometric software. Therefore, the responses were transformed to numeric values using a standardized scale. For the questions using Likert scales, the values were transformed from 1 to 5.

All missed values were replaced by 0, although for all calculation and estimation, the 0 values were ignored. The numeric transformations were performed twice in order to spot potential mistakes in the conversion process. No mistakes in the data were identified.

4.4. Data Analysis

Using the standardized data set obtained from the sample, an econometrical data analysis is conducted with the assistance of a specialized software package: STATA IC 13. This section is referred to the results obtained through this data analysis.

4.4.1. Descriptive Statistics and Correlations

This section shows the descriptive statistics and correlations for the variables selected in this study. The descriptive statistics are defined for variables that have been built through a 5-point Likert scales, therefore their minimum value is 1, whilst their maximum is 5, with a neutral/medium point at 3.

The next table shows the values for the variables technological capabilities, marketing capabilities and three categories of local linkages: local horizontal links with competitors, local horizontal links with supporting institutions and local vertical links with suppliers and buyers (see Table 48). As shown in Table 48, the coffee producers included in the sample have an average for technological capabilities and marketing capabilities which is below the neutral value (less than 3). However, the average values for the importance of local linkages for innovation purposes is higher than the neutral value (higher than 3).

Table 48. Descriptive Statistics

Variables		All Countries	Costa Rica	Guatemala	Others
Technological Capabilities	Mean	2.94	2.87	3.02	2.92
	Std. Dev.	0.75	0.88	0.57	0.62
	Obs.	182	93	70	19
Marketing Capabilities	Mean	2.93	2.80	3.06	3.06
	Std. Dev.	0.89	1.00	0.81	0.58
	Obs.	177	86	70	21
Local Horizontal Links with Competitors	Mean	3.70	3.61	3.79	3.71
	Std. Dev.	0.96	1.09	0.80	0.99
	Obs.	157	72	68	17
Local Horizontal Links with Supporting Institutions	Mean	3.17	3.34	3.07	2.81
	Std. Dev.	1.02	1.10	0.80	1.28
	Obs.	155	73	64	18
Local Vertical Links with Suppliers and Buyers	Mean	3.36	3.41	3.35	3.22
	Std. Dev.	1.05	1.16	0.95	0.96
	Obs.	160	75	67	18

Note: All variables has a value range between 1 and 5

The correlations among the main variables are calculated in Table 49. According to these results, technological capabilities and marketing capabilities seems to be highly positively correlated. A similar situation is found in the positive correlation between local horizontal links and the other types of local linkages: local horizontal links with supporting institutions and local vertical links with suppliers and buyers.

Table 49. Correlations

	Variables	1	2	3	4	5	6
1	Technological Capabilities	1.0000					
2	Marketing Capabilities	0.6509	1.0000				
3	Absorptive Capacity	0.4620	0.4418	1.0000			
4	Local H. Links with Competitors	0.3954	0.1610	0.1856	1.0000		
5	Local H. Links with Sup. Institutions	0.5027	0.2853	0.3177	0.5202	1.0000	
6	Local V. Links with Suppliers and Buyers	0.4937	0.3121	0.2619	0.6094	0.3960	1.0000

4.4.2. Regression Analysis

Regression analysis is conducted to test the relationship between local linkages and firm capabilities. Although a classification of independent and dependent variables is being considered in the models, this research has no elements to suggest causality on these

variables. Therefore, the regression results should be interpreted just as correlations and not necessarily as a cause-effect relationship.

As mentioned before, a selection of control variables are incorporated in these quantitative evaluations. These control variables are related to country of origin (Costa Rica, Guatemala and others) and being a small producers (<20 hectares).

4.4.2.1. Technological Capabilities and Local Linkages

This first set of models explores the potential influence of local linkages on the degree of technological capabilities in these coffee farms. The data suggests a positive relationship between technological capabilities (index) and local linkages (see Table 50, model 2). Nonetheless, this positive correlation is of a lower magnitude in the case of small producers (see Table 50, model 1, 2 and 3).

Table 50. Model Set 2.1. Linear OLS (robust) Regressions: Technological Capabilities and Local Linkages

Independent Variables:	Dependent Variable: Technological Capabilities		
	Model 1	Model 2	Model 3
Control Variables			
Country of Origin: Costa Rica	0.219	0.110	0.170
Country of Origin: Guatemala	0.139	0.114	0.131
Size: Small Producer	-0.367***	-0.289*	-0.254*
Main Independent Variables			
Local Horizontal Links with Competitors		0.129	0.102
Local Horizontal Links with Supporting Institutions		0.181**	0.124
Local Vertical Links with Suppliers and Buyers		0.128	0.125
Moderating Variables			
Absorptive Capacity			0.191**
Collective Efficiency			0.0664
Constant	2.986***	1.533***	0.935**
N	170	140	126
R-sq	0.0477	0.3320	0.4503
AIC	378.1082	254.5246	194.1373
BIC	390.6514	275.1161	219.6639

*p<0.05, **p<0.01, ***p<0.001

Considering the evaluation of the relative importance of local links in their relationship with technological capabilities, it can be proposed that local horizontal links with supporting institutions and local vertical links with supplier and buyers are both highly important factors (see Table 51, model 2 and 3).

Table 51. General Dominance Analysis (Standardized Weights and Rankings): Technological Capabilities and Local Linkages

Independent Variables:	Dependent Variable: Technological Capabilities		
	Model 1	Model 2	Model 3
Control Variables			
Country of Origin: Costa Rica	0.0814 (2)	0.0127 (6)	0.0102 (7)
Country of Origin: Guatemala	0.0598 (3)	0.0144 (5)	0.0085 (8)
Size: Small Producer	0.8588 (1)	0.1040 (4)	0.0725 (6)
Main Independent Variables			
Local Horizontal Links with Competitors		0.2119 (3)	0.1341 (5)
Local Horizontal Links with Supporting Institutions		0.3406 (1)	0.2015 (2)
Local Vertical Links with Suppliers and Buyers		0.3164 (2)	0.2406 (1)
Moderating Variables			
Absorptive Capacity			0.1914 (3)
Collective Efficiency			0.1410 (4)
Total	1.0000	1.0000	1.0000

No moderating effects of either absorptive capacity or collective efficiency in the correlations between local linkages and technological capabilities (index and subcategories) could be detected in these evaluations (see Table 52, models 1 to 6).

Table 52. Moderation Test: Technological Capabilities, Local Linkages and Moderating Variables

Independent Variables:	Dependent Variable: Technological Capabilities					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Main Independent Var. (a)						
Local Horizontal Links with Competitors	0.164			-0.177		
Local Horizontal Links with Supporting Institutions		0.0341			0.0968	
Local Vertical Links with Suppliers and Buyers			0.0463			-0.114
Moderating Variables (b)						
Absorptive Capacity	0.261	0.0808	0.0683			
Collective Efficiency				-0.0459	0.153	-0.0569
Interaction Terms (a x b)	0.0164	0.0596	0.0623	0.0957	0.0282	0.0941
Constant	1.301	1.979*	1.890**	2.469***	1.796**	2.371***
N	140	140	144	153	154	157

*p<0.05, **p<0.01, ***p<0.001

4.4.2.2. Marketing Capabilities and Local Linkages

The data shows a positive relationship between marketing capabilities and local links (see Table 53, model 2). Local vertical links with suppliers and buyers is positively correlated with marketing capabilities (see Table 53, model 2).

Table 53. Model Set 2.2. Linear OLS (robust) Regressions: Marketing Capabilities and Local Linkages

Independent Variables:	Dependent Variable: Marketing Capabilities		
	Model 1	Model 2	Model 3
Control Variables			
Country of Origin: Costa Rica	0.0736	-0.135	-0.155
Country of Origin: Guatemala	0.0566	-0.0507	-0.0890
Size: Small Producer	-0.425**	-0.296	-0.218
Independent Variables			
Local Horizontal Links with Competitors		-0.0203	-0.0523
Local Horizontal Links with Supporting Institutions		0.0427	-0.0316
Local Vertical Links with Suppliers and Buyers		0.293**	0.226*
Moderating Variables			
Absorptive Capacity			0.311**
Collective Efficiency			0.102
Constant	3.113***	2.170***	1.392***
N	165	136	123
R-sq	0.0537	0.1785	0.3036
AIC	423.4868	334.3371	270.8072
BIC	435.9106	354.7257	296.1168

*p<0.05, **p<0.01, ***p<0.001

This positive correlation is increased when absorptive capacity is included in the model (see Table 53, model 3).

Table 54. General Dominance Analysis (Standardized Weights and Rankings): Marketing Capabilities and Local Linkages

Independent Variables:	Dependent Variable: Marketing Capabilities		
	Model 1	Model 2	Model 3
Control Variables			
Country of Origin: Costa Rica	0.0921 (2)	0.0339 (5)	0.0214 (7)
Country of Origin: Guatemala	0.0534 (3)	0.0130 (6)	0.0073 (8)
Size: Small Producer	0.8545 (1)	0.2026 (2)	0.0999 (4)
Independent Variables			
Local Horizontal Links with Competitors		0.0762 (4)	0.0360 (6)
Local Horizontal Links with Supporting Institutions		0.1618 (3)	0.0465 (5)
Local Vertical Links with Suppliers and Buyers		0.5124 (1)	0.2495 (2)
Moderating Variables			
Absorptive Capacity			0.4210 (1)
Collective Efficiency			0.1184 (3)
Total	1.0000	1.0000	1.0000

Similarly as in the case of technological capabilities, in this research there is no statistical evidence of a moderating effect of absorptive capacity and collective efficiency in the relationship between marketing capabilities and local linkages (see Table 55, models 1 to 6).

Table 55. Moderation Test: Marketing Capabilities, Local Linkages and Moderating Variables

Independent Variables:	Dependent Variable: Marketing Capabilities					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Main Independent Var. (a)						
Local Horizontal Links with Competitors	-0.0588			-0.268		
Local Horizontal Links with Supporting Institutions		-0.355			-0.331	
Local Vertical Links with Suppliers and Buyers			0.00986			-0.115
Moderating Variables (b)						
Absorptive Capacity	0.290	0.0268	0.229			
Collective Efficiency				0.00499	-0.105	-0.116
Interaction Terms (a x b)	0.0491	0.128	0.0530	0.0913	0.120	0.0981
Constant	1.664*	2.683**	1.616**	2.729**	3.012***	2.571**
N	137	137	141	149	149	153

*p<0.05, **p<0.01, ***p<0.001

4.5. Results

The following section presents the results obtained in the data analysis. These results are presented following the order of the seven hypotheses that have been proposed at the beginning of this document (section 4.2.6).

- **Hypothesis 2.1a:** There is a positive relationship between local linkages and technological capabilities.

This hypothesis 2.1a can be accepted, as the coefficients of the independent variables for the three types of local linkages considered in this research: local horizontal links with competitors, local horizontal links with supporting institutions and local vertical links with suppliers and buyers, are all positive (see Table 56). Nevertheless, as these three types of local linkages are highly and mutually correlated, only one of the coefficients seems to be significant in the tested model (see Table 56).

Hypothesis 2.1b: There is a positive relationship between local linkages and marketing capabilities.

The hypothesis 2.1b can be accepted in the cases of two types of local linkages: local horizontal links with supporting institutions and local vertical links with suppliers and buyers, as their coefficients are positive (see Table 56). However, the coefficient for the local horizontal links with competitors is negative, although is not significant in the model for the same reason previously explained (see Table 56).

Table 56. Results of Regression Analysis (OLS): Firm Capabilities and Local Linkages

Independent Variables:	Dependent Variables:	
	Technological Capabilities	Marketing Capabilities
Control Variables		
Country of Origin: Costa Rica	0.110	-0.135
Country of Origin: Guatemala	0.114	-0.0507
Size: Small Producer	-0.289*	-0.296
Independent Variables		
Local Horizontal Links with Competitors	0.129	-0.0203
Local Horizontal Links with Supporting Institutions	0.181**	0.0427
Local Vertical Links with Suppliers and Buyers	0.128	0.293**
Constant	1.533***	2.170***
N	140	136
R-sq	0.3320	0.1785
AIC	254.5246	334.3371
BIC	275.1161	354.7257

*p<0.05, **p<0.01, ***p<0.001

- **Hypothesis 2.2a:** Local horizontal links with supporting institutions and Local vertical links with suppliers and buyers are both highly important factors in regard to the correlations between local linkages and technological capabilities.

  The hypothesis 2.2a is accepted. As shown in Table 57, the relative importance of Local horizontal links with supporting institutions and Local vertical links with suppliers and buyers are quite similar in the model for technological capabilities (34% and 31.6%, respectively).

- **Hypothesis 2.2b:** Local horizontal links with supporting institutions and Local vertical links with suppliers and buyers are both highly important factors in regard to the correlations between local linkages and marketing capabilities.

  The hypothesis 2.2b has to be rejected, as the relative importance of Local horizontal links with supporting institutions and Local vertical links with suppliers and buyers greatly differs in the model explaining marketing capabilities (16% and 51%, respectively).

- **Hypothesis 2.3:** Local horizontal links with competitors are not much relevant in the correlations between local linkages and firm capabilities.

The hypothesis 2.3 is accepted, as the relative importance of linkages with local competitors are lower than the ones for other types of local linkages, in regard to the models explaining technological capabilities and marketing capabilities (see Table 57).

Table 57. Results of Relative Importance: Local Linkages, Firm Capabilities and Other Variables

Independent Variables:	Dependent Variables:	
	Technological Capabilities	Marketing Capabilities
Control Variables	0.1311 (4)	0.2496 (2)
Local Horizontal Links with Competitors	0.2119 (3)	0.0762 (4)
Local Horizontal Links with Supporting Institutions	0.3406 (1)	0.1618 (3)
Local Vertical Links with Suppliers and Buyers	0.3164 (2)	0.5124 (1)
Total	1.0000	1.0000

- **Hypothesis 2.4:** Absorptive capacity moderates the relationship between local links and firm capabilities.

The hypothesis 2.4 cannot be accepted, as the proposed moderating effect for the variable absorptive capacity cannot be statistically detected (see Tables 58 and 59).

Table 58. Results of Moderation Test: Technological Capabilities (Index), Local Linkages and Moderating Variables

Independent Variables:	Dependent Variable: Technological Capabilities					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Main Independent Var. (a)						
Local Horizontal Links with Competitors	0.164			-0.177		
Local Horizontal Links with Supporting Institutions		0.0341			0.0968	
Local Vertical Links with Suppliers and Buyers			0.0463			-0.114
Moderating Variables (b)						
Absorptive Capacity	0.261	0.0808	0.0683			
Collective Efficiency				-0.0459	0.153	-0.0569
Interaction Terms (a x b)	0.0164	0.0596	0.0623	0.0957	0.0282	0.0941
Constant	1.301	1.979*	1.890**	2.469***	1.796**	2.371***
N	140	140	144	153	154	157

*p<0.05, **p<0.01, ***p<0.001

- **Hypothesis 2.5:** Collective efficiency moderates the relationship between local links and firm capabilities.

Similarly to the previous case, this last hypothesis 2.5 cannot be accepted either, as the moderating effect for the variable collective efficiency cannot be statistically detected (see Tables 58 and 59).

Table 59. Results of Moderation Test: Marketing Capabilities, Local Linkages and Moderating Variables

Independent Variables:	Dependent Variable: Marketing Capabilities					
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Main Independent Var. (a)						
Local Horizontal Links with Competitors	-0.0588			-0.268		
Local Horizontal Links with Supporting Institutions		-0.355			-0.331	
Local Vertical Links with Suppliers and Buyers			0.00986			-0.115
Moderating Variables (b)						
Absorptive Capacity	0.290	0.0268	0.229			
Collective Efficiency				0.00499	-0.105	-0.116
Interaction Terms (a x b)	0.0491	0.128	0.0530	0.0913	0.120	0.0981
Constant	1.664*	2.683**	1.616**	2.729**	3.012***	2.571**
N	137	137	141	149	149	153

*p<0.05, **p<0.01, ***p<0.001

4.6. Discussion

The positive relationship between technological capabilities and local environmental conditions have been widely proposed in the literature (Frost, 2001; Gilbert, McDougall & Audretsch, 2008). Local dynamics and interactions among individuals, companies and other organizations embedded in clusters facilitates the sharing of knowledge and information that can be advantageous for capability building and innovation achievements within firms (Lee, Lee & Pennings, 2001; Riain, 2006; Breschi & Malerba, 2007; Ciravegna, 2011).

Local horizontal linkages (with supporting institutions) and local vertical linkages (with suppliers and buyers) have been suggested as significant factors for capability building in previous cluster's studies (e.g. Cooke & Ehret, 2009; Brown, McNaughton & Bell, 2010). Nonetheless, although some types of local linkages may be influential, they are not equally useful for capability building purposes within companies. Moreover, according to the specific local linkage that may be evaluated, the relative importance of a particular firm capability can vary. In fact, the quantitative evidence obtained from these Latin American coffee farmers seems to suggest that local horizontal linkages with supporting institutions are more closely and positively related to technological capabilities, whilst local vertical linkages with suppliers and buyers are more directed related to marketing capabilities.

Moreover, the political influence of a few traditional agricultural activities, such as the agricultural coffee production, may explain the high degree of involvement by most Latin American governments with respect to supporting, fomenting and regulating the local coffee industry, particularly at the farm level. This governmental support normally is

focused on the small and medium producers (SMEs) (González, 1998). Under this scheme of high governmental support, the local supporting institutions try to help SME producers in a large number of business activities, with a particular emphasis on production, but also in marketing and distribution. Interestingly, the producers seem to appreciate more the assistance received from these supporting institutions in terms of their technological capabilities, but they concede them much less importance in regard to their role on marketing capability building, even though they receive abundantly help in both areas, technology and marketing, from the governmental and other local supporting institutions.

In cluster research, some advantages of the horizontal linkages with competitors have been identified (Humphrey, 2005; Pietrobelli, 2007). Cooperation linkages with competitors may improve the competitiveness and business results of all participants through the exploitation of some economies of scale (St. John & Pouder, 2006; Baark et al., 2011). Nonetheless, as expected, this ideal situation seems not to be truth in the case of these coffee producers. Indeed, horizontal linkages with competitors do not have a high relative importance for firm's capability building in these coffee farmers. As proposed by Iammarino (et al., 2012), rivalry and lack of trust may explain this behaviour among coffee producers and as this could be an obstacle for mutual cooperation and improvements.

According to the literature, absorptive capacity (ACAP) may enhance the assimilation of external knowledge from the local cluster to the companies (Cohen & Levinthal, 1990; Zahra & George, 2002; Hervas Oliver, Albors & De Miguel Molina, 2009). Similarly, cluster research suggests that the presence of collective efficiency could help the building of firm capabilities in companies located within clusters (Schmitz, 1995; Diaz-Perez et al., 2011; Bessant et al., 2012).

Nevertheless, the potential moderating effects that are expected, according to the literature, for absorptive capacity and collective efficiency on the relationship between local linkages and firm capabilities, are not statistically detected in this research. This statistical fact do not necessarily means that there is no moderating effect on these proposed variables. Indeed, the obtained non-significant result may be explained due, for instance, to the relatively small size of the sample. In any case, this research results cannot demonstrate that there is a moderation effects among these variables.

Geography, Linkages and Capabilities: Innovation in the Agricultural Coffee Production in Latin America

Chapter 5. Localisation versus Globalisation: External Linkages for Capability Building in the Latin America's Coffee Production

Abstract: The third and final section of this doctoral research explores the effects of localisation and globalisation strategies through external linkages with respect to capability building. The results suggest a strong and clear positive relationship among local and non-local external linkages and the two types of firm capabilities considered in this research: technological capabilities and marketing capabilities. Nevertheless, extra-cluster linkages seems to be the most influential. These results highlight the importance of global value chains (GVC) and globalisation strategies for capability building even in the case of a highly-clustered productive activities in developing countries, such as the agricultural coffee production in Latin America.

Keywords: Technological capabilities, marketing capabilities, absorptive capacity, resource-based view, product innovation, process innovation, managerial/ organisational innovation, marketing innovation, local linkages, extra-cluster linkages, clusters, global value chains, Latin America, Coffee.

Geography, Linkages and Capabilities: Innovation in the Agricultural Coffee Production in Latin America

Chapter 5. Localisation versus Globalisation: External Linkages for Capability Building in the Latin America's Coffee Production

5.1. Chapter Introduction

This chapter represents the third and final part on a series formed by three closely related studies that, altogether, constitute a doctoral research. The first study (presented in Chapter 3) deals with firm capabilities and their influence on innovation performance. The second study (Chapter 4) incorporates into the analysis the cluster's effects with regard to their potential influence on capability building. Finally, this third study proposes a contribution on the debate on localisation vs. globalisation, as it considers an evaluation of both local (cluster) and non-local (extra-cluster) influences on capability building.

It is structured in six sections. The first section is this brief introduction. The second section presents the literature review and the conceptual framework proposed for this work. Next, the research methodology is explained. The fourth and fifth section presents the data analysis and the results. Finally, the last section discusses the main findings of this research.

This chapter is the third and last part of this doctoral research. It evaluates the reciprocal influences of the firm's internal conditions and a selection of external influences at two geographical contexts, in the case of the agricultural coffee production in Latin America. The research tries an integration of the study of internal conditions and firm capabilities, borrowed from the resource-based view theory (RBV) (Wernerfelt, 1984;

Prahalad & Hamel, 1990; Barney, 1991, 2001), with the local environmental influences proposed by economic geography and industrial cluster research (Krugman, 1991; Porter, 1990) and the extra-cluster impacts proposed by global value chain (GVC) literature (Humphrey & Schmitz, 2002).

The firm's internal conditions considered by this work are two types of firm capabilities: a) technological capabilities and b) marketing capabilities, which arguably are two of the most important firm's internal conditions included in previous evaluations of innovation and business performance (Isobe, Makino & Montgomery, 2008; Eng & Spicket-Jones, 2009; Zawislak et al., 2013). Also, external linkages at two geographical contexts: local (cluster) and non-local (extra-cluster) are incorporated as potential external influences for the firm's capability building and innovation performance, as stated in previous studies (Caniels & Romijn; 2003; Wu, Gu & Zhang, 2008; Su,Tsang & Peng, 2009; Rasiah, Nolintha & Songvilay, 2011).

These external (local and non-local) linkages are evaluated following three categories adapted from previous studies on clusters and networks: a) horizontal linkages with competitors, b) horizontal linkages with supporting institutions, and c) vertical linkages with suppliers and buyers (e.g. Freel, 2000; Shu, Wong & Lee, 2005)

According to the literature, both local linkages and extra-cluster linkages are important elements related to capability building and innovation performance (Pietrobelli, 2007; Primo & DuBois, 2012). This statement is mostly certain in the case of Latin American companies, as these firms normally participate simultaneously in regional business clusters as well as in global value chains (Pietrobelli & Rabellotti, 2004; Giuliani, Pietrobelli & Rabellotti, 2005). Indeed, the agricultural coffee production in Latin America arguably may be considered a clear example of this situation.

The potential mutual relationships among internal capabilities, local environment and extra-cluster influences have been pursued in a few previous quantitative studies (e.g. Ianmarino et al., 2008). Moreover, this relative scarcity of previous research on this topic is more intense in the case of innovation studies performed on agricultural activities in developing countries.

Indeed, the evaluation of the extra-cluster influences into the local cluster dynamics, through the implementation of the global value chain's conceptual framework and exploring the potential interrelations between these two geographical contexts (cluster and extra-cluster contexts) for capability building, are issues of interest in the literature (Bair & Gereffi, 2001; Hervas-Oliver et al., 2008; Fuerst, 2010; Crestanello & Tattara, 2011). In this sense, this research tries to make a contribution to the academic debate about the advantages and conveniences of localisation versus globalisation strategies with respect to the firm's capability building for innovation (Andersen, 2006; Belussi, Samarra & Sedita, 2006; Fuerst, 2010).

Arguably, global value chain research has been mostly focused on governance and upgrading (Sun & Zhang, 2009). Until Morrison, Pietrobelli & Rabellotti (2009), technological capabilities analysis had not been a topic of interest in global value chain research. Even after that, technological capabilities have been scarcely explored in value chain studies, particularly in regard to its three main subcategories: investment capabilities, production capabilities and linkage capabilities (Morrison, Pietrobelli & Rabellotti, 2009).

The pursued examination is applied to the specific case of the agricultural coffee production in Latin America, which may be considered as an interesting case of innovation worthy to be explored for several reasons. Firstly, coffee is an economic activity simultaneously interrelated to a very dynamic local business clusters as well as to a highly

sophisticated global value chain; therefore coffee industry could be considered a good field for testing the relative importance of localisation vs globalisation with respect to firm's innovation performance. Secondly, most of the innovation related to agricultural coffee production are actively promoted by external suppliers and supporting institutions in the local, national or international geographical contexts, although this normally only happens if there is a complete participation of the coffee farmers; thus innovation performance may be not only correlated to the degree of firm capabilities, but also to the ability of the companies to cooperate and to exploit successfully external networks for innovation.

Previous studies on high-technology clusters state the high importance of informal interactions of engineers, technicians and other related people to enhance technological capabilities and innovation on those firms (Saxenian & Hsu, 2001; Ciravegna; 2011). However, it may be considered as interesting to test this hypothesis within a context of an agricultural production activity, such as the coffee production, to demonstrate if these types of social dynamics may promote the same positive results in the case of agricultural farms. Also, the coffee industry has been historically an activity with a high degree of political leverage in Central America and other countries from Latin America (Samper, 1998; Bertrand & Rapidel, 1999; Roseberry & Gudmundson, 2001). This historical political influence may have helped to promote a relatively intense governmental involvement and sectorial regulations within this activity, as well as a generous amount of public subsidies, including high investments in specialized public research and supporting institutions.

5.2. Literature Review

The presented literature review includes the following three aspects: a) the conceptual foundations followed by this chapter, b) a presentation of the main findings from

close-related previous studies, and c) the potential contribution of this research to the literature.

Three main conceptual definitions are applied in this third study: firm capabilities, business clusters and global value chain. The two first conceptual definitions have been already addressed and explained in previous chapters. Nevertheless, a new concept is introduced in this research and it needs to be explained. Global value chain (GVC) can be defined as the international network of business activities distributed among companies that add value to a product (Gereffi et al., 2001).

In the literature, there are two types of GVC: producer-driven GVC, where large producers dominates the value chain through capital intensive, technology; and buyer-driven GVC, where large retailers dominates the value chain through branding and market power, just as in the case of light manufacturing and agribusiness (Gereffi, 1999). Indeed, buyer-driven is the type of GVC that works for most of the coffee negotiated in the international markets.

5.2.1. Business Clusters and Technological Capabilities

The literature suggests a positive relationship between technological capabilities and the externalities caused by regional agglomerations and business clusters (Almeida, 1996; Frost, 2001; Gilbert, McDougall & Audretsch, 2008). According to previous studies, the building of technological capabilities are enhanced in firms located within business clusters in part due to the presence of a collaborative environment where more intensive local interrelations among companies and supporting institutions are promoted (Riain, 2006; Ciravegna, 2011).

Primo & DuBois (2012) state that geographical proximity may encourage knowledge sharing and improvements of technological capabilities in clusters. Also, Peerally &

Cantwell (2011), in their study of textile companies in an export processing zone in Mauritius, identifies a positive impact of local linkages with suppliers on their level of innovative technological capabilities in local firms and global subsidiaries in that country.

Local linkages with national governmental offices, industry associations and other supporting institutions are also important for technological capability building (Ianmarino et al., 2008). However, although clusters externalities may be important for technological capability building (Wang & Zhou, 2013), previous studies suggest that cluster externalities are harder to be assimilated by local companies if they have a low level of technological capabilities (Sajarattanochote & Poon, 2009).

5.2.2. Global Networks and Technological Capabilities

Beyond the local/regional influence of clusters on a firm's capabilities and innovativeness, the literature has identified other external influences that may be crucial to explain firm capabilities and business performance. This includes the external linkages between the firm and other companies and institutions outside the relevant cluster. This is companies and institutions to be found at the national or international level (Bair & Gereffi, 2001; Pietrobelli & Rabelloti, 2004, 2006).

Similarly as in the case of local linkages, extra-cluster linkages are also crucial for companies located within clusters, as they can serve as a channel for new knowledge that may allow to build competitive advantage in these clusters (Giuliani & Bell, 2005; Silvestre & Dalcol, 2009). For instance, Primo & DuBois (2012) find evidence of a positive relationship between the level of technological capabilities in companies located in developing countries and the insertion of these companies in a global value chain.

Linkages with international buyers and suppliers have been identified as an important external influence for a firm's upgrading and innovation performance (Gereffi, 1999; Gereffi et al. 2005). For instance, the Global Value Chain (GVC) theory suggests that the governance characteristics of these chains may determine the upgrading options and resources available for the companies involved in them (Gereffi et al., 2005; Humphrey & Schmitz, 2000, 2001; Schmitz, 2004). In this context, governance may be defined as "the way in which 'lead firms' sought to externalize low profit functions and achieve organizational flexibility" (Gibbon, 2008, p. 37). In other words, governance explains who is in charge within a particular value chain.

According to Morrison, Pietrobelli & Rabellotti (2009), although global value chain literature recognize the importance of internal conditions and technological capabilities for upgrading and innovation, it does not put much emphasis on integrate the firm's internal conditions on their conceptual frameworks. Arguably, the literature on global value chain research is mainly focused on governance and upgrading (Sun & Zhang, 2009). Also, in global value chain stream research, technological capabilities are scarcely explored in regard to its three subcategories: investment capabilities, production capabilities and linkage capabilities (Morrison, Pietrobelli & Rabellotti, 2009).

Primo & DuBois (2012) finds evidence of a positive relationship between the level of technological capabilities in companies located in developing countries and the insertion of these companies in a global value chain. Nonetheless, firms can take advantage of the knowledge provided by other companies that participate in global value chains, only if they possess a certain degree of firm capabilities that may allow them to benefit from that knowledge in order to innovate (Morrison, Pietrobelli & Rabellotti, 2009).

5.2.3. Localisation versus Globalisation: The Simultaneous Influences of Clusters and Global Networks on Capability Building

The literature highlights the growing importance of extra-cluster linkages for companies located within clusters (Gereffi, 1999; Giuliani, Pietrobelli & Rabellotti; 2005). In fact, in cluster research, it is not uncommon to notice that local firms frequently develop interconnections not only with other local companies and organizations, but also with organizations located outside the cluster (Silvestre & Dalcol, 2010).

Clusters and geographical agglomerations of companies are the part of global value chains with the most frequency and intensity of interactions (Sturgeon, 2003; Schmitz, 2004; Pietrobelli & Rabellotti, 2009). Nonetheless, in developing countries, clusters are normally focused on the exploitation of the lowest value-added activities within a global value chain (Chaminade & Vang, 2008).

Technological capabilities are positively related to open innovation and the formation of local and extra-cluster innovation networks (Chesbrough, 2003; Wu, Gu & Zhang, 2008). Moreover, Iammarino et al. (2012) suggests that open innovation conceptual framework reinforces the previous findings in the literature about a positive correlation between technological capabilities and external linkages (Chesbrough, 2003; Laursen & Salter, 2006; Iammarino et al., 2012).

5.2.4. Conceptual Framework

The third and last part of the conceptual framework, explores altogether the potential relationship among external local linkages, extra-cluster linkages and firm capabilities (Figure 4). In this sense, two specific elements are tested. First, quantitative evidence regarding which one of the two types of external linkages (local or extra-cluster linkages) is

more significant for product innovation performance, at least in the case of the coffee sector in Latin America, is explored. Second, it tries to examine the potential relationship between a particular type of external linkages and a particular type of firm capabilities. In other words, it intends to explore what type of external linkages may be more crucial for technological capabilities, and what type may be for marketing capabilities.

Firms in developing countries normally find knowledge from both local and extra-cluster sources. As Li (2011) states, in China, companies can get new technologies from developed countries, but they also look for some other types of technologies from local sources, such as universities, research institutes and other Chinese producers (Liu & White, 2001; Li, 2011).

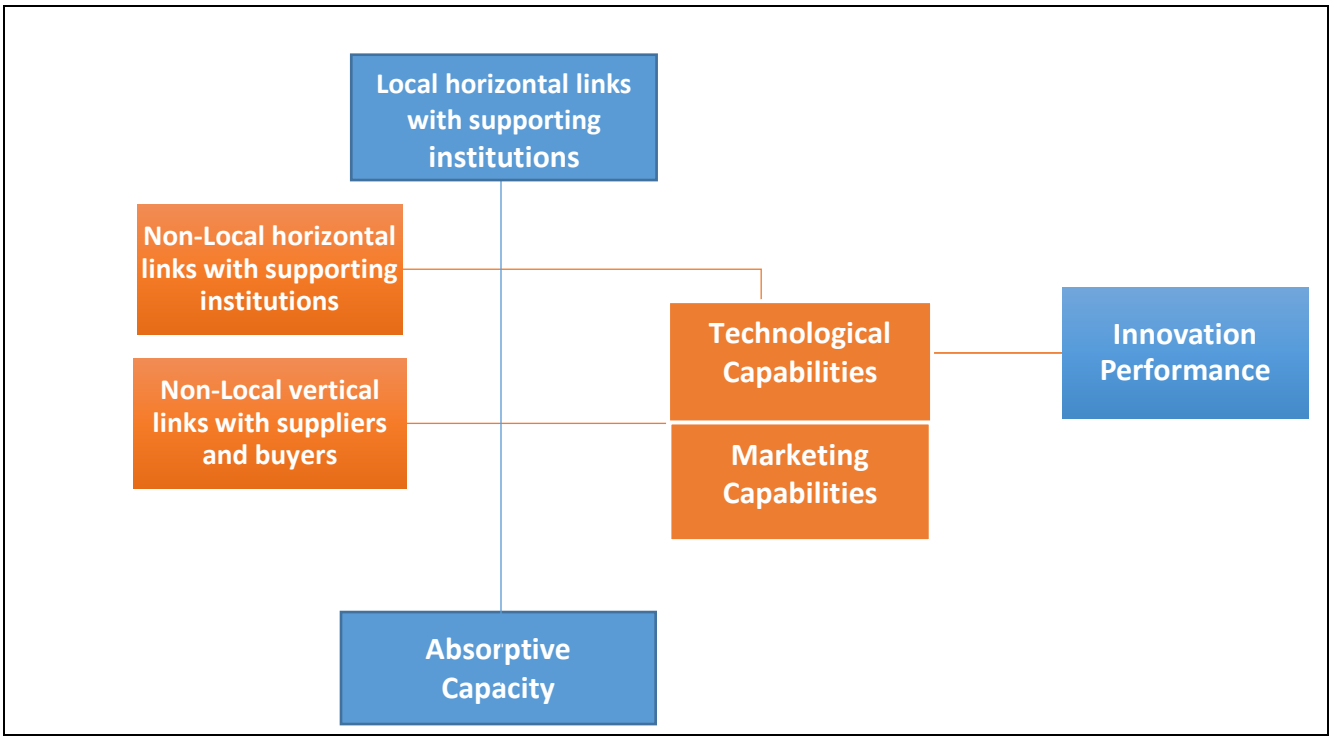


Figure 4. Extra-cluster Linkages and Firm Capabilities

As stated by Wolfe & Getler (2004), successful clusters normally establish strong extra-cluster linkages with other companies (competitors, customers and suppliers) as well as with institutions outside the cluster´s area of influence. Therefore, in this conceptual framework, both local linkages and extra-cluster linkages are considered as potentially crucial in order to explain a firm's capability building.

5.2.5. Research Hypotheses

In the literature, it is well established that environmental factors are influential with respect to technological advance and innovation (Bessant, Kaplinsky & Morris, 2003; Rothaermel & Hess, 2007; Wu, Gu & Zhang, 2008; Su, Tsang & Peng, 2009; Yokakul & Zawdie, 2010). Moreover, it is suggested that technological capabilities are impacted by internal and external factors (Bortagaray, 2007).

Local and extra-cluster linkages potentially are important influences for business performance in Latin American companies as, in this region, firms normally operates in economic activities where the participation on both regional business clusters and global value chains (GVC) are quite relevant and crucial for the competiveness and survival of these companies (Pietrobelli & Rabellotti, 2004; Giuliani, Pietrobelli & Rabellotti, 2005).

Due to the potential positive influences of the coffee's global value chain (Humphrey & Schmitz, 2001, 2002) on the Latin American coffee farmers, it is expected a positive correlation between extra-cluster (non-local) linkages and firm capabilities (Bessant, Kaplinsky & Morris, 2003; Chiarvesio et al., 2010; Ianmarino et al., 2012), therefore the first two hypotheses of this research are proposed as follows:

- **Hypothesis 3.1a:** There is a positive relationship between extra-cluster (non-local) linkages and technological capabilities.

- **Hypothesis 3.1b:** There is a positive relationship between extra-cluster (non-local) linkages and marketing capabilities.

According to the literature, external linkages are expected to be positively correlated with firm capabilities (Humphrey & Schmitz, 2002; Ianmarino et al., 2008; Konsti-Laakso et al., 2012). However, this research is following an adaptation of Humphrey & Schmitz (2002), where selected types of non-local (extra-cluster) linkages are being considered as proxies for quasi-hierarchical and non-hierarchical influences. In this sense, the following classification is proposed:

- **Quasi-hierarchical linkages:** Non-local links with suppliers and buyers are considered as a proxy variable for quasi-hierarchical linkages.
- **Non-hierarchical linkages:** Non-local links with supporting institutions are considered as a proxy variable for non-hierarchical linkages.

Therefore, applying the aforementioned two proxy variables, it is expected a positive influence of quasi-hierarchical linkages on their relationship with technological and production capacities of coffee farmers, but not with respect to their marketing capacities, as suppliers and buyers may not be interested in delegate their commercialization functions within the coffee global value chain (Humphrey & Schmitz, 2002; Pietrobelli, 2007; Pietrobelli & Rabellotti, 2004). On the other hand, governmental supporting institutions at the national level are normally more involved in improving the marketing capacities of farmers, as this is an important measure to increase their profitability in the international markets (Primo & DuBois, 2012). Thus, the two following hypotheses are proposed:

- **Hypothesis 3.2a:** Quasi-hierarchical linkages have the highest relative importance for technological capabilities.
- **Hypothesis 3.2b:** Non-hierarchical linkages have the highest relative importance for marketing capabilities.

A high level of absorptive capacity (ACAP) eases the assimilation of external knowledge into the firm (Cohen & Levinthal, 1990; Zahra & George, 2002). Then, it is expected a positive moderating effect of ACAP in the relationship between extra-cluster linkages and firm capabilities. Therefore, the next hypothesis is stated:

- **Hypothesis 3.3:** Absorptive capacity moderates the relationship between extra-cluster (non-local) linkages and firm capabilities.

Hervas-Oliver et al. (2008) argues that local supporting institutions may have a role to promote innovation in companies located within clusters. However, this is not always the case as the same Hervas-Oliver as well as other authors also propose that some innovative and competitive clusters do not rely much on the advantages of local supporting institutions, but mostly on the advantages of extra-cluster linkages (Meyer-Stamer et al., 2004; Hervas-Oliver et al., 2008). Similarly, Malmberg & Power (2005) proposes that extra-cluster linkages for cooperation and innovation are normally more important than local interactions.

In any case, previous research have also shown that global value chain and cluster dynamics are related to each other and, moreover, they are usually complementary

(Pietrobelli & Rabellotti, 2004, 2006). For that reason, a complementary positive cluster's influence is expected in regard to the correlation between firm capabilities and external linkages (Isaksen, 2009; Li & Geng, 2012; Belussi & Sedita, 2012). Following that previous argument, the influence of the cluster's local supporting institutions may serve as a moderator in the relationship between extra-cluster links and firm capabilities. Therefore, a new hypothesis is suggested:

- **Hypothesis 3.4:** Local horizontal links with supporting institutions moderate the relationship between extra-cluster linkages and firm capabilities.

Previous studies suggest the high relevance of both local and non-local environment conditions for the firm's competitive advantage and business performance (Giuliani, Pietrobelli & Rabellotti, 2005; Pietrobelli, 2007; Oliver, Garrigos & Porta, 2008; Sturgeon et al., 2008; Belussi & Sedita, 2012). There is also evidence in the literature for the relationship between external links and capability building (Ianmarino et al., 2012). Therefore, the purpose of the last two proposed hypotheses is to verify this statement in the case of the coffee farmers in Latin America, assuming that there is a similar relative importance for both types of external linkages (local and non-local) for technological capabilities and marketing capabilities:

- **Hypothesis 3.5:** Local linkages and extra-cluster linkages have a similar relative importance for technological capabilities.
- **Hypothesis 3.6:** Local linkages and extra-cluster linkages have a similar relative importance for marketing capabilities.

5.3. Methodology

This section briefly presents the principal elements of the methodology followed by this study. Nonetheless, in the Chapter 2 of this document, a more complete description is explained.

5.3.1. Target Population and Unit of Analysis

The target population that has been selected for this examination is the Latin American coffee farms. The specific unit of analysis is the owners (or managers) of these agricultural farms. The total population of coffee producers in Latin America is unknown but this number most certainly is in the order of the hundreds of thousands. The majority of this population is composed by small farmers, i.e. farmers with a production area of 20 hectares or less. Accordingly, small farmers are expected to be predominant in the sample.

5.3.2. Sample and Data Collection

The total population of coffee producers in Latin America is not known but it is estimated in hundreds of thousands. This research's sample was identified through data sources from electronic databases from a few public and private institutions. However, the main source for the sample was a survey conducted in the field, applied either through personal interviews or in workshops offered by local supporting institutions. Therefore, this is not a probabilistic sample but a convenience sample, which is one important limitation.

The total number of coffee producers included in the sample may be close to 1,200 people. The exact number is unknown by the author because supporting organizations agreed to share the instrument without revealing the quantity of people reached by them. A self-reporting questionnaire was the instrument established for the data collection. In Costa Rica, the author participated in four workshops in three of the main coffee producing

regions: Tarrazú, Grecia and Atenas. In Guatemala, personal interviews in important producing areas were achieved. A total of 186 valid responses were obtained: 95 from Costa Rica, 70 from Guatemala and 21 from other Latin America countries (see Table 60). Small producers (20 hectares or less) are 58% of the total sample (see Table 61).

Table 60. Coffee Farmers by Country

Country	Frequency	%
Costa Rica	95	51.1
Guatemala	70	37.6
Other Latin American countries	21	11.3
Total	186	100

Table 61. Coffee Farmers by Size

Country	Frequency	%
Up to 5 hectares	51	29.3
6 to 20 hectares	50	28.7
More than 20 hectares	73	42.0
No response	12	-
Total	186	100

5.3.3. Measures

The following are the measures proposed for this study. These measures are based on adaptations of scales found in the literature.

5.3.3.1. Dependent Variable: Technological Capabilities

Technological capabilities are a broad and multi-dimensional latent construct; therefore, its quantification is a challenging task (Coombs & Bierly, 2006). In the literature, technological capabilities can be measured through qualitative scales built on manager's perceptions (e.g. Isobe et al., 2008; Shan & Jolly, 2012). Indeed, Shan & Jolly (2012) implement this qualitative approach, using the three categories proposed by Lall (1992) in a multi-item scale in their quantitative research about tech-based companies in China. In this research, technological capabilities are measured as an index variable composed by three sub-index multi-item variables (self-reporting 5-point Likert scales) in the three categories proposed by Lall, following an adaptation of the multi-item scale implemented by Shan & Jolly (2012). The multi-item construct are explained in Chapter 2.

5.3.3.2. Dependent Variable: Marketing Capabilities

In this research, marketing capabilities are measured, following Vorhies, Morgan & Autry (2009), through a simplified scale. This simplified scale incorporates eleven 5-point Likert-scale items, adapted from the categories suggested by Vorhies & Morgan (2005) and Eng & Spicket-Jones (2009). For more information, see Chapter 2.

5.3.3.3. Cluster (Local) Linkages for Innovation Purposes

Local linkages are measured through a self-reporting 5-point Likert scale applied in a questionnaire distributed among the coffee producers in the sample. The relevant local (or regional) horizontal and vertical linkages for innovation with other companies and institutions are introduced. The specific categories adapted in this research combine local competitors (other local coffee producers), local suppliers, local buyers (or customers),

local research and academic institutions, local financial institutions and other local institutions. More information in Chapter 2.

5.3.3.4. Extra-cluster (Non-local) Linkages for Innovation Purposes

Extra-cluster linkages are evaluated following a self-reporting questionnaire with 5-point Likert-scale questions applied to the coffee growers in the sample. The included categories for these external linkages are the same ones previously established for the local linkages but, obviously, this time only extra-cluster companies and institutions are considered into the evaluations. More information in Chapter 2.

5.3.4. Econometric Models

The third part of this doctoral research considers two sets of regression models. In each of these two sets, technological capabilities and marketing capabilities are considered as the dependent variables, whilst external linkages (local and/or non-local) are incorporated as the independent variables (see Table 62). In addition, two selected control variables, as well as absorptive capacity and local horizontal linkages with supporting institutions (the two proposed potential moderating variables) are also included as other independent variables to evaluate their potential impact on the proposed models (see Table 62).

Table 62. Proposed Econometric Models for the Regression Analysis

Independent Variables:	Dependent Variable: Firm Capabilities		
	Model 1	Model 2	Model 3
Control Variables			
Country of Origin	X	X	X
Size	X	X	X
Main Independent Variables			
Non-Local Horizontal Links with Supporting Institutions		X	X
Non-Local Vertical Links with Suppliers and Buyers		X	X
Moderating Variables			
Absorptive Capacity			X
Local Horizontal Links with Supporting Institutions			X

The specification for the proposed econometric models are presented below:

Techcap = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \varepsilon$

Techcap = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4NonLocalhor + \beta 5NonLocalver + \varepsilon$

Techcap = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4NonLocalhor + \beta 5NonLocalver + \beta 6Acap + \beta 7Localhor + \varepsilon$

Markcap = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \varepsilon$

Markcap = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4NonLocalhor + \beta 5NonLocalver + \varepsilon$

Markcap = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4NonLocalhor + \beta 5NonLocalver + \beta 6Acap + \beta 7Localhor + \varepsilon$

Where:

Techcap: Technological capabilities

Markcap: Marketing capabilities

dcr: Dummy variable for coffee producer from Costa Rica

dgu: Dummy variable for coffee producer from Guatemala

dsmall: Dummy variable for small coffee producer (20 hectares or less)

NonLocalhor: Non-Local horizontal links with supporting institutions for innovation

NonLocalver: Non-Local vertical links with suppliers and buyers for innovation

Acap: Absorptive Capacity

Localhor: Local horizontal links with supporting institutions for innovation

In order to perform regression analysis, this study proposes a classification of dependent and independent variables. Nevertheless, this study cannot assume a causality relationship among these variables, as the use of instrumental variables was not considered achievable. Consequently, the presented results need to be interpreted just as correlations and not as cause-effect relationships.

5.3.5. Control Variables

The following is a brief description of the control variables proposed for this study. These control variables are included in the models as dummy variables.

a. Country of origin (dcr, dgu): This control variable is incorporated through dummy variables that values “1” for coffee farmers from the respective country: Costa Rica (dcr) or Guatemala (dgu). It values “0” for farmers from other countries.

b. Small producers (dsmall): This is a dummy variable that values “1” for coffee farmers with a production area of 20 hectares or less. It values “0” for farmers with a production area that is larger than 20 hectares.

5.3.6. Validity and Reliability

In this research, the measurement validity and construct validity relies in the use of adaptations of scales and constructs used in previous studies. Moreover, face validity was tested, as all the constructs and items were checked with the valuable help of industry experts in the field and coffee producers through personal and electronic interviews. As a consequence of these revisions, some changes and adjustments were incorporated to the final version of the questionnaire applied in the survey.

According to Bryman (2001), the Cronbach's alpha test is a common procedure for evaluating reliability in a data set.The Cronbach's alphas results show a good internal consistency reliability for the multi-item constructs used in this research, as all Cronbach's alphas are higher than the critical value of 0.8.

5.3.7. Data Transformations and Standardisation

The data set obtained through the survey was reviewed and adjusted in order to make it compatible with standard econometric software. Therefore, the responses were transformed to numeric values using a standardized scale. For the questions using Likert scales, the values were transformed from 1 to 5.

All missed values are being replaced by 0, although for all calculation and estimation, the 0 values were ignored. The numeric transformations are performed twice in order to spot potential mistakes in the conversion process. No mistakes in the data have been identified.

5.4. Data Analysis

Using the standardized data set obtained from the sample, an econometrical data analysis is conducted with the assistance of a specialized software package: STATA IC 13. This section is referred to the results obtained through this data analysis.

5.4.1. Descriptive Statistics and Correlations

The next tables present the descriptive statistics and the correlations for the variables included in this study (see Tables 63 and 64).This includes the descriptive statistics for the total sample (all countries included) are presented, as well as for three sub-samples according to their country of origin: Costa Rica, Guatemala and other Latin American countries.

Table 63. Descriptive Statistics

Variables		All Countries	Costa Rica	Guatemala	Others
Technological Cap. (Index)	Mean	2.94	2.87	3.02	2.92
	Std. Dev.	0.75	0.88	0.57	0.62
	Obs.	182	93	70	19
Marketing Capabilities	Mean	2.93	2.80	3.06	3.06
	Std. Dev.	0.89	1.00	0.81	0.58
	Obs.	177	86	70	21
Local Horizontal Links with Competitors	Mean	3.70	3.61	3.79	3.71
	Std. Dev.	0.96	1.09	0.80	0.99
	Obs.	157	72	68	17
Local Horizontal Links with Supporting Institutions	Mean	3.17	3.34	3.07	2.81
	Std. Dev.	1.02	1.10	0.80	1.28
	Obs.	155	73	64	18
Local Vertical Links with Suppliers and Buyers	Mean	3.36	3.41	3.35	3.22
	Std. Dev.	1.05	1.16	0.95	0.96
	Obs.	160	75	67	18
Non-Local Horizontal Links with Competitors	Mean	3.30	3.34	3.31	3.11
	Std. Dev.	1.20	1.37	1.07	1.08
	Obs.	140	58	64	18
Non-Local Horizontal Links with Supporting Institutions	Mean	3.01	3.29	2.86	2.63
	Std. Dev.	1.10	1.19	0.92	1.24
	Obs.	140	59	64	17
Non-Local Vertical Links with Suppliers and Buyers	Mean	3.47	3.48	3.49	3.39
	Std. Dev.	1.05	1.22	0.85	1.12
	Obs.	147	63	66	18

Note: All variables has a value range between 1 and 5

Table 64. Correlations

	Variables	1	2	3	4	5	6	7	8	9
1	Technological Capabilities	1.0000								
2	Marketing Capabilities	0.6509	1.0000							
3	Absorptive Capacity	0.4620	0.4418	1.0000						
4	Local Horizontal Links with Competitors	0.3954	0.1610	0.1856	1.0000					
5	Local Horizontal Links with Supporting Institutions	0.5027	0.2853	0.3177	0.5202	1.0000				
6	Local Vertical Links with Suppliers and Buyers	0.4937	0.3121	0.2619	0.6094	0.3960	1.0000			
7	Non-Local Horizontal Links with Competitors	0.3836	0.2333	0.2038	1.0000	0.5423	0.6458	1.0000		
8	Non-Local Horizontal Links with Supporting Institutions	0.4920	0.2591	0.3249	0.6112	0.3554	0.4073	0.3347	1.0000	
9	Non-Local Vertical Links with Suppliers and Buyers	0.5279	0.3498	0.2577	0.6639	0.1931	0.6117	0.3964	0.5887	1.0000

5.4.2. Regression Analysis

Regression analysis is conducted to test the relationship among the considered variables. Although a classification of independent and dependent variables is being considered in the models, this research has no elements to suggest causality on these variables. Therefore, the regression results should be interpreted just as correlations and not necessarily as a cause-effect relationship.

As explained in previous sections, these quantitative evaluations include two model sets. The first model set proposes a quantitative evaluation using linear OLS (robust) regressions. These models include firm capabilities (technological capabilities and marketing capabilities) as dependent variables, and external linkages (local and extra-cluster linkages) as the independent variables. The second model set applies Ordered Probit regressions for four types of innovation performance (product innovation, process innovation, managerial/organisational innovation and marketing innovation) as dependent variables. Also, different combinations of two types of firm capabilities (technological

capabilities and marketing capabilities) and six categories of external influences (local and extra-cluster linkages for innovation) are included as the independent variables.

As stated before, a selection of control variables are incorporated in these quantitative evaluations. These control variables are related to country of origin (Costa Rica, Guatemala and others), small producers (<20 hectares) and a higher degree of absorptive capacity.

5.4.2.1. Technological Capabilities and Extra-Cluster Linkages

This first set of models explores the potential influence of local linkages for innovation on the degree of capability building of the coffee farms. The results suggest a general positive influence of local linkages on both considered two types of firm capabilities: technological capabilities and marketing capabilities.

The data suggests that technological capabilities are positively correlated to the two types of extra-cluster linkages considered in this research. However, the highest positive impact seems to be associated to the proxy for quasi-hierarchical linkages (non-local vertical links with suppliers and buyers). The proxy for non-hierarchical linkages (non-local horizontal links with supporting institutions) seems also to be positively influential as well, although in a lower magnitude (see Tables 65 and 66, model 2).

Table 65. Model Set 3.1. Linear OLS (robust) Regressions: Technological Capabilities and Extra-Cluster Linkages

Independent Variables:	Dependent Variable: Technological Capabilities		
	Model 1	Model 2	Model 3
Control Variables			
Country of Origin: Costa Rica	0.219	0.0940	0.0690
Country of Origin: Guatemala	0.139	0.0424	0.0561
Size: Small Producer	-0.367***	-0.221*	-0.169
Main Independent Variables			
Non-Local Horizontal Links with Supporting Institutions		0.114*	0.0632
Non-Local Vertical Links with Suppliers and Buyers		0.258***	0.115
Moderating Variables			
Absorptive Capacity			0.181**
Local Horizontal Links with Supporting Institutions			0.164**
Constant	2.986***	1.813***	1.334***
N	170	132	119
R-sq	0.0477	0.3622	0.3828
AIC	378.1082	219.29	187.6749
BIC	390.6514	236.5868	209.9078

When the variables for internal conditions and cluster's institutional support are included (absorptive capacity and local horizontal links with supporting institutions), the extra-cluster linkages turn non-significant in regards to the correlation with technological capabilities (see Table 65, model 3). The only control variable that seems to be relevant in this evaluation is the size (small producers) (see Table 65, model 1). However, in the most complex models the significance of the control variable for size is not detected (see Table 65, model 2 and 3).

Table 66. General Dominance Analysis (Standardized Weights and Rankings): Technological Capabilities and Extra-Cluster Linkages

Independent Variables:	Dependent Variable: Technological Capabilities		
	Model 1	Model 2	Model 3
Control Variables			
Country of Origin: Costa Rica	0.0814 (2)	0.0091 (4)	0.0087 (6)
Country of Origin: Guatemala	0.0598 (3)	0.0036 (5)	0.0038 (7)
Size: Small Producer	0.8588 (1)	0.0842 (3)	0.0534 (5)
Main Independent Variables			
Non-Local Horizontal Links with Supporting Institutions		0.3561 (2)	0.2038 (3)
Non-Local Vertical Links with Suppliers and Buyers		0.5469 (1)	0.2551 (2)
Moderating Variables			
Absorptive Capacity			0.1900 (4)
Local Horizontal Links with Supporting Institutions			0.2851 (1)
Total	1.0000	1.0000	1.0000

Any statistical evidence for potential moderating effects in the previous explored relationship for absorptive capacity or local institutional support could not be found in this data (see Table 67, models 1 to 4).

Table 67. Moderation: Technological Capabilities, Extra-Cluster Linkages and Moderators

Independent Variables:	Dependent Variable: Technological Capabilities			
	Model 1	Model 2	Model 3	Model 4
Main Independent Variables (a)				
Non-Local Horizontal Links with Supporting Institutions	0.287		0.154	
Non-Local Vertical Links with Suppliers and Buyers		0.0343		0.266*
Moderating Variables (b)				
Absorptive Capacity	0.293	0.0127		
Local Horizontal Links with Supporting Institutions			0.157	0.204
Interaction Terms (a x b)	-0.0177	0.0659	0.0126	-0.00861
Constant	1.328	2.057***	1.922***	1.533***
N	130	137	136	140

*p<0.05, **p<0.01, ***p<0.001

5.4.2.2. Marketing Capabilities and Extra-Cluster linkages

In the evaluation of marketing capabilities, the obtained results suggest that non-local vertical links with suppliers and buyers are the type of extra-cluster linkages most strongly and positively correlated with this type of firm capabilities (see Table 68, model 2).

Table 68. Model Set 3.2. Linear OLS (robust) Regressions: Marketing Capabilities and Extra-Cluster Linkages

Independent Variables:	Dependent Variable: Marketing Capabilities		
	Model 1	Model 2	Model 3
Control Variables			
Country of Origin: Costa Rica	0.0736	0.000759	-0.00571
Country of Origin: Guatemala	0.0566	-0.0488	-0.00575
Size: Small Producer	-0.425**	-0.281	-0.166
Main Independent Variables			
Non-Local Horizontal Links with Supporting Institutions		0.0223	0.0188
Non-Local Vertical Links with Suppliers and Buyers		0.345**	0.200
Moderating Variables			
Absorptive Capacity			0.359***
Local Horizontal Links with Supporting Institutions			-0.0234
Constant	3.113***	1.943***	1.254**
N	165	129	116
R-sq	0.0537	0.2383	0.2552
AIC	423.4868	306.5965	262.8347
BIC	435.9106	323.7554	284.8634

*p<0.05, **p<0.01, ***p<0.001

Similarly, the aforementioned independent variable of non-local vertical links with suppliers and buyers seems to have the highest relative importance in regard to the explanation of the proposed relationship. (see Table 69, model 2).

Table 69. General Dominance Analysis (Rankings): Marketing Capabilities and Extra-Cluster Linkages

Independent Variables:	Dependent Variable: Marketing Capabilities		
	Model 1	Model 2	Model 3
Control Variables			
Country of Origin: Costa Rica	0.0921 (2)	0.0139 (4)	0.0085 (6)
Country of Origin: Guatemala	0.0534 (3)	0.0053 (5)	0.0061 (7)
Size: Small Producer	0.8545 (1)	0.1364 (3)	0.0723 (4)
Main Independent Variables			
Non-Local Horizontal Links with Supporting Institutions		0.2249 (2)	0.1003 (3)
Non-Local Vertical Links with Suppliers and Buyers		0.6194 (1)	0.2559 (2)
Moderating Variables			
Absorptive Capacity			0.5064 (1)
Local Horizontal Links with Supporting Institutions			0.0505 (5)
Total	1.0000	1.0000	1.0000

Finally, there is no statistical evidence for a potential moderating effects of the proposed moderating variables. Indeed, there is no evidence for moderation neither for

absorptive capacity nor for local horizontal links with supporting institutions in the evaluated models (see Table 70, models 1 to 4).

Table 70. Moderation: Marketing Capabilities, Extra-Cluster Linkages and Moderators

Independent Variables:	Dependent Variable: Marketing Capabilities			
	Model 1	Model 2	Model 3	Model 4
Main Independent Variables (a)				
Non-Local Horizontal Links with Supporting Institutions	0.0382		-0.0698	
Non-Local Vertical Links with Suppliers and Buyers		-0.0699		0.149
Moderating Variables (b)				
Absorptive Capacity	0.363	0.0752		
Local Horizontal Links with Supporting Institutions			-0.184	-0.207
Interaction Terms (a x b)	0.0243	0.0914	0.0935	0.0675
Constant	1.447	1.947*	2.873***	2.385**
N	127	134	132	136

*p<0.05, **p<0.01, ***p<0.001

5.4.2.3. Simultaneous Effects of Local Linkages and Extra-cluster linkages on Firm Capabilities

The first model set explore the potential influence of local and extra-cluster linkages on capability building. The general results suggest a positive impact of both types of external linkages (local and extra-cluster) on firm capabilities.

a) Technological Capabilities, Local Linkages and Extra-cluster Linkages

In this section, a comparative evaluation of both local and non-local influences are proposed. The specification of the evaluated econometric models are presented below:

Techcap = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \varepsilon$

Techcap = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4Local + \beta 5NonLocal + \varepsilon$

Techcap =

$\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4Localcomp + \beta 5Localhor + \beta 6Localver +$

$\beta 7NonLocalcomp + \beta 8NonLocalhor + \beta 9NonLocalver + \varepsilon$

Markcap = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \varepsilon$

Markcap = $\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4Local + \beta 5NonLocal + \varepsilon$

Markcap =

$\alpha + \beta 1dcr + \beta 2dgu + \beta 3dsmall + \beta 4Localcomp + \beta 5Localhor + \beta 6Localver +$

$\beta 7NonLocalcomp + \beta 8NonLocalhor + \beta 9NonLocalver + \varepsilon$

Where:

Techcap: Technological capabilities

Markcap: Marketing capabilities

dcr: Dummy variable for coffee producer from Costa Rica

dgu: Dummy variable for coffee producer from Guatemala

dsmall: Dummy variable for small coffee producer (20 hectares or less)

Local: Local linkages (index) for innovation

NonLocal: Non-Local linkages (index) for innovation

Localcomp: Local horizontal links with competitors for innovation

Localhor: Local horizontal links with supporting institutions for innovation

Localver: Local vertical links with suppliers and buyers for innovation

NonLocalcomp: Non-Local horizontal links with competitors for innovation

NonLocalhor: Non-Local horizontal links with supporting institutions for innovation

NonLocalver: Non-Local vertical links with suppliers and buyers for innovation

For technological capabilities, the results suggest that the impacts of vertical links with suppliers and buyers, both at the local and extra-cluster geographical contexts, seems to be the most relevant for this type of firm capabilities (see Table 71, model 3). In this sense, local and extra-cluster linkages seems to be complementary to explain technological capabilities.

Table 71. Model Set 4.1. Linear OLS (robust) Regressions: Technological Capabilities, Local Linkages and Extra-Cluster Linkages

Independent Variables:	**Dependent Variable: Technological Capabilities**		
	Model 1	**Model 2**	**Model 3**
Control Variables			
Country of Origin: Costa Rica	0.219	0.0835	0.0731
Country of Origin: Guatemala	0.139	0.0317	0.0598
Size: Small Producer	-0.367***	-0.238**	-0.262*
Local linkages (Index)		0.252***	
Local horizontal links with competitors			0.104
Local horizontal links with supporting institutions			0.0385
Local vertical links with suppliers and buyers			0.0997
Extra-cluster linkages (Index)		0.212***	
Non-Local horizontal links with competitors			-0.0391
Non-Local horizontal links with supporting institutions			0.174*
Non-Local vertical links with suppliers and buyers			0.146
Constant	2.986***	1.561***	1.328***
N	170	138	120
R-sq	0.0477	0.3886	0.4796
AIC	378.1082	216.7432	183.7718
BIC	390.6514	234.35	211.6467

*p<0.05, **p<0.01, ***p<0.001

Table 72. General Dominance Analysis (Standardized Weights and Rankings): Technological Capabilities, Local Linkages and Extra-Cluster Linkages

Independent Variables:	Dependent Variable: Technological Capabilities		
	Model 1	Model 2	Model 3
Control Variables			
Country of Origin: Costa Rica	0.0814 (2)	0.0097 (4)	0.0067 (8)
Country of Origin: Guatemala	0.0598 (3)	0.0030 (5)	0.0037 (9)
Size: Small Producer	0.8588 (1)	0.0829 (3)	0.0690 (7)
Local linkages (Index)		0.4625 (1)	
Local horizontal links with competitors			0.0883 (5)
Local horizontal links with supporting institutions			0.1747 (3)
Local vertical links with suppliers and buyers			0.1428 (4)
Extra-cluster linkages (Index)		0.4419 (2)	
Non-Local horizontal links with competitors			0.0787 (6)
Non-Local horizontal links with supporting institutions			0.2088 (2)
Non-Local vertical links with suppliers and buyers			0.2273 (1)
Total	1.0000	1.0000	1.0000

b) Marketing Capabilities, Local Linkages and Extra-cluster Linkages

The data analysis suggest that the influences of vertical links with suppliers and buyers, both at the local and extra-cluster geographical contexts, seems to be important for marketing capability building (see Table 73, model 3, and Table 74, model 3). This may suggest the complementary effects of local and extra-cluster linkages on marketing capabilities, similarly as it was previously identified in the case of technological capabilities.

Table 73. Model Set 4.2. Linear OLS (robust) Regressions: Marketing Capabilities, Local Linkages and Extra-Cluster Linkages

	Dependent Variable: Marketing Capabilities		
	Model 1	**Model 2**	**Model 3**
Control Variables			
Country of Origin: Costa Rica	0.0736	-0.0740	-0.143
Country of Origin: Guatemala	0.0566	-0.0650	-0.0807
Size: Small Producer	-0.425**	-0.283*	-0.285
Local linkages (Index)		0.154	
Local horizontal links with competitors			-0.0643
Local horizontal links with supporting institutions			-0.183
Local vertical links with suppliers and buyers			0.285**
Extra-cluster linkages (Index)		0.251**	
Non-Local horizontal links with competitors			-0.0391
Non-Local horizontal links with supporting institutions			0.162
Non-Local vertical links with suppliers and buyers			0.271*
Constant	3.113***	1.931***	1.822***
N	165	134	118
R-sq	0.0537	0.2057	0.3027
AIC	423.4868	313.7389	279.5115
BIC	435.9106	331.1259	307.2184

*p<0.1, **p<0.05, ***p<0.01

Table 74. General Dominance Analysis (Standardized Weights and Rankings): Marketing Capabilities, Local Linkages and Extra-Cluster Linkages

Independent Variables:	Dependent Variable: Marketing Capabilities		
	Model 1	Model 2	Model 3
Control Variables			
Country of Origin: Costa Rica	0.0921 (2)	0.0142 (4)	0.0177 (8)
Country of Origin: Guatemala	0.0534 (3)	0.0051 (5)	0.0051 (9)
Size: Small Producer	0.8545 (1)	0.1550 (3)	0.1196 (4)
Local linkages (Index)		0.3114 (2)	
Local horizontal links with competitors			0.0266 (7)
Local horizontal links with supporting institutions			0.0787 (6)
Local vertical links with suppliers and buyers			0.2348 (2)
Extra-cluster linkages (Index)		0.5143 (1)	
Non-Local horizontal links with competitors			0.0799 (5)
Non-Local horizontal links with supporting institutions			0.1433 (3)
Non-Local vertical links with suppliers and buyers			0.2943 (1)
Total	1.0000	1.0000	1.0000

5.5. Results

In this section, the results of this research are presented with respect to the eight hypotheses that have been proposed.

- **Hypothesis 3.1a:** There is a positive relationship between extra-cluster (non-local) linkages and technological capabilities.

The hypothesis 3.1a is accepted. There is a positive relationship between extra-cluster linkages and technological capabilities (see Table 75).

- **Hypothesis 3.1b:** There is a positive relationship between extra-cluster (non-local) linkages and marketing capabilities.

The hypothesis 3.1b is also accepted, as there is a positive relationship between extra-cluster linkages and marketing capabilities (see Table 75).

Table 75. Results of Regression Analysis (OLS): Extra-Cluster Linkages and Firm Capabilities

Independent Variables:	Dependent Variables	
	Technological Capabilities	Marketing Capabilities
Control Variables		
Country of Origin: Costa Rica	0.0940	0.000759
Country of Origin: Guatemala	0.0424	-0.0488
Size: Small Producer	-0.221*	-0.281
Independent Variables		
Non-Local Horizontal Links with Supporting Institutions	0.114*	0.0223
Non-Local Vertical Links with Suppliers and Buyers	0.258***	0.345**
Constant	1.813***	1.943***
N	132	129
R-sq	0.3622	0.2383
AIC	219.29	306.5965
BIC	236.5868	323.7554

*p<0.05, **p<0.01, ***p<0.001

- **Hypothesis 3.2a:** Quasi-hierarchical linkages have the highest relative importance for technological capabilities.

  As expected, the quasi-hierarchical links have the highest relative importance to explain technological capabilities. Therefore, the hypothesis 3.2a is accepted (see Table 76).

- **Hypothesis 3.2b:** Non-hierarchical linkages have the highest relative importance for marketing capabilities.

  The hypothesis 3.2b is rejected, as the highest relative importance to explain marketing capabilities is presented for the quasi-hierarchical links, and not for the non-hierarchical links as it was expected (see Table 76).

Table 76. Results of Relative Importance: Extra-Cluster Linkages and Firm Capabilities

Independent Variables	Dependent Variables	
	Technological Capabilities	Marketing Capabilities
Control Variables	0.0970 (3)	0.1557 (3)
Non-Local Horizontal Links with Supporting Institutions (Non-Hierarchical)	0.3561 (2)	0.2249 (2)
Non-Local Vertical Links with Suppliers and Buyers (Quasi-Hierarchical)	0.5469 (1)	0.6194 (1)
Total	1.0000	1.0000

- **Hypothesis 3.3:** Absorptive capacity moderates the relationship between extra-cluster (non-local) linkages and firm capabilities.

The hypothesis 3.3 cannot be accepted, as the moderation effect for the variable absorptive capacity cannot be detected in the sample (see Tables 77 and 78).

Table 77. Moderation: Technological Capabilities, Extra-Cluster Linkages and Moderators

Independent Variables:	Dependent Variable: Technological Capabilities			
	Model 1	Model 2	Model 3	Model 4
Independent Variables (a)				
Non-Local Horizontal Links with Supporting Institutions	0.287		0.154	
Non-Local Vertical Links with Suppliers and Buyers		0.0343		0.266*
Moderating Variables (b)				
Absorptive Capacity	0.293	0.0127		
Local Horizontal Links with Supporting Institutions			0.157	0.204
Interaction Terms (a x b)	-0.0177	0.0659	0.0126	-0.00861
Constant	1.328	2.057***	1.922***	1.533***
N	130	137	136	140

*p<0.05, **p<0.01, ***p<0.001

- **Hypothesis 3.4:** Local horizontal links with supporting institutions moderate the relationship between extra-cluster linkages and firm capabilities.

The hypothesis 3.4 is not accepted, as the moderation effect for the variable local horizontal links with supporting institutions cannot be statistically detected in the data analysis (see Tables 77 and 78).

Table 78. Moderation: Marketing Capabilities, Extra-Cluster Linkages and Moderators

Independent Variables:	Dependent Variable: Marketing Capabilities			
	Model 1	Model 2	Model 3	Model 4
Independent Variables (a)				
Non-Local Horizontal Links with Supporting Institutions	0.0382		-0.0698	
Non-Local Vertical Links with Suppliers and Buyers		-0.0699		0.149
Moderating Variables (b)				
Absorptive Capacity	0.363	0.0752		
Local Horizontal Links with Supporting Institutions			-0.184	-0.207
Interaction Terms (a x b)	0.0243	0.0914	0.0935	0.0675
Constant	1.447	1.947*	2.873***	2.385**
N	127	134	132	136

*p<0.05, **p<0.01, ***p<0.001

- **Hypothesis 3.5:** Local linkages and extra-cluster linkages have a similar relative importance for technological capabilities.

  This hypothesis 3.5 is accepted, as the relative importance of local linkages and extra-cluster linkages seems to be close to each other in the case of their positive relationship with technological capabilities (see Table 79).

- **Hypothesis 3.6:** Local linkages and extra-cluster linkages have a similar relative importance for marketing capabilities.

  The hypothesis 3.6 cannot be accepted. Indeed, extra-cluster linkages seems to be relatively more important (51.43%) to explain marketing capabilities than local linkages (31.14%) (See Table 79).

Table 79. Results of Relative Importance: Local and Extra-Cluster Linkages (Indexes) and Firm Capabilities

Independent Variables:	Dependent Variables	
	Technological Capabilities	Marketing Capabilities
Control Variables	0.0956 (3)	0.1743 (3)
Cluster (Local) Linkages (Index)	0.4625 (1)	0.3114 (2)
Extra-cluster (Non-Local) Linkages (Index)	0.4419 (2)	0.5143 (1)
Total	1.0000	1.0000

5.6. Discussion

Environmental factors have been suggested in the literature as important influences for firm's capability building for innovation purposes (Bortagaray, 2007). The impact of local linkages have been widely studied in the research stream of business cluster and regional innovation systems. Similarly, extra-cluster influences have been vastly explored in network literature and global value chain previous studies (Humphrey & Schmitz, 2002; Konsti-Laakso et al., 2012). However, few previous studies integrates internal conditions and environmental influences at two two geographical contexts: cluster (local) and extra-cluster (non-local), evaluating them quantitatively and simultaneously in these two contexts.

Most of the main industries in Latin America are heavily based on the exploitation of basic natural resources and the exporting of basic commodities. These basic commodities primarily includes oil and other minerals, light manufacturing products and agricultural products. Coffee exports is one of the main agricultural commodities that Latin American countries trades with the rest of the world and, as many other agricultural commodities, agricultural coffee producers operates simultaneously in a local cluster as well as in a global value chain (GVC) (Pietrobelli & Rabellotti, 2004; Giuliani, Pietrobelli & Rabellotti, 2005).

The main research questions of the third part of this doctoral research may be states as: which external influence is more crucial for capability building for innovation purposes in the Latin American coffee farmers, local or extra-cluster linkages? Also, which specific type of external linkages is more relevant with respect to the two firm capabilities considered in this study, technological capabilities and marketing capabilities?

The results suggest that both local and extra-cluster linkages are important influences for capability building in these Latin American coffee producers. However, local linkages seems to have a slightly higher impact on the building of technological capabilities, whilst extra-cluster linkages seems to be much more important for marketing capabilities. Indeed, the influence of the interactions with global value chains to improve the firm's marketing capacities cannot be dismissed.

Following an adaptation of Humphrey & Schmitz (2002), the general dominance statistical analysis suggest that quasi-hierarchical linkages, i.e. non-local vertical linkages with suppliers and buyers, is a more influential factor than non-hierarchical linkages in order to explain both technological capabilities and marketing capabilities. A higher relative importance of quasi-hierarchical links to explain marketing capabilities is considered an unexpected result, as according to Pietrobelli (2007), it may not be in the best interest of the suppliers and buyers to promote an increasing in the marketing and commercialization capacities of the coffee farmers.

This work also tests the potential moderating effects of two variables: absorptive capacity (ACAP) and local horizontal links with supporting institutions, on the positive relationship of extra-cluster linkages on firm capability building. Previous studies suggest a positive influence of absorptive capacity (ACAP) in the assimilation of knowledge and information from the external environment into the firm, enhancing the possibilities of further firm capabilities building (Cohen & Levinthal, 1990; Zahra & George, 2002; Hervas-Oliver, Albors & De Miguel Molina, 2009). Also, the literature suggest that local horizontal linkages with supporting institutions may have a similar positive effect on firm capabilities (Hervas-Oliver et al., 2008; Isaksen, 2009; Li & Geng, 2012; Belussi & Sedita, 2012). However, no moderating effects of neither of these two variables could be statistically

detected in the performed econometrical analysis. As stated in the discussion section of the previous chapter 4, this statistical result not necessarily means that there is no moderating effect in these variables, as the non-significant result of the moderation may be explained by the relatively small size of the sample.

Geography, Linkages and Capabilities: Innovation in the Agricultural Coffee Production in Latin America

Chapter 6. Conclusions and Future Implications

6.1. Main Findings and Discussion of Research Questions

This research explores the mutual relationships between some selected internal conditions and potential external influences on innovation performance and capability building in a sample of coffee farmers from Latin America. This is conducted with an emphasis on two important coffee-exporting countries within this region: Costa Rica and Guatemala. The evaluated internal conditions include two firm capabilities: technological capabilities and marketing capabilities, as well as a potential moderating variable for absorptive capacity. The external influences have been studied at two different geographical proximity contexts: local (cluster) context and non-local (extra-cluster) context.

The selected approach tries to achieve an integration of the frameworks for capabilities adopted from the Resource-Based View (RBV) theories, with some elements borrowed from the research streams for business clusters and global value chains (GVC). Its main purpose is to build on previous quantitative evaluations for innovation performance, considering the less explored case of a mature low-tech industry located in developing countries, more specifically the agricultural coffee production in Latin America.

The following is a review of each of the ten research questions proposed in this document, and how they are being addressed by the results of this work.

First Part: Firm Capabilities and Innovation Performance in the Agricultural Coffee Production in Latin America (Chapter 3)

1. ***What is the relationship between innovation performance and technological capabilities in the case of a mature low-tech industry (agricultural coffee sector) in Latin America?***

The results of this research suggest a strong positive relationship among firm capabilities and innovation performance in this examined sample of Latin American coffee farmers. This positive correlation is significant for all types of innovation performances evaluated in this research, including: product innovation, process innovation, managerial/organisational innovation and marketing innovation, as well as for the general innovation performance indicator, an index built as an average of the previously mentioned four types of innovation indicators.

For product innovation and process innovation, their positive correlations with technological capabilities can be considered as something expected, as they have been proposed by numerous previous research (e.g. Zhou & Wu, 2010, Bao et al., 2012). However, for managerial/organisational innovation and marketing innovation these potential positive relationships are not that clear, as further research have been recommended.

Indeed, at the beginning of this work, it was not clear if technological capabilities and marketing capabilities could be both significant and positively related to all the four types of innovation evaluated by this work. For instance, it was not clear if marketing capabilities could be significantly related to managerial/organisational innovation. In the same way, it was not clear if technological capability can be a positive influential for marketing innovation. The results suggest that this is exactly the case, at least with respect to the

selected sample: marketing capabilities has a positive effect on managerial/organisational innovations, whilst technological capability are positively influential to marketing innovation. They all are significantly and positively correlated.

2. ***Given their differences in the social, economic and institutional current situations, is this relationship stronger for Costa Rica´s coffee growers than for Guatemala´s?***

Some differences related to the country of origin had been proposed and expected in this research. Indeed, due to the presence of a more developed and supportive social, economic and institutional conditions that are predominant in Costa Rica (including in her rural areas), it was considered as highly probable to find a statistical deviation in the outcomes for coffee farmers in Costa Rica in comparison with producers from other Latin American countries, such as Guatemala. For instance, it was expected that producers from Costa Rica would need a lower level of firm capabilities to achieve a certain degree of innovation performance and capability building, in comparison to the coffee producers from other less developed coffee-exporting countries like Guatemala, for example.

In Costa Rica, it sounded plausible that local coffee producers may take advantage of the stronger institutional support and better business climate conditions available for them in that country. Nevertheless, this advantage for Costa Rica cannot be confirmed in this research, as the applied statistical procedures cannot detect any significant differences in most of the proposed models in regards to the control variable for country of origin. In reference to the second control variable considered in this research, size, the results suggest that the potential differences for small producers (producers with 20 hectares or less in production area) are neither significant in the proposed correlations between firm capabilities and innovation performance.

Second Part: The Cluster Effects: Local Influences and the Building of Internal Capabilities in the Latin American Coffee Farms (Chapter 4)

3. What is the mutual impact of local linkages and firm capabilities in the case of a mature low-tech industry (agricultural coffee production) in Latin America?

The positive relationship between local environmental conditions and technological capabilities has been demonstrated in previous research (Afuah, 2000; Frost, 2001; Gilbert, McDougall & Audretsch, 2008). Clusters dynamics promotes local interrelations that allows more intense knowledge sharing that can improve firm capabilities and innovation performance (Lee, Lee & Pennings, 2001; Riain, 2006; Breschi & Malerba, 2007; Ciravegna, 2011).

Indeed, local horizontal and vertical linkages have been suggested as important for capability building in cluster literature (e.g. Cooke & Ehret, 2009; Brown, McNaughton & Bell, 2010). Nonetheless, it is expected that not all types of local linkages present the same relative importance for the improvement of internal technological or marketing capabilities. The results of this research propose that local horizontal linkages with supporting institutions are more relatively important for technological capabilities, whilst local vertical linkages with suppliers and buyers are more influential for marketing capabilities.

4. Does absorptive capacity (ACAP) have a moderating effect on this relationship between local linkages and firm capabilities?

The potential moderating effects (Baron & Kenny, 1986) of absorptive capacity (ACAP) is tested with respect to the relationship between local linkages and firm capabilities. However, no statistical evidence of any moderation effect have been detected in this sample. Nonetheless, the incorporation of the variable ACAP significantly improves the goodness of fit of the proposed models. Therefore, although the moderation effect cannot

be demonstrated, there is a positive influence of the variable ACAP in the relationship between local linkages and firm capabilities.

5. ***Does collective efficiency have a moderating effect on this relationship between local linkages and firm capabilities?***

Similarly as in the case of absorptive capacity, there is no statistical evidence for the potential moderating effects for collective efficiency in the relationship between local linkages and firm capabilities.

Third Part: Localisation versus Globalisation: External Linkages for Capability Building in the Latin America's Coffee Production (Chapter 5)

6. ***What is the mutual impact of extra-cluster linkages for innovation purposes and firm capabilities in the case of a mature and low-tech industry (coffee agricultural production) in Latin America?***

The extra-cluster linkages are significantly and positively related to the two firm capabilities evaluated in this research: technological capabilities and marketing capabilities.

7. ***Does absorptive capacity (ACAP) have a moderating effect on the correlation between extra-cluster linkages and firm capabilities?***

No moderating effects have been detected for absorptive capacity on the relationship between extra-cluster linkages and firm capabilities. However, absorptive capacity has a positive impact as well as a high relative importance to explain the relationship between extra-cluster linkages and firm capabilities.

8. ***Does local horizontal linkages with supporting institutions have a moderating effect on the correlation between extra-cluster linkages and firm capabilities?***

An evaluation of the potential moderation effects of local horizontal linkages with supporting institutions is performed in the relationship between extra-cluster linkages and firm capabilities. Nevertheless, according to the results of these moderation tests, the potential moderation effect cannot be demonstrated statistically.

9. What is the relationship among cluster influences, extra-cluster linkages and internal capability building in agricultural coffee producers of Latin America?

The data analysis suggests that local (cluster) environmental conditions, although significant for the analysis, are not the most important factor to explain potential differences in regard to capability building (and, indirectly, to innovation performance as well) among these evaluated Latin American coffee producers. Indeed, the extra-cluster linkages are the variables with the highest relative importance to explain firm capabilities. The highest positive influence seems to be related to the non-local vertical linkages with suppliers and buyers.

These results can be considered as an evidence of the high importance of the participation in the coffee global value chain (GVC) for the farmers involved in the coffee agricultural production, even in the cases where there is also a business cluster actively functioning. This outcome also implies a combined positive influence of both local and non-local conditions on firm capabilities when they are acting simultaneously. In these evaluations, the relative importance and the magnitude of the impact of both local and non-local linkages are quite comparable; nonetheless, the influences of non-local linkages seems to be slightly stronger than the ones exerted by the local conditions.

10. Does absorptive capacity (ACAP) have a moderating effect on the correlation between local linkages, extra-cluster linkages and technological capabilities?

In the performed evaluations, a moderating effect for absorptive capacity cannot be detected. However, absorptive capacity presents a high relative importance to explain the relationship between firm capabilities and extra-cluster linkages.

6.2. Research Contributions

The main contribution of this research is the proposal of a model that incorporates three level of analysis to explain the interrelations between firm capabilities and firm's innovation performance, applied to the case of an agricultural activity in Latin America. In this sense, the models have been designed and quantitatively tested, with an acceptable level of goodness of fit. The results suggest that the mutual correlations among these variables are clearly and significantly positive in most of the cases.

The first part of this work (Chapter 3) focuses on the study of the mutual influences between firm capabilities and innovation performance. More specifically, the combined effects and the individual relative importance of technological capabilities and marketing capabilities are evaluated. The main contribution of this part is the evaluation of the three subcategories of technological capabilities: investment capabilities, production capabilities and linkage capabilities, for a better understanding about the effects of each element in regard to each of the four types of innovation performance that are included in this work, as well as how they interrelates among each other. To determine which subcategory of technological capabilities has a higher impact on a specific type of innovation performance could be an important information for policy makers and for the coffee farmers themselves, as they are dealing with highly competitive and outstandingly challenging international markets (Hausmann et al., 2007).

Also, two less explored types of innovation have been included in the four innovation performances tested in this research: managerial/organisational innovation and marketing innovation (Krasnikov & Jayachandran, 2008). The results suggest a positive relationship between these two types of innovation and the selected firm capabilities evaluated, as it is in the case of the wider researched types of product innovation and process innovation (Krasnikov & Jayachandran, 2008; Ju, Zhou, Gao & Lu, 2013).

The second part of this research (Chapter 4) deals with the relationship between technological capabilities and local linkages (Frost, 2001; Gilbert, McDougall & Audretsch, 2008; Cooke & Ehret, 2009; Brown, McNaughton & Bell, 2010). According to the data analysis of this research, the relative importance of each type of local linkages varies according to the specific firm capability that can be considered. Indeed, the modest contribution of this part is limited to a quantitative evaluation in these agricultural coffee producers that suggests that local horizontal linkages with supporting institutions has a stronger positive relationship with technological capabilities, whilst local vertical linkages with suppliers and buyers is closely and positively related to marketing capabilities. The coffee farmers seem to appreciate the assistance from supporting institutions for the improvement of their technological capabilities, but not that much for the enhancement of their marketing capabilities.

The third and final part of this research (Chapter 5) incorporates into the analysis the potential effects of extra-cluster influences, specifically, the influences of three types of non-local linkages. Although previous studies have identified the importance of local and non-local external linkages for capability building (Bortagaray, 2007; Humphrey & Schmitz, 2002; Konsti-Laakso et al., 2012), a few previous studies integrates internal conditions and environmental influences at two two geographical contexts: cluster (local) and extra-cluster

(non-local), evaluating them quantitatively and simultaneously in these two contexts (Pietrobelli & Rabellotti, 2004; Giuliani, Pietrobelli & Rabellotti, 2005). The integration of these two context levels with the firm's internal conditions is precisely the main contribution of the last part and of all this research.

The results suggest that both local and extra-cluster linkages are important for capability building in the case of the studied coffee producers. Nonetheless, local linkages seems to have a slightly higher impact for technological capabilities, whilst extra-cluster linkages seems to be more important for marketing capabilities.

Moreover and following an adaptation of Humphrey & Schmitz (2002), the relative importance analysis suggests that quasi-hierarchical linkages (non-local vertical linkages with suppliers and buyers), are more important than non-hierarchical linkages (non-local horizontal linkages with supporting institutions) to explain both technological capabilities and marketing capabilities. The higher relative importance of quasi-hierarchical links to explain marketing capabilities is not an expected outcome, as the international suppliers and buyers may not feel motivated to promote marketing and commercialization capacities in the primary coffee producers (Pietrobelli, 2007).

6.3. Future Research Agenda

This research focuses almost exclusively on coffee farmers from Costa Rica and Guatemala. Future studies should expand the geographical scope of this study in order to include other important countries in Latin America, in particular the two larger coffee producer and exporter countries in this region, Brazil and Colombia.

More insight may be needed about the operational details of the governmental institutional support. This research only considers supporting institutions as a whole category. However, a discrimination and a detailed specification of the roles and impacts of the external links with governmental supporting institutions on innovation performance and firm capabilities could be an interesting addition to explore in the proposed model. Moreover, the incorporation of the formal concept of open innovation (Chesbrough, 2003, 2012) could also be an interesting addition to be considered in future research related to the integration of firm's internal conditions with external influences at cluster and extra-cluster levels.

6.4. Research Limitations

This research has several important limitations that is necessary to be recognized. The following is a list of these limitations:

1. This research has no elements to suggest any causal relationships among the included dependent and independent variables. Indeed, all the proposed models and regression analysis presented in this research should be assumed as correlations and not necessarily as a cause-effect relationship.
2. The Latin American countries in general, and the Central American and other countries examined in this research in particular, present a situation of general lack of information. Industry-specific statistical information on production, innovation and other key business performance are practically inexistent, as the opposite situation in Europe and other developed countries. Moreover, the few specific data that may be available may not be considered as accurate, in most if the cases. This limitation means that any research in

Latin American business needs to start for collecting its own data, as it is the case in this research.

3. One important limitation of this research is related to the data collection. Indeed, most of the variables used in this study have been obtained through self-reporting scales. At the firm level, hard data related to variables such as technological capabilities, marketing capabilities and innovation performance, are not available in the Latin America business context; therefore, self-reporting Likert scales obtained through a questionnaire are applied for data collection purposes. This procedure may incorporate a high level of subjectivity in the data; however, the use of self-reporting subjective scales is suggested in the literature as a valid procedure when hard data is not available (Davies & Ko, 2006; Isobe et al., 2008; Su, Tsang & Peng, 2009; Shan & Jolly, 2012).
4. The scale applied for measuring marketing capabilities is a simplified one. The complete multi-item scale normally found in the specialized literature is not being implemented in this research. Nevertheless, this simplification may be considered as a valid procedure because internationally recognized academics in marketing capabilities research have used this kind of simplified scales in previous studies related to marketing capabilities, as in the case of the paper by Vorhes, Morgan and Autry (2009).
5. Most of the coffee farmers (89%) included in the sample are located in two Latin American countries: Costa Rica and Guatemala. The representation of coffee producers from other Latin American countries in the applied sample is minimal.
6. Finally, this research is not using a probabilistic (random) sample, but a convenience sample, which is probably one its most important limitation. The use of a random sample was not considered as feasible due to the geographical dispersion and other population's characteristics as well as limitations in time and resources available to the author.

Appendix A

Survey instrument

Conditions for Innovation in the Latin America's Coffee Industry

Section 1. General Information

Welcome and thank you very much for your kind cooperation in this doctoral research from the University of Essex, directed to (agricultural) coffee producers in Latin American countries.

The survey consists of 27 questions, divided into 5 sections.

For any question or comments, please contact Mr. Luis Figueroa, at the University of Essex through the follwing email: lrfigu@essex.ac.uk. Thank you very much!

1. In which country is (mainly) located your coffee production?

- ◯ Mexico
- ◯ Peru
- ◯ Bolivia
- ◯ Colombia
- ◯ Costa Rica
- ◯ El Salvador
- ◯ Honduras
- ◯ Guatemala
- ◯ Nicaragua
- ◯ Panama

Other (please specify)

2. In which state/province/department?

3. In which municipality?

4. How many years has your farm (or company) been involved in the coffee business?

- ◯ Up to 5 years
- ◯ 6 to 10 years
- ◯ 11 to 15 years
- ◯ 16 to 20 years
- ◯ More than 20 years
- ◯ Don't know / No answer

Conditions for Innovation in the Latin America's Coffee Industry

5. What is the current area of your coffee production? (hectares)

- ◯ Up to 5 hectares
- ◯ 6 to 10 hectares
- ◯ 11 to 20 hectares
- ◯ 21 to 50 hectares
- ◯ 51 to 100 hectares
- ◯ More than 100 hectares
- ◯ Don't know / No answer

6. Are you a member of a coffee producer cooperative?

- ◯ Yes
- ◯ No
- ◯ Don't know / No answer

7. How much of your coffee production is exported? (% volume)

- ◯ 0%
- ◯ 1%-25%
- ◯ 26%-50%
- ◯ 51%-75%
- ◯ 76%-100%
- ◯ Don't know / No answer

8. Do you export your coffee directly by yourself?

- ◯ Yes
- ◯ No
- ◯ Don't know / No answer

9. In which countries does your coffee is exported? (please mark all valid options)

- ☐ Local market (inside your country)
- ☐ United States and Canada
- ☐ European Union (EU)
- ☐ Japan
- ☐ China
- ☐ Other countries in Latin America and the Caribbean
- ☐ Other countries in other regions
- ☐ Don't know / No answer

Conditions for Innovation in the Latin America's Coffee Industry

10. Do you sale your coffee using your own brand name?

- ◯ Yes
- ◯ No
- ◯ Don't know / No answer

Section 2. Firm Capabilities (Marketing capabilities and Technological capa...

11. What is your evaluation of the following MARKETING capabilities in your farm (or company) in comparison to your competitors?

	Don't know / No answer	Very Weak	Weak	Regular	Strong	Very Strong
Price determination and management	◯	◯	◯	◯	◯	◯
New product development	◯	◯	◯	◯	◯	◯
Good relationship with distributors	◯	◯	◯	◯	◯	◯
Advertising and promotion	◯	◯	◯	◯	◯	◯
Public relations	◯	◯	◯	◯	◯	◯
Branding and corporate image	◯	◯	◯	◯	◯	◯
Selling skills	◯	◯	◯	◯	◯	◯
Use of Internet in marketing activities	◯	◯	◯	◯	◯	◯
Market infomation - Generation and exploitation	◯	◯	◯	◯	◯	◯
Marketing planning and strategy	◯	◯	◯	◯	◯	◯
Effectiveness in marketing implementation	◯	◯	◯	◯	◯	◯

Conditions for Innovation in the Latin America's Coffee Industry

12. What is your evaluation of the following INVESTMENT CAPABILITIES for technological innovation in your farm (or company) in comparison to your competitors?

	Don't know / No answer	Very Weak	Weak	Regular	Strong	Very Strong
Technological R&D made by the firm itself.	◯	◯	◯	◯	◯	◯
Technological R&D services facilitated by external institutions.	◯	◯	◯	◯	◯	◯
Acquisition of tangible technology (machinery and equipment).	◯	◯	◯	◯	◯	◯
Acquisition of intangible technology (patents and licences).	◯	◯	◯	◯	◯	◯
Marketing of new or improved products.	◯	◯	◯	◯	◯	◯
Staff training related to innovative activities.	◯	◯	◯	◯	◯	◯

13. What is your evaluation of the following PRODUCTION CAPABILITIES for technological innovation in your farm (or company) in comparison to your competitors?

	Don't know / No answer	Very Weak	Weak	Regular	Strong	Very Strong
Improvement and adaptation of production process	◯	◯	◯	◯	◯	◯
Improvement of product quality	◯	◯	◯	◯	◯	◯
Design of changes to production organization	◯	◯	◯	◯	◯	◯
Development of firm's own technology	◯	◯	◯	◯	◯	◯
Imitation of technologies brought in by competitors	◯	◯	◯	◯	◯	◯
Imitation of innovation in products developed by competitors	◯	◯	◯	◯	◯	◯
Design of new products	◯	◯	◯	◯	◯	◯

Conditions for Innovation in the Latin America's Coffee Industry

14. What is your evaluation of the following LINKAGE CAPABILITIES in regards of technological innovation within your farm (or company) in comparison to your competitors?

	Don't know / No answer	Very Weak	Weak	Regular	Strong	Very Strong
Linkages with OTHER COFFEE PRODUCERS	◯	◯	◯	◯	◯	◯
Linkages with PROVIDERS	◯	◯	◯	◯	◯	◯
Linkages with BUYERS	◯	◯	◯	◯	◯	◯
Linkages with ACADEMIC AND RESERACH CENTERS	◯	◯	◯	◯	◯	◯
Linkages with FINANCIAL INSTITUTIONS	◯	◯	◯	◯	◯	◯
Linkages with OTHER ORGANIZATIONS	◯	◯	◯	◯	◯	◯

15. The following capabilities inside your farm (or company) are more a consequence of individual efforts inside your farm (or company) or, instead, the result of associative efforts with other farms (or companies)?

	Don't know / No answer	Totally individual efforts	Mostly individual efforts	Half individual / Half associative	Mostly associative efforts	Totally associative efforts
Marketing capabilities	◯	◯	◯	◯	◯	◯
Technological capabilities	◯	◯	◯	◯	◯	◯

Section 3. Business and Innovation Performance

Conditions for Innovation in the Latin America's Coffee Industry

16. Evaluate the following afirmations in relation to the GENERAL BUSINESS PERFORMANCE of your farm (or company) during the last 2 years:

	Don't know / No answer	Totally disagree	Partially disagree	Neutral	Partially agree	Totally agree
Your COFFEE PRODUCTION (total volume) grew faster than other coffee producers's in your local area	◯	◯	◯	◯	◯	◯
Your PRODUCTIVITY (volume per hectare) grew faster than other coffee producers's in your local area	◯	◯	◯	◯	◯	◯
The MARKET SHARE of your coffee products grew faster than other coffee producers's in your local area	◯	◯	◯	◯	◯	◯
The MARKET RECOGNITION of your company and/or your brand name grew faster than other coffee producers's in your local area	◯	◯	◯	◯	◯	◯
The QUALITY of your coffee products was higher than other coffee producers's in your local area	◯	◯	◯	◯	◯	◯
The PRICES of your coffee products were higher than other coffee producers's in your local area	◯	◯	◯	◯	◯	◯
The PROFITABILITY of your coffee products were higher than other coffee producers's in your local area	◯	◯	◯	◯	◯	◯

Conditions for Innovation in the Latin America's Coffee Industry

17. Evaluate the following afirmations in relation to the INNOVATION PERFORMANCE of your farm (or company) during the last 2 years:

	Don't know / No answer	Totally disagree	Partially disagree	Neutral	Partially agree	Totally agree
Your farm (or company) is stronger than other coffee producers in your local area in terms of PRODUCT INNOVATION	◯	◯	◯	◯	◯	◯
Your farm (or company) is stronger than other coffee producers in your local area in terms of PROCESS INNOVATION	◯	◯	◯	◯	◯	◯
Your farm (or company) is stronger than other coffee producers in your local area in terms of MANAGERIAL INNOVATION	◯	◯	◯	◯	◯	◯
Your farm (or company) is stronger than other coffee producers in your local area in terms of MARKETING INNOVATION	◯	◯	◯	◯	◯	◯

Section 4. Collective Efficieny and Extra-Cluster Linkages

18. Do you think that the inter-relations with the following companies and institutions located IN YOUR SAME GEOGRAPHICAL LOCAL AREA/REGION have facilitated significantly the product innovation performance of your company?

	Don't know / No answer	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
OTHER COFFEE PRODUCERS located in your same region.	◯	◯	◯	◯	◯	◯
SUPPLIERS based in your same region.	◯	◯	◯	◯	◯	◯
BUYERS based in your same region.	◯	◯	◯	◯	◯	◯
ACADEMIC AND RESEARCH CENTERS based in your same region.	◯	◯	◯	◯	◯	◯
FINANCIAL INSTITUTIONS based in your same region.	◯	◯	◯	◯	◯	◯
OTHER ORGANIZATIONS located in your same region.	◯	◯	◯	◯	◯	◯

Conditions for Innovation in the Latin America's Coffee Industry

19. Do you think that the inter-relations with the following companies and institutions located IN OTHER REGIONS OF YOUR COUNTRY OR IN OTHER COUNTRIES have facilitated significantly the product innovation performance of your company?

	Don't know / No answer	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
OTHER COFFEE PRODUCERS located in other regions of your country or in other countries	◯	◯	◯	◯	◯	◯
SUPPLIERS located in other regions of your country or in other countries	◯	◯	◯	◯	◯	◯
BUYERS located in other regions of your country or in other countries	◯	◯	◯	◯	◯	◯
ACADEMIC AND RESEARCH CENTERS located in other regions of your country or in other countries	◯	◯	◯	◯	◯	◯
FINANCIAL INSTITUTIONS located in other regions of your country or in other countries	◯	◯	◯	◯	◯	◯
OTHER ORGANIZATIONS located in other regions of your country or in other countries	◯	◯	◯	◯	◯	◯

20. Do you think that the following conditions of your geographical local area /region have impacted positively your own product innovation performance?

	Don't know / No answer	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Specialized LABOR MARKET at your local area/region.	◯	◯	◯	◯	◯	◯
Availability of INPUTS at your local area/region.	◯	◯	◯	◯	◯	◯
MARKET INFORMATION available at your local area/region.	◯	◯	◯	◯	◯	◯
TECHNICAL INFORMATION available at your local area/region.	◯	◯	◯	◯	◯	◯
ACCESS TO MARKETS from your local area/region.	◯	◯	◯	◯	◯	◯

Section 5. Absorptive Capacity and Other Conditions

Conditions for Innovation in the Latin America's Coffee Industry

21. Joint actions with other coffee producers have been INDISPENSABLES to achieve concrete improvements within your farm (or company) in relation to:

	Don't know / No answer	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Training and technical advice	◯	◯	◯	◯	◯	◯
Product innovation	◯	◯	◯	◯	◯	◯
Production processes	◯	◯	◯	◯	◯	◯
Marketing and sales	◯	◯	◯	◯	◯	◯
Exporting	◯	◯	◯	◯	◯	◯
Input procurement	◯	◯	◯	◯	◯	◯
Adquisition of machinery and equipment	◯	◯	◯	◯	◯	◯

22. During the last 2 years, how many of the following types of companies or organizations have been closely and oftenly related to your farm (or company) for innovation purposes?

	Don't know / No answer	0	1 to 2	3 to 4	5 to 6	7 or more
OTHER COFFEE PRODUCERS	◯	◯	◯	◯	◯	◯
SUPPLIERS	◯	◯	◯	◯	◯	◯
BUYERS / CUSTOMERS	◯	◯	◯	◯	◯	◯
ACADEMIC AND RESEARCH CENTERS	◯	◯	◯	◯	◯	◯
FINANCIAL INSTITUTIONS	◯	◯	◯	◯	◯	◯
OTHER ORGANIZATIONS	◯	◯	◯	◯	◯	◯

23. Evaluate the following sentences in relation to your farm's (or company's) R&D investments:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't know / No answer
During the last 2 years, you have invested more resources in RESEARCH AND DEVELOPMENT than other coffee producers of a similar size as yours located within your local area.	◯	◯	◯	◯	◯	◯

Conditions for Innovation in the Latin America's Coffee Industry

24. Evaluate the following sentences related to your company's permanent employees:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Don't know / No answer
Your permanent staff are equipped with excellent profesional/technical skills.	◯	◯	◯	◯	◯	◯
Your permanent staff can acquire quickly and thoroughly new knowledge requiered by the work.	◯	◯	◯	◯	◯	◯
Your permanent staff have better working skills than the staff of your competitors.	◯	◯	◯	◯	◯	◯
Your permanent staff have higher educational qualifications than the staff of your competitors.	◯	◯	◯	◯	◯	◯
Your permanent staff have the ability to use and organize the acquired knowledge.	◯	◯	◯	◯	◯	◯

25. How many of your permanent staff participate directly in activities related to:

	Don't know / No answer	0 people	1-2 people	3-5 people	5-10 people	10-20 people	More than 20 people
R&D and Technological innovation?	◯	◯	◯	◯	◯	◯	◯
Marketing?	◯	◯	◯	◯	◯	◯	◯

Section 6. Types of Products and Services

26. How much of your coffee sales are represented by the following types of coffee beans? (% volume)

	0%	Don't know / No answer	1%-25%	26%-50%	51%-75%	76%-100%
Conventional coffees (undifferentiated)	◯	◯	◯	◯	◯	◯
Certified coffees (Organic, Fair trade, Rainforest alliance, Bird-friendly, UTZ Kapeh, etc.)	◯	◯	◯	◯	◯	◯
Specialty coffees (Gourmet, Estate, etc.)	◯	◯	◯	◯	◯	◯

Conditions for Innovation in the Latin America's Coffee Industry

27. How much of your coffee sales are represented by the following types of coffee products? (% volume)

	Don't know / No answer	0%	1%-25%	26%-50%	51%-75%	76%-100%
Bulk non-roasted coffee	◯	◯	◯	◯	◯	◯
Bulk roasted coffee	◯	◯	◯	◯	◯	◯
Retail packaged coffee	◯	◯	◯	◯	◯	◯
Soluble (instant) coffee	◯	◯	◯	◯	◯	◯
Decaffeinated coffee	◯	◯	◯	◯	◯	◯
Other coffee products (eg. drinks, sweets, handicrafts, etc.)	◯	◯	◯	◯	◯	◯
Services related to coffee (tours, consulting, financial services, etc.)	◯	◯	◯	◯	◯	◯

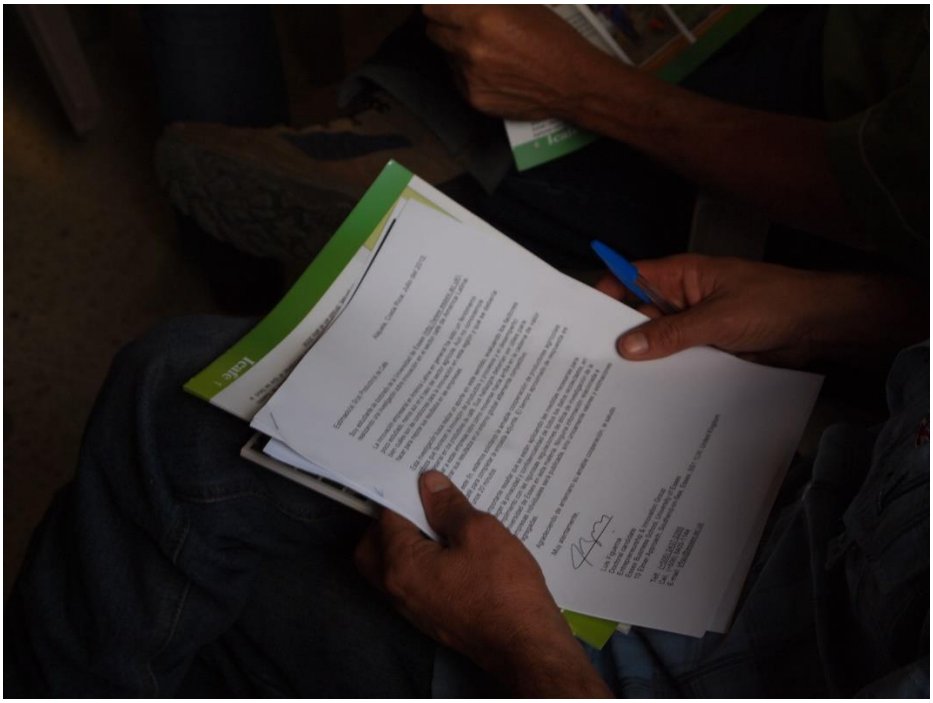
Appendix B

Photos of data collection

2.1. Workshop 1. July 19th, 2012. 8:30 am. Coopeatenas. Atenas, Alajuela, Costa Rica.


6 FOOT COMMERCIAL FOLDING TABLE

2.2. Workshop 2. July 19th, 2012. 2:00 pm. Salón Parroquial, Frailes de Desamparados. Tarrazú, San José, Costa Rica

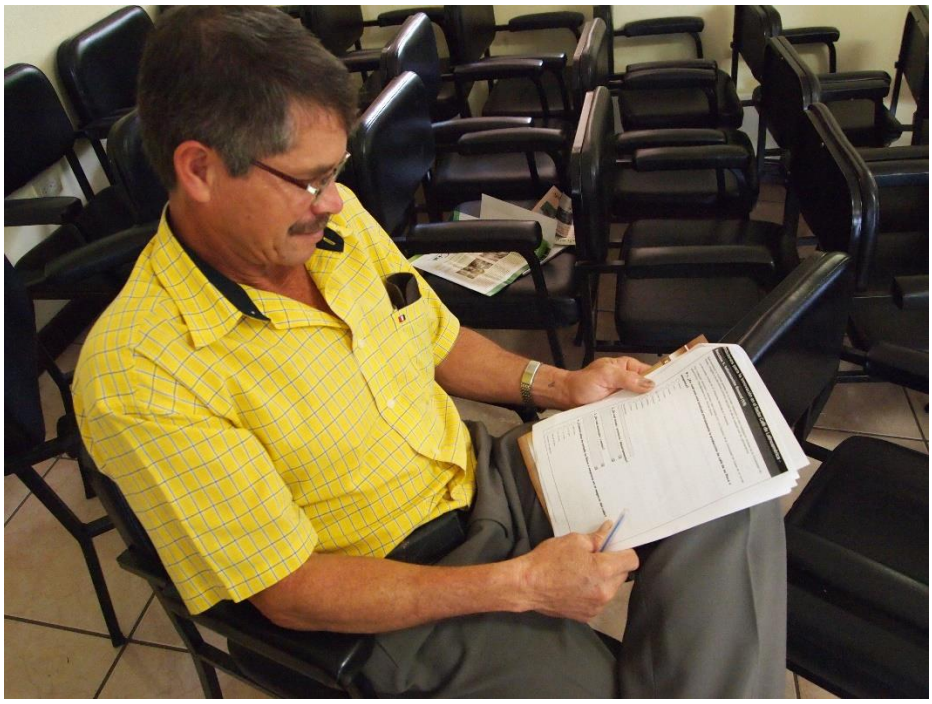



NIKE


FINAL TOUCH

2.3. Workshop 3. July 26th, 2012. 2:00 pm. Típico La Sabana, San Marcos de Tarrazú, San José Costa Rica.

2.4. Workshop 4. Aug 09th. 8:30 am. Coopevictoria, Grecia, Alajuela, Costa Rica.

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