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Understanding participation in modern supply chains under a social network perspective – evidence from blackberry farmers in the Ecuadorian Andes

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Abstract. In this paper, we use semi-structured interviews with firm representatives and original survey data to study the factors influencing farmers' participation in modern supply chains in the Ecuadorian blackberry sector. Previous research has emphasized the important role of farm size and non-farm assets enabling participation in these chains. Going beyond this scope of analysis, we argue that farmers' social networks can be an important avenue to facilitate inclusion. Using different probit model specifications, we find that individual farmers' social networks are important determinants for participation in modern supply chains in an environment characterized by a homogenous farm sector. Further research is needed to explore the specific pathways through which social networks exert their influence.

Keywords. supply chains, social networks, blackberries, food markets, transaction costs, Ecuador

JEL codes. D23, D80, Q13, Z13

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1. INTRODUCTION

Over the past two decades, developing country agrifood markets have undergone structural changes from the consumption of staple foods towards growing demand for safer and higher quality fresh produce and processed food (World Bank, 2007). Agrifood industry firms have reacted to these new domestic market conditions with a systematic adjustment and reorganization of their procurement practices termed modernization (Biénabe, Berdegué, & Peppelenbos, 2011; Reardon, Timmer, Barrett, & Berdegué, 2003). Lead firms[1] in agrifood supply chains have introduced explicit requirements on product quality, delivery schedules and supply volumes of agricultural products which these actors convey and supervise through close types of vertical coordination like verbal agreements or written contracts (Reardon, Barrett, Berdegué, & Swinnen, 2009). The system of transformed modern supply chains implies broader marketing opportunities for farmers that offer a number of benefits such as higher prices (Rao & Qaim, 2010) or better access to farm inputs and extension services (Miyata, Minot, & Hu, 2009) that affect poverty outcomes. Yet, farmers often face high barriers to enter these supply chains that stem from the stringent demands of the modern agrifood industry (Reardon, Barrett, Berdegué, & Swinnen, 2009). From a development policy perspective, it is therefore essential to understand what kind of and how farmers are able to respond to these structural changes in market conditions which may have direct implications for farm incomes and wider agricultural product markets.

Previous research has largely applied household and farm level perspectives in order to explain patterns of modern supply chain participation among farmers. In this article, we extend this scope of analysis by drawing on theoretical and empirical reasoning of the literature on social networks in developing countries. Research in this strand of literature demonstrates that the economic behavior of households – such as entering modern supply chains – may not only be the result of an individual decision but also depend on the behavior of individual social network members. For example, Matuschke & Qaim (2009) and Bandiera & Rasul (2006) find a positive relationship between the seed adoption decision of farmers and the adoption decision of their network members. Further empirical evidence suggests that different types of social networks can play an important role for access to credit (Wydick, Hayes, & Kemp, 2011; Okten & Osili, 2004) and for participation in non-farm employment (Mano, Yamano, Suzuki, & Matsumoto, 2011; Zhang & Ly, 2003).

Despite of the close link between households' decision-making and the decisions of their individual social networks, there is surprisingly scant evidence on the influence of social networks on farmers' participation in modern supply chains. We build on the heuristic model outlined in Reardon, Barrett, Berdegué & Swinnen (2009) that was laid out under the assumption that farmers may *choose* to participate in modern

[1] We consider a chain actor a lead firm, when it can exert sufficient power to exercise control over what, when, how and how much will be produced.

supply chains which depends on a number of household and farm level characteristic. A *choice*, however, would require that farmers are aware of several marketing options – in particular the modern one(s) – in order to be able to make an informed decision where to sell. This might not be very realistic in many rural contexts in which farmers may simply not be aware of modern channels that to a large extent have only recently emerged and are usually much thinner in terms of volumes than traditional ones. As a result, modern supply chains might be hidden or invisible implying that farmers in fact cannot *choose* this channel. Farmers' social networks can help to overcome the problem of limited access to information about modern supply chains either through farmers that have already entered these chains or 'bridging' contacts that can link farmers to sourcing agents of these particular chains. We argue that participation is not only influenced by the behaviour and characteristics of farmers, but also the buyers' preferences and choices. In order to be chosen by the buyer, the farmer has to be 'known' to buyers or their business and social contacts, a fact that has been overlooked in available studies so far. Invisible farmers would even not be considered as a potential supplier.

We further argue in this study that previous research has often over-generalized the importance of farm size and agricultural assets – such as irrigation systems, greenhouses, plastic mulching – that can assist farmers to meet the requirements of modern lead firms. More importantly, we believe that these tendencies are highly context-specific and depend on factors such as the structure of the farm sector, degree of technology-intensity of cultivation practices, and agro-ecological conditions. We present empirical evidence from an environment that is characterized by a homogenous small farm sector, relative equal distribution of agricultural assets and high labor-intensity of production. In this context, procurement agents of the modern agrifood industry face high level of transaction costs for arranging supply relationships, because large-scale, capital-intensive and therefore presumably more commercially oriented farmers are missing that might lead to increasing reliance on the procurement agents' network of contacts to discover capable smaller farmers.

We contribute to the existing literature in three ways. First, we integrate the two literature strands on the determinants of participation in modern supply chains in developing countries and the effects of social networks on individual economic behavior. We intend to motivate follow-up studies in this research direction. Second, we apply different model specifications and explore whether farmers' social networks matters for participation in modern supply chains. Third, given the hype about the supermarket revolution (Guarín, 2013), we seek to draw attention to the largely underestimated role of modernization strategies among agro-processing firms and respective consequences for the organization of agrifood supply chains. This has to be seen against the background of higher shares of processed and semi-processed product sales in modern retail – as compared to fresh fruits and vegetables (FFV) – which implies that processing firms

exert substantial influence on the procurement practices of many food items sold in supermarket shelves (Humphrey, 2007).

Our study touches upon a number of important policy decisions. The allocation of funds and resources to policy interventions targeting the inclusion of farmers in modern supply chains necessitates a thorough understanding of famers' barriers to entry which will have to be removed. For example, tailor-made support programs that address factors at the household or farm level such as provision of irrigation systems or extension services on post-harvest practices might be ineffective when the hurdle for participation in fact stems from limited access to information and unawareness of these marketing opportunities that might call for a more comprehensive solution aimed at whole communities. Moreover, a successful policy strategy of responding to the structural changes of agrifood market conditions in developing countries in a poverty reducing manner must more extensively focus on to the procurement decisions of agro-processors which might become influential for shaping the transformation of agrifood supply chains.

We will address these questions by building on fieldwork conducted in the Ecuadorian Andes between November 2012 and March 2013. We carried out semi-structured interviews with key informants of up- and downstream actors operating at different nodes in the blackberry supply chain. In addition, we organized a household survey with blackberry growers in Tungurahua Province. We chose the blackberry sector, because the cultivation and marketing of blackberries is an important livelihood strategy for a large number of smallholder farmers. The organization of the blackberry sector further allows sufficient variation in marketing channels that is crucial for the design of this study. Blackberry products are traditionally highly appreciated by Ecuadorian consumers and have experienced growing demand in the national market. It thus serves as a reasonable example for the rise of high-value markets in developing countries and the induced changes in market conditions.

The article proceeds as follows. In section 2, we review the relevant literature on modern supply chains and social networks and combine these two streams of literature. Section 3 provides background information on the blackberry sector in Ecuador and the respective characteristics of the supply chains. Subsequently, we inform about the underlying data and methodology. The estimation strategy is presented in Section 5, before we discuss descriptive and econometric results in section 6. We conclude with policy recommendations in the last section.

2. LITERATURE REVIEW

2.1 RESTRUCTURING OF NATIONAL AGRIFOOD MARKETS IN DEVELOPING COUNTRIES

An extensive body of literature has highlighted the transformation of domestic agrifood markets in developing countries and the resulting implications for the farm sector and rural development. Following the

general structure outlined by Humphrey (2007), the impact pathways in this strand of literature can be summarized in four arguments. First, consumer preferences in developing countries have changed towards higher quality and healthier food products which results in increasing importance of the modern agrifood industry[2] in the overall food market that is able to provide these products with the desired attributes demanded by consumers. Second, the sales of the categories of FFV and semi-processed and processed food in modern retail formats are expanding. Third, the modern agrifood food industry introduces novel sourcing practices for agricultural products which, fourth, will have profound implications for farm production and the welfare of farm households. We will address each argument more thoroughly in the following.

In many developing countries, consumer preferences have shifted from the consumption of staple foods to higher value and safer food products such as FFV, meat, dairy, and other processed products (Reardon, Barrett, Berdegué, & Swinnen, 2009). For example, in Indonesia food consumption expenditure has risen sharply between 1981 and 2005 for meat, fish and dairy products, FFV, and prepared foods while expenditure for traditional staples as cereals and tubers shrank (World Bank, 2007). This shift can be attributed to supply- and demand-side factors that vary in their magnitude and depth. On the supply side, market liberalization policies in developing countries have spurred massive foreign direct investments (FDI) in the agro-processing and retail sector. Multinational firms tapped new markets in order to compensate saturating demand and fierce competition in their host economies (Reardon, Timmer, Barrett, & Berdegué, 2003). Available studies have particularly emphasized FDI undertaken by large supermarket chains as Walmart or Carrefour, but largely ignored the market entry of agro-processing firms and their consequences on domestic market restructuring in developing countries (Dries & Swinnen, 2004; Wilkinson, 2004). A second supply side driver relates to the introduction of centralized procurement systems in the modern retail sector that allows the implementation of standardized procedures for quality control (Reardon, Timmer, Barrett, & Berdegué, 2003). On the demand side, income growth has led to rising demand for non-staple food products and increasing ownership of cars and refrigerators which favors the purchase of high-value and processed products from modern retailers (Reardon & Berdegué, 2002). In addition, raising urbanization rates especially among young people has broadened the potential consumer base of supermarkets and exposed consumers to global diets and lifestyles (World Bank, 2007) while entry of women into labor markets reduced their time availability for home cooking at the expense of purchasing convenience and processed food (Reardon, Timmer, Barrett, & Berdegué, 2003).

The second element in this line of argumentation deals with the magnitude of the above explained change in consumer preferences and the role of modern retail formats. Appropriate indicators to measure this magnitude are supermarket food sales in total retail food sales as this captures both higher quality FFV and processed products. Data on shares of supermarket sales in total retail sales provide a fairly clear pic-

[2] In this article, modern agrifood industry refers to both sectors, retailing and agro-processing that have experienced modernization of procurement systems.

ture. In Latin America for example, supermarkets made up 50-60% of national food retail already by 2000 (Reardon, Timmer, Barrett, & Berdegué, 2003). Despite of the general importance of supermarkets for the food system in developing countries, the extent differs across different food categories. For FFV sales in supermarkets, the shares in total food retailing are much lower than for processed foods. This is largely due to resilience of traditional markets like corner stores that consumers prefer because of their perceived lower prices and better freshness (Cadilhon, Moustier, Poole, Giac Tam, & Fearne, 2006). For the case of FFV sold in supermarkets, there is a direct link from supermarkets to the farm sector. For processed and semi-processed food items sold in supermarkets, however, the impact on the farm sector is channeled through the strategies of lead firms in the agro-processing sector (Humphrey, 2007).

The third element in this line of reasoning is associated with a change in procurement practices among the modern agrifood industry. This has become necessary in order to be able to more efficiently respond to the changing consumer preferences or was introduced by foreign-owned companies that undertook FDI in developing countries. Another motivation was to strategically differentiate from competitors in traditional retail food markets (Biénabe, Berdegué, & Peppelenbos, 2011). This change is referred to as the modernization of procurement practices in the literature (Reardon, Barrett, Berdegué, & Swinnen, 2009). As compared to traditional, modern procurement systems lower transaction costs by exercising tighter control over cultivation techniques, product quality and transaction specifications (Hernández, Reardon, & Berdegué, 2007). This procurement model is characterized by four elements: (1) The introduction of private norms and standards to assure product quality and safety, (2) a shift from spot-market transactions to more explicit forms of vertical coordination like contracts specifying quality parameters, volume and delivery times of farm products (3) reliance on specialized procurement agents – usually traders – that are commissioned with sourcing agricultural products from farmers (4) the implementation of centralized procurement through distribution centers (Berdegué, Balsevich, Flores, & Reardon, 2005). Although the latter has largely been discussed in the context of retailing, all four elements were introduced in both, the agro-processing and retail sector (Reardon, Barrett, Berdegué, & Swinnen, 2009). There is seldom a simultaneous introduction of all four elements, however, which implies a varying degree of procurement modernization across sectors, products and countries.

The last aspect of this chain of argumentation infers the potential impacts from these modern procurement practices implemented by the modern agrifood industry on the farm sector and on welfare of farm households. On the one hand, it is argued that modern supply chains create opportunities for farmers to tap into markets that offer various incentives and benefits such as price premia (Hernández, Berdegué, & Reardon, 2012), more price stability and, thus, reduction of price risks (Michelson, Reardon, & Perez, 2011), better access to inputs and credit through resource-providing contracts, and transfer of technology and knowledge about farming practices through farm assistance programs (Miyata, Minot, & Hu, 2009). On

the other hand, concerns are raised that particular groups of disadvantaged farmers might be excluded given the stringent requirements in these markets and the smaller product volumes demanded from the industry (Reardon, Barrett, Berdegué, & Swinnen, 2009).

Against this background, an extensive body of literature has examined factors that influence farmers' access to these modern supply chains. The major part of this discussion has been centered on the extent to which small farmers can be included in these chains presupposing that the farm sector is scale-dualistic. One of the reasons for exclusion of small farmers from modern supply chains is the missing economies of scale in production. Neven & Reardon (2004) for supermarkets, and Stringer, Sang & Croppenstedt (2009) and Swinnen (2004) for the agro-processing sector and show that firms operating in this industry prefer to source from large-scale and probably more capable and commercially oriented farmers to avoid the high transaction costs incurred when sourcing from numerous small farmers. Likewise, Hernández, Berdegué & Reardon (2012) for guava supplied to modern markets in México and Escobal & Cavero (2011) for potatoes sold to agro-processors in Peru identify a positive effect of farm size on access to the particular chain under analysis. The empirical evidence on the influence of farm size on access to modern channels, however, is much more mixed than widely believed. Consequently, Dries & Swinnen (2004) for milk sales to agro-processors in Poland, Blandon, Henson & Cranfield (2009) for FFV supplied to supermarkets in Honduras, Hernández, Reardon & Berdegué (2007) for tomatoes delivered to supermarkets in Guatemala and Myata, Minot & Hu (2009) for apples and green onions sold to packers in China find that farm size does not play a role for participation in modern supply chains. A possible avenue to compensate for missing individual economies of scale is to engage in collective marketing activities by forming farmer groups. This is advantageous from the perspective of modern agrifood companies, since entering supply relationships with farmer organizations would increase delivery volumes and therefore reduce transaction costs. Membership in a farmer group can thus be an important determinant of access to modern supply chains which some studies demonstrate (Escobal & Cavero, 2011; Moustier, Thi Giac Tam, Dao The Anh, Vu Trong Binh, & Thi Tan Loc, 2010).

Another factor that may cause farmers' exclusion from modern supply chains is related to the ownership of two types of assets: farm and non-farm assets. Ownership of farm assets such as irrigation or other more advanced farming technology can help farmers to produce year-round and consistent produce with the quality attributes demanded by the modern food industry. Empirical evidence suggests that irrigation systems (Escobal & Cavero, 2011; Hernández, Reardon, & Berdegué, 2007), plastic mulching (Berdegué, Hernández, & Reardon, 2008) and cooling tanks (Dries & Swinnen, 2004) can be crucial for access to modern supply chains. Other studies (Escobal & Cavero, 2011; Rao & Qaim, 2010) have shown that the availability of non-farm assets such as vehicles can be important, because firms may expect that farmers transport their farm products themselves to a collection point. When this is the case, in particular small

farmers might be excluded, since acquiring a vehicle involves considerable costs (Reardon, Barrett, Berdegué, & Swinnen, 2009).

When members of farm households are employed in non-farm activities, we may expect opposing effects on participation in modern markets. Hernández, Reardon & Berdegué (2007) show that non-farm employment (NFE) is negatively related to access, because cultivating crops with high quality attributes is often labor-intensive and thus requires abundant family labor dedicated to these activities which would not be the case if household members participate in NFE. Conversely, Rao & Qaim (2010) find that farmers engaged in NFE can also gain access to modern marketing channels. The underlying link could be that NFE households can generate higher incomes that can be used for investment in farm technology. NFE may also be a livelihood diversification strategy that can mitigate the risks associated with production rejection or payment delay when entering more sophisticated supply relationships.

The last dimension of factors influencing farmers' participation in modern supply chains relates to their geographic location and spatial proximity. Hernández, Reardon & Berdegué (2007) and Hernández, Berdegué & Reardon (2012) show that farmers are more likely to be included if their homestead is located closer to paved roads. Berdegué, Hernández & Reardon (2008) find a strong and negative influence of the distance of farmers' homestead to agro-processing plants and participation in this channel. Likewise, Vásquez & Poole (2006) suggest that the local endowment with adequate physical infrastructure is an essential factor for the integration of potato farmers into supply chains of agro-processing firms. These observations reflect two issues: first, the importance of adequate road infrastructure to avoid fruit damage and quality losses during transport and second, the necessity of spatial proximity, since remoteness drives up transportation costs. Another geographic context that is advantageous for farmers' inclusion in modern supply chains is their location in specific districts. For example, Hernández, Berdegué & Reardon (2012) reveal that farmers are more likely to enter these chains, when their farm is located in more commercially developed districts. Furthermore, Escobal & Cavero (2011) observe that farmers located in districts with a high concentration of medium- to large-scale growers are more likely to gain access.

2.2 SOCIAL NETWORKS

In recent years, the number of studies that explore the effects of social networks has grown rapidly, but has been outnumbered by the extensive body of literature on food supply chains. The underlying assumption of network research is that the behavior of social network members is able to influence household decision-making that may directly affect welfare outcomes (Maertens & Barrett, 2012). Social network can be an important source of information and a welcome opportunity to engage in social learning. This is particularly important in the light of imperfect markets, limited access to information, weak public extension services and geographical remoteness that many poor households face in the rural areas of the devel-

oping world (Ma, Spielman, Nazli, Zambrano, Zaidi, & Kouser, 2014). A social network can be defined as "individual members (nodes) and the links among them through which information, money, goods or services flow" (Maertens & Barrett, 2012, p. 353). These links may be unidirectional (for example, from early to late adopters of agricultural technology) or bidirectional (for example, between two farmers that simultaneously adopt the same technology) (ibid., 2012).

The effects of social networks have become the focus of attention in different research directions. First, social networks have been integrated into models that explain agricultural technology adoption such as improved plant varieties. Despite of its potential for productivity increase and food security (Matuschke & Qaim, 2009), improved technologies are not adopted uniformly, but adoption depends on household and farm level factors which has been extended by the introduction of social network analysis (Maertens & Barrett, 2012). Social networks are considered as important mechanisms for the diffusion of information about these technologies that offer the opportunity for network members to engage in social learning and compensate for missing or weak public extension and technology transfer services (Ma, Spielman, Nazli, Zambrano, Zaidi, & Kouser, 2014). Empirical evidence indeed suggests that the adoption decision of farmers' social network members positively influences the adoption decision the individual farmer. For example, Bandiera & Rasul (2006) demonstrate that the number of sunflower adopters among farmers' family and friends positively affects the individual farmer's propensity to adopt sunflower. Further survey-based evidence suggests that farmers' individual social networks are positively related to the adoption of hybrid seeds (Matuschke & Qaim, 2009) and Bt-cotton (Ma, Spielman, Nazli, Zambrano, Zaidi, Kouser, 2014). Wollni & Andersson (2014) find that the adoption of organic agriculture is strongly influenced by the availability of information in farmers' neighborhood networks.

In a second literature stream, the notion of social networks has been used to explain diversification of income activities. Johny, Wichmann & Swallow (2014) find that a higher diversification of income activities in households' social networks has a positive effect on the diversification strategy of that particular household. Likewise, Mano, Yamano, Suzuki & Matsumoto (2011) examine employment processes in the cut flower industry of Ethiopia. They find that local and personal networks are important recruitment channels as they enable the dissemination of information about employment opportunities in this sector.

A third line of research explores the role of social networks for improved access to credits in developing countries. Wydick, Hayes & Kempf (2011) analyze determinants of microfinance borrowing and discover that households are more likely to gain access to microfinance when members of their church network and geographical neighbors have already obtained a microfinance credit. Similarly, Okten & Osili (2004) show that participation in community meetings and the number of economically active siblings positively affects an individuals' access to credit.

2.3 SYNTHESIS OF SUPPLY CHAIN AND NETWORK RESEARCH

In the previous two chapters we have reviewed two key issues. First, the restructuring of agrifood markets and supply chains in developing countries that has sparked a systematic reorganization – the modernization – of procurement practices among agrifood firms. The potential socio-economic implications of these practices for the farm sector have been discussed. Second, we have summarized literature from different streams that emphasize the ability of social networks to influence decisions and the economic behavior and situation of households. We will combine ideas of these two literature strands and elaborate on potential underlying pathways that could support our hypothesis that social networks play a role for participation in modern supply chains. We draw on four common hypotheses regarding the influence of networks on farmers' access to modern marketing channels.

We begin the explanation of the *'information cost hypothesis'* (Mano, Yamano, Suzuki, & Matsumoto, 2011) with our view of a general misconception of the entrepreneurial decision-making of farmers. Studies on farmers' access to modern supply chains have been designed and modeled under the assumption of a marketing channel *choice* (Reardon, Barrett, Berdegué, & Swinnen, 2009). *Choice* implies, however, that farmers have the chance to make a decision between more than one option, in this case marketing options. This might not be very realistic in many rural contexts, since farmers may simply not be aware of or lack information on certain marketing opportunities, in particular not of modern chains that have limited access and are usually much thinner in terms of absorbed volume. These modern supply chains may appear to be hidden or invisible to farmers such that they essentially do not have a choice. Social networks may be a source of information and promising avenue to share valuable experience through word-of-mouth about marketing opportunities other farmers were not aware of. Farmers can learn how to adapt their production and harvest practices which would make it more likely to be chosen as supplier of the demanding sourcing agents. Information on these chains, however, is not ubiquitous, but tends to circulate among certain groups of farmers – in particular farmers that have already entered modern supply chains. The latter may also disseminate information about the reliability or trustworthiness of the buyer in a modern channel to their social network members (Wydick, Hayes, & Kempf, 2011). This is relevant, because payment delay or opportunistic behavior in such modern supply relationships is not uncommon (Barrett, Bachke, Bellemare, Michelson, Narayanan, & Walker, 2011). Moreover, in traditional societies where cultural habits lead to mistrust and reluctance to do business with strangers, such indications might be essential.

The second underlying process behind the influence of social networks on participation in modern supply chains is called the *'screening hypothesis'* (Mano, Yamano, Suzuki, & Matsumoto, 2011; Wydick, Hayes, & Kempf, 2011). Here we have to change the perspective from the farmer to the buyer that sources and

delivers farm products along a modern supply chain. The farmers' capability to meet the stringent requirements in modern chains is usually unobserved for the buyer. This hidden information to be buyer arises from asymmetric information, because farmers are obviously better informed if they are capable of complying with the requirements than the buyer. Information asymmetry in turn increases uncertainty among the buyer and leads to a higher level of transaction costs. A potential solution to this is screening when buyers rely on the introduction of the so far unknown farmer B as a potential supplier who belongs to the social network of farmer A who is already a supplier. The buyer can be certain that A would recommend a motivated, capable and reliable fellow farmer, because A would not risk losing trust or even jeopardizing the existing supply relationship with the buyer. This might be of particular relevance in agricultural marketing systems in which farmers' breaching of previous marketing agreements is common in order to take advantage of seasonally higher prices offered in alternative market outlets (Barrett, Bachke, Bellemare, Michelson, Narayanan, & Walker, 2011). Under these circumstances, buyers may face unexpected shortfalls in supply volumes. The loss in produce volume incurred and the fear of jeopardizing marketing relationships with downstream actors requires a flexible and quick reaction of the buyer. In order to effectively reduce additional transaction costs, the buyer may rely on the recommendation of a farmer who belongs to the social network of an already supplying farmer.

The *'peer-pressure hypothesis'* assumes that buyers incur costs for monitoring the normally unobserved behavior of farmers after supply agreements have been made which is termed hidden action (Mano, Yamano, Suzuki, & Matsumoto, 2011). This situation can be circumvented or monitoring costs at least be reduced when farmer A has been accepted as supplier with the introduction through farmer B. Farmer A will then make sufficient effort to avoid that farmer B looses reputation or jeopardizes the supply relationships.

Piracha, Tani & Varia-Lucero (2013) and Milagrosa & Slangen (2006) emphasize the *multidimensional character* of social networks and compute indexes to measure the effect on labor market performance and to determine the general endowment with social capital. This is plausible, because this index measures the overall social connectedness. It might be that farmers with higher social connectedness are more likely to be able to informally meet the 'right' people that can be key to open doors and to successfully link the farmer to a buyer of a modern supply chain. For example, it could be that governmental employees in agricultural departments closely interact with the agrifood industry to figure out their business constraints or to improve their business environment. Agrifood firms may rely on these employees in order to establish contacts with potential farmer suppliers, because they are usually well informed about the environment and capabilities of farmers and enjoy a good reputation among them. Therefore, it could be an efficient and transaction cost reducing strategy for the buyer to take advantage of the network of farmer contacts of employees or other actors such as NGOs in order to select farmers as suppliers. This appears to be

of particular importance in contexts of a homogenous small farm sector in which the larger and probably more commercial farmers are simply not present which raises the buyer's transaction costs. In the case of potato growers in Peru, Escobal & Cavero (2011) show that NGOs are able to provide such links and support farmers in negotiating contracts with agro-processing firms

3. CONTEXT – THE FOOD MARKET AND BLACKBERRY SECTOR IN ECUADOR

3.1 STRUCTURE AND DYNAMICS OF THE ECUADORIAN FOOD MARKET

The Ecuadorian retail food market can be divided into five formats i) supermarkets & hypermarkets, ii) grocery stores, iii) independent small stores, iv) mini marts and v) traditional wet markets (USDA, 2003). Supermarkets & hypermarkets are the most rapidly growing retail form. Estimates suggest that 34% of Ecuadorian consumers – 4.5 million people – shop food products in a super- or hypermarket[3]. Their average monthly food expense in this retail form amounts to $160. In the middle- and upper-income group the ratio of supermarket food shopping is even higher and account for 68% (USDA, 2003). The market share of supermarkets in total retail food sales further underlines the importance for the national food market. According to recent estimates, this market share is 40% that places Ecuador in a middle position in the Latin American context (World Bank, 2007). The share of this dominant retail format is followed by traditional wet markets (25%), grocery stores (15%), mini marts (10%) and independent stores (10%). Available retail market data also demonstrate an expansion of the number of supermarket stores from 85 in 1998 to around 160 in 2004 (Zamora, 2007).

The growing importance of modern retail outlets is driven by major two factors. First, the entry of women in labor markets. This has led to higher household income spurring demand for higher-quality supermarket food products. It has also reduced the availability of time for cooking which results in more frequent purchase of convenience and processed foods. The second driving factor relates to the large number of Ecuadorian emigrants that have adopted foreign diets and lifestyles that are either passed on to their Ecuadorian siblings or introduced when migrants return to their home country (USDA, 2004). Currently, there are four modern retail chains operating in the country. Interestingly, all have Ecuadorian ownership (Zamora, 2007) which is in marked contrast to the dominant pattern of market entry of multinational chains such as Walmart, Casino or Carrefour that can be observed in other Latin American countries (Reardon & Berdegué, 2002). The Ecuadorian retail market is led by the retail chains La Favorita and El Rosado that incorporate different retail outlets like hypermarkets, supermarkets or discount stores. Their combined retail market share ranges from 37% (Zamora, 2007) to 55% (USDA, 2003) and constitutes 57% of all modern retail stores in the country (Zamora, 2007).

[3] Although we recognize differences between supermarket and hypermarket, for reasons of simplicity we use the term supermarket in the following that refers to both retail forms.

The Ecuadorian food processing sector takes advantage of the countries' rich and diverse agricultural resources that originate from various agro-ecological zones allowing the year-round cultivation of fresh produce (USDA, 2009). In recent years, this industry has witnessed growing demand for consumer-ready processed food products that is partly generated by raising consumer awareness for higher quality and safer food products. Nowadays, food processing is an important economic activity in Ecuador as it contributes 45% to the manufacturing GDP. Despite of its importance, the food processing industry is marked by a dualistic technological level. A small number of large technologically advanced processors compete with a larger number of small food processing firms that mainly rely on traditional production processes (USDA, 2013). A closer look at the ownership structures of food processors operating in Ecuador is essential, because it can have consequences for the adoption of stringent vertical coordination mechanisms along the supply chain. As opposed to the retail sector that is dominated by Ecuadorian firms, the food processing sector is characterized by a mixed structure. On the one hand, we find substantial presence of multinational companies such as Nestlé, Quicornac, and Tampico Beverages which have entered the Ecuadorian market either through foreign direct investments in production plants or different types of firm cooperation like joint ventures or license agreements. On the other hand, there are also a large number of Ecuadorian firms present in the market that are dedicated to processing of meat, milk, fruits and other raw materials.

3.2 BLACKBERRY CULTIVATION

Blackberry is a plant that originates from cold and moderately warm climates of the Andes mountain range in Ecuador and Colombia, but has been introduced later on also in Guatemala, Panamá and México. Today, the latter is one of the biggest exporters of this fruit (INIAP, 2010). Blackberry plants require specific agro-climatic conditions to grow such as a precipitation of 600-800 mm per year and an average temperature of 12-13 °C. These optimal growing conditions are usually found in high altitudes of 2,400-3,100 m. The geographic areas in Ecuador that can offer these conditions are situated in the inter-Andean valley. The favorable conditions in this zone allow a year-round and often weekly blackberry harvest. The harvest volume seasonally varies, however, due to changing climatic conditions (INIAP, 2008). The cultivation practices of blackberry are highly labor-intensive as they involve a number of activities such as pruning or hand picking that can hardly be mechanized. Household members that participate in the cultivation techniques can be an important asset, because production costs are reduced as less farm laborers have to be recruited. Ecuadorian farmers cultivate a broad range of blackberry varieties. These can be differentiated by their taste, size, water- and sugar content and firmness. The variety *blackberry de castilla* is the most widely grown, reaching 98% in terms of area under cultivation (INIAP, 2010). Blackberry is inherently susceptible to physical damage and therefore requires careful handling during harvest and postharvest

activities to avoid deterioration in quality. Furthermore, it is a highly perishable fruit which make short storage time and rapid transport essential.

Most recent statistical information obtained from the latest Ecuadorian agricultural census of 2000 indicates that the total national area under blackberry cultivation amounts to 5,247 ha (MAGAP, 2014a). The cultivation of blackberry is geographically concentrated in the inter-Andean valley. The three central Andean provinces Tungurahua (2,223 ha), Cotopaxi (1,360 ha) and Bolívar (1,098 ha) alone account for nearly 90% of the national area under blackberry cultivation (MAGAP, 2014b). Given the dearth of current agricultural data, we interviewed sector experts in order to ensure validity of agricultural census data. Interviewees reported that the area under blackberry cultivation has shrunk considerably over the past years. Their estimates suggest that current national area under blackberry cultivation amounts to 2,200 ha. Furthermore, key informants explained that the blackberry farm sector is dominated by small farmers, who commonly combine blackberries with the cultivation of a wide range of other fruits such as apples, pears or strawberries and staple foods such as potatoes, beans or maize.

3.3 ORGANIZATION OF THE BLACKBERRY SUPPLY CHAIN

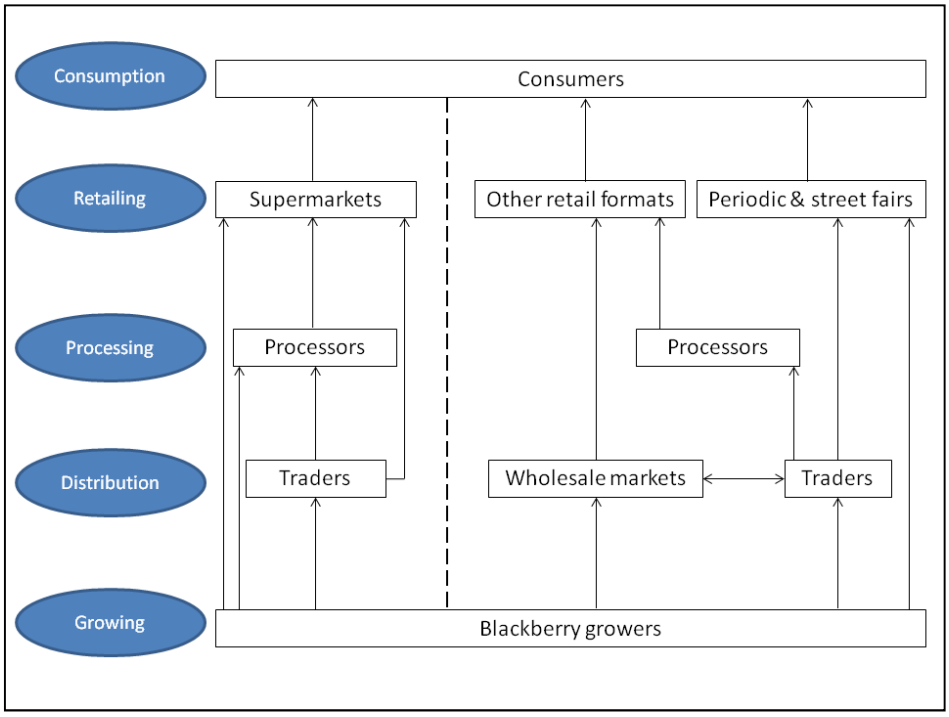
The consumption of fresh blackberries and processed blackberry products is a cultural habit and long-standing tradition in Ecuador. This Ecuadorian custom ensures a stable albeit growing blackberry demand in the national market. Consumers are attracted by the fruit's aromatic taste, its excellent nutritional values and perceived health benefits, i.e. the high level of antioxidant capacity. Ecuadorian families consume fresh blackberry and processed blackberry products on a daily basis with an average weekly consumption of two kg per family (Corpei, 2009; INIAP, 2010). As opposed to the dynamic domestic market, recent years indicate only marginal export volumes. The maximum export quantity with 27.2 t was recorded in 2004 (Corpei, 2009). Therefore, we solely focus on the dynamic domestic market in our analysis.

Figure 1 provides an overview of the Ecuadorian blackberry supply chain. The map depicts two sets of themes. First, vertically we can differentiate between production and marketing functions that are sequentially performed along the chain by their respective actors. Second, horizontally we distinguish between the modern supply chain on the left and the traditional supply chain on the right, both divided by a dotted line. Blackberry growers have a broad range of marketing opportunities as symbolized by the various arrows originating from the category 'blackberry growers' at the bottom of the map.

The dominant agricultural market outlet in the country is the wholesale market. Wholesale markets are located in the biggest market centers of the country such as Quito, Cuenca, Guayaquil and Ambato. The latter is the capital of Tungurahua province where we conducted fieldwork. It therefore deserves closer attention. The important position of the wholesale market in Ambato in the Ecuadorian food distribution system stems from its geographic location. Ambato has the necessary infrastructure conditions to effi-

ciently connect the town to Northern and Southern parts of the Andes and the Western and Eastern lowlands. Favorable agro-ecological conditions have stimulated the cultivation of a large diversity of fruits and vegetables. Both aspects have resulted in a long-standing tradition of this market that can be traced to the nineteenth century (Stadel & Moya, 1988).

Figure 1: Generic map of Ecuadorian blackberry supply chain



Source: Own elaboration based on INIAP (2010) and semi-structured interviews

The wholesale market in Ambato is periodic as it has five market days a week with one section of the market only dedicated to blackberries. Farmers directly pack blackberries into wooden baskets with a mean volume of 10 kg and use their own vehicles or public transport to bring their harvest to the market. Transactions are anonymously made out on the spot and typically governed by price that is negotiated directly on-side. This excludes prior agreement on product quality or other specifications and mostly rules out obligation to a long-term trading relationship. Within wholesale markets, farmers sell to two types of buyers. First, to wholesale market traders that rent their own stand in the market and second, to traders that purchase larger volumes and distribute them across the country. These two types of traders create strong bargaining power that enables them to exercise pressure on the price. One of the reasons for weak bargaining power among blackberry farmers is the perishability of blackberries. Once harvested, farmers that lack adequate storage facilities have to market their berries and accept the offered price. Moreover, public grading systems are missing in the Ecuadorian blackberry sector. This disincentives the production of non-standardized and higher quality blackberries, for example through careful selection or value-adding activi-

ties. As a result, traders face low switching costs in finding alternative farmer suppliers in these markets which enhances their bargaining power. The organization of the wholesale market bears three implications for farmers participating in blackberry marketing. First, the price which is the main coordination mechanism of transactions and the dearth of public grading regulations raise transaction costs for both actors, farmers and buyers. More specifically, search and negotiation costs that are two important categories of transaction costs will be affected. Second, high degree of power asymmetry and the seasonal price fluctuation of blackberries enhance price risks for farmers that participate in this market segment. This may impede or delay investments, for example in advanced farming technology. Third, despite of existing price risks, the wholesale market is a secure market outlet, because it nearly absorbs the full amount of supplied agricultural products independent of product quality and quantities. Product rejections are very rare in wholesale markets.

A second marketing opportunity in the traditional supply chain is to sell to traders. Traders directly pick-up blackberries at the farm-gate and frequently consolidate these purchases with the collection of additional fruits and vegetables to benefit from economies of scale in transport. Traders are fairly diverse in their scale of operation, but essential in their function as distributors, because they are able to overcome long distances, for example between Ambato and market centers in the Coastal region. In this region, traders typically supply the main trading centers that are usually wholesale markets. Figure 1 further depicts that farm-gate traders may also supply small-scale processors or open air and street fairs. Blackberry farmers may also directly sell to consumers in popular periodic markets called *plazas* or street fairs. Traditional retail formats such as kiosks or mini-marts typically offer fresh blackberries or blackberry products to consumers while purchasing from wholesale markets or small-scale suppliers.

In the following, we will turn the discussion to the modern segment of the blackberry supply chain. Based on the interviews conducted we can infer at least two major differences to the traditional chain. First, the modern chain is typically shorter and includes the following actors: farmers, traders, processors and supermarkets. Buyers of the modern chain entirely bypass the wholesale market[4]. Second and more importantly, marketing relationships are governed through closer vertical coordination that involves a usually verbal prior agreement between the transaction partners. These agreements specify product quality, quantity, delivery times and the price. Sporadically, transaction partners may also agree to sign a written contract. This shift from spot-market relationships that we can observe in traditional markets to more explicit types of vertical coordination is considered a central element of the modernization of procurement systems (Reardon, Barrett, Berdegué, & Swinnen, 2009). In our study context, the lead firms in the blackberry supply chain that pursue modern procurement strategies are agro-processors and modern retailers such as

[4] Firm representatives we interviewed reported to entirely circumvent the wholesale markets. We cannot rule out, however, that firms we were not able to interview source from the wholesale market.

super- and hypermarkets[5]. Next, we will elaborate on their product and transaction requirements and the consequences for their procurement practices.

Agro-processing firms use blackberries as raw materials for the production of juice, marmalade and pulps. The most important market outlet for the large majority of these firms is the domestic market. Companies targeting this market have outlined clear quality requirements that supplied blackberries have to match. Company representatives reported to demand blackberries with the following quality parameters: phyto-sanitary condition, appearance, degrees brix, pH and type of packaging. In terms of phytosanitary aspects, blackberries have to be free of fungus and other plant diseases which farmers can control by adequately applying fungicides. Fungicide residues, however, are not inspected in neither of the visited companies. Appearance is defined as the fruit color that determines the degree of ripeness and freshness. The moment of harvest is crucial for this which farmers are able to influence. Degrees brix indicate the sugar content of the fruit, while pH defines the acidity level of the berry. Agro-processors demand blackberries with high sugar content and mediocre pH which reflects the preferences of the consumers. Farmers can influence these parameters with the choice of the blackberry variety and their crop management practices. The ideal variety for meeting the demands of agro-processors is *blackberry de castilla* with thorns which is the most commonly grown variety among blackberry farmers. Farmers that envisage supplying to agro-processing firms must deliver their berries in plastic boxes. This type of packaging is important, because it reduces mechanical damage and bursting of the fruit during transport while preserving its quality attributes. This is different from many traditional channels in which wooden baskets are the main types of packaging. Apart from quality requirements, agro-processing firms insist on a weekly target volume and a clear delivery time that suppliers must comply with.

In Ecuadorian supermarkets, blackberries are sold in fresh, semi-processed (e.g. frozen, canned) or processed (e.g. juice, marmalade) forms. Agro-processors are responsible for supply chain coordination of semi-processed and processed products as they provide the supermarkets with these product categories. The case is different for fresh blackberries. Fresh blackberries originate directly from the farm which implies that the requirements of the supermarkets have to be put into practice in farm management. Interviews with supermarket managers have revealed stringent quality requirements for blackberry supply that relate to appearance. At the moment of delivery specific parameters such as size, shape, freshness or firmness are inspected and evaluated on the basis of predetermined norms. Pesticide residues are not inspected in neither of the visited supermarkets. Farmers are thus able to influence these parameters by carefully hand-picking the berries at the moment of harvest that produces the quality characteristics which conform to the guidelines of the supermarkets. Farmers also have to pay attention to the type of packaging. Supermarkets often prefer blackberries packed in accurate plastic clamshells of 250 g that are directly placed in

[5] In the following we will refer to supermarkets, when in fact we mean various modern retail formats.

the supermarket shelf. Supermarkets specify a weekly target volume and delivery time that suppliers must comply with.

After we have systematically described the supply requirements in the supermarket and agro-processing sector, we will now focus on the implications for their procurement strategies. We can differentiate between two supply models for the sectors: the farmer - firm and the farmer - specialized trader - firm model. Both models have in common that lead firms in the particular chain – supermarkets and agro-processing – have sufficient power to determine the governance of the supply relationships. The majority of these supply relationships between either of these actors are coordinated through verbal agreements. These agreements outline the product- and transaction-specific characteristics of the marketing relationships such as quality, quantity, delivery times and the price. Written contracts are only sporadically arranged. We can borrow from elements of transaction cost theory (TCT) to explain the choice of coordination mechanisms in the blackberry supply chain. TCT assumes that buyer and seller incur costs when carrying out a market exchange. These costs are termed transaction costs. Williamson (1979) argues that the type of governance structure of transactions bears the potential to lower transaction costs. The level of transaction costs in turn is determined by three characteristics of the transaction that are uncertainty, asset specificity and frequency. We draw on these three determinants in order to explain the choice of governance mechanisms.

Figure 1 depicts that the wholesale market is circumvented in modern supply chains. The reason for this is the prevalence of anonymous spot-market relationships in this market associated with imperfect information about cultivation, harvest and post-harvest practices that buyers cannot observe and control. From the buyer's perspective, this leads to a high degree of *uncertainty* about important product quality characteristics. Another driving force of high levels of uncertainty is the large number of continuously alternating sellers that buyers have to negotiate with, as repeated interactions are hardly feasible. Identifying a suitable trading partner in wholesale markets can thus involve considerable costs. *Asset specificity* relates to a non-standardized investment that is necessary to gain access to a certain – normally modern – market. Asset-specific investments are not relevant due to the labor-intensive nature of blackberry farming technology in the Ecuadorian Andes and the fact that the modern agrifood companies do not demand such investments from their suppliers. *Frequency* describes how often transactions are carried out with a given degree of uncertainty and asset-specificity. Lead firms in the blackberry supply chain usually place weekly orders such that frequency can be considered as high. In other words, the high level transaction costs arising from uncertainty that prevails in spot-market transactions of blackberries like in wholesale markets is intensified through the high frequency of transactions.

We have shown that blackberry procurement through spot-market relationships leads to a high level of transaction cost. Against this background, lead firms in the agrifood sector have applied mechanisms to

intensify vertical coordination. These vertical coordination mechanisms are verbal agreements and sometimes written contracts using preferred supplier lists. These governance forms allow exerting better control over cultivation practices and harvest as well as post-harvest handling of blackberries on the farm. Likewise, it will help to guarantee a constant supply volume at predetermined delivery times. As a result, uncertainty is reduced which will lower the firms' transaction costs.

Firm interviews have demonstrated that verbal agreements are the preferred coordination mechanism. We outline four arguments why contractual arrangements are scarce in the blackberry supply chain. First, from a theoretical point of view, participation in modern markets frequently requires quality enhancing asset-specific investments from farmers that are compensated through higher prices in this particular market. This would make it necessary to safeguard these investments through contracting which provides the farmer with guaranteed sales and higher and stable prices. In our study context, lead firms in blackberry supply chain do not demand such asset-specific investments from farmers. As a result, contractual arrangements are only sporadically implemented. Second, producer assistance programs that may include the provision of inputs or agricultural extension services are rarely offered to blackberry farmers. If provision of inputs were the case, firms would be more likely to implement contractual arrangements in order to closer bind farmers to their sourcing strategies. Third, farmers have expressed resistance to the formalization of marketing relationships. This is perceived as a risky entrepreneurial decision due to dependency on only one buyer and the threat of juridical consequences when not being able to comply with the requirements imposed by the buyer. Fourth, purchasing managers argued that contracts are not particularly helpful to guarantee farmers' compliance. Instead, they emphasize mutual respect, trust and regular communication as main determinants for compliance and for establishing a long-term marketing relationship. This may also point to a distinct business culture that prevails not only in the blackberry sector, but was also found for the Ecuadorian potato sector (Vásquez & Poole, 2006) and therefore might more generally reflect the business culture of the Ecuadorian Andes.

The role of specialized traders is indispensible for the organization of the modern supply chain. In many cases, supermarkets and agro-processors commission the procurement of blackberries to specialized traders. This is advantageous from the companies' perspective, because managing relationships with only few traders as compared to a large number of small farmers helps to lower the level of transaction costs. Traders are comprehensively trained about the requirements of the firms, before they receive the firms' orders. Traders address these orders by collecting blackberries directly from the farm where they carry out a first selection. In this context they can benefit from their large network of farmers and the familiarity with the local blackberry production zone. This is another advantage of traders which gives them the opportunity to flexibly and spontaneously react to shortfall in supply that may occur when farmers harvest small quanti-

ties for example. Traders frequently consolidate the pick-up of blackberries with the purchase of other FFV in order to take advantage of economies of scale in transport.

We also interviewed company representatives about the constraints they would face for their sourcing strategies. The responses can be summarized in four major constraints: First, traders explained that the majority of blackberry farmers traditionally sell to local or wholesale markets that typically involve spot-market relationships and conventional harvest and post-harvest techniques. For participation in modern blackberry supply chains, farmers would have to adapt these practices to the requirements of the lead firms. This adaption process, however, is slow, because many farmers lack seriousness and commitment to undertake the necessary changes. This would incur additional costs for training and supervision. Second, in times of seasonal price spikes in the blackberry market, farmers tend to break verbal agreements and side-sell to wholesale or local markets in order to benefit from higher prices. This dynamism of farmers entering and leaving modern chains may result in high coordination costs for sourcing agents like traders, since they would have to replace the loss in supply volume incurred when farmers decide to side-sell. Third, lead firms expressed their preferences to source blackberries from large-scale farmers, because these would be more capable and commercial and allow a reduction of transaction costs. The Ecuadorian blackberry sector, however, is composed of a large number of small farmers that have the potential to only produce small quantities. A potential avenue to compensate for missing economies of scale could be the formation of farmer groups that coordinate joint marketing efforts. Collective marketing efforts, however, remain rather rare among farmer groups. Fourth, blackberry production is characterized by seasonally changing agro-climatic conditions that result in unpredictable and unstable blackberry supply to the market. Changing supply leads to sharp price fluctuation in the market which prevents buyers from paying fixed prices throughout the year.

4. DATA

We carried out fieldwork in the Ecuadorian province of Tungurahua which is located in the Central Andes. This study area is suitable for our study design, because it is one of the major blackberry production zones in the country and the most important fruit catchment area of supermarkets and agro-processors as sector experts reported. Farm households engage in the cultivation of a variety of fruits and vegetables such as berries, apples, pears or onions in order to generate income and in the production of maize, potatoes or beans for subsistence. Another common and traditional livelihood activity in our study area is to keep livestock – in particular guinea pigs or rabbits – for sale or the production of manure.

The data collection was conducted in cooperation with the *Instituto Nacional de Investigaciones Agropecuarias* (INIAP). INIAP was particularly helpful in facilitating access to key informants in firms and to blackberry farmers. We collected data in two stages. First, between December 2012 and January 2013 we

held personal semi-structured interviews with key informants. We interviewed representatives – usually purchasing managers – of three supermarket chains and seven agro-processing firms and eight traders that supply these firms. In addition, we held informal interviews with blackberry growers usually after they had completed specific training courses. The objectives of these interviews were twofold: first, to reconstruct the blackberry supply chain and to better understand the organization of marketing relationships along this chain. Second, we carefully requested supplier lists of farmers that were necessary for the second stage of data collection. In stage two, we collected original survey data from blackberry farming households between February -and March 2013. The structured questionnaire contained several sections that elicited information on household and farm characteristics, agricultural production and production costs, social network activities, asset ownership. In addition, farmers provided detailed information on blackberry production and quality, blackberry production costs and sales proportion to different buyers or markets. We collected this recall data for the year 2012. Interviews were conducted face-to-face with the help of carefully selected local fieldwork assistants, who participated in an intensive training course and the pre-test of the questionnaire. For the cross-sectional design of our study we selected households based on a stratified random sampling technique. The two strata represent blackberry farmers that participate in modern supply chains and farmers participating only in traditional supply chains. We categorize farmers as participants of modern supply chains if they sold any blackberries in 2012 to a buyer that is either a modern lead firm such as a supermarket or an agro-processor or to a specialized trader that is commissioned as sourcing agents to supply to these firms. Despite of varying degrees of procurement modernization across the interviewed firms we observe a clear and common tendency towards modernization. Therefore, we can confidently treat the lead firms and their respective modernized procurement practices – which we explain in section 5 – as one homogenous group.

We used semi-structured interviews with agrifood sector companies in order to collect complete lists of blackberry farmers and traders operating in Tungurahua province. In case a farmer was a direct supplier to these companies we obtained the contact details of these farmers. In case a trader collects blackberries from farmers and delivers to these companies, the interview partner could only provide contact details of the traders. In a second step, we approached the traders and carefully asked for their preferred supplier lists of blackberry farmers. This has proven complicated, because several traders were simply not willing to disclose this information and some of the provided supplier lists were distorted. Yet, we managed to compile a list of 51 blackberry farmers that participate in modern supply chains. We oversampled this group of farmers and interviewed all of them in order to assure a sufficient coverage for the analysis. The second stratum is made up of blackberry farmers who exclusively participate in traditional supply chains. A compilation of contact details of all these farmers from which a random sample could have been drawn was not feasible due to budget and time constraints. Therefore, we first purposively chose the five *can-*

tones[6] that we already covered in first strata and added *cantones* Patate and Baños in order to ensure a representative and dispersed sample for the whole province. Second, we purposively selected *parroquias*[7] within the chosen *cantones* based on discussions with blackberry sector experts. The key criteria for selection was the presence of a sufficient number of blackberry farmers in *parroquias* and the possibility of compiling lists of these farmers with the help of blackberry sector experts, field-guides and enumerators. We interviewed 313 blackberry farmers that we categorize as traditional supply chain participants. Our full sample thus consists of 364 blackberry farming households.

5. ESTIMATION STRATEGY

Our first probit model estimates the probability of a farmer's participation in modern supply chains in the most general form:

(1) $MSC_i = \beta X_i + \varepsilon_i$

where MSC_i is a binary variable that equals one if a blackberry farmer participates in modern supply chains and zero otherwise. X_i refers to a set of explanatory variables that hypothetically influence participation and ε_i is the error term. The choice of explanatory variables is based on theoretical considerations in the literature review and field observations.

In the second model, we are interested in the individual social network effect on participation. We build on the literature of agricultural technology adoption (Bandiera & Rasul, 2006; Matuschke & Qaim, 2009) and include a variable that captures the number of modern supply chain suppliers in a farmer's social network. We elicited this information from farmers by asking them how many other farmers they would know that sell to agro-processing firms and supermarkets or their dedicated traders and if they would communicate with these farmers about blackberry marketing. This effect is commonly referred to as the endogenous social network effect in the literature (Bandiera & Rasul, 2002; Matuschke & Qaim, 2009; Wydick, Hayes, & Kempf, 2011), because it may capture the influence of the network on the individual farmer, but also the behavior of the individual that influences the network. Manski (1993) refers to this reverse causality issue as the reflection problem. Available studies suggest using an instrumental variable approach to address this problem (Okten & Osili, 2004; Matuschke & Qaim, 2009). The candidate instrument should be correlated with the potentially endogenous social network variable, but uncorrelated with any unobservable variables and the participation variable. Thus far, we were unfortunately not able to find a valid instrument. Furthermore, Matuschke & Qaim (2009) discuss exogenous social network effects on technology adoption among farmers. This refers to correlated unobservable characteristics of the farmer

[6] Canton is the second lowest administrative unit in Ecuador.
[7] Parish is the lowest administrative unit in Ecuador.

and their network members. In the case of agricultural technology adoption for example, it could be that the farmer and the network member share the same risk preferences or cultivate the same crops which would have an influence on network formation that may result in overestimation of the social network effect. As we do not have data on the characteristics of the social network members, we are not able to measure the exogenous effect. For the second model, we run the following regression:

(2) $MSC_i = \beta X_i + \gamma SN_i + \varepsilon_i$

where MSC_i is again the binary variable that equals one if a blackberry farmer participates in modern supply chains and zero otherwise. γ measures the individual social network effect. X_i refers to the same set of explanatory variables and ε_i is the error term.

It is conceivable, however, that the social network effect on participation in modern supply chains is not only established through farmers that already participate in these chains. There are potentially other key contacts among the farmers' network that are able to provide the necessary link to the buyer of a modern chain. We argue that institutional connectedness can be crucial to this. For example, it could be that farmers socially or professionally interact with governmental employees in agricultural departments. These employees in turn may maintain contacts with the agrifood industry in order to be informed about or to influence their business environment and constraints. Agrifood firms may rely on these employees and their network of farmer contacts in order to select these farmers as potential suppliers. This could be an efficient and transaction cost reducing strategy for the buyer. The foregoing would call for a multidimensional approach of social networks. Milagrosa & Slangen (2006) and Piracha, Tani & Vaira-Lucero (2013) propose an index to account for this multidimensionality. This is plausible, because an index circumvents collinearity problems among the variables of interest which would occur when including them separately in the regression. We follow this proposition and use principal component analysis (PCA) to compute a social network index (SNI). PCA is a statistical procedure which reduces the number of variables into smaller combinations that best explains the common information of these variables (Filmer & Pritchett, 2001). The advantage of PCA is that it statistically and therefore more objectively determines the weights for each of the included variables that form the index. As no standard procedure for variable selection for SNI exists, we propose to use the following variables: (1) Participation in farmer field day (dummy), (2) farmer associated with *cadena de la mora*[8] (lagged dummy), (3) membership in farmer group (lagged dummy), and (4) number of agricultural technicians in farmer's social network (lagged). The first three variables are dummy variables and take the values 0 or 1. Variable (4) is continuous and was therefore

[8] *Cadena de la mora en la Provincia de Tungurahua* is a public sector-led market linkage program with the objective of organizing and facilitating direct collective marketing with firms.

normalized by its mean and standard deviation to appear in the same range as the first three[9]. We are confident in using the first linear component to extract the scoring factor, because this component already explains 59% of the total variance. The scoring factors assigned to each variable are displayed in table 1. We also calculate the impact factor for each variable. This is calculated dividing the scoring factor of each variable by their standard deviation. The value of the impact factor describes the change in SNI if the variable moves from 0 to 1. For example, had a household participated in a farmer field day would increase its SNI by 1.043 points. In order to facilitate interpretation, we normalize the index result and obtain values ranging from 0 to 1. We test the reliability of our PCA by computing the Bartlett-Test of sphericity and the Kaiser-Meyer-Olkin measure of sampling adequacy.

Table 1: Scoring factors and impact factor of variables included in PCA

Variable	Scoring factors	Impact factor
Participation in farmer field day on blackberry (dummy)	0.512	1.043
Associated with *cadena de la mora* (dummy) (lag)	0.440	1.803
Membership in farmer group (dummy) (lag)	0.517	1.117
No. of agricultural technicians in SN (lag)	0.527	2.928

The results of the Bartlett-Test show that we can be very confident (p-value = 0.000) to reject the null hypothesis that the selected variables are not intercorrelated. The overall Kaiser-Meyer-Olkin measure is 0.743 which is highly satisfactory. Our PCA thus proves to be reliable. Another advantage of the SNI as opposed to the social network variable in model (2) is that the index is less prone to endogeneity, since variables are specified with a time-lag where necessary. Our third model is thus specified as follows:

(3) $MSC_i = \beta X_i + \gamma SNI_i + \varepsilon_i$

Farmers in our sample in Tungurahua province are fairly scattered across seven *cantons.* We recognize that there might be unobserved and heterogeneous *canton* characteristics such as spatial concentration of blackberry farmers, accessibility or agro-ecological conditions that may have an effect on farmers' inclusion in modern supply chains. Therefore, we include *canton* fixed effects in our estimations that capture heterogeneity of *canton* attributes in order to test the robustness of our results. These fixed effects also help to control for correlated unobservable variables at the *canton* level that might affect our measure of social networks in model (2). For example, it could be that buyers of modern chains prefer to source a specific *canton* that possesses favorable characteristics like accessibility that were mentioned earlier. This would increase the number of modern channel participants in that area. Consequently, the probably that a

[9] We normalized variable (4) using the following formula: $x_i = \frac{x_i - x_{min}}{x_{max} - x_{min}}$ where x is the number of agricultural technicians in the social network of farmer i, x_{min} and x_{max} are the minimum and maximum values of x.

farmer who lives in the same *canton* has a high number of participants in his or her social network is much stronger. As a result, the social network effect in model (2) could be overestimated. We complement models (1), (2) and (3) with *canton* fixed effects *j* which are measured in δ:

(4) $MSC_i = \beta X_i + \delta C_j + \varepsilon_i$

(5) $MSC_i = \beta X_i + \gamma SN_i + \delta C_j + \varepsilon_i$

(6) $MSC_i = \beta X_i + \gamma ISNI_i + \delta C_j + \varepsilon_i$

6. RESULTS

6.1 DESCRIPTIVE STATISTICS

Table 2 provides information on the differences in household characteristics between the group of blackberry farmers that participate in modern supply chains and the one that exclusively participates in traditional supply chains. A number of salient findings emerge.

Table 2: Household characteristics by supply chain

	Full sample (N = 364)	Modern supply chain (N = 51)	Traditional supply chain (N = 313)
Male household head (dummy)	0.871	0.902	0.866
	(0.336)	(0.300)	(0.341)
Altitude in which farmer lives (meters)	3011.508	2959.255	3020.022
	(324.113)	(250.254)	(334.163)
Age of household head (years)	50.319	54.059**	49.709
	(13.813)	(13.681)	(13.830)
Education household head (years)	6.451	8.922***	6.048
	(3.649)	(4.677)	(3.290)
Mother tongue of HH-head Spanish (dummy)	0.951	1.000*	0.943
	(0.217)	(0.000)	(0.233)
Household head owns cell phone (dummy)	0.555	0.745***	0.524
	(0.498)	(0.440)	(0.500)
Household size (members)	4.006	3.961	4.013
	(1.683)	(1.549)	(1.706)
Household labor capacity [a]	3.089	3.173	3.067
	(1.383)	(1.291)	(1.399)
Off-farm employment (% of HH-members)	0.174	0.253***	0.161
	(0.236)	(0.295)	(0.222)

Notes: Standard deviation in parentheses; * p<0.1, ** p<0.05, *** p<0.01; [a] Household members were converted to man-equivalent units following Runge-Metzger (1988): household member < 9 years olds = 0; 9 to 15 years or above 49 years = 0.7; 16 to 49 years = 1

Modern supply chain farmers are significantly older and more educated as their counterparts. For example, their mean years of education amount to 8.9 as compared to 6.1 years in the latter group. On average, 75% of household heads of modern chain suppliers own a cell phone as opposed to 52% of traditional chain suppliers. Availability of a cell phone can be important for participation in modern chains, because traders or firms usually use these phones in order to place orders and to quickly react to shortfall in supply that may occur due to farmers' incentives to side sell to traditional market formats or insufficient harvest volume. Household size and household labor capacity are fairly equal between the two groups. Another significant difference relates to the participation in off-farm employment. Among modern chain suppliers, about 25% of all household members work in the off-farm sector as compared to roughly 16% in the traditional-channel group.

In table 3 we compare farm characteristics between the two groups of farmers. The first prominent finding is that the farm sector in our study context is dominated by small farmers. The average owned farm size is only 0.98 ha. We also take into account the standard deviation in order to be more confident on the genuine homogeneity of the farm sector. The standard deviation of 2.7 ha is rather low and therefore underscores the existence of a homogenous and small-scale farming structure. The standard deviation is even strongly influenced by two extreme values (15 and 46 ha). Excluding these values would even yield a much lower standard deviation of only 1.1 ha. Furthermore, there is no systematic difference in average farm size between the two groups. This questions the common hypothesis which suggests that modern supply chains farmers are large-scale and therefore wealthier and less sensitive to risks as farmers participating in traditional channels (Neven & Reardon, 2004; Reardon, Barrett, Berdegué, Swinnen, 2009). The area of land cultivated with blackberries[10] is a measure for the farmer's potential to achieve scale-effects in production that modern chain buyers prefer, because it would allow them to reduce transaction costs for their procurement strategies (Stringer, Sang, & Croppenstedt, 2009; Swinnen, 2004). Unexpectedly, the average blackberry cultivation area is equally distributed across the two groups. The modern chain farmers' blackberry cultivation area is slightly above (0.36 ha), but not systematically different from traditional chain farmers' area (0.33 ha). This observation is reflected in the number of available blackberry plants in productive age which is another measure for the scale-effect. Likewise, there is no significant difference between the two groups. Farmers supplying modern markets more often (71%) market other fresh fruits and vegetables such as strawberries, tree tomatoes or apples in comparison with farmers supplying traditional markets (43%). The latter are probably more dedicated to growing lower-value staples such as potatoes, maize and other traditional Andean crops for home consumption and the local market. Participation in modern supply chains is associated with a more frequent application of irrigation systems (90% vs. 70%). In table 3 we also compare the farm asset index which captures the technological level of farmers

[10] This refers to total farm size that farmers are able to cultivate and subsumes owned, rented-in, shared-in, and shared-out land.

and therefore their capability to produce higher quality agricultural products that can be crucial for access to more quality-demanding channels. We use an index instead of including all assets separately in the regression, because that would probably result in collinearity problems and also because we could not discover a particular key asset that the interviewed firms would exclusively require. There are different procedures to compute this index. Related studies use monetary values such as median or index prices (Escobal & Cavero, 2011; Hernández, Berdegué, & Reardon, 2012) or factor analysis (Michelson, 2013). Factor analysis or PCA was not feasible in our case, because the variables had only low correlation and the KMO was unsatisfactorily small. We also do not use prices, because we are not interested in the value of an asset, for example a crop sprayer, but the function that it performs and whether the particular farm household owns it or not. Therefore, we suggest using the unweighted summing of all assets.

Table 3: Farm characteristics by supply chain

	Full sample (N = 364)	Modern supply chain (N = 51)	Traditional supply chain (N = 313)
Farm size owned (ha)	0.983	1.095	0.965
	(2.722)	(0.933)	(2.912)
Blackberry specialization (% of farm size owned)	0.555	0.485	0.566
	(0.375)	(0.578)	(0.331)
Total blackberry cultivation area (ha)	0.330	0.364	0.325
	(0.424)	(0.251)	(0.446)
Years growing blackberry	13.923	12.137	14.214
	(10.169)	(9.938)	(10.192)
No. of blackberry plants in productive age	589.148	453.980	611.173
	(2359.814)	(372.393)	(2540.334)
Marketing other FFV (dummy)	0.470	0.706***	0.431
	(0.500)	(0.460)	(0.496)
Ownership of livestock (dummy)	0.898	0.922	0.895
	(0.303)	(0.272)	(0.308)
Ownership of irrigation system (dummy)	0.731	0.902***	0.703
	(0.444)	(0.300)	(0.458)
Farm asset index	2.462	3.059***	2.364
	(0.898)	(0.988)	(0.844)

Note: Standard deviation in parentheses; * p<0.1, ** p<0.05, *** p<0.01

The farm asset index is thus composed of a series of dummy variables indicating the households' holdings of pruning shears, grass cutter, motorized crop sprayer, manual crop sprayer, tractor, plow, and water pump. On average, we observe that the farm asset index is systematically higher among the modern chain participants. A higher score on farm assets and a higher proportion of farmers equipped with irrigation systems in the group of modern chain suppliers is expected and consistent with previous related studies

(Escobal & Cavero, 2011; Hernández, Reardon, & Berdegué, 2007; Rao & Qaim, 2010). Although there is a marked structural difference in endowment of farm assets and irrigation, it is not clear yet whether this will also have an influence on access to modern supply chains.

Table 4 summarizes the average socio-economic characteristics of the two groups of farmers. Several striking differences stand out. The *'bono de desarrollo humano'* (BDH) is a governmental conditional cash-transfer program targeting poor households and elders. It is a composite measure of household wealth that includes 27 variables such as access to infrastructure or household assets. Only one person in a household is eligible to receive the BDH (Ponce & Bedi, 2010).

Table 4: Socio-economic characteristics by supply chain

	Full sample (N = 364)	Modern supply chain (N = 51)	Traditional supply chain (N = 313)
Wealth			
HH receives bono de desarrollo (dummy)	0.544	0.235***	0.594
	(0.499)	(0.428)	(0.491)
Access indicators			
Access to credit (dummy)	0.401	0.490	0.387
	(0.491)	(0.505)	(0.488)
Access to extension (dummy)	0.420	0.706***	0.374
	(0.494)	(0.460)	(0.485)
Distance to provincial capital Ambato (km)	21.618	17.176	22.342
	(20.849)	(15.294)	(21.552)
Social networks			
Membership in farmer group (dummy)	0.390	0.726***	0.336
	(0.489)	(0.451)	(0.473)
Participated in farmer field day (dummy)	0.401	0.804***	0.335
	(0.491)	(0.401)	(0.473)
Associated with *'cadena de la mora'* (dummy)	0.115	0.471***	0.058
	(0.320)	(0.504)	(0.233)
Number of modern chain blackberry farmers in SN	1.052	5.922***	0.259
	(3.107)	(5.837)	(1.124)
Number of agricultural technicians in SN	0.830	1.922***	0.652
	(1.384)	(1.659)	(1.249)
Social network index (SNI)	0.516	1.072***	0.425
	(0.529)	(0.597)	(0.458)

Note: Standard deviation in parentheses; * p<0.1, ** p<0.05, *** p<0.01

Therefore, we can use the dummy variable if the household has received BDH as a convenient measure for household wealth. The result is clear. The farmers that exclusively participate in traditional supply chains (59%) are poorer than modern supply chain farmers (24%). This is not surprising and in line with

previous studies (Escobal & Cavero, 2011; Rao & Qaim, 2010). The direction of causality, however, is ambiguous, because it could be both, a result or a cause of participation in modern markets. We can also see that selling to modern supply chains is associated with better access to agricultural extension service.

In the following, we turn to our variables of interest that are subsumed under the category social network. It is obvious that the modern chain farmers differ greatly and systematically from traditional chain farmers in almost all social network characteristics. The former is more frequently member in farmer groups (73%) and a larger share of these farmers has already participated in a farmer field day targeted at blackberry farmers (80%). We list farmer field day in this category, because field observations have revealed that this can be an opportunity to make key contacts such as buyers that search for suppliers during these events or local government authorities that may be crucial for institutional support. In the blackberry sector, the role of farmer groups has to be interpreted differently from the more common function as facilitators of collective marketing. In only 9.9% of the cases, farmer group members indicated that collective marketing would be an important benefit. Therefore, we argue that farmer groups in our study context work as a platform for exchange of information for example on marketing, cultivation practices and as an instrument for institutional support. *'Cadena de la mora en la Provincia de Tungurahua'* is a public sector-led market linkage program with the objective of organizing and facilitating direct collective marketing with firms. The proportion of farmers associated with this program is significantly higher (47% vs. 6%) among the ones included in modern supply chains. This demonstrates that the market linkage program seems to reach its objectives. Table 4 further reveals a structural difference on the number of blackberry farmers with access to modern supply chains in farmers' social network. There are around 5.9 of them in the modern and only 0.3 in the traditional farmer group. Interpretation is not straightforward, however, because it can be that farmers have already been supplying individually to modern chains and have met only later while delivering or in supplier seminars. This would mean that the decision to supply modern chain was made independently. Furthermore, we compare the number of governmental agricultural technicians in individual farmers' social network across suppliers of modern and traditional chains. We incorporated agricultural technicians under social networks, because they are very familiar with the blackberry community, but simultaneously maintain many contacts in the private sector in particular to traders and purchasing managers of modern agrifood industry firms. We assume that these contacts can be crucial for informally linking farmers to modern supply chains. As table 4 displays, modern chain suppliers have a higher number of agricultural technicians in their individual social network as traditional supply farmers. Eventually, we can observe that selling to modern markets is associated with a higher score in our composite social network index (SNI).

6.2 BLACKBERRY FARMERS' MARKETING BEHAVIOR

In a first step, we are interested in understanding farmers' perceptions about blackberry marketing. We analyze the perceptions of the whole sample of farmers, but also differentiate between farmers classified as modern and traditional supply chain suppliers. Exploring subjective statements of farmers is important, because it provides a clearer picture of their preferences and can help interpreting econometric results.

Table 5 shows the perceived marketing constraints of blackberry farmers in our sample. The major concerns relate to the price for blackberries. 46% of blackberry growers indicated low prices to be a main problem, while 32% complained about price instability. The proportion of farmers that point to low prices as a marketing problem is statistically higher among the farmers categorized in the traditional supply chain (50%) in comparison with modern supply chain farmers (20%). This is plausible and consistent with previous studies (Rao & Qaim, 2010; Hernández, Berdegué, & Reardon, 2012) that have identified higher prices offered in modern channels which reward farmers' compliance with modern food companies' requirements. The share of farmers stating that price instability is a marketing constraint is almost identical across the two groups (33% vs. 32%). This is rather unexpected given the high seasonal price fluctuation in the traditional market for blackberries that we observed in the field and empirical evidence which suggests that more stable prices are offered in modern marketing channels (Michelson, Reardon, & Perez, 2011; Miyata, Minot, & Hu, 2009). Another important marketing constraint is the strong bargaining power of traders that was stated by 21% of all survey respondents which is fairly equal across the two supply chain groups.

6% of the interviewed farmers perceived lack of marketing alternatives to the wholesale market in Ambato as a major constraint while the majority of farmers in our sample (72%) sold to this market outlet. The very low percentage of the former is indeed surprising, because field observations have lead to the assumption that alternative marketing opportunities are desirable, but difficult to find among others due to the historical role of the Ambato wholesale market as the highly dominant market center for FFV in Ecuador (Stadel & Moya, 1988). Another interpretation could be that farmers are aware of marketing alternatives, but do not tap them since incentives are low or risks perceived to be high. Yet, it could also be that farmers are relatively satisfied selling blackberries to the wholesale market, because they are able to generate a secure weekly cash income by selling the full amount of produce which they harvest. Therefore, despite of price fluctuation and weak bargaining power of the farmers in the wholesale market, farmers may simply not search for alternative buyers which can explain why the farmers' perceived lack of marketing alternatives to wholesale market is so low.

Quality requirements are not considered to be major a constraint in both markets. This is plausible for the traditional, but surprising for the modern supply chain where firms demand products with explicit quality

attributes. A reason could be that quality parameters are largely confined to product norms such as appearance which is easier to manage than process norms that include for example guidelines on the applied sorts and doses of pesticides. Payment delay was not found to be an issue as only 1% of farmers perceived this as a main constraint.

Table 5: Farmers' perceived marketing constraints by supply chain (in %), 2012

Marketing constraint	Full sample (N = 364)	Modern supply chain (N =51)	Traditional supply chain (N = 313)
Low prices	45.6	19.6***	49.8
Price instability	32.1	33.3	32.0
Bargaining power of traders	20.6	23.5	20.1
Lack of alternatives to WM [a]	6.0	3.9	6.4
Quality requirements	1.1	2.0	1.0
Payment delay	0.8	2.0	0.6

Notes: * p<0.1, ** p<0.05, *** p<0.01; farmers were allowed to mention more than one constraint; [a] WM stands for wholesale market

We also asked the farmers what criteria they would take into account in order to choose a certain buyer for selling blackberries (table 6). Four key findings emerge. First, cash payment is the most important criterion for 51% of the surveyed farmers. There is a marked difference, however, between farmers that participate in modern supply chains and those who do not. For the former, a systematically lower proportion (33%) considers cash payment an important criterion as compared to farmers that sell to traditional markets (54%). This makes sense, because cash payments are much less common in modern markets as in traditional ones. Farmers that prefer cash payment are therefore probably more inclined to sell to traditional marketing channels where this payment mode is pervasive. Cash payments, however, are often associated with lower prices which reflect the stated marketing constraints of traditional chain suppliers shown in table 5.

Table 6: Farmers' criteria for choosing a buyer by supply chain (in %), 2012

Criteria	Full sample (N = 364)	Modern supply chain (N = 51)	Traditional supply chain (N = 313)
Cash payment	51.4	33.3***	54.3
High price	29.4	37.3	28.1
Trust	14.0	27.5***	11.8
Low requirements	9.6	3.9	10.5
Price stability	8.5	27.5***	5.4

Note: Farmers were allowed to mention more than one criteria

Second, a high price is the second most important criterion that influences the decision to sell to a particular buyer which is anticipated. The share among modern chain farmers in this regard is only slightly, but

not significantly higher. Third, trust is another influencing factor of the selection of a buyer. Among the modern chain farmers, trust is a statistically more significant criterion. This might mirror the opportunities for long-term marketing relationships governed by verbal or written agreements in the modern segment as opposed to rather anonymous transactions without obligation for repetitions that commonly prevail in traditional market formats. Fourth, the proportion of farmers considering price stability as an important criterion is found to be higher among the modern supply chain group (28% vs. 6%). This is conceivable, because buyers operating in modern supply chains usually offer a more stable - if not fixed - price as compared to traditional chain buyers.

One of the objectives of the survey was to collect data on individual blackberry sales proportion to different buyers and markets[11] using 2012 as the recall year. We are now interested in the composition of this marketing portfolio that is illustrated in table 7. Blackberry farmers in our sample sold to 417 buyers which means that the vast majority (87%) marketed to only one buyer. We can observe that blackberry marketing is fairly concentrated, since 72% of blackberry farmers indicated to having sold at least once to the wholesale market in Ambato. This is consistent with our expectations that we had created after conducting the qualitative interviews with key informants. 18% of surveyed farmers sold to a farm-gate trader. For both channels, wholesale market and farm-gate traders, we are not able to reconstruct the final target market which means that we have to be satisfied with information about the first-buyer. The direct marketing channel to agro-processing firms was used by roughly 10% of blackberry farmers. An additional 5% of blackberry farmers sold to specialized traders that supply agro-processing firms and supermarkets. The direct channel to supermarkets is marginal with only 1.1% of surveyed farmers participating.

Table 7: Blackberry farmers' first-buyer (in %), 2012

Buyer (N = 417)	Farmer sold to buyer (%)
Wholesale market Ambato	72.0
Farm-gate trader	17.6
Agro-processing (directly)	9.9
Open-air & street fairs	8.2
Specialized trader to supermarket/agro-processing	4.7
Supermarket (directly)	1.1
Other	1.1

Note: Farmers were allowed to mention more than one buyer

Based on the sales information we gathered from farmers and the semi-structured interviews, we were able to categorize the full set of buyers into two groups. A buyer is classified as 'modern' if he is an agro-processor or supermarket or a specialized trader that delivers to these firms and 'traditional' otherwise (see

[11] We are not able to differentiate between the numerous buyers within the wholesale market and open-air and street fairs, but treat each as one single market.

section 3.3 for more explicit explanation of criteria). We were eager to better understand the specific marketing and transaction peculiarities between the farmers and the first-buyers and therefore included these supplementary aspects in the questionnaire. The results are displayed in table 8.

There is a marked difference in terms of the governance structure of marketing relationships between the farmers and the buyers across the modern and traditional supply chain groups. Among the former, verbal agreement is the principal governance structure (77%), while some 8% are governed under written contracts and 15% are spot-market relationships. In the traditional supply chains, spot-market relationships prevail (91%) which was expected. This clear outcome of closer vertical coordination in modern chains is anticipated and can be predicted drawing on elements of transaction cost theory (see section 3.3 for comparison).

Table 8: Transaction characteristics by supply chain (in %), 2012

Aspect	Full sample of first-buyers (N = 417)	Modern supply chain buyers (N = 60)	Traditional supply chain buyers (N = 357)	Mean comparison
Governance structure				
Spot market	79.6	15.0	90.5	***
Verbal agreement	19.2	76.7	9.5	***
Contract	1.2	8.3	0.0	---
Payment mode				
Cash	92.8	55.0	99.2	***
On credit	6.2	38.3	0.8	***
Other	1.0	6.7	0.0	---
Satisfaction with buyer [a,b]	3.0	3.2	3.0	***
Very satisfied	23.2	32.2	21.7	
Satisfied	57.1	59.3	56.7	
Dissatisfied	18.9	8.5	20.8	**
Very dissatisfied	0.8	0.0	0.9	---
Farmers transport	85.6	81.7	87.1	
Collective marketing	7.2	38.3	2.0	***
Long-term relationship [c]	68.0	16.7	77.0	***
Product rejection	2.6	5.0	2.2	---

Notes: Farmers (N=364) were allowed to mention more than one buyer; --- mean comparison was not possible due to insufficient number of observations; [a] buyer satisfaction was computed from a scale from 1 (very dissatisfied) to 4 (very satisfied); [b] due to missing data buyer satisfaction has only 396 observations; [c] Farmer has a long-term relationship when he/she has sold each year between 2008-2012 to this buyer

The almost negligible role of written contractual arrangements is presumably associated with two factors. First, blackberry farming in the Ecuadorian Andes does not involve any asset-specific investments that

would probably shift the governance structure along the continuum to contracts in order for farmers to safeguard this investment. Second, this may reflect the preferences of farmers who oppose the risk of being dependent on, and binding to one sole buyer. Now we turn to a comparison of the payment mode of transactions. The dominance of cash payments in the traditional supply channel is obvious and statistically significant. Almost 100% of transactions are regulated through cash payment. This mirrors the large extent of spot-market transactions in this channel. A slightly different picture emerges in the modern chain group. Sales on credit are more common (38%) in this group while cash payments still dominate (55%).

Table 8 also depicts the farmers' satisfaction level that arises after a farmer had sold to a particular buyer or market. Overall, 76% of all farmers in the sample are satisfied or very satisfied with their market transactions. There are two main differences in satisfaction levels between farmers selling to modern and traditional buyers. The proportion of very satisfied (32% vs. 22%) is higher and the share of dissatisfied significantly lower (9% vs. 21%) in relationships occurring in modern chains. This tendency is also reflected in the slightly, but statistical significantly higher satisfaction level in the modern chain group.

In the following, we look more closely at physical aspects of the transaction. First, we are interested in the responsibility of a transaction partner for transportation of blackberries. In both channel types, farmers commonly supply blackberries themselves to the buyers' collection point or directly to the market (86%). This demonstrates the existence of adequate road infrastructure and the availability of means of transportation through either vehicles or public transport. Collective marketing institutionalized by farmer groups can be an important avenue to strengthen bargaining power and to lower transaction costs for the farmer and the buyer. In our study context, farmers' collective marketing is generally sporadic (7%), but significantly more widespread to buyers of modern supply chains (38% as compared to 2%). The direction of causality, however, is not so clear. It could be that modern chain buyers choose to source from existing farmer groups that have been performing collective marketing or conversely, that these buyers requested and facilitated the formation of marketing groups for example with support of the local government or NGOs.

Next, we focus on the duration of supply relationships. This is important, because long-term relationships can help to foster trust and increase efficiency due to higher frequency of transactions. In our case, a farmer is considered to have a long-term relationship with a particular buyer when he has been selling each year between 2008 and 2012 to the identical buyer. In modern supply chains, we can observe very dynamic and unstable relationships as only 17% of farmers supplying to a modern buyer in 2012 have also maintained a long-term relationship. The reasons are unclear and are difficult to be elucidated even with the background information gathered through semi-structured interviews. Two potential causes can be discerned. First, it is conceivable that some modern supply chains have only recently been placed in this geographic area. Second, there could be substantial dynamics in supply relationship originating from buy-

ers decision of geographic placement of their supply chain. Interestingly, product rejections are not a serious problem in blackberry marketing. Only 3% of all survey participants have experienced any product rejection in 2012. This proportion is only slightly higher for farmers that sold to modern chain buyers. The interpretation of this observation may point to two opposite directions. One could be that the quality requirements that are predominantly restricted to product norms such as appearance are easy to manage for farmers. An alternative would be that quality requirements demanded by modern buyers are high and stringent, but that farmers are capable, reliable and organized enough to comply with them.

6.3 ECONOMETRIC RESULTS

Table 9 displays the result of the estimated probit models (1), (2) and (3) that are specified in section 5. We begin with the results of model (1) that we estimated without the social network variables of interest. There are a number of salient findings. Older farmers are more likely to participate in modern supply chains. This is unexpected, because we assumed based on field observations that younger farmers are more innovative and willing to carry out the necessary changes at the farm level in order to comply with the requirements of the buyer. An explanation could be that younger household heads have better outside options such as off-farm employment while considering the labor-intensive blackberry farming for modern markets as a less important and attractive livelihood activity. Yet, the effect of age is in line with Rao & Qaim (2010) who suggest that this would be associated with longer farming experience. We control for experience with blackberry farming in our model and find the opposite effect. Farmers with longer experience in blackberry farming are less likely to have access to modern supply chains which is consistent with findings in Bignebat, Koc & Lemeilleur (2009). Conversely, late adopters of blackberry – the farmers that more recently have started to grow blackberries – are possibly more innovative and entrepreneurial and therefore more open to managerial and organizational changes at the farm level that are necessary to gain access to modern markets. This might also reflect the conventional harvesting and marketing habits of the farmers targeting the wholesale or local markets that are – according to some interview partners – difficult to breach.

Moreover, our results show that education of the household head is positively related to inclusion in modern supply chains. This is plausible, because more educated farmers might be better able to understand and to comply with the stricter requirements imposed in these chains. Higher education might also imply higher confidence among farmers which can be important for the decision to enter more serious, formal and sophisticated business relationships with buyers of modern chains. Thus far, there is no scientific consensus as to which education matters for participation. For example, Rao & Qaim (2010) find a positive, and Miyata, Minot, & Hu (2009) a negative relationship between education and participation while many other studies cannot identify any significant relationship. Table 9 also yields evidence of a positive influence of

cell phone ownership on inclusion in modern channels. This makes sense, because verbal agreements that are the main governance mechanism in these channels involve constant and flexible communication. We further introduced a dummy variable specifying whether farmers sell additional FFV such as strawberries, tree tomatoes or apples to any market outlet. If they do so, we find that their probability to sell to modern markets for blackberry is significantly higher. There are three potential explanations for this effect: first, experience with and awareness of how to cultivate, handle and market high-value crops helps farmers to develop confidence for entering into marketing relationships with more demanding buyers and for meeting their strict requirements. Second, this may signal a greater technological capability of farmers, because FFV marketing is highly correlated with ownership of irrigation systems (r = 0.42). Third, we may interpret this finding as a strong commercial orientation, because these farmers engage in the cultivation of crops that usually ensure higher margins as compared to staple crops like maize or beans. Table 9 also shows that wealthier farmers are more likely to participate in modern supply chains, since a household that receives the '*bono de desarrollo humano*' is less likely to have access to modern channels. This points to the exclusion of poor households that appears consistent with some previous studies (Escobal & Cavero, 2011; Neven, Odera, Reardon, & Wang, 2009 Rao & Qaim, 2010).

In this study, we deviate from the common proxy for household wealth – farm size –, because BDH more comprehensively predicts household wealth. We may treat it as an exogenous variable that only affects participation in modern supply chains and not reverse which is due to composition of BDH. The BDH is a composite index of household wealth that includes 27 variables which in particular measure household assets, access to infrastructure or community services. We argue that these measures of household wealth are fairly stable over time as compared to household income for example. Moreover, even if farmers increased their income through participation relative to their traditional chain farmers, this would not automatically change farmers' household asset formation and hence the BDH. Likewise, some of these indicators like infrastructure and community-related variables cannot be directly affected by farmers' inclusion in modern supply chains. Our findings further indicate that farmers less prominent endowed with irrigation systems and agricultural assets are able to participate in modern chains which challenge widespread believes (Berdegué, Hernández, & Reardon, 2008; Hernández, Reardon, & Berdegué, 2007; Hernández, Berdegué, & Reardon, 2012; Neven, Odera, Reardon, & Wang, 2009). In our farm sector context dominated by small farmers, we cannot find exclusion of farmers with small blackberry farm size which measures the potential to produce higher volumes of blackberries. We use blackberry farm size instead of farm size, because it more precisely measures the scale effect in production. Although in a small farm environment, we cannot find evidence that supports the widespread assumption that modern agrifood companies source from farmers that can produce sufficiently large volumes which previous research has discovered and hypothesized (Hernández, Berdegué, & Reardon, 2012; Stringer, Sang, & Croppenstedt, 2009; Swinnen, 2004).

Table 9: Determinants of farmers' participation in modern supply chains

	Full model (N = 364)					
Explanatory variables	(1)	Marginal effect (1)	(2)	Marginal effect (2)	(3)	Marginal effect (3)
Household head male (dummy)	-0.197	-0.034	0.073	0.009	-0.084	-0.014
	(0.307)		(0.327)		(0.289)	
Age of household head	0.023***	0.004	0.018*	0.002	0.017**	0.003
	(0.008)		(0.009)		(0.009)	
Education household head	0.078***	0.014	0.012	0.001	0.049**	0.008
	(0.025)		(0.033)		(0.025)	
Cell phone ownership (dummy)	0.365*	0.063	0.327	0.040	0.285	0.047
	(0.214)		(0.253)		(0.215)	
Household labor capacity	0.082	0.014	0.057	0.007	0.087	0.014
	(0.068)		(0.072)		(0.070)	
Off-farm employment (dummy)	0.250	0.043	0.109	0.013	0.200	0.033
	(0.210)		(0.236)		(0.216)	
Blackberry production area (lag)	-0.159	-0.028	-0.442	-0.054	-0.145	-0.024
	(0.259)		(0.335)		(0.265)	
Blackberry specialization	0.056	0.010	0.287	0.035	0.099	0.016
	(0.248)		(0.344)		(0.251)	
Experience growing blackberry	-0.021**	-0.004	-0.023*	-0.003	-0.029***	-0.005
	(0.010)		(0.012)		(0.011)	
Farmer markets other FFV (dummy)	0.555***	0.096	0.429*	0.052	0.516**	0.085
	(0.214)		(0.253)		(0.217)	
Ownership of irrigation system (lag)	0.098	0.017	-0.015	-0.002	-0.004	-0.001
	(0.231)		(0.280)		(0.238)	
Agricultural asset index (lag)	0.016	0.003	-0.169	-0.020	-0.077	-0.013
	(0.101)		(0.116)		(0.095)	
Distance to provincial capital Ambato	0.004	0.001	0.006	0.001	0.008	0.001
	(0.006)		(0.006)		(0.006)	
Bono de desarrollo humano (dummy)	-0.603***	-0.105	-0.542**	-0.066	-0.466**	-0.077
	(0.222)		(0.265)		(0.237)	
Number of modern chain blackberry farmers in SN			0.317***	0.389		
			(0.060)			
Social network index (SNI)					1.475***	0.243
					(0.425)	
Constant	-3.181***		-2.629***		-3.029***	
	(0.706)		(0.735)		(0.711)	

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

We also interpret the marginal effects of model (1), because they may help to understand the magnitude of the effects which is necessary for prioritizing policies and programs. Table 8 depicts that if farmers cultivate and market other FFV, they are 9.6% more likely to participate in modern supply chains. If farm households are poor according to the definition of the BDH, their probability to participate falls by 10.5%. The remaining marginal effects for other determinants are rather modest.

In model (2), we add the endogenous social network effect on participation in modern marketing channels. This variable turns out to be highly significant. In other words, a higher number of farmers participating in modern supply chains in the individuals' network are associated with a higher likelihood of that individual farmer to participate. Since we consider the endogenous effect in our estimation, we cannot establish a causal relationship. We can confidently say, however, that the network influences the farmer and the farmer simultaneously may influence his or her social network. The marginal effect of the endogenous social network is strong. It shows that having one additional participating blackberry farmer in his or her social network increases the probability of being chosen as a supplier to these markets by 39%. Model (2) further reveals that some of the effects we identified in model (1) are less pronounced. This is probably due to the fact that our social network variable which was omitted in model (1) is correlated with many of the significant variables of the first model. The positive effect of age and marketing other FFV and the negative influence of experience remains robust. The marginal effects, however, are lower in most of the cases.

The third model specification includes the social network index (SNI) and omits the social network variable included in the second model. SNI is highly significant and thus suggests that institutional connectedness plays a prominent role for farmers' participation in modern supply chains. The marginal effects indicate that an increase from 0 to 100% of the index is associated with a 24.3% increase of the probability that a farmer sells to modern markets. Factors that turned out to be insignificant in the second estimation, become – albeit slightly lower – significant determinants in model (3).

Next, we included *canton* fixed effects in the three model specifications to test the robustness of our results. The results of the models (4), (5) and (6) are presented in table 10. In model (4), the effects – except for experience – remain robust to the inclusion of canton-fixed effects, but smaller. This suggests that geographic peculiarities such as *canton* characteristics matter for farmers' inclusion in modern supply chains. Moreover, it shows that some of the household and farm level characteristics interact with certain districts. For example, a decrease in the significance level of household wealth measured by BDH indicates a correlation between district level characteristics and BDH.

Table 10: Determinants of participation in modern supply chains (canton fixed-effects specification)

	Canton fixed-effects (N = 364)					
Explanatory variables	(4)	Marginal effect (4)	(5)	Marginal effect (5)	(6)	Marginal effect (6)
Household head male (dummy)	-0.086	-0.014	0.079	0.009	-0.026	-0.004
	(0.309)		(0.350)		(0.299)	
Age of household head	0.027***	0.004	0.014	0.002	0.022**	0.003
	(0.009)		(0.010)		(0.009)	
Education household head	0.062**	0.010	-0.008	-0.001	0.044*	0.007
	(0.026)		(0.031)		(0.026)	
Cell phone ownership (dummy)	0.388*	0.061	0.306	0.036	0.321	0.050
	(0.224)		(0.254)		(0.222)	
Household labor capacity	0.080	0.013	0.023	0.003	0.085	0.013
	(0.071)		(0.074)		(0.073)	
Off-farm employment (dummy)	0.260	0.041	0.162	0.019	0.205	0.032
	(0.222)		(0.245)		(0.227)	
Blackberry production area (lag)	-0.189	-0.030	-0.416	-0.049	-0.144	-0.022
	(0.288)		(0.368)		(0.281)	
Blackberry specialization	0.134	0.021	0.230	0.027	0.184	0.028
	(0.238)		(0.353)		(0.243)	
Experience growing blackberry	-0.015	-0.002	-0.016	-0.002	-0.021*	-0.003
	(0.010)		(0.012)		(0.011)	
Farmer markets other FFV (dummy)	0.404*	0.064	0.342	0.040	0.377*	0.058
	(0.228)		(0.266)		(0.229)	
Ownership of irrigation system (lag)	0.100	0.016	-0.014	-0.002	0.038	0.006
	(0.241)		(0.291)		(0.244)	
Agricultural asset index (lag)	-0.108	-0.017	-0.240**	-0.028	-0.161	-0.025
	(0.110)		(0.119)		(0.106)	
Distance to provincial capital Ambato	-0.049**	-0.008	-0.050**	-0.006	-0.042*	-0.007
	(0.023)		(0.025)		(0.023)	
Bono de desarrollo humano (dummy)	-0.430*	-0.068	-0.423	-0.050	-0.388	-0.060
	(0.261)		(0.308)		(0.269)	
Number of modern chain blackberry farmers in SN			0.312***	0.036		
			(0.063)			
Social network index (SNI)					1.084**	0.167
					(0.421)	
Constant	-2.978***		-1.770**		-2.759***	
	(0.803)		(0.855)		(0.806)	

Notes: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Model (5) shows that the endogenous social network effect on participation remains robust. Hence, we can be more confident that this variable genuinely measures the network effect and not only correlated behavior on the *canton* level. Age, experience and the decision if a farmer markets other FFV becomes insignificant. Model (6) confirms the robustness of our main variable of interest, SNI. Comparing the results to the corresponding model (3) that excludes fixed effects, we find that almost all explanatory variables remain significant determinants.

7. CONCLUSIONS

The emergence of modern supply chains in many developing countries offers opportunities for farmers to generate higher incomes and to upgrade farm technologies. High requirements of agrifood companies imposed on supply relationships with upstream suppliers pose considerable access barriers to farmers. Against this background, a number of studies have explored factors that influence farmers' capability to meet these requirements and to participate in modern markets.

We collected original survey data from blackberry farmers in the Ecuadorian Andes to examine the role of individual social networks for inclusion in these markets. The Ecuadorian blackberry sector is characterized by a large number of small-scale farmers that exclusively supply to the quality-differentiated domestic market. Modern agrifood firms that procure blackberries in this market face high levels of transaction costs associated with uncertainty about the small farmers' capability to comply with the firms' demands. As a result, firms decided to set up new and modernized supply chains using mechanisms such as verbal agreements or contracts to more closely control cultivation, harvest and delivery conditions.

It is conceivable, however, that the social network effect on participation in modern supply chains is not only established through farmers that already participate in these chains. There are potentially other key contacts among the farmers' network that are able to provide the necessary link to the buyer of a modern chain. We argue that institutional connectedness can be crucial to this. For example, it could be that farmers socially or professionally interact with governmental employees in agricultural departments. These employees in turn may maintain contacts with the agrifood industry in order to be informed about or to influence their business environment and constraints. Agrifood firms may rely on these employees and their network of farmer contacts in order to select these farmers as potential suppliers.

In this article, we show that a farmer's individual social network plays an important role for participation in modern supply chains. We differentiate between two specifications of social network. First, we estimate the endogenous social network effect and control for correlated unobservable factors at the level of *cantons*. Our results suggest that the number of suppliers to modern markets in a farmer's network positively influences the probability that the farmer participates in modern chains. Second, we computed a social

network index (SNI) consisting of variables institutional connectedness to take account of the multidimensionality of social network. We find that SNI has a positive and highly significant effect on participation.

Our study also suggests more cautiousness about the role of farm size and farm technology for participation that have been singled out as the key determinants in previous research (Berdegué, Hernández, & Reardon, 2008; Escobal & Cavero, 2011; Hernández, Berdegué, & Reardon, 2012; Hernández, Reardon, & Berdegué, 2007; Reardon, Barrett, Berdegué, & Swinnen, 2009) and to avoid overly general statements about their influence. In our study context, the blackberry farm sector is homogenously composed of a large number of small farmers that own around 1 ha on average. Consequently, agrifood companies must source from small farmers. We also cannot find evidence of exclusion of farmers based on their blackberry area under cultivation which proves that even farmers with lower production volumes can be included. Likewise, our results show that ownership of *threshold-assets* such as agricultural assets and irrigation systems are not significant determinants of participation. This is due to the different context in which farmers cultivate blackberries. Blackberry cultivation practices in the Ecuadorian Andes are typically labor-intensive where technology is not a major barrier to enter modern supply chains. Companies procuring blackberries also do not demand such investments from their suppliers. Moreover, our study confidently shows that older, more educated, late adopters of blackberry and farmers marketing other FFV are more likely to participate.

The findings of our study bear a number of implications for the design of policies and programs. We propose a two-step procedure: first, effective and sustainable interventions to support farmers' inclusion in modern supply chains should be embedded in a thorough and careful analysis of the market and the magnitude of market transformation towards modern formats of the crop under study. This is essential given the continuing persistence of traditional retail outlets in many low-income countries (Cadilhon et al., 2006; Humphrey, 2007). This would require firm visits and semi-structured interviews with key representatives in order to better understand their sourcing preferences, constraints and resulting procurement decisions. Such an approach allows inference of the prospective growth dynamics of the modern market segment and the respective product volumes that will be channeled through these chains. This is important to know, because the potential scope to sustainably integrate farmers into modern supply chains is to a large extent contingent on the expansion of this modern market segment and the strategic decisions of firms.

Second, the results of our study lend support to the necessity to provide farmers with social ties that can facilitate participation in modern supply chains. This may involve better access to information and creation of awareness of these marketing opportunities in the form of information platforms such as farmer field days in which farmers can informally exchange experience. Such events could also be used to facilitate interactions between farmers and agrifood companies that can help to overcome prejudices and uncertainties originating from asymmetric information. This would also call for a re-definition of governmental

support services that are predominantly targeted at improving cultivation practices or the adoption of agricultural technologies. Adapting these services to the requirements of modern markets may also help to induce behavioral change and to break traditional habits of harvest and post-harvest handling which might be barriers for early adopters of blackberries according to our estimations. Our findings also yield evidence that support to farmers tailored to the expansion of irrigation systems and other technologically advanced agricultural assets would not guarantee their participation in modern channels. We argue here that such kind of support has to be carefully adjusted to the specific context of the farm sector, the state of farming technology and agro-ecological conditions. Our estimations further imply the need to make sure that these presumably more profitable marketing opportunities reach poor farm households and farmers that are – except for blackberry – engaged in the cultivation and marketing of lower value crops.

The link between social networks and supply chain participation remains a fairly unexplored research direction. In this contribution, we offer a first step into this direction and integrate these important research areas. We set out to prompt further research that investigates different facets of this interplay. A potential direction could be a more in-depth analysis of the underlying pathways through which social networks affect modern supply chain participation such as the *screening* or *information cost hypotheses*. In our study, we assume that farmers' social networks positively affect inclusion. We recognize, however, that social networks effects can also lead to dropouts from modern supply chains when farmers share bad experiences such as opportunistic behavior or payment delays of the buyer. Panel data can be a useful improvement of our study design that helps to explore the duration of supply relation under a social network perspective. In our estimations, we were only able to measure the endogenous social network effect. Future research should find ways to circumvent the endogeneity problem and identify a clearer direction of causality.

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