IMPROVING THE COMPETITIVENESS OF THE SOUTH AFRICAN FRESH APPLE EXPORT VALUE CHAIN

BY

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DECLARATION

I hereby certify that, unless specifically indicated to the contrary in the text, this dissertation is the result of my own original work, which has not already been accepted in substance for any degree and is not being submitted in candidature for any other degree.

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ABSTRACT

Since 1996, South African (SA) apple producers have faced major structural changes following the deregulation of SA apple marketing and the declining profitability of apple exports as world prices have fallen in real terms. Global retail consolidation has also shifted market power in fresh fruit value chains towards downstream firms (retailers, category managers, and import receivers), and put pressure on upstream (exporter, packer and producer) margins. Retailers have become more demanding about which apple cultivars they will stock, and more sensitive about non-product terms of sale, such as fruit handling methods, social and ethical issues and consumer sensitivities. With competition from other apple exporting countries (such as France and Chile) likely to increase, players in the SA fresh apple export value chain must implement appropriate strategies to try and improve its competitiveness.

This study investigates aspects of cooperation between SA apple producers, packers and exporters in the Western Cape and Langkloof East areas during 2001, in order to show where these players need to commit more resources to make the SA fresh apple export value chain more competitive. Fresh apple exports are the focus of the study as about 58 per cent of annual gross income on SA apple farms is derived from export sales. A recursive Ordinary Least Squares model shows that higher levels of trust led to more cooperation (joint problem-solving and communication) between these players. Higher levels of joint problem-solving and communication, in turn, encouraged producers to commit more human resources to working with packers and exporters to find ways of making the chain more competitive. Results also suggest that the players need to particularly improve cooperation in production planning, delivery scheduling and quality control. Packers and exporters ranked climatic conditions as the top constraint currently facing the SA fresh apple industry, probably reflecting their concerns over the annual "pack-out" (quality distribution) of the apple crop. Other factors affecting competitiveness include the recent withdrawal of government export incentives, restrictive labour policy, high real interest rates, a lack of market information, and the growing and marketing of inappropriate apple cultivars.

Key industry players suggest that SA fresh apple producers need to consider whether or not to invest in new apple cultivars, like the Pink Lady, in order to meet the changing demands of international fresh apple consumers. This study, therefore, also compares the relative potential

profitability of investing in orchards to produce the Pink Lady and the Golden Delicious - a traditional SA fresh apple export cultivar. Given uncertainty about the yields, costs and prices, and that apple orchard investment costs are irreversible (cannot be fully recovered in the short term), an ex ante version of the Dixit-Pindyck investment model is used to assess the viability of these investment alternatives under uncertainty and irreversibility. This model accounts for uncertainty and irreversibility by raising the orthodox hurdle rate that must be met to justify the orchard investment by an amount that reflects the value of the option to postpone the investment.

Typical Pink Lady apple orchards in the Western Cape and Langkloof East areas have higher orchard establishment, crop harvesting and crop spraying costs than do Golden Delicious apple orchards, but retailers will currently pay R493 per ton (25.3 per cent) more, on average, for Class I apples of the Pink Lady brand. Results show that a potential Pink Lady orchard investment is relatively more profitable than a potential Golden Delicious orchard investment. In addition, SA apple producers taking into account uncertainty and irreversibility should only invest in a 35-year Pink Lady or Golden Delicious apple orchard if the expected annual real rate-of-return is above 11.41 per cent or 9.45 per cent, respectively. These modified hurdle rates are about two times the orthodox real rate of five per cent that is commonly used in capital budgeting analyses. Such differences between orthodox and modified hurdle rates have also been reported in recent studies on the adoption of dairy technology and grapefruit orchard investments in the United States.

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INTRODUCTION

The resource-based view of the firm proposes that a firm must develop appropriate resources and capabilities that are valuable, rare and are difficult to substitute or copy in order to create a sustainable competitive advantage (O'Keeffe, 1998a; Thompson and Strickland, 1998). This focus on the firm as the main unit of analysis overlooks the potential competitive advantages or disadvantages that are created by the linkages that a firm has with other players in a value chain. For any industry, the value chain encompasses all activities associated with the flow and transformation of goods from the raw materials stage, through to the end-user, as well as the associated information flows (Handfield and Nichols, 1999). The relational view of competitive advantage focuses on these linkages, and contends that collaborating firms can use relation-specific assets (such as specialized capital investments, information, language and know-how), knowledge-sharing, complementary resource endowments (such as collective reputation and excellent customer and supplier relationships), and effective governance, to strengthen the competitive edge created by differentiation and/or low-cost competitive strategies (Dyer and Singh, 1998). Managers, therefore, need to consider how to cooperate across firms to build alliances and leverage resources that make their value chains more competitive.

Cooperation describes a process by which firms develop mechanisms to come together, interact and form relationships for mutual benefit (Anderson and Narus, 1990). These mechanisms may be informal or formal, and are likely to change over time, depending on the willingness of the firms to continue in cooperative relationships (Ring and Van de Ven, 1994; Smith *et al.*, 1995). Higher levels of cooperation are expected to: help improve the rate of learning and innovation; lower transaction costs (Dyer, 1997; Lazzarini *et al.*, 2001); and achieve effective coordination, leading to better human and product performance (Hewett and Bearden, 2001; Smith *et al.*, 1995).

The first aim of this study is to consider how players in the South African (SA) fresh apple export value chain can improve cooperation in order to address constraints that prevent the chain from being more competitive internationally. Since 1996, SA fresh apple producers have faced major structural changes following the deregulation of SA apple marketing. In addition the profitability of apple exports fell from 1995 to 1999 as world prices fell in real terms (O'Rourke, 2001). Real world fresh apple prices rose in 2000 but declined again in 2001 (The Directorate:

Agricultural Statistics, 2002). Despite a recovery in the net export realization price of SA fresh apple exports (helped by a weaker Rand against the British Pound, US Dollar and Euro) and higher local prices (Nelsen, 2002), the profitability of many SA fresh apple producers has fallen due to prolonged drought, global retail consolidation, and increased supply from rival exporters. Global retail consolidation has shifted market power in fresh fruit value chains towards downstream firms (retailers, category managers, and import receivers), and put pressure on upstream (exporter, packer and producer) margins (Cook, 1998; O'Rourke, 2001). About 10 per cent of SA fresh apple producers faced liquidation of their business operations in 2000 (Dall, 2001). With competition from other apple exporting countries likely to increase, players in the SA fresh apple export value chain must implement appropriate strategies to try and improve its competitiveness. This dissertation describes the challenge to become more internationally competitive, and in Chapter 1, discusses how the SA fresh apple export value chain has performed in global markets since 1996. It then considers how players in the SA fresh apple export value chain – producer, packers and exporters – can make the chain more competitive internationally. Fresh apple exports are the focus of this study since about 58 per cent of annual gross income on SA apple farms is derived from export sales in a typical season (Directorate: Agricultural Statistics, 2001).

A conceptual model of cooperative behaviour amongst the players in a value chain is outlined in Chapter 2 as a basis for developing research hypotheses and applying these to the case of the SA fresh apple export value chain. This model draws on work by Anderson and Weitz (1991), Campbell (1992), Hunt *et al.* (2002), and Smith *et al.* (1995), to highlight the role of trust in promoting cooperative behaviour – like joint problem-solving and communication – and how such behaviour encourages the players to commit more human resources to chain activities. The model is then extended to consider how monitoring changes internal and external to the value chain, and evaluating the risks associated with chain specific investments, can help to build trust and implement cooperation by identifying the key constraints on competitiveness that the players need to manage over time. This study analyses these issues by using the *first* empirical survey of the perceptions of apple producers, packers and exporters in the major SA apple producing areas of the Western Cape and Langkloof East conducted in 2001. Chapter 2 describes the data sources and research methodology, while Chapter 3 reports and discusses the research results, including the most important factors that the players perceive constrain the competitiveness of the SA fresh apple export value chain.

Interviews with key industry players (Dall, 2001; Finn, 2001; Jensen, 2001; Rabe 2001) at all levels in the SA fresh apple export value chain during March 2001 showed that the failure by SA apple producers to adopt more widely new apple cultivars to meet changing consumer tastes was a serious threat to their competitiveness. Ongoing consolidation and the increasing price-making influence of multi-national retail grocery stores has allowed retailers to become increasingly more aggressive about which apple cultivars they will stock (O'Rourke, 2001). The World Apple Report, which rates retailer perceptions about current apple cultivar preferences, and the extent to which they plan to hold more of each cultivar in the next season, identifies Gala, Red Delicious, Braeburn, Fuji and Pink Lady as the five most popular cultivars for the future (World Apple Report, 2001a). The Pink Lady[1] cultivar was perceived by retailers to be the most popular of the new apple cultivars currently exported from SA, and on average most of the surveyed retailers planned to stock more Pink Lady apples in the future. Granny Smith and Golden Delicious apples – which together constitute about 68 per cent of total SA apple exports – were ranked in sixth and tenth position, respectively. Clearly, the current basket of apples grown in SA seems out of line with future consumer trends, and threatens the international competitiveness of the SA apple industry.

To counteract this threat, it has been suggested that a systematic approach of introducing emerging cultivars into the current SA apple basket is probably required by replanting apple orchards at the end of their lifespan with these cultivars rather than with the original cultivars (Dall, 2001; Rabe, 2001). This strategy aims to create sustainable competitive advantage by supplying retailers with apples having better taste, shape, size and colour so that they successfully compete for the foreign consumer's Dollar/Euro/Pound despite the wider availability of traditional and exotic fruits. This means that SA apple producers must consider planting or replanting orchards with apple cultivars that match expected future consumer needs. Determining *which* apple cultivar investment opportunity is the best alternative given limited capital resources, and deciding *when* to invest, are critical components of the investment decision, particularly given uncertainty about the future income, costs and performance of the new apple orchard investment. A "wrong" or a regrettable choice is usually costly, since most investment expenditures – including apple orchards – are partially or completely irreversible (Dixit and Pindyck, 1995). Irreversibility means that the start-up

[1] Pink Lady is the trade mark name used for the Cripps-pink apple cultivar.

investment costs are sunk costs once the investment expenditure occurs, and cannot be fully recovered in the short-term.

The expected Net Present Value (NPV) and the Internal Rate-of-Return (IRR) approaches to capital budgeting are commonly used to assess the desirability of an investment opportunity. These methods involve (1) estimating the expected net cash flows for each period of the investment's productive life, and then (2) discounting these cash flows at a discount rate that reflects the weighted average cost of capital required to finance the project. Although the orthodox decision rules are to accept the investment with the greatest positive NPV and IRR, Collins and Hanf (1998) suggest that these NPV and IRR estimates have significant bias because they ignore the possibility that investment expenditure can be delayed. Typically, NPV evaluations assume that investors face a dichotomous "now" or "never" decision with no possibility to postpone the investment until a later time when more information might be available. In most cases, however, investment expenditure can be delayed, and the possibility to benefit from "hindsight" can profoundly affect *if* and *when* a manager might make the investment, especially when expected net returns from the investment are uncertain (Purvis *et al.*, 1995; Dixit and Pindyck, 1995). Thus, given uncertainty and irreversibility, *an option to postpone* a capital investment has value. Investing now would mean that managers would give up the opportunity to use the option, implying that the value of the lost option is an opportunity cost that must be added to the direct cost of the investment. Incorporating this value into orthodox NPV and IRR evaluations would raise the costs or required rates of return that must be "hurdled" in order to justify investing now, and so help managers to make more appropriate capital investment decisions.

To the best of the author's knowledge, no previous published research on evaluating agricultural investments in SA has attempted to incorporate the value of postponing a capital investment when making NPV and IRR evaluations. Rather, past studies of the SA apple industry have focused on evaluating national competitiveness by comparing SA fresh apple production and market share performance with that of countries like Chile and France (Du Toit, 2000; Esterhuizen and Van Rooyen, 1999; Steenkamp, 1999). The second aim of this study, therefore, is to show how to modify NPV and IRR evaluations to account for uncertainty and irreversibility, and the value of the option to postpone an investment, by comparing the potential profitability of investments in Pink Lady and Golden Delicious apple orchards. Chapter 4 first discusses why the Pink Lady apple

cultivar can play a role in improving the competitiveness of the SA fresh apple export value chain relative to more traditional SA apple cultivars like the Golden Delicious. Both the Pink Lady and Golden Delicious cultivars are seen as good eating-out-of-hand and cooking apples. Chapter 4 then explains how the *option to postpone* concept can be applied to capital budgeting using a model proposed by Dixit and Pindyck (1994), and discusses the research methodology and data sources. Chapter 5 summarizes the results and discusses the implications for managers wishing to use the modified NPV and IRR approaches to make capital budgeting decisions. Finally, a concluding chapter draws on the findings of Chapters 2 through 5, and discusses some policy and management implications for decision-makers in the SA fresh apple export industry.

CHAPTER 1

KEY CHALLENGES FACING THE SOUTH AFRICAN FRESH APPLE EXPORT VALUE CHAIN

This chapter describes intensifying competition in the global fresh apple export market, and shows how SA's fresh apple exports volumes compare with those from the rest of the world.

1.1 Intensifying Global Competition

Global rivalry among leading apple-exporting countries like SA, New Zealand, Chile and France, is intensifying. World apple supplies of deciduous fruit have expanded more rapidly than demand, such that global per capita supplies of apples and pears rose 31 and 56 per cent in the 1990's, respectively. Oversupply and low fresh apple demand growth, due to an aging total population, the decline of traditional family households, more eating away from home, increased competition from exotic fruits and increasing availability of competing snack foods, together reduced real global apple prices by more than 25 per cent from about US$ 700 per ton in 1992 to some US$ 430 per ton in 1999 (see **Figure 1.1**) (O'Rourke, 2001). No apparent recovery from these levels has occurred since then, and sentiment is that real apple prices are unlikely to rise in the next five years (Rabe, 2001). When demand for a product is growing slowly, and industry conditions tempt stakeholders to use price cuts or other competitive weapons (like better packaging and service) to boost unit sales, and when customer costs to switch to new suppliers are low (such as for apple consumers), rivalry usually becomes more aggressive as competitors strive to dominate their rivals (Thompson and Strickland, 1998: 76). If China's consumption of fresh apples falls behind its considerable large and growing apple production – some 38 per cent of world annual production in 2001 – and there is continued excess supply on the world market, the most likely outcome will be to raise the level of rivalry between apple exporting nations. According to O'Rourke (2001), rivalry has already increased as apple-exporting countries have sought to sell more apples in developing markets (e.g. the Middle East and Far East) other than the traditional European outlets. Typically, SA fresh fruit exporters send about 75 per cent of all SA apples, pears and table grapes to the European market, and 10 per cent to North American markets (Rabe, 2001).

Cleasby and Darroch (1991) estimated that the income elasticity of export demand for all deciduous fruit in SA's major trading-partner countries was 1.41, suggesting that SA export volumes would increase as real per capita incomes in importing countries rose. Per capita income growth in Europe has, however, remained relatively stable in the last decade (IMF, 2001), and apple export prices appeared to be driven more by supply conditions than demand forces. The only published SA fresh apple price elasticity of demand estimate (–9.662) was reported by Vosloo and Groenewald in 1969. Based on the more recent studies of international competitiveness of the SA fresh apple export value chain, the next section gives a brief profile of global fresh apple markets and considers the comparative performance of the SA fresh apple export value chain.

1.2 The SA Apple Industry in a Global Context

An estimated 4.76 million metric tons of apples, with a trading real value of US$ 2.76 billion (1999=100), crossed international borders in 1999 (FAO, 2001). France was the largest net exporter of apples in the same year, followed by the United States (US) and Italy. In 2001, SA was ranked the 21st largest apple producer, and the eighth and ninth largest exporter of apples in 1999 and 2000; respectively. Regarding apple consumption, Germany remains the most important net importer of apples, importing 0.73 million tons in 1999, followed by the UK and The Netherlands. The 20 leading fresh apple producing countries during 1998 and 1999, the 20 largest fresh apple exporters, and the major apple importing countries in 1999 and 2000 are listed in **Appendix 1A** (page 74 of the dissertation), **Appendix 1B** (page 75) and **Appendix 1C** (page 76), respectively. In its annual comparison of 27 major apple-producing countries, the World Apple Report found that New Zealand was still overall the most competitive producer of apples, followed by Chile and The Netherlands (World Apple Report, 2001b). South Africa – ranked ninth overall – was better placed in categories reflecting Production Efficiency (fifth), Infrastructure and Inputs (seventh), than in the Financial and Markets category (sixteenth). **Appendix 2** shows the competitiveness position of each of the 27 apple exporting countries in each of these three categories.

Steenkamp (1999) stated that "[apple] trade promotion efforts face an uphill task that requires looking at bottlenecks... and both the supply and demand side" (Steenkamp, 1999: 8). In contrast, Esterhuizen and Van Rooyen (1999) used a relative market share approach to show that SA fresh apple producers were internationally competitive and competitiveness appeared to improve through "value adding" activities, such as apple juicing. Neither of these two studies tried

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to isolate possible sources of competitive advantage or disadvantage, and furthermore, neither made recommendations to improve the performance of the SA fresh apple industry. In a later study, Du Toit (2000) compared the competitiveness of the SA apple value chain and the Chilean apple industry, with particular emphasis on the supply of fresh apples to the European market from these two countries. The aim was to isolate sources of national competitive advantage using four broad areas of investigation, including: firstly, industry structure, strategy and competition; secondly, factor conditions; thirdly, supporting industries; and lastly, demand conditions. Following the definition of national competitive advantage given by Porter (1990: 23) [that is, "...the specific characteristics of a nation's national circumstances that enables a specific industry within that nation to create and maintain competitive advantage"], Du Toit (2000) indicates that Chile's favourable natural resources gave it a significant competitive advantage. Support services in Chile also play a role in creating overall competitiveness, particularly those services providing market information. Chile appears to have a better flow of apple price and quality information through the apple value chain than does SA, and better signaling of changing consumer tastes and consumer buying patterns. Simultaneously, South American apple exporters are disadvantaged by high transportation costs, and SA exports can be delivered in Europe at 60 per cent of the transportation cost of a Chilean exporter (Dall, 2001).

1.3 Profile of the SA Fresh Apple Industry

The 522 fresh apple producers in SA as of 2001 operate mainly in the Western Cape and the Langkloof East regions of SA. About 76 per cent of these producers use one of the 37 SA packhouses offering apple-packing services. A list of packers provided by the Deciduous Fruit Producers' Trust (DFTP) suggests that about 54 per cent of packers now function as private companies, most of which probably operated under a co-operative governance and financial structure prior to deregulation in 1996. Packers typically provide sorting, storage and packing services, while export agencies are responsible for the export transportation, logistics, marketing, finance and administration functions once apple delivery at the packhouse is made by the apple grower. Exporters generally carry out business on a "consignment" basis, meaning ownership of the product remains with the apple producer until the wholesaler point-of-sale, whereupon exporters charge a commission for services rendered. The apple exporter usually then reimburses the packer on behalf of the apple producer, before a final transfer of proceeds to the apple producer is made.

temperature in the "cold chain", examination of ship temperatures and daily recording of perishable shipments leaving SA ports (Finn, 2001). Despite statutory obligation, the Board is financed independently and is expected to cover operational costs through competitive service fees.

Given increased rivalry in global fresh apple markets and the likelihood that real world apple prices will remain relatively lower in the next five years, SA fresh apple export value chain players need to come together and address the constraints that prohibit the SA apple industry from becoming more internationally competitive. The next chapter introduces value chain principles as the basis for developing a conceptual model that can help to investigate how to improve cooperation in order to make the SA fresh apple export value chain more competitive.

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CHAPTER 2

COOPERATION IN, AND COMPETITIVENESS OF, THE SOUTH AFRICAN FRESH APPLE EXPORT VALUE CHAIN

Improved competitiveness in the SA fresh apple export value chain can be achieved by creating a cost advantage and/or a product differentiation/value added advantage (Porter, 1985; Kennedy *et al.*, 1997), such that the greater the advantage, the greater the firm's competitive capacity and ability to withstand strategic moves and attacks by rivals. This chapter first discusses how value chain concepts can play a strategic role in helping firms create and sustain competitive advantage. After discussion of research by Porter (1985), the development of supply chain concepts, and the evolution from Resourced-based to Relational-based competitive theory, a value chain approach to evaluate how the SA fresh apple industry can become more internationally competitive is discussed in section 2.1, emphasizing trust as a key success factor for building more effective value chain relationships. A conceptual model of cooperative behaviour among the players in a typical value chain is outlined as a basis for developing generic research hypotheses – in section 2.1.3 – that are then applied to the case of the SA fresh apple export value chain in section 2.1.4. Chapter 2 ends with a description of the research methodology and data sources used to analyze the key aspects of cooperative relationships between players in the SA fresh apple export value chain.

2.1 Key Value Chain Principles

The need to capitalize on all resources and capabilities in the value chain (including collective reputation, brand names, trust, and knowledge management) has encouraged a theoretical movement away from *firm* versus *firm* competitive analysis to a *system* versus *system* analysis (O'Keeffe, 1998a). The relaxation of legal and managerial firm boundaries mirrors the concept of a *value chain*, which Porter (1985) – similar to Handfield and Nichols (1999) cited in the dissertation introduction – defines as the process in which multiple enterprises within a shared market cooperatively plan, implement, and manage the flow of goods, services, and information from point of origin to point of consumption. Firms are viewed in the context of an interconnected system where the actions of input suppliers and forward channel allies directly impact the operating and financial performance of an associated firm. The evolution of supply chain management theory reflects value chain concepts by focusing on improving production and marketing systems through quicker player responsiveness to changing consumer tastes, and by finding ways to reduce

distribution costs (Ricks *et al.*, 1999; Titus, 1995). Supply chain management also emphasizes how the design and the nature of the inter-linkages between value chain players can lead to competitive advantage by defining and benchmarking the specific responsibilities, actions and performance for each function along the value chain (Maurer and Wright, 1998).

Resource-based theory proposes that a firm must develop resources and capabilities that are valuable, rare and difficult to substitute or copy, and that intangible assets – such as corporate reputation and brand names – can be used to strengthen the competitive advantage created by differentiation and/or low-cost strategies. Although the Resource-based view helps managers to understand the sources of competitive advantage emanating from within the boundaries of the firm, it overlooks the potential advantages and disadvantages that result from interaction between linked firms (Dyer and Singh, 1998). Recent studies suggest that productivity gains leading to competitive advantage in the value chain are possible when value chain partners are willing to make relation-specific investments and combine resources in unique ways (Dyer, 1997). These studies show that firms that cooperate and form unique relationships with trading partners are likely to benefit from one of four documented sources of competitive advantage: (1) investments in relation-specific assets; (2) substantial knowledge exchange (often leading to joint learning); (3) combining of complementary resources and capabilities; and (4) lower transactions cost (Dyer and Singh, 1998). As a working definition, cooperation refers to similar or complementary coordinated actions taken by firms in independent relationships to achieve mutual or singular outcomes with expected reciprocation over time (Anderson and Narus, 1990). Higher levels of cooperation imply better business relationships between members of a value chain.

2.1.1 Cooperation and Trust

Social factors that contribute to the formation and maintenance of cooperative relationships include the beliefs, attitudes, values and goals held by the players (Smith *et al.*, 1995). Mutual trust helps to build shared values between the players and to reduce the risks of doing business (Barney and Hansen, 1994; Dyer, 1997). Nitschke and O'Keeffe (1999) emphasize the role that trust experiences have played in developing vertical and horizontal relationships between growers and marketers in the Australian grain industry, concluding that the successful management of the supply chain was attributable to this valuable and rare resource. Similarly, McKay (1993) and Hunt *et al.*

(2002) found that mutual trust must be present before a strategic alliance can flourish. Galizzian and Venturini (1999) show that cooperation tends to be rather vulnerable and unstable in the absence of trust. Cooperation, therefore, is likely to be stronger the more trust that the players have in their business relationships with one another.

In evaluating trust-based supply relationships in SA, Tregurtha and Vink (1999) highlighted the complexities involved in building commercial supply relationships, noting that institutional-based trust, characteristic-based trust and process-based trust were three prerequisites for long-term sustainability. Private and public institutions operating at the industry level can promote trust, and reduce transactions costs, through establishing and maintaining certainty about industry trade procedures and protocols (Ortmann, 2000). Non-compliance with these codes of conduct can result in exclusion from a representative group (such as the DFPT) along with any group privileges, such as access to market statistics and information. Institutional-based trust is most effective, therefore, when the parties involved would rationally avoid high external (legal) costs resulting from contract violation, or when the benefits of group membership are economically valuable (Tregurtha and Vink, 1999).

Commercial trustworthiness of a firm is established through the revealed customs, culture and codes of conduct particular to that business (Thompson and Strickland, 1998), which are often embodied in the firm's "mission statement". Morrow *et al.* (1999) indicate that the level of trust can be based, at times, solely upon the character of the associated parties, regardless of the governance structure prescribing the behavior of the players involved. Here, the first party reasons that a violation or breach of trust by the second party would trigger an internal cost that the second party would rationally avoid because of the particular character of the second party. The internal cost of violating one's own character is considered to be as strong a deterrent to opportunistic behaviour as the external costs imposed by other types of governance mechanisms. Evidences of pure characteristic-based trust are rare (Morrow *et al.*, 1999), but, nonetheless, illustrate the valuable role that trust can play in reducing the costs of participating in a market.

The Australian grain industry example used by Nitschke and O'Keefe (1999) stresses the ongoing need to develop and improve trust throughout the duration of the contract. Process-based trust implies frequent, meaningful contact, and an openness and eagerness to share knowledge and

information (of a technical, market, operational or financial nature) that is mutually beneficial (Tregurtha and Vink, 1999). Arms-length decision-making weakens the impact of incentives for firms to cooperate, and diminishes the expected rewards from renewing a contract. Boehlje *et al.* (1999) – who also stress the significance of trust in inter-firm relationships – point out that successful coordination involves matching good (poor) performance with the appropriate rewards (penalties). Implementing a robust and trustworthy incentive structure that best rewards a party's fulfillment of their obligations is a key challenge when seeking to build a successful value chain.

2.1.2 Cooperative Behaviour, Commitment and Competitiveness

The optimization of production and operations, lower transactions costs, and the appropriation of property rights are sources of value that can result from more effective vertical linkages (Lazzarini *et al.*, 2001). The need to improve downstream performance by, for example, adapting to market changes, can lead downstream players to cooperate more closely with upstream firms to cut costs, improve product quality, develop new products, etc. (Browning *et al.*, 1995; Langfield-Smith and Greenwood, 1998). Following Heide and John (1990) and Campbell (1992), the degree of cooperation between firms can be evaluated by studying the *cooperative behaviour* characteristics within that relationship. Joint problem-solving, communication, monitoring, adaptations, joint decision-making and assistance offered are all inter-firm behaviours that are associated with cooperation (Anderson and Narus, 1990; Frazier *et al.*, 1988). What aspect of cooperative behaviour to focus on depends on the unique key success factors in a particular value chain (Hardman *et al.*, 2002). For example, firms in technology-related industries should be concerned about working jointly on scientific innovation, testing and performance problems and making appropriate adaptations to current operations, while firms in marketing and service-related industries might focus more on aspects of communication, such as fast and courteous customer assistance, accurately recording how customer needs are changing, and ways to maximize net returns on advertising.

Stronger cooperative behaviour between the players makes exiting from the relationship undesirable, and causes a deeper commitment from the players to the value chain to overcome factors that constrain its future competitiveness. Over time, the players are likely to learn more

about the external and internal environments in which the value chain operates, the task of the value chain, each other and how to work together, their respective skills, and how to mould compatible goals. They are then likely to be more committed to reevaluate their linkages and to implement necessary changes to make the value chain perform better (Doz, 1996; Heide and John, 1990; Steffel, 2000). An unfavourable reputation with final buyers, lack of production and operating flexibility, and declining product and service quality through the value chain, are examples of competitive disadvantages that all players need to commit to solving before competitiveness can improve. Commitment to a trading relationship can be defined – in a behavioural sense – by the amount of long-term idiosyncratic investments made by the value chain partners (Campbell, 1992). A conceptual model of the links between trust, cooperation and commitment described above is developed in the next section as a basis for driving research hypotheses for this study.

2.1.3 A Conceptual Model of Trust, Cooperation and Human Resource Commitment

The value chain concepts outlined in sections 2.1.1 and 2.1.2 above imply that the level of cooperation is determined by the level of trust between players in a value chain, and that the level of human resource commitment depends on the level of cooperation. Causality, therefore, runs from TRUST → COOPERATION → HUMAN RESOURCE COMMITMENT (Anderson and Weitz, 1991; Campbell, 1992; Hunt *et al.*, 2002; Smith *et al.*, 1995). Based on these elements, stronger commitment implies a greater ability to deal more effectively with obstacles that constrain the competitiveness of a value chain. Appropriate research hypotheses to investigate this generic conceptual model can thus be summarized as follows:

Hypothesis 1(a): The higher are the levels of trust that producers (upstream players) have in their working relationships with packers and exporters (downstream players), the greater will be the level of cooperative behaviour as evidenced by higher levels of joint problem-solving, communication, monitoring, adaptations, joint decision-making, and assistance offered.

Hypothesis (1b): The higher are the levels of joint problem-solving, communication, monitoring, adaptations, joint decision-making, and assistance offered, the greater will be the level of human

resources that producers (upstream players) will commit to their working relationships with packers and exporters (downstream players).

Past research by Boehlje *et al.* (1999), Doz (1996), and O'Keeffe (1997; 1998b), suggests that the process of building trust and implementing cooperation will be helped if the partners monitor changes in the external and internal environment, and evaluate the risks associated with their investments in the value chain. This helps them to identify the key barriers or constraints to chain competitiveness over time, and how best to adjust to, and manage, these factors for mutual benefit. The third plausible research hypothesis for the generic conceptual model, therefore, is:

Hypothesis 1(c): Identifying and communicating the key barriers or constraints that limit value chain competitiveness will improve the players' understanding of each other's business and of where resources must be committed to jointly solve problems.

The above generic conceptual model is adapted in the next section to indicate the research hypotheses that were applied in this study to try and evaluate how players in the SA fresh apple export value chain can improve cooperation to make this value chain more competitive.

2.1.4 Applying the Conceptual Model to the Case of the SA Fresh Apple Export Value Chain

Fresh apples are highly perishable and many factors affect apple quality, implying that players in the SA fresh apple export value chain must constantly communicate about aspects such as the effect of recent weather patterns, how crops are responding to chemical sprays, and current levels of fruit ripeness[2]. Maintaining and improving product freshness, and dealing with supply shocks caused by hail damage, disease (codling moth), etc. often involves trying to solve associated logistical and fruit quality problems. Personal interviews with experts in the SA apple industry[3] during 2001 indicate that the industry must give more attention to joint problem-solving and

[2] Once apples are delivered to the packhouse, packers sort, store and pack the apples, and then export agencies carry out export transportation, logistics, marketing, finance and administration functions on behalf of the apple producer.
[3] Mr P. Dall (Chairman, Deciduous Fruit Producers' Trust), Mr P. Finn (Group Manager: Quality Services, Perishable Products Export Control Board), Mr V. Jensen (Chairman, Fresh Products Exporters' Forum), and Mr A. Rabe (Managing Director, Deciduous Fruit Producers' Trust).

communication, in particular, to try and respond to falling export revenues (caused by lower real world apple prices) and greater rivalry in export markets. These experts also identify production planning, delivery scheduling, apple marketing and quality control, as key activities in the SA fresh apple export value chain that are related to cooperative behaviour. To assess what may influence SA producers of fresh apple exports to 'cooperate with packers and exporters to be more competitive', this study adapts *hypotheses 1(a)* and *1(b)* in the generic conceptual model outlined in section 2.1.3 above and tests the following *a priori* expectations about players in the SA fresh apple export value chain:

Hypothesis 2(a): The higher are the levels of trust that SA apple producers have in their working relationships with apple packers and exporters, the greater will be the level of cooperative behaviour as evidenced by higher levels of joint problem-solving and communication.

Hypothesis 2(b): The higher are the levels of joint problem-solving and communication, the greater will be the level of human resources that SA apple producers will commit to their working relationships with packers and exporters.

Hypothesis 1(c) in the generic conceptual model can also be adapted by listing potential key constraints that limit the competitiveness of the SA fresh apple export value chain and then having the players evaluate these constraints and add any others that they may deem appropriate. Drawing from research by Eidman (1990), Sonka and Patrick (1984), and Woodburn *et al.* (1995) on the sources of risk in agriculture, and personal interviews held with SA apple industry experts, it is expected *a priori* that:

Hypothesis 2(c): Committing human and other resources to managing constraints like poor climatic conditions, the withdrawal of government export incentives, greater rivalry in export markets, high interest rates, and the production and marketing of inappropriate apple cultivars, can help SA apple producers, packers and exporters to improve the competitiveness of the SA fresh apple export value chain.

The next section discusses the sources of data and the research methodology used to assess these three research hypotheses for the case of the SA fresh apple export value chain.

2.2 Data Sources and Research Methodology

The target population of 522 apple producers, 37 apple packers and 14 apple exporters in the Western Cape and Langkloof East regions of SA were sent questionnaires by post or e-mail in April and May 2001, or personally interviewed during July 2001, to obtain information about (1) the degree of trust, joint problem-solving, communication, and human resources commitment, between them in the SA fresh apple export value chain; (2) their levels of cooperation in production planning, harvest scheduling, apple marketing and quality control; and (3) the factors that they perceive constrain the industry from becoming more competitive internationally (see the full producer questionnaire as an example in **Appendix 3,** page 78 of the dissertation). The Langkloof East and Western Cape regions were chosen for this study because 83 and 14 per cent of commercial apple trees grown in SA are situated in these areas, respectively (CIAMD, 2001). The five largest apple packers in SA (dealing with 34 per cent of fresh apple exports), the seven largest apple exporters (handling 68 per cent of fresh apple exports) and 37 producers returned usable questionnaires.

Production, handling, or marketing of fresh apples constituted the core business activity for all of the respondents, but typically each firm engaged in some enterprise diversification, such as pear production (92 per cent of producer respondents), stone fruit production (69 per cent of producers respondents) or grape, livestock, dairy, cut-flower or guava enterprises (see **Table 2.1** overleaf). Given the complementarities between the SA fresh apple export value chain and the SA fresh pear and stone fruit value chains in activities such as fruit sorting, storage, packing and cold-chain transportation, the findings of this study could possibly help SA pear and stone fruit value chain players find ways to become more competitive internationally. Over the last three years, the average apple output by producer respondents was about 2731 tons per annum – which contributed on average about 54 per cent (median = 70 per cent) to total turnover – with the largest apple producer recording 17167 tons per year over the three years. Some 33 per cent of producer respondents indicated that their business was operated as a Trust, while 23, 23, 15 and six per cent operate as a private company, individual owner, partnership or a close corporation, respectively. Respondents were generally unwilling to provide financial information and, therefore, financial analyses of the firms' performance are not presented.

Another 30 producers indicated during personal interviews that they did not have time to complete a full questionnaire but would briefly describe the nature of their relationships with packers and exporters, and identify constraints that limit the competitiveness of the SA fresh apple export value chain. These producers' comments supported the links between trust, cooperation and resource commitment, and the major constraints that were identified after the 37 usable producer questionnaires were analyzed as reported in Chapter 3.

Table 2.1. Descriptive statistics of, and cases of enterprise diversification by, sample fresh apple producers (n=37), packers (n=5) and exporters (n=7) in the SA apple export value chain, 1998-2000.

	Mean	Median	Minimum	Maximum
Average output (1998-2000)		**(Tons/Year)**		
Producer	2731	1184	4	17167
Packer	22653	16922	3216	62000
Exporter	10893	6250	4375	29667
Enterprise	**Cases**	**% of Total Respondents**	**Mean % Contribution to Turnover**	
Producer				
Apples	37	100	54.0	
Citrus	8	22	8.6	
Stone Fruit	25	69	13.9	
Pears	33	92	19.3	
Grapes	4	11	14.4	
Dairy	4	11	13.6	
Vegetables	6	17	23.6	
Livestock	11	31	7.2	
Wheat	2	6	5.6	
Flowers	5	14	17.0	
Other	3	8	28.6	
Packer				
Apples	5	100	76.6	
Citrus	3	60	2.8	
Stone Fruit	4	80	3.6	
Pears	5	100	17.0	
Exporter				
Apples	7	100	33.4	
Citrus	4	57	27.1	
Stone Fruit	5	71	10.0	
Pears	7	100	13.1	
Grapes	5	17	15.6	
Sub-Tropical Fruit	3	42	0.7	

Individual producer's perceived levels of trust in their working relationships with packers and exporters were estimated using an index derived from their scores on Likert-type scales that showed how strongly they agreed or disagreed with five statements including "We have a strong personal confidence in each other", "We have a strong business confidence in each other," and "We can always rely on each other when it counts" (see **Table 2.2** overleaf). To avoid neutral responses (do not agree or disagree with the statements), respondents had to select one of four responses – strongly agree, agree, disagree or strongly disagree – for each statement. For example, producers that strongly agreed with a statement scored a four, while those that strongly disagreed scored a one. An index of the level of trust perceived by each producer was then estimated by taking his/her average score over the five statements that related to aspects of trust in the business relationship. For example, if he/she scored a 2, 3, 3, 3 and 2 for the five statements, he/she scored 2.6 on the level of trust index ([2 + 3 + 3 + 3 + 2]/5). Estimated trust index scores for producers ranged from 2.00 to 4.00, with a mean score of 3.10 for the sample. Index values above 3.5 indicate high levels of trust, while values below 1.5 suggest low levels of trust in the working relationship.

Individual producer's perceived levels of communication, joint problem-solving and human resource commitment in working relationships with packers and exporters were similarly estimated by averaging their Likert-type scores for linked statements (also given in **Table 2.2**) about each of these behaviours. High communication scores imply that respondents strongly agreed with statements like "We often discuss issues such as changes in technology and market conditions", and "We have extensive formal and informal communications", and strongly disagreed that "We discuss only need-to-know information that relates directly to our relationship". Producers who perceived high levels of joint problem-solving strongly agreed that they make joint decisions about reducing exporting costs in the packhouse, delivery schedules, and fruit quality control, and that both players worked together to achieve productivity gains for mutual benefit. Individual levels of human resource commitment were estimated by whether producers agreed or disagreed that "We devote considerable time trying to improve this relationship", and "We devote considerable time trying to improve the packer's productivity", and that they had made a substantial number of adaptations in their delivery schedule in order to deal more effectively with a packer.

Table 2.2. Questions used to capture SA apple producer perceptions about the levels of trust, cooperation (joint problem-solving and communication) and commitment between players in the SA fresh apple export value chain.

To what extent do you **agree or disagree** with the following statements regarding your **relationship with your packer** (please mark the appropriate block)?				
Statement	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
Trust				
We have a strong personal confidence in each other				
We have a strong business confidence in each other				
We can always rely on each other when it counts				
I believe this packer will work hard in the future to maintain a close relationship with my firm				
I am very confident that this relationship will continue in the future				
Communication				
We often discuss issues such as changes in technology and market conditions				
We have extensive formal and informal communications				
We discuss only need-to-know information that relates directly to our relationship				
Joint-Problem-Solving				
We make joint decisions about:				
Reducing costs in the packhouse				
Delivery scheduling				
Quality control				
In this relationship, both sides work together to achieve productivity gains from which both sides benefit				
Commitment				
We devote considerable time trying to improve this relationship				
We devote considerable time trying to improve the packer's productivity				
We have made a substantial number of adaptations in our delivery schedule in order to deal more effectively with this packer				

Producers, packers and exporters were also asked to rank their perceptions about the level of cooperation in production planning, harvest scheduling, apple marketing, and quality control on

Likert-type scales from one (very low) to five (very high). **Table 2.3** shows the format of this question used to assess producer perceptions about the level of cooperation in these activities for the producer-packer link. Finally, producer, packer and exporters' perceptions of the major barriers that limit SA fresh apple export value chain competitiveness were elicited by asking them to rank the set of potential constraints listed in **Table 2.4** on page 24 on Likert-type scales from one (minor constraint) to five (major constraint). As explained in section 2.1.4 above, these constraints are developed with reference to past research on the sources of risk in agriculture, personal interviews held with SA apple industry experts, and academics with knowledge of the current drivers of change in SA agribusiness (Darroch, 2001; Ortmann, 2001). The players were also requested to score any other constraint(s) that they wanted to add to the hypothesized list.

Table 2.3. Questions used to capture SA fresh apple producers' perceptions about the level of cooperation with packers in key SA fresh apple export value chain activities.

How would you describe the level of **cooperation** between **you and your packer** in the following business activities (please mark the appropriate block)?					
Business Activity	**Very High**	**High**	**Moderate**	**Low**	**Very Low**
Production Planning					
Harvest Scheduling					
Apple Marketing					
Quality Control					

Based on the 37 usable producer questionnaires, Ordinary Least Squares (OLS) regression was applied to estimate recursive models (Gujarati, 1995: 680) to test the adapted *hypotheses 2(a)* and *2(b)* for the producer-packer link and the producer-export link in the SA fresh apple export value chain. Each recursive model showed how the level of cooperation between the two players (joint problem-solving and/or communication) depends on the level of trust, and, in turn, how the level of human resource commitment by producers depends on the level of cooperation (joint problem-solving and/or communication) between the two players. These models, therefore, reflect the unilateral causal chain relationship from trust to cooperation to human resource commitment specified in the generic conceptual model of cooperative behaviour outlined in section 2.1.3. The levels of trust, cooperation (joint problem-solving and communication), and human resource commitment were represented by the estimated producer index scores for these concepts derived from the Likert-type scales as explained above.

Table 2.4. List of potential constraints that limit the competitiveness of the SA fresh apple export value chain.

In your opinion, what are the **major obstacles** hindering the SA apple export industry from becoming more **competitive**? Rate the following aspects on a scale of 1 (**minor constraint**) to 5 (**major constraint**) and add any further factors that you view as important.					
Constraint	**Score**				
	Minor Constraint				**Major Constraint**
	1	2	3	4	5
Abandoning of fruit handling protocols through the supply chain					
Ageing apple exporting infrastructure					
Climatic conditions					
Crime					
Current levels of investment in research and development (R & D) of apple cultivars					
Exporter inexperience in international trade					
Exporter liquidity problems					
Harbour terminal bottlenecks					
High interest rates					
Increased competition from Southern Hemisphere countries					
Lack of foreign investment into SA					
Lack of market information					
Lack of training and human development					
No government export incentives					
Over-capitalization at packhouses					
Production and marketing of inappropriate apple cultivars					
Restrictive government labour policy					
Other: Please specify:					
Other: Please specify:					

The next chapter presents the empirical results of the recursive models of the links between trust, cooperation and human resource commitment in the SA fresh apple export value chain, and give respondents' rankings of the key constraints an the chain's competitiveness.

CHAPTER 3

COOPERATION IN THE SOUTH AFRICAN FRESH APPLE VALUE CHAIN: RESULTS AND DISCUSSION

Producer scores for their perceived levels of trust, cooperation and human resource commitment with packers and exporters in the SA fresh apple export value chain are reported in section 3.1. The estimated OLS recursive models of expected relationships between these factors, as summarized in *hypothesis 2(a)* and *2(b)* in Chapter 2, are then reported in section 3.2. Perceived constraints on chain competitiveness are then presented in section 3.3. A discussion of these results concludes the chapter.

3.1 Index Scores for the Perceived Levels of Trust, Joint Problem-solving, Communication and Human Resource Commitment

The mean, minimum, and maximum index scores showing SA fresh apple producers' perceived levels of trust, cooperation (joint problem-solving and communication) and human resource commitment in their working relationships with fresh apple packers and exporters are reported in **Table 3.1** on page 27. Scores for the producer-packer link ranged from 1.50 for joint problem-solving, to a maximum of 4.00 for trust, joint problem-solving and human resource commitment. Mean scores close to 3.00 for all four aspects of the relationships suggest that producers in the sample, on average, perceive relatively high levels of trust, joint problem-solving, and communication in their relationships with packers, and that producers are quite strongly committed to these relationships. Scores for the producer-exporter link ranged from 1.00 for joint problem-solving and communication to a maximum of 4.00 for all surveyed aspects of the link. Given mean scores again close to 3.00, producers in the sample, on average, seem to perceive relatively high levels of trust, joint problem-solving, and communication in their relationships with exporters, and are quite strongly committed to these relationships.

Table 3.1. Producer scores for their perceived levels of trust, joint problem-solving, communication and human resource commitment in working relationships with packers and exporters in the SA fresh apple export value chain.

Aspect of Relationship	Packer relationship[a]				Exporter relationship[a]			
	Minimum index score	Maximum Index score	Mean index score	Std. Error	Minimum index score	Maximum index score	Mean index score	Std. Error
Trust	2.00	4.00	3.10	0.557	1.60	4.00	3.09	0.658
Joint Problem-Solving	1.50	4.00	2.69	0.754	1.00	4.00	2.78	0.814
Communication	1.67	3.67	2.91	0.499	1.00	4.00	2.71	0.725
Human Resource Commitment	2.00	4.00	2.72	0.533	1.67	4.00	3.13	0.567

[a] Scores ranging from 1 (strongly disagree) to 4 (strongly agree) indicate to what extent producers agree or disagree with statements linked to aspects of their packer and exporter relationships. Scores near 1 suggest a perceived weak aspect of the relationship, while scores near 4 indicate a strong aspect.

3.2 Recursive Models of the Trust - Cooperation – Commitment Link

The estimated recursive models, as expected, showed that higher levels of trust encouraged more upstream cooperative behaviour in the SA fresh apple export value chain. In the producer-packer recursive model, the level of perceived trust (TRUST) had a positive impact on the level of joint problem-solving (JPS) between these players (equation (3.1)). Greater levels of joint problem-solving between them also lead to greater levels of human resource commitment (RES) by producers to the working relationship (equation (3.2)). Estimated t values for equation (3.1) and equation (3.2) are given in parentheses, ** and *** indicate statistically significant estimated coefficients at the 5% and 1% levels of significance, respectively, and df show the number of degrees of freedom. These results give some support to hypotheses *1(a), 1(b), 2(a)* and *2(b)* about determinants of cooperation and human resource commitment derived in section 2.1.3 and 2.1.4 above. The level of communication was not statistically significantly related to either TRUST or RES, and so this aspect of cooperation was omitted from the reported producer-packer recursive model.

Producer-Packer link: **JPS = 0.729 + 0.641 TRUST** **(3.1)**

*(0.930) (2.579)***

Adjusted R^2 = 0.191 F = 6.649** df = 35

Producer-Packer link: **RES = 2.155 + 0.279 JPS** **(3.2)**

*(5.639)*** (2.056)***

Adjusted R^2 = 0.119 F = 4.229** df = 35

In the producer-exporter recursive model, TRUST had a positive effect on the level of communication (COMM) between these players (equation (3.3)). The level of joint problem-solving (JPS) was not statistically significantly related to TRUST, but was significantly related to both COMM and RES. To overcome the multicollinearity problem between JPS and COMM, RES was regressed on a principal component, defined as "Cooperation" (COOPN), that explained 79.43 per cent of the variation in JPS and COMM. The positive relationship between COOPN and RES implies that higher levels of communication and joint problem-solving encouraged producers to commit more human resources to this working relationship (equation (3.4)). Estimated t values for equation (3.3) and equation (3.4) are given in parentheses, *** showing statistically significant estimated coefficients at the 1% level of significance, and df again shows the number of degrees of freedom. These results also give some support to hypotheses *1(a), 1(b), 2(a)* and *2(b)* about determinants of cooperation and human resource commitment derived in section 2.1.3 and 2.14.

Producer-Exporter link: **COMM = 0.466 + 0.727 TRUST** **(3.3)**

*(0.925) (4.565)****

Adjusted R^2 = 0.415 F = 20.842 df = 35***

Producer-Exporter link: **RES = 2.058 + 0.285 COOPN (3.4)**

(5.651) (3.024)*****

Adjusted R^2 = 0.230 F = 9.386 df = 35***

The next section reports on the perceived levels of cooperation between producers, packers and exports in production planning, delivery scheduling, apple marketing and quality control, and how these players ranked perceived constraints that limit the competitiveness of the SA fresh apple export value chain.

3.3 Overall Cooperation and the Perceived Constraints on the Competitiveness of the SA Fresh Apple Value Chain

Producer, packer and exporter perceptions of their levels of cooperation with each other regarding key activities in the SA fresh apple export value chain are summarized in **Table 3.2** below using average scores that could range from one (very low cooperation) to five (very high cooperation).

Table 3.2. Respondents' scores for their perceived levels of cooperation with other players in key SA fresh apple export value chain activities.

Activity	Chain Player					
	Producer[a]		Packer[a]		Exporter[a]	
	Packer	Exporter	Producer	Exporter	Producer	Packer
Production Planning	3.41	2.46	2.25	2.80	2.72	3.00
Delivery Scheduling	3.78	2.31	2.75	2.80	2.85	-
Apple Marketing	3.12	2.70	2.50	3.00	3.14	3.40
Quality Control	3.89	2.04	2.50	3.00	3.14	3.40
Overall Cooperation	**3.55**	**2.38**	**2.50**	**2.90**	**2.96**	**3.26**

[a] Scores were based on the players' perceptions of the level of cooperation for each activity in the SA fresh apple export value chain, and could range from 1 (very low cooperation) to 5 (very high cooperation).

Producers view overall cooperation with packers as "moderate" to "high", with high cooperation in delivery scheduling and quality control. They also perceive that exporter cooperation is "low" to "moderate", with low cooperation regarding fruit quality control. Similarly, exporters

felt that overall producer cooperation was "moderate", with production planning and delivery scheduling as activities where the least cooperation exists. Production planning involves, among other things, planting new apple cultivars and the cultivars that final consumers demand. As retailers are becoming more selective about which apple cultivars they will stock to meet consumers' needs (World Apple Report, 2001a), producers that grow an inappropriate mix of apple cultivars will find their access to some markets restricted and will become less competitive. **Table 3.2** shows that there is still scope to improve the level of overall cooperation between these three players in the SA fresh apple export value chain. The players' rankings of the key constraints that limit SA fresh apple export value chain competitiveness that are shown in **Table 3.3** identify further aspects that they need to communicate about, commit resources to, and jointly solve.

Table 3.3. Respondents' rankings of the key constraints on SA fresh apple export value chain competitiveness.

Constraint	Ranking of Constraints[a]		
	Producers	Packers	Exporters
Climatic conditions	4	1	1
No government export incentives	1	2	6
Increased competition from rival apple-exporting countries	5	6	2
Restrictive government labour policy	2	3	9
High interest rates	3	6	3
Production and marketing of inappropriate apple cultivars	13	3	9
Harbour terminal bottlenecks	16	6	4
Lack of training and human development	14	10	4
Relaxation of fruit handling protocols through the supply chain	8	5	7
Over-capitalization at packhouses	6	10	8
Lack of independent market information	6	14	9
Exporter inexperience in international trade	10	6	13
Exporter liquidity problems	17	12	9
Ageing apple exporting infrastructure	9	14	15
Current levels of investment in R &D of apple cultivars	10	12	15
Crime	12	16	17
Lack of foreign investment into SA	15	17	13

[a] Rankings are based on the players' average scores on each constraint, which ranged from 1 (minor constraint) to 5 (major constraint). Constraints are listed in descending order of importance according to the lowest total across the respondent classes.

Producers ranked the recent withdrawal of government export incentives, restrictive labour policy, business (climate) and financial (interest rate) risks, rival exporters, and lack of independent market information as the six main constraints they face currently. Climatic conditions were ranked the top current constraint by packers and exporters, probably reflecting concerns that they and

producers have about the effect of recent drought on the overall "pack-out" (quality distribution) of recent apple crops. Poor quality apples are channeled away from packing and exporting facilities towards juicing and other processing plants. This cuts packer and exporter volumes, and thus reduces their competitiveness by driving up operating costs per unit. Total annual apple production in SA remained stable in the last decade, but export (high value) volumes fell by 11 and 22 per cent in 1999 and 2000, respectively, due to warm and dry winters.

Apple packers also ranked the lack of export incentives and restrictive labour policy in their top three constraints, but seemed more concerned than producers and exporters about whether an appropriate mix of apple cultivars was being produced and marketed. Packers viewed the relaxation of pre-harvest and post-harvest fruit handling protocols as their fifth ranked constraint. Although ranked slightly lower by producers and exporters, this constraint reflects concerns about the potential effect of market deregulation on the quality and "image" of SA fruit exports now that more fruit classes are exported than before deregulation in 1996. Packers ranked exporter trade experience, harbour terminal bottlenecks, high interest rates and rival international exporters jointly as the sixth most pressing constraint. Exporters ranked rivalry, high interest rates and terminal bottlenecks in their top four constraints, along with a lack of training and human development. They perceived that harbour terminal bottlenecks, and training and development were more pressing constraints than did producers and packers. With an understanding of these perceived constraints, the players can now make better decisions about where to allocate scarce human and other resources in order to improve the international competitiveness of the SA apple export value chain. The constraints identified in **Table 3.3** give some support to the *hypothesis 1(c)* and *2(c)* derived above in sections 2.1.3 and 2.1.4.

3.4 Discussion

In the SA fresh apple export value chain, higher levels of trust lead to more joint problem-solving between producers and packers and to more communication between producers and exporters. More joint problem-solving between producers and packers encouraged producers to commit greater levels of human resources to the working relationship. At the producer-exporter link, higher levels of both communication and joint problem-solving lead to higher human resource commitment by producers to the relationship. These players could cooperate more closely on

delivery scheduling and quality control to promote the competitiveness of the SA fresh apple export value chain. These efforts can be assisted if the players communicate more about what are, and how to overcome, the perceived key constraints that limit competitiveness.

Although the three players rank the main constraints differently, and some factors are more specific to each player, there is broad agreement on some of the constraints that must be addressed. Climatic conditions are essentially beyond the players' control and affect the delivery quantity and quality of SA apple exports. Patrick *et al.* (1985), and Woodburn *et al.* (1995) also identified yield (weather) variability as a major source of risk for US and SA crop farmers, respectively, while Wermund and Fearne (2000) cite variable climate as a major constraint on production in the British stone fruit industry. The withdrawal of export incentives will affect the sustainability of those producers that were most heavily dependent on this assistance. The policy question is whether these producers would exit the industry without support due to a lack of appropriate management skills. The SA government is currently addressing calls from the business community to reduce the transaction costs of implementing new labour legislation. This would improve the medium-term viability of producers facing lower real world apple prices. Local interest rates are likely to remain relatively high in nominal and real terms, implying that more leveraged players must give more attention to debt management and consider strategies like debt roll-over, debt consolidation and possible mergers.

All three players acknowledge the threat posed by rival global fresh apple exporters. In European markets, particularly the UK, quality and price competition from apple producers in France and Chile are the main threat. In this regard, more timeous provision of information on where apple consignments leaving SA ports are destined for, could help SA exporters to make better decisions about where and when to send apples to avoid problems of over-supply (and lower prices) on specific markets. The PPECB currently collects these data, but information dissemination is delayed by up to six months. Exporters need to consider working with the Board to improve this turn-around time, or consider alternative price information sources – provided that the benefits of timely access to consignment information outweigh the cost of accessing such data.

The longer-term question is whether or not competitiveness could be improved by growing a better mix of traditional and new apple cultivars. Fresh apple marketing experts emphasize that SA

apple producers need to become more responsive to changing international fresh apple consumers' preferences, although producer views could reflect the limited scope for producing new apple cultivars in SA, especially in areas where there is a lack of sufficiently cold conditions to promote fruit colouring, taste and yields. Potential adopters of new apple cultivars may also be concerned about the uncertain yields, prices and production costs once a new cultivar has been adopted. As explained above, the World Apple Report (2001) indicates that apple cultivars such as Gala and Pink Lady are becoming increasingly popular, yet these contribute only about 10 per cent of the annual SA crop. Chapter 4 and Chapter 5 partly address these concerns by using modified NPV and IRR capital budgeting methods to evaluate and compare the relative profitability of Golden Delicious (traditional cultivar) and Pink Lady apple orchard investments for SA apple producers. This information can help to show whether producing more Pink Lady apples could provide a better mix of traditional and new apple cultivars for the SA fresh apple export value chain.

All three players need to focus on quality control, given the perceived lack of cooperation in this activity and the relaxation of protocols on fruit handling. Product quality assurance standards, such as Hazard Analysis Critical Control Point (HACCP), and management quality assurance standards, such as ISO 9000, are tools that the players can integrate into current fruit handling systems to improve apple quality management throughout the SA fresh apple export value chain. Most of the apple producers in this study were prepared to pay a levy towards funding research on key industry issues, such as how to preserve and enhance the quality of apples through the "cold chain". Finally, packers and exporters need to cooperate more and work together with downstream firms to overcome harbour terminal bottlenecks. The players could also cooperate more in identifying and overcoming gaps in staff training and development throughout the chain.

The next chapter discusses how to evaluate and compare investments in the Golden Delicious, a traditional SA fresh apple export cultivar, and the Pink Lady.

CHAPTER 4

EVALUATING POTENTIAL APPLE ORCHARD INVESTMENTS IN SOUTH AFRICA UNDER UNCERTAINTY AND IRREVERSIBILITY

Gala, Braeburn, Cameo, Fuji and Pink Lady are expected to be the most popular apple cultivars for the future (World Apple Report, 2001a). Interviews with key industry players (Dall, 2001; Finn, 2001; Jensen, 2001; Rabe, 2001) at all levels in the SA fresh apple export value chain during March 2001 indicate that the need by SA apple producers to more widely adopt these new apple cultivars was a serious threat to the future competitiveness of the SA fresh apple export value chain. **Table 3.3** also showed that SA fresh apple producers, exporters and packers perceive that the current mix of fresh apples grown in SA is out of line with international apple consumption trends. To counteract this threat, it has been suggested that a systematic approach of introducing emerging apple cultivars into the current SA apple basket is required (Dall, 2001; Rabe, 2001). Chapter 4, and Chapter 5, evaluate the implications and scope of this strategy to make SA fresh apple exports more competitive by comparing the expected financial performance of a promising new apple export cultivar, the Pink Lady, to that of a traditional apple export cultivar, the Golden Delicious in SA. The next section considers the expected changes in income and costs when a new apple cultivar is adopted. Section 4.2 then discusses how to evaluate potential apple orchard investments when, due to uncertainty about yields, prices and apple production costs, and the irreversible nature of such investments, the option to postpone the investment has value. Section 4.3 concludes the chapter by describing the data sources and research methodology.

4.1 Expected Changes in Income and Costs When a New Cultivar is Adopted

The success or failure of adopting new apple cultivars to try to create sustainable competitive advantage can be judged by the extent to which adoption affects the firm's expected income and costs. The cumulative difference that a new cultivar contributes to a producer's income over the life-span of an apple orchard will depend on (1) the difference in annual fresh apple yields, (2) the difference in pack-outs, (3) the relative difference in per carton apple price, and (4) the comparative growth/decline in demand for each cultivar over time (Dall, 2001). Annual production costs can also vary from one cultivar to another due to different input (e.g. fertilizer, water, labour, machinery and chemical) use, and modifications to methods used for pre-harvest and post-harvest

handling of the fruit. An investment in the new cultivar could also result in SA apple producers needing to annually purchase cultivar-specific inputs, whose long-term real prices are uncertain over the orchard's life-span. If the new cultivar requires additional storage facilities and unique atmospheric controlling devices to improve fruit colouring or to preserve taste, the firm's working capital requirements would change, causing higher debt servicing charges if capital is borrowed. Depending on how many additional facilities are needed and the firm's capacity to meet capital expenditure, the opportunities to convert to a new cultivar may range from nil to extensive.

Producers may also incur relatively high search and information costs when they try to reduce the uncertainty about how the new cultivar will perform under SA conditions. *Information costs* refer to those expenses incurred when sourcing and buying information about new cultivars, such as details on nutrient, water and annual cold-unit requirements. If there are no applicable published records, growers may have to conduct their own, potentially expensive, in-field research and development trials. The administrative burden of collecting, sorting and processing such data adds to the total information costs as it requires management time, which has an opportunity cost (Calkins and DiPietre, 1983:115).

The future competitive performance of the SA fresh apple export industry is uncertain due to potential changes in government labour policy and real interest rates, increased rivalry from other fresh apple exporting countries like Chile and France, and variability in climatic conditions as discussed in Chapters 2 and 3. Poor climatic conditions restrict the growth and colouring of Pink Lady apples, leading to lower volumes of top quality apples. Postponing a Pink Lady apple orchard investment will give SA apple producers more time to acquire information about expected Pink Lady price premiums (currently the price is about 18 per cent higher than that for Golden Delicious apples), cost and production techniques. The question is whether SA apple producers should invest in a new Pink Lady apple orchard now, and capitalize on the expected price premium, or wait another period and only invest if the real Pink Lady apple price remains favourable, and when more knowledge about how to improve this cultivar's performance is available.

If farmers are typically risk-averse, they would prefer to adopt a farm plan that provides a satisfactory and more predictable level of income, even if this means sacrificing income on average (Hazell & Norton, 1986:216). Assuming that the expected income for a risky alternative is higher

than for a certain outcome, sacrificed income amounts to an opportunity cost such that risk-averse farmers sacrifice increasingly more income by selecting more certain outcomes. Risk-averse producers, therefore, will forfeit potentially higher incomes associated with a new cultivar, but non-adoption shields them from potential losses due to disease, poor cultivar responses to climatic conditions (such as poor apple colouring), further changes in consumer tastes, and losses incurred while gaining operating and handling experience for the new cultivar. This means that the rate at which a new cultivar is adopted also depends on the level of risk-aversion of the chief decision-makers. To assess whether adopting the Pink Lady apple cultivar can potentially improve the financial standing of a typical SA fresh apple producer, this section of the study will first tests the following hypothesis:

Hypothesis 3(a): Fresh apple farmers in SA that grow and export the Pink Lady cultivar are expected to earn greater net returns on an orchard investment per hectare than if they grow and export the Golden Delicious cultivar.

The next section describes how orthodox NPV and IRR capital budgeting techniques to evaluate *hypothesis 3(a)* must be modified to account for uncertainty and irreversibility.

4.2 Modifying Orthodox Capital Budgeting Methods to Account for the Option to Postpone an Investment

Recent studies in the US show that the conventional expected NPV and IRR approaches to capital budgeting that ignore uncertainty and irreversibility are likely to report biased NPV and IRR estimates, leading to inappropriate investment behaviour (Elmer *et al.*, 2001; Collins and Hanf, 1998; Purvis *et al.*, 1995; and Dixit and Pindyck, 1995). Biased NPV and IRR estimates are a consequence of incorrectly assuming that investors face a dichotomous "now" or "never" investment decision with no possibility to postpone the investment until a later time when more information might be available. In many cases, however, an investor can delay the project until later, and by doing so benefit from the opportunity to avoid downside risk if market conditions become unfavourable. The opportunity to avoid a "wrong" decision implies that the *option to postpone* the investment expenditure has value. Incorporating this option value into the orthodox NPV and IRR evaluations reduces the bias in NPV and IRR estimates and can help managers who

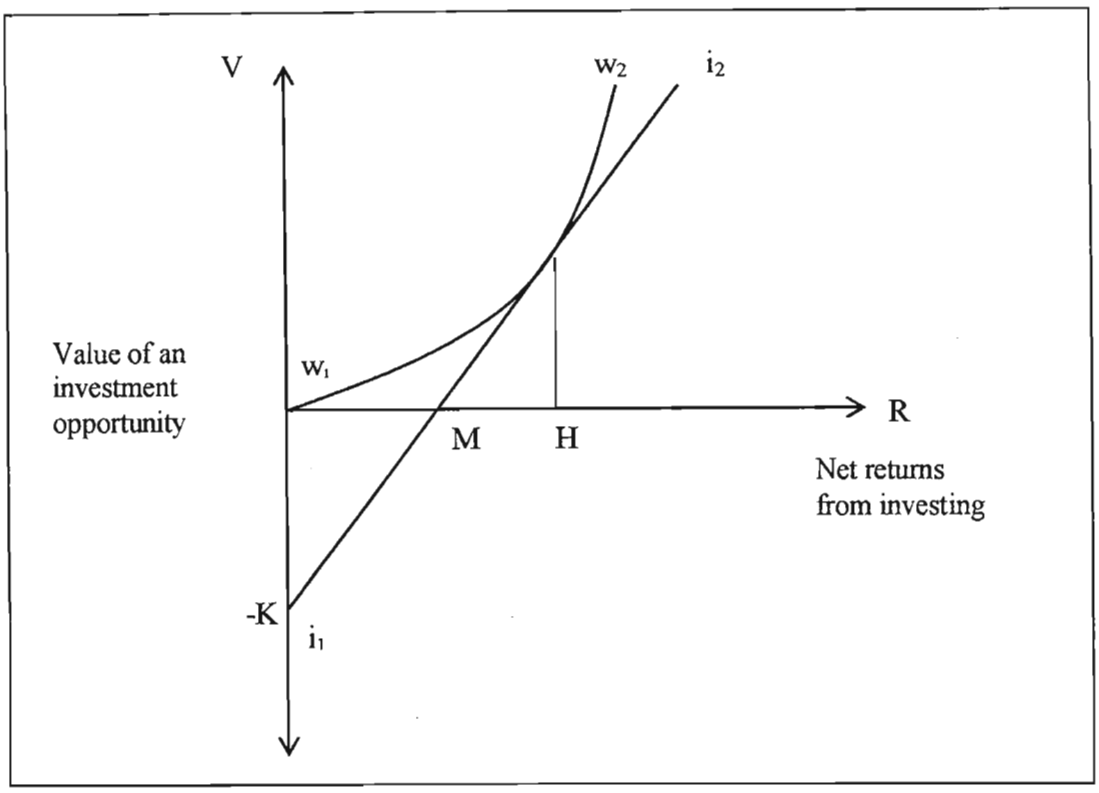
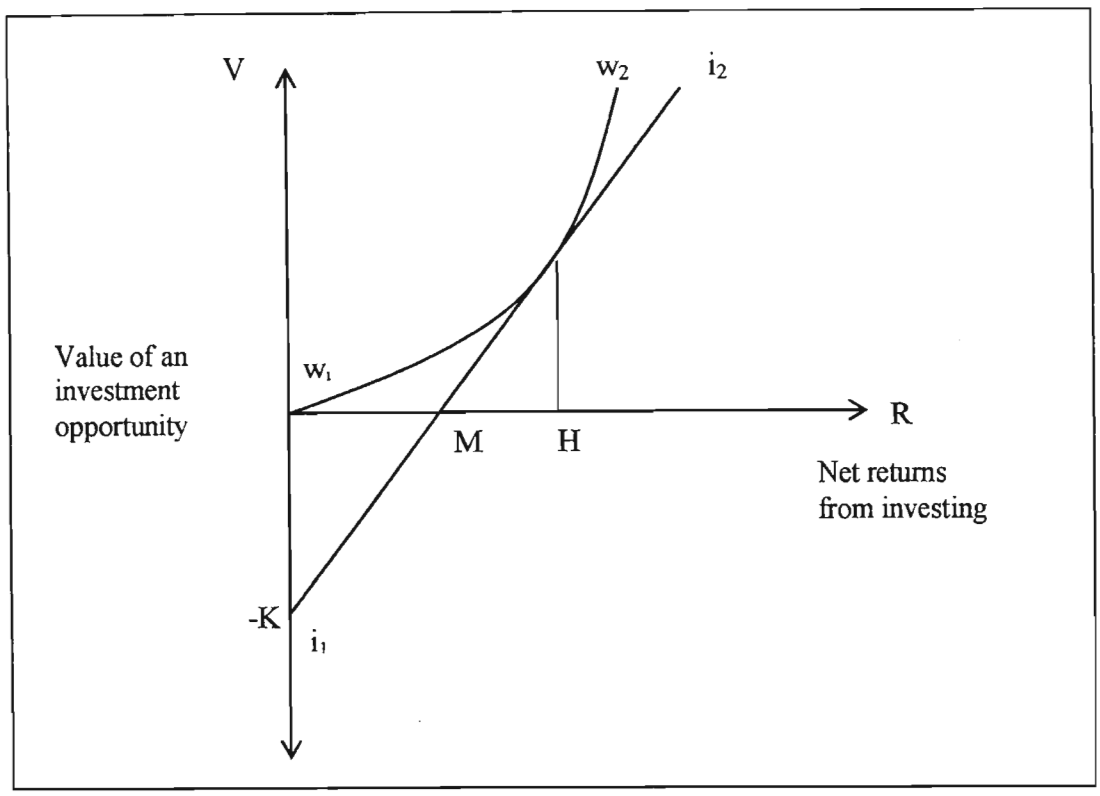


FIGURE 4.1 The optimal timing of an investment (the value of waiting to invest (curve w_1w_2) is equal to the value of investing immediately (curve i_1i_2)). (Source: Purvis *et al.*, 1995).

If, however, an investor values the option to wait to invest, *M* must be modified and adjusted upward to reflect the value of the foregone opportunity to postpone the investment. If the present value of the discounted expected returns then exceeds the modified investment trigger, the investment is acceptable, as the expected returns cover the full cost (direct cost plus opportunity cost) of making the investment. The value of waiting (w_1w_2) is estimated by WR^B, where the shifter *W* fixes the position of *W* and *B* determines its slope. The origin of w_1w_2 is at R = 0 and V(R) = 0. An investor who waits will exercise an option to invest only if V(R) were positive. Gains from waiting are positively correlated with R because the expected returns are stochastic. The gains from waiting in the case of apple orchard investments result from being able to avoid downside risk such as lower real apple prices and adverse climatic conditions. The point where the value of waiting and the value of investing are tangent corresponds to *H* on the horizontal axis, and *W* equals $(H - \rho K)/H^B$ (Purvis *et al.*, 1995). Taking this expression Dixit and Pindyck (1994: 142) derive the modified (optimal) investment trigger (*H*) as



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$$H = \frac{B}{B-1}\rho K \quad . \qquad (4.1)$$

The H in equation (4.1) is greater than M by the factor $B/(B-1)$ which is the "option value multiple". At H, the discounted expected returns from investing now are sufficiently high to cover both K and the opportunity cost of not waiting. The parameter B is a component of the function that Dixit and Pindyck (1994) derive to calculate the value of waiting, and it is jointly determined by ρ and σ^2 as

$$B = \frac{1}{2}\left[1 + \sqrt{1 + \frac{8\rho}{\sigma^2}}\right]. \qquad (4.2)$$

A lower real discount rate, ρ, and/or greater uncertainty about the expected returns from investing, σ^2, reduces B and *increases* $B/(B-1)$. This *increases* the H, implying that the opportunity cost of exercising the option to invest has risen. A lower real discount rate increases the present value of later expected net returns and so encourages waiting, while greater uncertainty also increases the expected gains from waiting.

In addition to the modified H associated with the NPV method, Dixit (1992) proposes using the modified hurdle rate (ρ') to evaluate the desirability of making an investment now. The ρ' factors in the value of waiting by raising ρ (the equivalent of the required rate of return, RRR, in the IRR method) by the value of the option value multiple $B/(B-1)$ as

$$\rho' = \frac{B}{B-1}\rho \qquad (4.3)$$

where B is again estimated from equation (4.2). Elmer *et al.* (2001) estimated ρ' values ranging from 19 to 29 per cent when they applied real discount rates of between three and nine per cent to analyze the orchard investment decisions of Texas grapefruit farmers in the US. Purvis *et al.* (1995) report ρ' estimates of two to three times the real discount rate of three per cent that they applied to evaluate the adoption of dairy housing technology in the US. Summers (1987) found that the managers of US companies were applying hurdle rates ranging from eight to 30 per cent (with a

median of 15 per cent and mean of 17 per cent) in their investment decisions when nominal interest rates were about four per cent. Accounting for uncertainty and irreversibility is likely to make a difference to SA fresh apple producers that are considering investing in either a new Pink Lady apple orchard or a new Golden Delicious apple orchard to improve their competitiveness. The second hypothesis tested in this section of the dissertation, therefore, is as follows:

Hypothesis 3(b): Accounting for uncertainty and irreversibility, SA *fresh apple farmers that must decide now whether to grow and export the new Pink Lady or the traditional Golden Delicious apple cultivar are expected to apply a higher hurdle rate to the Pink Lady apple orchard investment (about which they have less information) to trigger expenditure than to the Golden Delicious apple orchard investment.*

The *a priori* expectation is that SA fresh apple farmers who value the option of waiting for more information about the future performance of the Pink Lady apple cultivar under SA conditions, will apply hurdle rates higher than the current real discount rate ($\rho' > \rho$) before deciding to invest in a Pink Lady apple orchard, and that this hurdle rate will reflect the greater uncertainty associated with a Pink Lady apple orchard investment compared to that of a Golden Delicious apple orchard.

4.3 Data Sources and Research Methodology

Equation (4.2) shows that the parameter B is jointly determined by the applied real discount rate, ρ, and the variance of the investment's expected annual net returns, σ^2. The researcher can set a range of plausible ρ levels based on previous work such as Elmer *et al.* (2001) and recommendations made in financial texts like Barry *et al.* (1995). Two different approaches can be used to estimate σ^2: The *ex post* approach involves collecting cross-sectional time-series data from investments similar to the capital investment under consideration, and then deriving σ^2 by averaging the variance of expected net returns in the observed cases. The implicit assumption is that expected net returns are homoscedastic, and that past estimates of the variance of expected net returns are the best measure of future expected variance. However, there is little reason to believe that the variance of expected annual net returns for apple orchard investments will remain stable over time, especially given lower real world apple prices, increasing competition from rival fresh apple exporters and the recent volatility of the Rand exchange rate. The *ex post* approach is also ineffective when a new unproven opportunity to invest arises, having no predecessor from which to obtain the necessary

time-series data. To overcome these constraints, an *ex ante* approach to the Dixit-Pindyck model for estimating σ^2, *and hence H* and ρ', was developed by Purvis *et al.* (1995), and it is used in this study.

First, define the natural log difference between the value of the opportunity to invest in an apple orchard now, V_t, and the potential value of that opportunity one period later, V_{t+1}, as $\Delta lnV_j \equiv lnV_t - lnV_{t+1}$. The present value of this investment with expected annual net returns of R_t, at time t, and an instant later, at t + 1, are then defined, respectively, as

$$PV_t = \sum_{i=0}^{n} \frac{R_t}{(1+\rho)^i} \tag{4.4}$$

and

$$PV_{t+1} = \sum_{i=1}^{n+1} \frac{R_{t+i}}{(1+\rho)^{i-1}} \,. \tag{4.5}$$

Following Dixit and Pindyck (1994: 175-212), the present value of the investment can be converted to the value of the equivalent opportunity to invest in perpetuity as

$$V_t = \frac{\left[\dfrac{\rho}{1-\left(\dfrac{1}{(1+\rho)^{n-t}}\right)} PV_t\right]}{\rho} \,. \tag{4.6}$$

Similarly, V_{t+1} is given by:

$$V_{t+1} = \frac{\left[\dfrac{\rho}{1-\left(\dfrac{1}{(1+\rho)^{n-t-1}}\right)} PV_{t+1}\right]}{\rho} \,. \tag{4.7}$$

The numerator of equations (4.6) and (4.7) gives the annuity required to generate a stream of benefits equivalent to the present value of the orchard investment for either of the apple cultivars. Dividing this annuity by the discount rate, ρ, converts the stream of benefits to its present value (Purvis, *et al.*, 1995).

The difference between the natural logarithms of V_t and V_{t+1}, or ΔlnV_j, gives a discrete estimate of the change in the value of an apple orchard investment opportunity, where j is the size of the sample over which this difference is calculated. Simulated over a large number of iterations, the expected R_t from investing that are used to estimate V_t and V_{t+1} are assumed to follow a geometric Brownian motion process, which characteristically provides a discrete approximation of a geometric Brownian motion variate in the limit (Cox *et al.*, 1979). Thus, the time path of this random process, with trend u_v and variance o^2_v , is estimated by measuring the movements that occur in infinitesimally small, discrete intervals over N iterations. The trend variable, u_v, is estimated by

$$u_v \approx \frac{1}{N}\sum_{j=1}^{N}\left[\Delta \ln V_j\right] \qquad (4.8)$$

and then it is applied to estimate the variance of the value of the opportunity to invest, o^2_v, as

$$\sigma_v^2 \approx \frac{1}{N}\sum_{j=1}^{N}\left[\Delta \ln V_j - u_v\right]^2 \qquad (4.9)$$

where $E[(\ln V_j - u_v)^2] >> 0$.

Using equations (4.1) through (4.9) above, the key parameters B, H and ρ' were estimated separately for the Pink Lady apple orchard investment and for the Golden Delicious apple orchard investment as follows: An MSExcel spreadsheet model was first constructed to proxy the expected annual net returns per hectare (R_t) over the 35-year lifespan of typical Golden Delicious and expected Pink Lady apple orchards in the Western Cape and Langkloof East regions of SA (Dall, 2001) using real annual net economic profit per hectare (accounting profit less estimated management costs, and less the opportunity cost of capital). Four apple exporters, two apple packers and two apple producers, selected from these regions between July 2001 and January 2002,

provided three-year apple pack-out quality and price data, and apple production cost data for the two apple cultivars. Variable cost estimates were based on real cost series data that were adjusted to reflect an orchard bearing 45 tons of apples per hectare per annum (the estimated industry average) (Dall, 2001). Where possible, data were evaluated for deviations from the DFPT's industrial averages that were estimated from DFPT apple producing members over the three corresponding years.

Next, three real discount rates (ρ's) were used to generate different PV_t and PV_{t+1} scenarios for each apple orchard investment using equations (4.4) and (4.5). Initially, projected real annual (2000 = 100) incomes and costs were discounted using ρ equal to *five* per cent (proxy for the rental rate of return to land in SA (Nieuwoudt, 1980)) to estimate each investment's PV_t and PV_{t+1}. A comprehensive sensitivity analysis using packer charges that fell/rose by R25 per bin, different exporter commission rates, different Class I fruit pack-out percentages, and changes in the real prices of the two cultivars, was also conducted to estimate plausible upper and lower PV_t and PV_{t+1} bounds. Depending on the nature of the services offered, and the type of packing material used, packer charges range from R89 to R135 per bin, while exporter commission rates currently range from three to 12 per cent (Dall, 2001). Assuming that the quality specifications for Class I apples remain the same, the year-on-year Golden Delicious and Pink Lady Class I percentage pack-out can change by up to seven percentage points and 20 percentage points, respectively (Griessel, 2002). Lower Class I percentage pack-outs often reflect unfavourable climatic conditions that are beyond the farmer's control, such as hail, apple yellowing, etc., that lead to poorer quality apples. Consultants advise Pink Lady apple producers to aim for a Class I apple pack-out above 40 per cent (a 29 per cent increase on current levels), but most farmers have yet to achieve this level (Dall, 2001). The real price of Golden Delicious apples was allowed to rise/fall by 10 per cent, while the real price of Pink Lady apples was varied upward by 10 per cent, but downwards by 20 per cent, to reflect an expected fall in the real prices as supply is expected to rise relative to demand in future as new orchards start producing. The sensitivity analysis was then repeated using real ρ's of three, and seven per cent, as plausible alternative levels of ρ that SA fresh apple producers could face. Elmer *et al.* (2001) used real ρ's of three, six, and nine per cent to analyze investments in Texas grapefruit orchards.

Thirdly, the plausible upper and lower PV_t and PV_{t+1} bounds generated in the sensitivity analyses were used in a Monte Carlo simulation model to estimate upper and lower bounds for the values of the opportunity to invest in perpetuity, V_t and V_{t+1}, for all three ρ values as per equations (4.6) and (4.7). The estimate of the discrete difference, $\Delta(\ln V_j)$, was simulated using @RISK software over N = 5000 iterations (Palisade Corporation, 2002) that selected PV_t and PV_{t+1} values at random from the range of values within their upper and lower bounds. Substituting these 5000 $\Delta(\ln V_j)$ estimates into equations (4.8) and (4.9) produced estimates of u_v and σ^2_v respectively for each cultivar. The latter variance statistic values were used to solve equation (4.2) for estimates of B at all three ρ values. Finally, the B estimates were substituted into equations (4.1) and (4.3), respectively, to estimate the modified investment trigger, H, and the modified hurdle rate, ρ', for each ρ value. Chapter 5 compares pack-out and price data, the annual net returns derived in the MSExcel spreadsheet, the sensitivity analysis results, and the estimates of H and ρ' for the two apple cultivars.

CHAPTER 5

APPLE ORCHARD INVESTMENTS UNDER UNCERTAINTY AND IRREVERSIBILITY: RESULTS AND DISCUSSION

This chapter first compares expected apple pack-outs, real prices and real annual net returns for the two apple cultivars. It then reports the sensitivity analysis of the expected investment present values for the two cultivars. The third set of results compares the modified investment triggers and hurdle rates for the two apple orchard investments.

5.1 Expected Apple Pack-outs, Prices and Annual Net Returns

Table 5.1 shows that between 1999 and 2001, SA fresh apple producers were paid, on average, R493 per ton (R6.16 per carton) more for Class I Pink Lady apples than for Class I Golden Delicious apples. Weighted according to pack-out, the average Pink Lady price per ton was 17.8 per cent higher, despite a greater percentage of Class I Golden Delicious fruit per ton.

Table 5.1. Golden Delicious and Pink Lady apple quality distribution and average real prices (2000=100), Western Cape and Langkloof East regions of South Africa, 1999-2001.

Class	Golden Delicious		Pink Lady		
	Pack-out %	Price/Ton[a]	Pack-out %	Price/Ton[a]	% Difference in Price/Ton
Class I	52	1943	31	2436	25.3
Class II	8	1732	36	1798	3.8
Class III	21	292	14	292	0.0
Processed	19	403[b]	19	403[b]	0.0
Weighted Average Price/Ton		**1289**		**1519**	**17.8**

Note: [a]Prices reflect producer average prices per ton (CIF value less packer service charges, exporter commissions, freight, sea insurance, loadings and port costs). [b]Packer service charges, exporter commissions, freight, sea insurance, loadings and port costs are not incurred for processed apples.

The relatively higher Golden Delicious Class I pack-out suggests that this cultivar is currently more suited to climatic conditions in SA, and also reflects the experience accumulated by managers and farm staff in producing and handling this cultivar. The higher Pink Lady weighted average income per bin is partly due to a higher share of Class II fruit (36 per cent of output) that was sold at R66 per ton more than Golden Delicious apples. Cartons of Class II apples are either

sold in domestic municipal markets or are exported. A key question is for how long will the current price premium for Pink Lady apples continue before falling over time as Pink Lady apple supply increases with new plantings, or as current Pink Lady orchards mature? Class III apples are mostly used in EconoPaks sold by SA retail chain stores, or purchased by hawkers for informal markets. Consistent with the industry average, between 15 and 20 per cent of production for both cultivars was sent for processing for a price of R403 per ton.

The Golden Delicious and Pink Lady apples are expected to have similar yields per hectare over 35 years in the main growing areas of the Western Cape and Langkloof East (Dall, 2001; Campbell, 2002; CIAMD, 2001). Estimated yields should typically rise to about 55-60 tons per hectare in year eight and then fall gradually to about 33 tons per hectare by year 35. Based on these expected yield levels, **Table 5.2** on page 48 shows the expected real annual income and real costs per hectare of Golden Delicious and Pink Lady apples in years 0, 10 and 35 after orchards establishment.

The higher expected gross income after service fees for the Pink Lady cultivar reflects its price premium compared to the Golden Delicious cultivar, despite slightly higher storage, commission, marketing and freight costs. Pink Lady orchard establishment costs (K in equation (4.1)) are nearly R10 000 higher at recommended tree planting densities per hectare, mainly due to the once-off royalty charges of R6 per tree, which raise operating costs for Pink Lady by R7.78 per ton. Based on the three-year series data, Pink Lady operating charges were on average R56 per ton higher than for Golden Delicious due to higher expected harvesting and spraying costs. Multiple picking is required for Pink Lady orchards and adds about R 39.67 per ton to operating costs – and there are two extra applications of chemical sprays as Pink Lady apples remain on the tree for longer. Given the period that apples remain in cold storage, the estimated average per ton price after service fees were deducted, and the estimated average real SA R150 bond market yield[4] of 4.12 per cent (South African Reserve Bank, 2002), the expected annual opportunity cost of keeping apples in cold storage was estimated at R14.76 per ton for Pink Lady, and R11.23 per ton for Golden Delicious apples. A fixed annual management fee of five per cent of gross income (Calkins and DiPietre, 1983:115) derived from an average annual yield of 45 tons per hectare for both cultivars

[4] Average real R150 bond yields = [((1+ i)/(1+CPIX))-1] (adapted from Kay and Edwards (1999)), where i = monthly average R150 bond yields, and CPIX = monthly adjusted consumer price index excluding interest and mortgage bonds, from January 2001 to January 2002.

was also included as a proxy for the opportunity cost of management time. The higher annual fee for the Pink Lady orchard (R3 417 versus R2 578) reflects more management time spent supervising multiple pickings and extra spray applications.

Overall, the Pink Lady generates relatively more expected net economic profit per hectare of established orchard (over 50 per cent by year 10) – its higher income offsets higher expected costs per hectare. At a ρ of five per cent, the estimated orthodox NPV per hectare for the Pink Lady and Golden Delicious apple orchard investments was R14 030 and R12 276, respectively. The corresponding estimated orthodox IRR was 10.24 per cent and 5.67 per cent, respectively. Based on orthodox capital budgeting methods to evaluate potential Pink Lady and Golden Delicious apple orchard investments, these results suggest that the Pink Lady apple orchard investment would be the relatively more profitable venture. These results support to *hypothesis 3(a)* on page 36 of the dissertation.

5.2 Sensitivity Analysis of Expected Investment Present Values

Assuming in the case of the Pink Lady apple orchard investment, a 31 per cent Class I and 36 per cent Class II quality distribution, a seven-and-a-half per cent exporter commission, a R120 per bin packing charge, a 120-day storage period for apples in controlled atmosphere storage, and a real apple price ranging from R2 436 per ton for Class I apples to R403 per ton for processed apples, the estimated PV_t for a Pink Lady apple orchard when ρ = five per cent was R205 000 per hectare. Using sensitivity analysis to vary these key parameters by plausible amounts – for example, Class I pack-out ranges from 25 per cent to 45 per cent, and 10 per cent increases and 20 per cent decreases in the real apple price range – a triangular distribution was estimated for PV_t with minimum and maximum values of R120 000 and R290 000 per hectare, respectively. **Figure 5.1** on page 49 shows the distribution of PV_t per hectare values for a Pink Lady apple orchard investment in SA generated by the Monte Carlo simulation. This procedure was repeated for the Pink Lady investment at ρ values of three per cent and seven per cent, and for the Golden Delicious investment at ρ values of three, five and seven per cent.

Table 5.2. Estimated real income and real costs per hectare for Golden Delicious and Pink Lady apples in South Africa for years 0, 10 and 35 after orchard establishment (2000=100).

Cultivar	Golden Delicious			Pink Lady		
Year	**0**	**10**	**35**	**0**	**10**	**35**
Projected Yields (tons per Ha)	**0**	**61**	**33**	**0**	**61**	**33**
Gross Income Before Service Fees	**0**	**125310**	**67791**	**0**	**142221**	**76939**
Packer Costs	0	15831	8564	0	15831	8564
Packer Storage Charges	0	8326	4504	0	9297	5030
Exporter Commission	0	8767	4743	0	10129	5480
Domestic Marketing	0	2292	1240	0	1528	826
Freight	0	11520	6232	0	12864	6959
Gross Income After Service Fees (1)	**0**	**78574**	**42508**	**0**	**92572**	**50080**
Operating Costs						
Harvesting	0	6471	3501	0	8952	4843
Fuel, Oil and Lubricants	2105	6572	3555	2105	6572	3555
Planting	39829	0	0	39829	0	0
Fertilizer	3646	2414	1306	3646	2414	1306
Weed Control	128	500	500	128	500	500
Orchard Maintenance	3252	3252	3252	3252	3252	3252
Irrigation	9000	500	500	9000	500	500
Chemical Sprays	306	7907	4278	310	8157	4413
Salaries & Wages	9448	11558	10494	9448	11558	10494
Depreciation	8434	8434	8434	8434	8434	8434
Other	11161	6695	4632	11161	6695	4632
Levies	0	816	441	0	816	441
Royalties	0	0	0	10000	0	0
Total Operating Costs	**87309**	**55119**	**40893**	**97313**	**57850**	**42370**
Opportunity Cost						
Apples Kept in Cold Storage	0	685	371	0	918	496
Management Fee	2578	2578	2578	3417	3417	3417
Total Opportunity Cost	**2578**	**3263**	**2949**	**3417**	**4335**	**3913**
Total Activity Cost (2)	**89887**	**58382**	**43842**	**100730**	**62185**	**46283**
Net Economic Profit (3) = (1) – (2)	**-89887**	**20192**	**-1334**	**-100730**	**30387**	**3797**

Note: These figures are weighted estimates based on plausible pack-outs for the four quality classes over the years 1999-2001. Packing service charges were R120 per bin (R320 per ton), and packer storage facilities were estimated at R136.89 and R150.14 per ton for Golden Delicious and Pink Lady, respectively (R5 per bin per week multiplied by the average number of weeks (17) that apples spent in cold storage during 2001 multiplied by the proportion of apples in cold storage). Exporter costs were calculated at 7.5 per cent of the average international selling price for each cultivar.

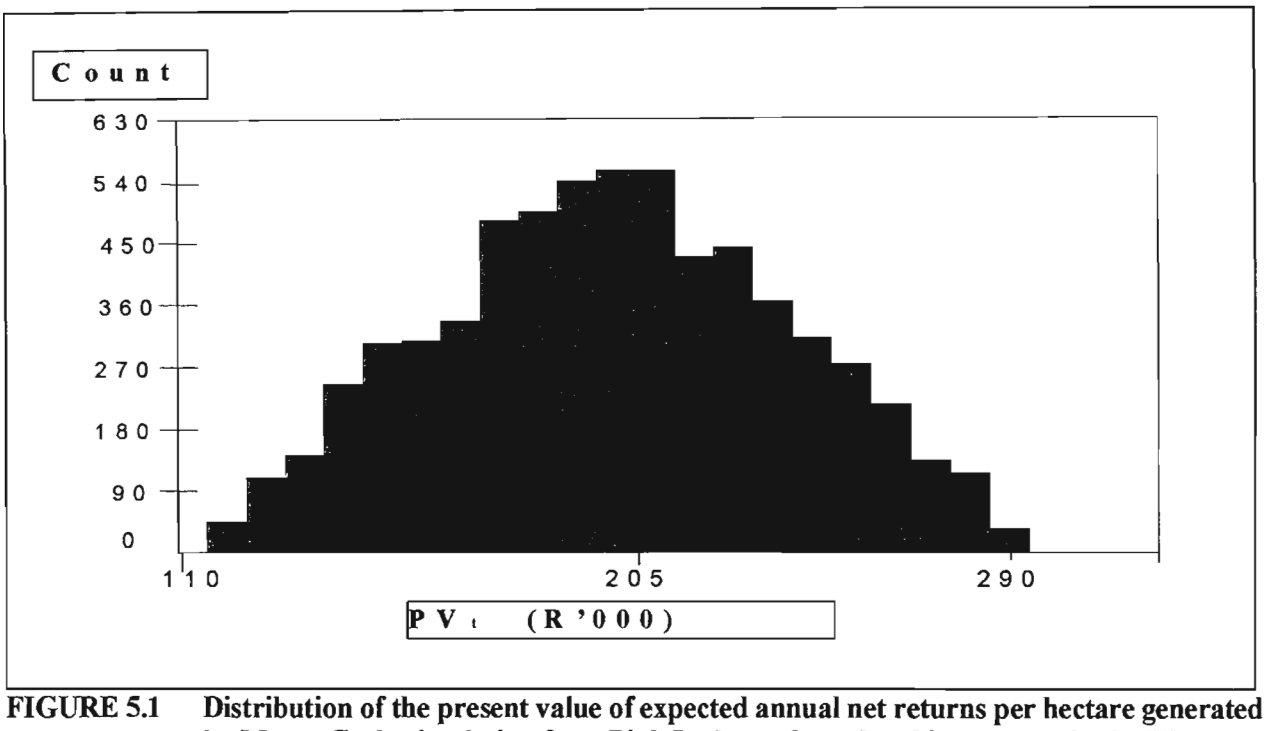

FIGURE 5.1 **Distribution of the present value of expected annual net returns per hectare generated by Monte Carlo simulation for a Pink Lady apple orchard investment in the Western Cape and Langkloof East regions, 2001.**

Table 5.3 summarizes the result of these sensitivity analyses. The corresponding PV_t estimates, as expected, had slightly lower values than the PV_t estimates (and PV_{t+1}) are higher and have a larger range than the Golden Delicious estimates – the investment with higher expected annual returns seems to have higher inherent business risk.

Table 5.3. Plausible lower, most likely and upper PV parameters for Golden Delicious and Pink Lady apple orchard investments using a real discount rate (ρ) of 3, 5 and 7 per cent.

	PV_t (R'000)		
	Lower Bound	**Most Likely**	**Upper Bound**
Golden Delicious			
ρ = 3 %	90	138	186
ρ = 5 %	50	94	138
ρ = 7 %	10	63	116
Pink Lady			
ρ = 3 %	180	289	370
ρ = 5 %	120	205	290
ρ = 7 %	50	147	235

5.3 Modified Investment Triggers and Hurdle Rates

Using the PV_t and PV_{t+1} ranges and the @RISK simulation models to estimate equations (4.4) through (4.9), and equation (4.2), for both the Golden Delicious and Pink Lady apple orchard investments, the estimated option value multiple, *B/(B-1)*, was 1.89 and 2.28 for ρ = five per cent, respectively. Orthodox NPV analysis of the Pink Lady orchard investment would estimate a Marshallian investment trigger, $M = \rho K$, at R5 037 per hectare (0.05 x R100 730). Substituting 2.28 for *B/(B-1)*, and R5 037 for M in equation (4.1), implies a modified investment trigger, H, of R12 994 per hectare in the first scenario where ρ = five per cent. Substituting 2.28 for B/(B-1), and ρ = five per cent into equation (4.3) gives an estimated modified hurdle rate for the Pink Lady apple orchard investment, ρ'_{PL}, of 11.41 per cent. These results imply that SA apple producers that value the option to postpone a Pink Lady apple orchard investment in the Western Cape and Langkloof East regions of SA must have an expected real IRR greater than 11.41 per cent, or equivalently, have an expected present value of real annual net returns above R12 994 per hectare, to trigger

investment expenditure. Similarly, potential Golden Delicious apple orchard investments in the Western Cape and Langkloof East regions of SA must have an expected real RRR greater than 9.45 per cent, or have an expected present value of real annual net returns above R8 493 per hectare, to trigger investment expenditure. These results and the modified H and ρ' hurdle rates for the other two scenarios where ρ = three per cent and seven per cent, respectively, are summarized in **Table 5.4**. Since the Pink Lady apple orchard investment has a higher modified hurdle rate than the Golden Delicious apple orchard investment at all levels of ρ, the results imply SA fresh apple farmers who value the option to invest in either cultivar require a higher expected rate of return for the Pink Lady apple orchard investment to initiate investment now. The results support *hypothesis 3(b)* in section 4.2. For all values of ρ, the estimated H and ρ' are between one and two-thirds to nearly three times higher than M and ρ, which is consistent with the US studies by Summers (1987), Elmer *et al.* (2001), and Purvis *et al.* (1995) cited above.

Table 5.4 Estimated modified real hurdle rates and optimal investment triggers per hectare for Golden Delicious and Pink Lady apple orchard investments in the Western Cape and Langkloof East, 2001.

Apple Cultivar, Investment Triggers and Hurdle Rates	Real Discount Rate		
	ρ = 3 %	ρ = 5 %	ρ = 7 %
Golden Delicious			
Option value multiple, $B/(B\text{-}1)$	2.25	1.89	1.69
Marshallian investment trigger, M	R2696	R4494	R6292
Optimal investment trigger, H	R6066	R8493	R10633
Modified hurdle rate, ρ'_{GD}	6.75%	9.45%	11.83%
Pink Lady			
Option value multiple, B/(B-1)	2.85	2.28	2.01
Marshallian investment trigger, M	R3022	R5037	R7051
Optimal investment trigger, H	R8613	R12994	R14173
Modified hurdle rate, ρ'_{PL}	8.55%	11.41%	14.14%

5.4 Discussion

The growing and marketing of inappropriate apple cultivars has been identified by producers, packers and exporters of fresh apples, and by apple industry experts, in SA as a serious threat to the competitiveness of the SA fresh apple export value chain. Fresh apple producers in SA that want to adopt new apple cultivars to improve their competitiveness must compare the expected gains and additional costs, including the risk of making a wrong investment decision. Gains from

investing will depend on current and future apple demand, yields, quality and real prices, while additional costs include higher search and information costs, greater input use, and the foregone option to delay investing (option value). The results show that if the option to postpone an investment in a Pink Lady or Golden Delicious apple orchard investment is ignored, the Pink Lady investment is relatively more profitable due to the higher orthodox IRR (10.24 per cent > 5.67 per cent). However, the *ex ante* version of the Dixit-Pindyck investment model – that accounts for uncertainty and irreversibility – used in this study suggests that a Pink Lady orchard investment has a higher modified investment trigger, and a higher modified hurdle rate that must be exceeded to initiate investment. This result is plausible, as the Pink Lady investment has higher expected net returns over its life span, but also greater variance of the expected annual net returns. Assuming a five per cent real discount rate, the Pink Lady apple orchard investment in SA should yield an expected modified net present value, H, of at least R12 994 per hectare and a modified real RRR, ρ'_{PL}, greater than 11.41 per cent to trigger investment expenditure. For a Golden Delicious orchard investment, the H and ρ'_{GD} values were estimated at R8 493 per hectare and 9.45 per cent, respectively. Decision-makers that apply lower real discount rates and that are more uncertain about future annual net returns from a new apple orchard investment will have relatively higher hurdle rates to justify investing now.

Since about 58 per cent of SA apple farm-level gross income is derived from sales of apples for export, the volatile performance of the Rand against the US Dollar, the British Pound and the Euro, has caused major variability in SA fresh apple farm profits. Furthermore, export freight, fuel, chemical sprays and other specialized input costs shift with changes in the value of the US Dollar, which adds to the complexity of forecasting the future net returns from an apple orchard investment. In the short-term, managers can try to reduce the impact of unfavourable exchange rate changes by exploring the use of forward exchange rate contracts, freight forwarding, or minimum price contracts with packers, exporters and import receivers.

Investors with less capital resources – due to lower real world apple prices, drought, the withdrawal of government export incentives, high real interest rates, and increased competition from other exporting rivals (Hardman *et al.*, 2002) – have less scope to adopt new apple cultivars. These players should focus on lowering production and operating costs; for example, finding lower-cost specialized production inputs (such as new chemical sprays to prevent disease or to improve

fruit ripening), trying to reduce apple transport costs through bulk product shipments, or improving orchard yields through better orchard maintenance programmes. In the long-run, however, retail consolidation trends are likely to continue or intensify, meaning that all players in the SA fresh apple export value chain will need to more closely track changing consumer needs, and respond by adjusting their production patterns.

CONCLUSION

The relational view of competitive advantage contends that players in a value chain must consider appropriate ways to link their firm's human resources with those of up- and downstream partners to create competitive advantage for mutual benefit. This study first developed a standard causal model showing how higher levels of trust lead to greater cooperation (joint problem-solving and communication) between value chain players, and how greater cooperation, in turn, encourages them to commit more human resources to value chain activities. The study then extends this model and contributes to theory with the hypothesis that identifying and communicating key constraints on value chain competitiveness can help the players to build trust and improve cooperation as they know where to focus resources to try jointly overcome these constraints. The extended model is then adapted to identify how to improve cooperation to make the SA fresh apple export value chain more competitive. The management implication of the extended model for any value chain is that over time, the players must learn more about the external and internal environments in which the chain operates, each other's business, and the key sources of risk associated with their investments. They are then likely to be more committed to reevaluate their linkages and work together to overcome the constraints and implement necessary changes to make the value chain perform better.

In the SA fresh apple export value chain, higher levels of trust led to more joint problem-solving between producers and packers, and to more communication between producers and exporters. More joint problem-solving between producers and packers encouraged producers to commit greater levels of human resources to the working relationship. At the producer-exporter link, higher levels of both communication and joint problem-solving led to higher human resource commitment by producers to the relationship. Following deregulation of SA apple marketing after 1996 and the relaxation of pre-harvest and post-harvest apple handling protocols, these players could cooperate more closely on delivery scheduling and quality control to promote the competitiveness of the SA fresh apple export value chain. Furthermore, these efforts can be assisted if the players communicate more about what are, and how to overcome, the perceived key constraints that limit competitiveness in a market characterized by falling real prices for apple exports.

The empirical survey of the perceptions of SA apple producers, packers and exporters operating in the Western Cape and Langkloof East regions of SA identifies climatic conditions, no government export incentives, increased competition from rival apple-exporting countries, restrictive government labour policy, high interest rates, the production and marketing of inappropriate apple cultivars, harbour terminal bottlenecks and lack of training and human development as key constraints that limit competitiveness. Dry winters in the late 1990's, which resulted in lower apple pack-outs and declines in average apple export earnings of 11 and 22 per cent in 1999 and 2000, respectively, focused attention on the SA fresh apple export value chain's vulnerability to supply shocks and the difficulties to coping with drought conditions in the short-term. Research institutions, such as universities and Hortec (Pty) Ltd (a subsidiary of the DFPT) can help to collect, analyze and disseminate regional information on the current performance of different apple cultivars so that apple producers can adjust their production plans to include cultivars that are more drought resistant. The DFPT can also play a key role in assisting producers to make better apple orchard investment decisions by providing key industrial statistics and technical help. Patrick *et al.* (1985), Woodburn *et al.* (1995) and Wermund and Fearne (2000) also indicated yield (weather) variability as a major source of risk for US, SA and British crop farmers, respectively. By adopting management and product quality assurance standards, such as Nature's Choice, Hazard Analysis and Critical Control Point (HACCP) and ISO 9000, managers can improve the consistency of their quality pack-outs. These systems also encourage the capture and monitoring of key production information, such as yields per hectare and the percentage pack-out of Class I fruit, that can be used to estimate more accurately the expected variability in annual net returns. Adopting drought tolerant apple cultivars could reduce the threat posed by poor climatic conditions in dry years and play a role in helping SA fresh apple growers to manage orchard yields and pack-outs over time.

No government export incentives, restrictive government labour policy and high interest rates were the main constraints perceived by the sample of SA fresh apple producers. Although the DFPT is mandated by its members to raise these issues at local and national government level, it is unlikely that government will reintroduce export incentives and compromise efforts to promote SA's integration into the world economy through the World Trade Organization, or provide subsidies on interest rates to existing apple producers. SA fresh apple exporters are more concerned about the impact of increased competition from rival apple exporting countries (e.g. Chile and

France), harbour terminal bottlenecks and the lack of training and human capital development than are apple producers and packers. The PPECB could advise stakeholders about aspects of apple handling methods to include in staff training programmes, or perhaps in on-farm workshops, that could improve the SA fresh apple export value chain's performance by reducing the cases of rejected SA apple consignments in foreign ports that occur due to human error. Further research would be required to investigate how players at all levels of the SA fresh apple export value chain, the DFPT, and government should cooperate and jointly create, implement and monitor appropriate strategies to develop skills in the SA fresh apple export value chain, and how these training projects should be financed.

The SA apple packers in the sample ranked the growing and marketing of inappropriate apple cultivars more highly as a constraint on the chain's competitiveness than did sample apple exporters or producers, although all respondents acknowledge that a better mix of apple cultivars grown in SA would make the SA fresh apple export value chain more competitive in global fresh apple markets. These findings concur with the views expressed by SA apple industry experts during personal interviews in 2001, that SA apple producers need to become more responsive to international apple consumer trends, and grow apple cultivars like Gala, Red Delicious, Braeburn and the Pink Lady.

Regarding investment appraisal, this study has highlighted the need for modified NPV and IRR analyses that explicitly account for uncertainty and irreversibility when assessing the potential profitability of new apple orchard investments. Uncertainty about the future annual net returns from a new apple orchard, and the irreversible nature of such investment, mean that investors may postpone capital expenditure, or seek higher returns to compensate them for uncertainty and irreversibility. For investors who account for uncertainty and irreversibility, the option to postpone an investment has value, and adds to the costs that must be hurdled in order to justify investing now rather than waiting. The value of waiting to invest is the result of an opportunity to avoid downside risk, and is estimated from two parameters – the real discount rate, ρ, and the variance of expected real annual net returns, σ^2. Decision-makers that apply lower real discount rates and that are more uncertain about future annual net returns from a new apple orchard investment will have relatively higher hurdle rates to justify investing now.

Study results show that if SA fresh apple producers who apply the orthodox rate, ρ, of five per cent, account for uncertainty and irreversibility, they should only invest in a Pink Lady apple orchard if the expected annual real rate-of-return is greater than 11.41 per cent – more than double the orthodox rate, and when the value of the investment opportunity exceeds R12 994 per hectare. For a Golden Delicious apple orchard investment the expected annual real rate-of-return and the value of the investment opportunity for these producers must be greater than 9.45 per cent and R8493 per hectare, respectively, to trigger capital expenditure. This result is plausible, as the Pink Lady orchard investment has higher expected annual net returns over its lifespan, but also greater variance of the expected annual net returns than the Golden Delicious orchard investment. Differences of this level between orthodox and modified hurdle rates have also been reported in recent studies of the adoption of dairy housing technology, and investment in grapefruit orchards, in the United States.

SUMMARY

Fresh apple growers, packers and exporters in the South African (SA) fresh apple export value chain must implement appropriate strategies that will help to improve competitiveness given declining real world apple prices (about 25 per cent since 1991), intensifying rivalry between fresh apple exporting countries like Chile and France, and global retail consolidation that shifts market power in fresh fruit value chains towards retailers, category managers, and import receivers. Chapter 1 of this dissertation discusses key drivers of change in the SA fresh apple export value chain, recent international and local studies of the comparative performance of the SA fresh apple export value chain relative to its rivals, and the players currently operating in the SA fresh apple industry. Using the *first* empirical survey of the perceptions of SA fresh apple producers, packers and exporters in the Western Cape and Langkloof East region conducted during 2001, this study investigates aspects of cooperation between these players in order to show where they need to commit more resources to make the SA fresh apple export value chain more competitive. The relational view of competitive advantage describes cooperation as the processes by which firms develop mechanisms to come together, interact and form relationships that are expected to benefit both partners by improving aspects of their business such as the rate of learning and innovation, lowering transaction costs, and achieving more effective coordination. Thus, managers can expect to sustain competitive advantage created by lower cost/differentiation competitive strategies by cooperating across firms to build alliances and leverage resources.

A conceptual model of cooperative behaviour among the players in a value chain is outlined in Chapter 2 as a basis for developing research hypotheses that are then applied to the case of the SA fresh apple export value chain. This model draws on work conducted in the United States, Australia, Europe and SA, to highlight the role of trust in promoting cooperative behaviour – like joint problem-solving and communication – and how such behaviour encourages the players to commit more human resources to chain activities. The model is then extended to consider how monitoring changes internal and external to the value chain, and evaluating the risks associated with chain specific investments, can help to build trust and implement cooperation by identifying the key constraints on chain competitiveness that the players need to manage over time.

The target population of 522 apple producers, 37 apple packers and 14 apple exporters in the Western Cape and Langkloof East region were sent questionnaires by post or e-mail in April and May 2001, or personally interviewed during July 2001, to obtain information about (1) the degree of trust, joint problem-solving, communication, and human resources commitment between them in the SA fresh apple export value chain, (2) their levels of cooperation in production planning, harvest scheduling, apple marketing and quality control, and (3) the factors that they perceive constrain the industry from becoming more competitive internationally. The player's perceptions of the level of these factors in their working relationships with value chain partners were estimated using an index derived from their scores on Likert-type scales that showed how strongly the players agreed or disagreed with statements pertaining to aspects of trust, communication, joint problem-solving and commitment.

The empirical results obtained using a recursive Ordinary Least Squares model show that higher levels of trust lead to more cooperation (joint problem-solving and communication) between these players. Higher levels of joint problem-solving and communication, in turn, encouraged producers to commit more human resources to working with packers and exporters to find ways of making the chain more competitive. Results also suggest that the players need to particularly improve cooperation in production planning, delivery scheduling and quality control.

Packers and exporters ranked climatic conditions as the top constraint currently facing the SA fresh apple industry, probably reflecting their concerns over the annual "pack-out" (quality distribution) of the apple crop. No government export incentives, increased competition from rival apple-exporting countries, restrictive government labour policy, high interest rates, production and marketing of inappropriate apple cultivars, harbour terminal bottlenecks and lack of training and human development are also major concerns among the players, although fresh apple producers rank macroeconomic factors (no government export incentives, restrictive government labour policy and high interest rates) relatively higher. SA fresh apple exporters identified the threat of increased competition from rival apple exporting countries, the impact of harbour terminal bottlenecks and the lack of training and human capital development as areas where more attention from all players is required. Packers ranked the growing and marketing of inappropriate apple cultivars as a constraint higher than did apple exporters and producers, although all respondents acknowledge that a better

mix of apple cultivars could probably improve the competitiveness of the SA fresh apple export value chain in global fresh apple markets.

The Pink Lady apple cultivar was identified as the most popular of the new apple cultivars grown in SA according to North American and European retailers. This study, therefore, compares the potential profitability of a Pink Lady apple orchard relative to the potential profitability of an orchard investment in a traditional SA fresh apple export cultivar – the Golden Delicious. The expected Net Present Value (NPV) and the Internal Rate-of-Return (IRR) approaches to capital budgeting are commonly used to assess the desirability of such investment alternatives, where the decision rules are to accept the investment with the greatest positive NPV and IRR. These orthodox NPV and IRR evaluations, however, assume that investors face a dichotomous "now" or "never" decision with no possibility to postpone the investment until a later time when more information might be available. In most cases investment expenditure can be delayed, and the possibility to benefit from "hindsight" can profoundly affect *if* and *when* a manager might make the investment, especially when expected net returns from the investment are uncertain. A "wrong" or a regrettable choice is usually costly since apple orchard investment expenditures are partially or completely irreversible (the start-up investment costs are sunk costs once the investment expenditure occurs, and cannot be fully recovered in the short-term).

To account for uncertainty and irreversibility, this study uses an *ex ante* version of the Dixit-Pindyck investment model to assess the viability of these alternative apple orchard investments. This investment model essentially raises the orthodox hurdle rate that must be met to justify investing now by an amount that reflects the value of the option to postpone the investment. An MSExcel spreadsheet model was constructed to proxy the expected annual net returns per hectare over the 35-year lifespan of typical Golden Delicious and Pink Lady apple orchards in the Western Cape and Langkloof East regions of SA using real annual net economic profit per hectare (accounting profit less estimated management costs, and less the opportunity cost of capital). Four apple exporters, two apple packers and two apple producers, selected from these regions between July 2001 and January 2002, provided three-year apple pack-out quality and price data, and apple production cost data for the two apple cultivars. Next, real discount rates of three, five and seven per cent were used to generate different estimates of the present value of the investment opportunity in the current period (PV_t) and one period later (PV_{t+1}). A comprehensive sensitivity analysis using

different Class I fruit pack-out percentages, different exporter commission rates, changes in the real prices of the two cultivars, and packer charges that fell/rose by R25 per bin, was also conducted to estimate plausible upper and lower PV_t and PV_{t+1} bounds. Thirdly, the plausible upper and lower PV_t and PV_{t+1} bounds generated in the sensitivity analyses were used in a Monte Carlo simulation model to estimate upper and lower bounds for the values of the opportunity to invest in perpetuity, V_t and V_{t+1}, for each real discount value, simulated using @RISK software over 5000 iterations. Finally, the modified hurdle rates are estimated by adjusting the orthodox real discount rates by an option value multiple derived from the mean and variance values of the discrete log-difference between V_t and V_{t+1} over the 5000 iterations.

Typical Pink Lady apple orchards in the Western Cape and Langkloof East areas have higher orchard establishment, crop harvesting and crop spraying costs than do Golden Delicious apple orchards, but retailers currently pay R493 per ton (25.3 per cent) more, on average, for Pink Lady apples. Results show that a potential Pink Lady orchard investment is relatively more profitable than a potential Golden Delicious orchard investment. In addition, for SA apple producers accounting for uncertainty, and who value the option to postpone an apple orchard investment decision, a Pink Lady apple orchard investment in SA needs to yield an expected value of at least R12 994 per hectare and a rate-of-return greater than 11.41 per cent (assuming a real discount rate of five per cent) to trigger investment expenditure, compared to a Golden Delicious orchard investment opportunity where the H and ρ' statistics were estimated at R8 493 per hectare and 9.45 per cent, respectively. This result is plausible, as the Pink Lady investment has higher expected net returns over its life span, but also greater variance of the expected net returns. These modified hurdle rates are about two times the orthodox rate of five per cent that is commonly used in capital budgeting analyses. Such differences between orthodox and modified hurdle rates have also been reported in recent studies on the adoption of dairy technology and grapefruit orchard investments in the United States.

Judging by the players' perceptions that climatic conditions prevent the SA fresh apple export value chain from becoming more competitive, and recent studies that identify yield (weather) variability as a major source of risk for US, SA and British crop farmers, climate-related export supply shocks are an important source of uncertainty in making decisions to invest in new apple orchards. Fresh apple producers in SA should, therefore, explore ways to reduce the uncertainty of

expected annual net returns from investing in new cultivars like the Pink Lady. For example, by adopting management and product quality assurance standards, such as Nature's Choice, Hazard Analysis and Critical Control Point (HACCP) and ISO 9000, managers can improve the consistency of their quality pack-outs. These systems also encourage the capturing and monitoring of key production information, such as yields per hectare and the percentage pack-out of Class I fruit, that can be used to more accurately estimate how expected annual net returns may vary with changes in climatic conditions. Subsequently, adopting drought tolerant apple cultivars could reduce the threat posed by poor climatic conditions in dry years and play a role in helping SA fresh apple growers to manage apple orchard yields and pack-outs.

Since about 58 per cent of SA apple farm-level gross income is derived from sales of apples for export, the volatile performance of the Rand against the US Dollar, the British Pound and the Euro, has caused major variability in SA fresh apple farm profits. Furthermore, export freight, fuel, chemical spray and other specialized input costs shift with changes in the value of the US Dollar, which adds to the complexity of forecasting the future net returns from an apple orchard investment. In the short-term, managers can try to reduce the impact of unfavourable exchange rate changes by exploring the use of forward exchange rate contracts, freight forwarding, or minimum price contracts with packers, exporters and import receivers.

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APPENDICES

Appendix 1A: The 20 largest apple producing countries in the world in 2000 and 2001.

	Country	2001 Tons '000	2000 Tons '000
1	China	24,007	20,437
2	United States of America	4,850	4,830
3	Turkey	2,500	2,500
4	Poland	2,224	1,450
5	Italy	2,156	2,156
6	France	2,150	2,157
7	Iran, Islamic Rep of	1,900	2,000
8	Argentina	1,565	833
9	Germany	1,490	2,631
10	India	1,380	1,380
11	Russian Federation	1,300	1,200
12	Brazil	1,150	1,160
13	Chile	1,075	909
14	Spain	932	755
15	Japan	800	800
16	Ukraine	750	648
17	Hungary	700	695
18	Korea, Dem People's Rep	650	650
19	Pakistan	577	577
20	Netherlands	575	575
21	**South Africa**	**565**	**565**
22	Mexico	550	519
23	Canada	532	532
24	Belgium-Luxembourg	500	497
25	New Zealand	485	620
	World	**62,897**	**58,543**

(Source: http://www.fao.org, 2001)

Appendix 1B: The 20 largest apple exporting countries during 1998 and 1999

	Country	1999 Tons '000	1998 Tons '000
1	France	718	766
2	United States of America	639	582
3	Italy	569	540
4	Chile	522	576
5	Netherlands	434	339
6	Belgium-Luxembourg	409	335
7	New Zealand	362	292
8	**South Africa**	**251**	**274**
9	China	219	170
10	Argentina	182	228
11	Iran, Islamic Rep of	158	176
12	Poland	149	169
13	Germany	69	52
14	Canada	68	65
15	Brazil	57	11
16	Spain	54	58
17	Czech Republic	53	64
18	Austria	40	34
19	Macedonia,The Fmr Yug Rp	40	40
20	Kyrgyzstan	35	35
	World	**5,330**	**5,158**

(Source: http://www.fao.org, 2001)

Appendix 1C: The 20 largest importing countries during 1998 and 1999.

	Country	1999 Tons '000	1998 Tons '000
1	Germany	725	708
2	United Kingdom	449	460
3	Netherlands	339	236
4	Belgium-Luxembourg	233	248
5	Spain	213	133
6	United States of America	164	142
7	China	164	159
8	Russian Federation	162	359
9	Mexico	136	84
10	Canada	121	115
11	Austria	117	62
12	France	101	88
13	China, Hong Kong SAR	94	92
14	Sweden	87	87
15	Saudi Arabia	86	126
16	United Arab Emirates	79	50
17	Portugal	77	65
18	Philippines	74	48
19	Denmark	74	43
20	Brazil	66	126
	World	**4,769**	**4,555**

(Source: http://www.fao.org, 2001)

Appendix 2: Competitive rankings of major world apple producers, 2001

Rank	Overall	Production Efficiency	Infrastructure & Inputs	Financial & Markets
1	N. Zealand	Austria	Chile	N. Zealand
2	Chile	Netherlands	U.S.	Netherlands
3	Netherlands	N. Zealand	Argentina	Belgium
4	Austria	Brazil	N. Zealand	France
5	France	**South Africa**	Canada	Chile
6	U.S.	Chile	France	Japan
7	Belgium	Belgium	**South Africa**	U.S.
8	Australia	France	Australia	Australia
9	**South Africa**	Germany	Italy	Italy
10	Japan	Australia	Turkey	U.K.
11	Argentina	Poland	Brazil	Canada
12	Italy	Italy	Austria	Austria
13	Canada	Japan	Belgium	Germany
14	Germany	U.S.	Japan	Argentina
15	Brazil	Turkey	Germany	Spain
16	U.K.	Yugoslavia	Netherlands	**South. Africa**
17	Spain	Canada	U.K.	Brazil
18	Turkey	Argentina	Spain	Greece
19	Greece	Russian Fed.	Greece	China
20	Poland	China	Mexico	Hungary
21	China	Greece	Poland	Poland
22	Hungary	Hungary	Hungary	Mexico
23	Mexico	Spain	China	Turkey
24	Yugoslavia	Bulgaria	Yugoslavia	Bulgaria
25	Bulgaria	U.K.	Bulgaria	Russian Fed.
26	Russian Fed.	Mexico	Russian Fed.	Yugoslavia
27	Romania	Romania	Romania	Romania

(**Source**: World Apple Report, 2001)

Appendix 3: Apple producer questionnaire: 2001

University of Natal

School of Agricultural Sciences and Agribusiness

Discipline of Agricultural Economics

APPLE PRODUCER QUESTIONNAIRE: 2001

To be completed by the principal decision-maker of the farm business.

The main objective of this questionnaire is to investigate how players at different levels in the apple export industry perform in order to identify factors that could improve overall competitiveness. If your firm **packs** your **own** apples, please ignore section B but complete section D. **YOUR SURVEY ANSWERS WILL BE KEPT STRICTLY CONFIDENTIAL.**

SECTION A: FIRM DETAILS

1. What form of business do you operate (please mark the appropriate block)?

Form	X
Private Company (Pty) Ltd.	
Public Company	
Close Corporation (CC)	
Partnership	
Individual Owner	
Other: Specify:	

2. How many **tons** of **fresh** apples were produced on your farm during the last three **financial years**?

	Quantity/year		
	1998	**1999**	**2000**
Apples (tons)			

3. Is the **firm** active in other production enterprises besides apple production (please mark the appropriate block)? What **proportion of turnover (sales)** does each enterprise contribute?

Production Enterprise	**X**	**Contribution to Turnover (%)**
Apples		
Citrus		
Stone Fruit		
Pears		
Grapes		
Dairy		
Livestock		
Field Crops: Wheat		
Field Crops: Other Specify:		
Vegetables		
Other: Please describe:		
		100

4. From your balance **sheet** and **income statement** please complete the following table.

Category	**Rand values in years**		
	1997/98	**1998/99**	**1999/00**
Total Assets			
Total Liabilities			
Gross Turnover (sales)			
Interest on all Debt			

5. From your **income** statements or **profit and loss accounts** for the **last three financial years**, indicate **total expenditure** for the following cost categories.

Cost Category	**Total Expenditure**		
	1997/98	**19998/99**	**1999/00**
Administration			
Depreciation			
Export agent costs			
Insurance			
Labour (Salaries, wages, WCA + UIF)			
Packaging			
Quality control			
Repairs: Equipment			
Repairs: Fixed improvements			
Water			
Electricity			
Fertilizer			
Chemicals and sprays			
Transportation (+ fuel + oil)			

6. Please rate your management **ability** (relative to other producers in your district) in the following areas of management (please mark the relevant block, where 1 = poor manager and 5 = excellent manager).

Area of management	**Management ability**				
	Poor				**Excellent**
	1	2	3	4	5
Production management					
Financial management					
Marketing management					
Overall management					

7. In your opinion, what are the **major obstacles** hindering the SA apple export industry from **becoming more competitive**? Rate the following aspects on a scale of 1 **(minor hindrance)** to 5 **(major hindrance)** and **add** any further factors that you view as important.

	Source of Hindrance	**Value of feature**				
		Minor Hindrance				**Major Hindrance**
		1	2	3	4	5
A	Crime					
B	Production and marketing of inappropriate apple cultivars					
C	Lack of foreign investment into SA					
D	Ageing apple exporting infrastructure					
E	Lack of market information					
F	No government export incentives					
G	Restrictive government labour policy					
H	Increased competition from Southern Hemisphere countries					
I	Climatic conditions					
J	High Interest rates					
K	Abandoning of fruit handling protocols through supply chain.					
L	Over-capitalization at packhouses					
M	Lack of training and human development					
N	Harbour terminal bottlenecks					
O	Exporter liquidity problems					
P	Exporter inexperience in international trade					
Q	Current levels of investment in research and development (R & D) of apple cultivars					
R	Other: Please specify:					
S	Other: Please specify:					

The next section deals with your relationship with your fruit packer. This section can be ignored if you pack your own apples.

SECTION B: PRODUCER/PACKER RELATIONSHIP

1. Please name the packer that you have used in the last 12 months: _____.

   _____.

2. When did you begin to use your **current fruit packer**? (Month/ Year) _____/_____.

3. How would you describe the level of **cooperation** between **you and your packer** in the following business activities (please mark the appropriate block)?

Business Activity	Extremely High	High	Moderate	Low	Extremely Low
Production Planning					
Harvest Scheduling					
Apple Marketing					
Quality Control					

4. Have you been involved in any **joint development projects** with this packer over the last year? (Yes/No) _____.
5. If **Yes**, describe: _____.

   _____.

   _____.

6. To what extent do you agree **or disagree** with the following statements regarding your **relationship with your packer** (please mark the appropriate block).

	Statement	**Strongly Agree**	**Agree**	**Disagree**	**Strongly Disagree**
A	We devote considerable time trying to improve this relationship				
B	We devote considerable time trying to improve the packer's productivity				
C	We have made a substantial number of adaptations in our delivery schedule in order to deal more effectively with this packer				
D	We often discuss issues such as changes in technology and market conditions				
E	We have extensive formal and informal communications				
F	We discuss only need-to-know information that relates directly to our relationship				
G	We make joint decisions about:				
G.1	Reducing costs in the packhouse				
G.2	Delivery scheduling				
G.3	Quality control				
H	In this relationship, both sides work together to achieve productivity gains from which both sides benefit				
I	We have a strong personal confidence in each other				
J	We have a strong business confidence in each other				
K	We can always rely on each other when it counts				
L	I believe this packer will work hard in the future to maintain a close relationship with my firm				
M	I am very confident that this relationship will continue in the future				

7. Do you plan to renegotiate **and** renew your contract with the packer for the forthcoming season? (Yes/No)_____.
8. If **No**, give reasons: _____.

_____.

_____.

The next section deals with your relationship with your fruit exporter.

SECTION C: PRODUCER/EXPORTER RELATIONSHIP

1. When did you start supplying this exporter? (Month/ Year)_____/_____.

2. Please indicate which exporter from the list below you have **used most**, if any. (Please mark appropriate block). If you have used more than one exporter, indicate the **percentage marketed** through each exporter.

	Exporter	**X**	**%**
A	BETKO		
B	CAPE FIVE EXPORT SA (PTY) LTD		
C	CAPESPAN		
D	COLORS FRUIT (SA) (PTY) LTD		
E	DEL MONTE FRESH PRODUCE (PTY) LTD		
F	DOLE SOUTH AFRICA (PTY) LTD		
G	DU TOIT VRUGTE		
H	FEDFA EXPORTERS (PTY) LTD		
I	TRU-CAPE (PTY) LTD		
J	LONA TRADING (PTY) LTD		
K	SAFE (PTY) LTD		
L	SOVEREIGN FRUITS		
M	Other: Please name:		
N	Other: Please name:		
O	Other: Please name:		
P	Other: Please name:		
Q	Other: Please name:		
			100

3. How would you describe the level of **cooperation** between **you and your <u>exporter</u>** in the following business activities? (Please mark the appropriate block).

Business Activity	**Extremely** High	**High**	**Moderate**	**Low**	**Extremely Low**
Production Planning					
Harvest Scheduling					
Apple Marketing					
Quality Control					

4. Have you been involved in any **joint development projects** (such as increasing storage capacity, or staff training) with this **exporter** within the last 12 months?

   (Yes/No)__. If **Yes**, describe: _____.

   _____.

   _____.

   _____.

5. To what extent do you **agree or disagree** with the following statements regarding your **relationship with your exporter**.

	Statement	**Strongly Agree**	**Somewhat Agree**	**Somewhat Disagree**	**Strongly Disagree**
A	We devote considerable time trying to improve this relationship				
B	We devote considerable time trying to improve the exporter's efficiency				
C	We have made a substantial number of adaptations in our delivery schedule in order to deal more effectively with this exporter				
D	We often discuss issues such as changes in technology and market conditions				
E	We have extensive formal and informal communications				
F	We discuss only need-to-know information that relates directly to our relationship				
G	We make joint decisions about:				
G.1	Reducing exporting costs				
G.2	Delivery scheduling				
G.3	Quality control				
H	Fruit tracking				
I	We have a strong personal confidence in each other				
J	We have a strong business confidence in each other				
K	We can always rely on each other when it counts				
L	I believe this exporter will work hard in the future to maintain a close relationship with my firm				
M	I am very confident that this relationship will continue in the future				

SECTION D: PRODUCER – PACKER QUESTIONS

1. When did your firm begin its apple **packaging** operation? (Month/Year) _____/_____.

2. What was the main reason for deciding to pack your own apples? _____.

   _____.

   _____.

   _____.

3. What is the **maximum** apple **packaging capacity** of the packhouse? _____**tons**.

4. How did last year's crop **pack out** according to the following classes?

	Class of fruit	**Percentage of Crop (%)**
A	Export	
B	Class I: Local	
C	Class II: Local	
D	Processed	
E	Other: Please Specify:	

THANK YOU FOR PARTICIPATING IN THIS STUDY.

All questionnaires will be handled in the strictest confidence and no individual producer will be identified. If you would like to receive a copy of the results of the study, please complete the following details:

Name of business:_____

Respondent's name:_____

E-mail address:_____

Telephone: (_____)_____Fax: (_____)_____