CHAPTER 6: Illustrating a current application of the proposed framework: the case of a commercial bank

6.1 Introduction

The third case study is of a South African commercial bank that has applied and is currently still applying the proposed framework of this study in order to make strategic financing decisions with respect to maize for the 2008/09 and 2009/10 seasons. This case study serves the purpose of showing how the framework was applied for a two-year period starting in the beginning of 2008, in order to develop views on risks and uncertainties that could potentially influence the market situation. Hence, the scenarios and modelling results that were developed in the beginning of 2008 still apply to the current situation, and therefore this case study can be seen as a "live" example of the application of the proposed framework.

Two different sessions were held in 2008 with the commercial bank's decision-makers. The first was on the 6th of February 2008 and the second was in April 2008, during which session the proposed framework was applied. Bank personnel who were present during the sessions were the risk manager, the acting head of the agricultural department, and a market analyst. Most of the information presented in this chapter is from the two reports that were compiled based on the discussions and simulations done during the two sessions. The two reports are available in Appendix D.

6.2 Background

The commercial bank to which this case study applies, is one of the major providers of credit to commercial and emerging farmers in South Africa. The credit is provided in three main forms, namely, production credit, moveable asset finance, and finance of land. The commercial bank needed to develop a strategy on how to provide and manage credit exposure with respect to the 2008/09 season and the 2009/10 season. Thus, it was important for the bank to develop views on risks and uncertainties that could significantly influence the outcome of the maize market over a two-year period, starting in 2008.

Based on these views, the bank had to develop robust strategies in terms of credit provision and management that could withstand these risks and uncertainties thereby ensuring that credit write-offs are minimised.

At the time of applying the proposed framework of this thesis in co-operation with the commercial bank, namely February and April 2008, no expectations whatsoever existed in the minds of the bankers involved in the sessions as to the possibility of the financial meltdown that eventually started playing out from July 2008 and onwards. As a result of the financial and economic meltdown, oil prices have decreased from $147/barrel in July 2008 to around $45/barrel in December 2008; international and domestic soft commodity prices have dropped significantly; the Rand/$ exchange rate has depreciated from around R6.50/$ in July 2008 to R10.5/$ in December 2008; inflation has decreased; most major economies went into recession, and international trade grinded to a halt.

Since the situation is still playing out, no eventual "actual" market situation exists in order to compare whether the application of the proposed framework of this study led the decision-makers of the commercial bank to make good decisions. Therefore, the results of the framework application as well as the stochastic model are compared to how the market situation has played out from May 2008 to December 2008 to test whether the risks and uncertainties that led to the current market situation (which accounts for the 2008/09 season) were sufficiently captured. Based on these comparative test results, one can argue which approach better captured the risks and uncertainties more sufficiently given the way the market played out from May 2008 to the time of writing this thesis, namely December 2008. In other words, the test results will be used to show which approach would potentially have assisted the decision-makers most in developing robust strategies to withstand the unfolding market situation which is currently resulting due to specific risky and unexpected events occurring.

In order to test whether applying the stochastic model or the proposed framework would best help decision-makers to develop robust strategies for the 2009/10 season, the results of both procedures are compared with current expectations of futures prices for the

2009/10 season. These prices are obtained from the South African Futures Exchange (SAFEX). After comparing the results with current expectations, a conclusion will be presented on which approach is most likely to facilitate robust decisions in the face of currently perceived risks and uncertainties with respect to the 2009/10 season.

6.3 Application of the framework

Two sessions were held with the bank's decision-makers, the first in February 2008 and the second in April 2008. During these two sessions the proposed framework of this thesis was applied, as stipulated in chapter four. First of all, the name of the game as well as the history of the game was discussed. From this discussion, it firstly became clear what the goals of the bank were, namely, minimising the risk of loan defaults while maintaining market share. Hence, it was important for the bank to finance maize production, but at the same time mitigate the risk of loan defaults. This would be done by following the correct strategy in terms of identifying and analysing potential clients and also structuring clients' debt correctly by means of using different combinations of finance products. Structuring debt correctly would mean minimising the risk of loan defaults as positive cash flow would be improved.

The discussion of the history of the game mainly focused on the maize industry, and historical trends and inter-relationships within the maize industry. The reason we only discussed the history of maize was because the bank was reluctant to provide detail on its exposure to the maize industry, particularly with regard to the amount of finance provided as well as past approaches toward financing maize production, as that would have meant disclosing confidential information. From the discussion, it became clear how important the macro-economic situation was in terms of its influence on maize prices, especially due to the growing link between fossil fuels and maize as a result of biofuel production.

Moving on to the next step, the players influencing the game were discussed in detail. Players identified that could significantly influence the macro-economy and therefore the maize industry were: global investors; the presidential race in the US (Obama potentially becoming president); the reaction and measures taken by the Fed should economic

conditions turn bad; OPEC and its reaction towards an economic crisis; the ability of Eskom to correct power problems within South Africa and thereby positively influence investor perceptions; and lastly, the outcome of the power struggle between the ANC and the government and how that would influence investor perceptions.

Following the discussion on players of the game, the rules of the game were debated. Two key rules were identified that would, to a large extent, determine the "playing field" on which the game would be played. The first was the rule that investors generally are risk averse. Therefore, should economic problems arise, these investors would flee to safe havens in whatever form these safe havens might present themselves. It might be commodities, a specific geographic market, or an investment instrument. However, what was important was that this rule would influence exchange rates, trade patterns, commodity prices and general macro-economic variables such as inflation and interest rates. The second rule was that the US was still the dominant economic power in the world, and therefore if the US picked up severe economic problems, it would mean global economic problems. Some uncertainty, however, existed in terms of the impact of US economic problems on China, India and the EU. Most market commentators at that stage argued and predicted that these three economic powers would have enough internal economic momentum to sustain economic growth paths regardless of what happened in the US.

Following the discussion on the history of the game, players of the game, and rules of the game, the key uncertainties were identified and discussed in detail. These were the following factors and players: the US economy going into a recession or not, and the impact of this on China, India and the EU.

As a result, three different scenarios were developed and simulated by means of the model of Meyer *et al.* (2006) through adjustment of functional forms and parameters based on each of the described scenarios, and also **without** including probabilities to ensure that uncertainty is technically captured in the correct manner. The scenarios were

set up and described as follows (directly taken from the second report written for the commercial bank, BFAP, April 2008)[6]:

"SCENARIOS FOR 2008/09

In order to draw plausible macroeconomic scenarios, the rules of the game, players of the game, key uncertainties and wild cards need to be identified and explored.

Rules of the game:

- ***Investors are generally risk averse****: the implication of this driver is that investors will seek havens where the level of risk is in line with the level of potential profit. Hence, in a situation where the world economy is unstable, investors will in general opt for the less risky and stable investment environment.*
- ***In general, the US economy has a significant impact on the rest of the world's economy:*** *the implication is that if the US sneezes, the rest of the world gets a cold. Except maybe for China and India?*

Key uncertainties:

- ***Will the US economy go into a recession?*** *At this stage nobody is sure of the answer to this question. Some give it a 50% probability, others say it's a given.*
- ***Should a US recession occur, what will be the macroeconomic impacts specifically on the EU, China and India?*** *In case the EU, China and India have enough internal momentum to keep their economies growing independently of a US recession, investors will see these economies as a haven. This implies international funds could flow towards these three economies, depending on general risk of the investment environment and the interest rate differentials, leaving the rest of the world economies high and dry. If the EU, China, and India do not have enough internal momentum, implying that a US recession also leads their economies into a recession, investors have very few safe havens left and low risk investments will become an attractive option e.g. gold, money market etc.*

Wild Cards and players of the game:

- ***If Obama becomes president of the US****, will it have a significant impact on the morale of US citizens leading to optimism and hence influencing investment in the US positively? Also, what will be the impact on the "war against terror" and hence how will it influence key diplomatic relationships e.g. the Middle East, Europe and China. Also, if the stance against the "war on terror" changes significantly, it could have a significant impact on Chinese economic growth since Chinese policies are geared towards an open, free and stable world economy.*
- *It is unknown if the* ***drastic monetary policy measures taken recently by the Fed*** *will swing the US back unto a growth path, and if so, how soon. Hence, will the US economy first go into a shallow recession, or will it stabilize at a very low growth level and then take off again?*

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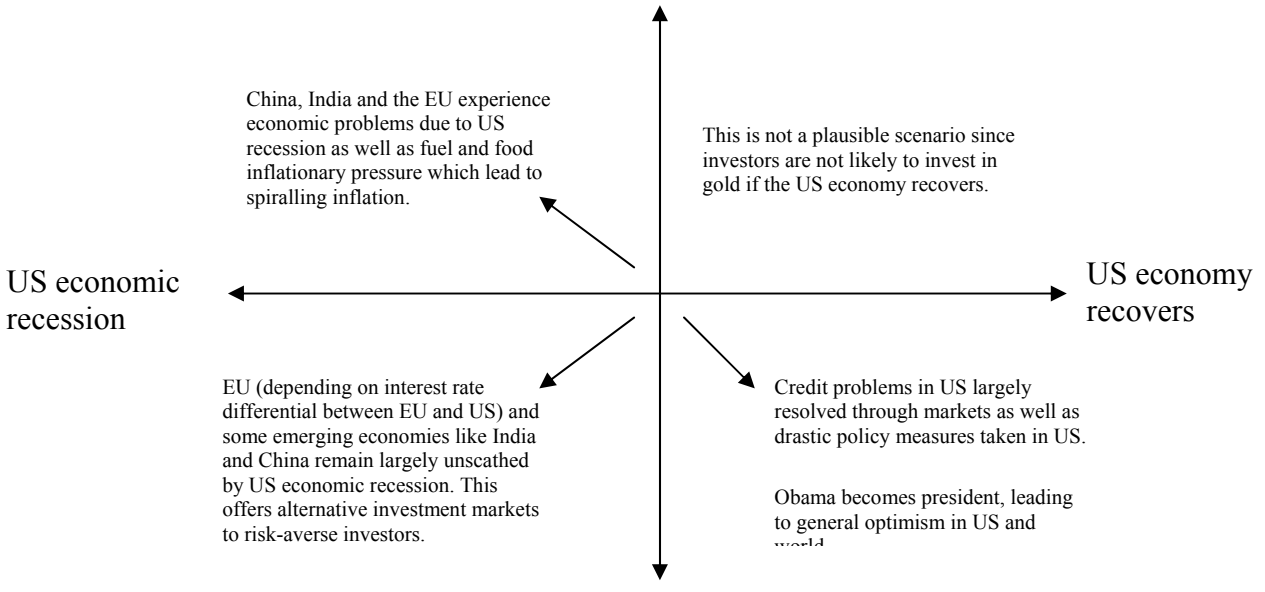
[6] The exact report is presented in order to indicate to the reader the true nature of the report that was presented to the decision-makers as early as April 2008. This serves to show exactly how the framework was applied and what the results were.

- *If a US recession does occur, what will be the **reaction of OPEC** be in terms of changing production policies? If they increase production or keep it stable to lower oil prices and, therefore, decrease energy costs to jump-start the world economy, the recession might be shorter and shallower than expected. If oil prices remain high and stable, the recession might last long as much fear. This could have a significant negative impact on Chinese economic growth.*
- *Will **Eskom** be able to manage power crisis successfully and assure investors that South Africa is a good long-term investment destination?*
- *Will the **power struggle between the present government and the newly elected ANC executive committee** have a crippling effect on the perception of South Africa as a potentially stable and prosperous investment haven or will the ANC and the present government manage to collaborate on key issues and hence create a perception of a stable and prosperous country.*
- ***Will Jacob Zuma become the next president of South Africa?** If he does, will he continue on the current policy paths, or will he drastically change policies in order to create a more social-democratic state driven by more socialist types of policies?*
- ***Will the Zimbabwe situation be solved in such a manner that the perceptions of international investors will become much more positive in terms of Southern Africa as a stable and profitable investment area?***

Scenarios

Scenario 1



Scenario 2 **Scenario 3**

Note: The key uncertainties form the two axes of the game board.

Implications of scenarios

Scenario 1:

- *Rand weakens significantly against the US$ and the €.*
- *SA inflation generally high due to high world inflation, but follows a declining trend as world economy weakens and global inflation pressure weakens.*
- *Interest rate, therefore, remains high but also follows a sharper declining trend than expected due to SARB being careful of adjusting interest rates because of frail economy.*
- *Oil price at first decrease significantly and then moves mostly sideways on the back of slowing demand, and unwillingness from OPEC to adjust production and production capacity.*

Scenario 2:

- *Oil price remains high since economies in emerging countries continue to grow. US economic problems have less of an impact on these countries' economies.*
- *Rand weakens against other currencies including US$, because risk averse investors rather invest in more stable and growing economies.*
- *Inflation remains high because of stable and high oil price, high international agricultural commodity prices, a depreciating Rand, as well as the inflationary whiplash of services inflation. Food inflation is a strong driver in this scenario, but the impact does however lessen over time since emerging economies keep growing and hence consumers can afford and get used to higher prices.*
- *Interest rate, therefore, remains stable but high. SARB does not increase interest rates in fear of seriously damaging already frail economy.*

Scenario 3:

- *Dollar strengthens against all currencies due to new optimism amongst investors. This causes the Rand to weaken significantly, especially due to political uncertainties in Southern Africa leading to investors becoming risk averse towards SADC investments.*
- *Oil price increase significantly due to renewed global economic growth. Is $200/barrel of oil possible in this scenario as forecasted by an international institution during the week of 4 May 2008?*
- *Rand weakness and increasing oil prices lead to significant inflationary pressure in SA.*
- *Interest rate remains high."*

The purpose of presenting the actual report directly, is to show exactly how the scenarios were developed, written, and how the implications of each scenario was presented to the bank's decision-makers. Based on the scenario results, scenario one was deemed to be the most important scenario as it was deemed to hold the greatest threat to the bank at the time the decision had to be made, namely April 2008. As a result, the model of Meyer *et al.* (2006) was used to simulate scenario one, **without** including probability distributions in order to include uncertainty in a technically correct way. Functional forms and

parameters were adjusted based on the description of the scenario so as to correctly reflect the scenario story by means of the model. Based on the model simulations, the assumptions and results were as follows (taken directly from the second report, BFAP, 2008)[7]:

"The scenario presented below indicates a global economy, which is severely affected by a recession in the US economy as well as overheating due to excessive high fuel and food prices. The assumption is, therefore, that the BRIC countries (Brazil, Russia, India, and China) do not have enough internal momentum to keep their economies growing at rates seen during the past few years, and also that inflationary pressure (due to excessive fuel and food prices) forces the economic growth in these countries to slow down in order to avoid excessive overheating. The macroeconomic assumption underlying this scenario is presented in Table 8[8].

Table 8: Scenario Projections: Economic indicators

		2008	2009	2010	2011
Crude Oil Persian Gulf: fob	$/barrel	105.00	80.00	79.47	78.39
Population	Millions	47.63	47.79	47.96	48.13
Exchange Rate	SA c/US$	780.00	900.00	945.00	992.25
South African Real GDP	%	3.00	3.00	4.00	3.50
South African Real per capita GDP	R/capita	18,017	18,557	19,300	19,975
Interest Rate (Prime)	%	15.00	14.00	12.00	10.00

Due to a change in the interest rate differential between the EU and the US, the Dollar strengthens, which forces oil prices down. On the back of this, the pressure on the demand for oil slightly weakens since trade and consumption of general goods and commodities slow down. The result is that oil prices drop unexpectedly to levels of around $80 per barrel[9].

The impact on the South African economy is a slowdown in economic growth, and a slowdown in inflation, which forces the Reserve bank to decrease interest rates more than expected in an attempt to get the economy back on the targeted growth path. This, however, does not happen and economic growth is generally below the 4% level except in 2010.

[7] The writings in the report are again taken directly from the report to show the reader exactly how the results and implications were presented to the decision-makers at the time they had to take a decision, namely April 2008.

[8] Table numbers are as was included in report.

[9] This sentence was written at a time when market forecasts of highly reputable institutions indicated a crude oil price of around $150 to $200 by the end of 2008. As a result, $80/barrel was seen as a totally crazy idea! Who would have thought an oil price of $44/barrel on 5/12/2008 was possible?

Table 9: Scenario projections - World commodity prices:

		2008	2009	2010	2011
Yellow maize, US No.2, fob, Gulf	US$/t	227.95	190.25	160.90	156.51
Wheat US No2 HRW fob (ord) Gulf	US$/t	243.67	203.38	172.00	167.30
Sorghum, US No.2, fob, Gulf	US$/t	223.07	171.42	149.43	144.82
Sunflower Seed, EU CIF Lower Rhine	US$/t	723.74	578.12	553.79	556.24
Sunflower cake(pell 37/38%) , Arg CIF Rott	US$/t	316.97	246.11	221.02	213.55
Sunflower oil, EU FOB NW Europe	US$/t	1860.00	1417.14	1407.75	1388.62
Soya Beans seed: Arg. CIF Rott	US$/t	490.98	451.00	404.67	408.62
Soya Bean Cake(pell 44/45%): Arg CIF Rott	US$/t	422.36	359.20	304.29	289.16
Soya Bean Oil: Arg. FOB	US$/t	1423.85	1084.84	1077.65	1063.01

Source: BFAP, 2008

Table 10: Scenario projections - SA commodity price projections:

		2008	2009	2010	2011
White maize (SAFEX)	R/ton	1976.2	1870.0	1746.8	1877.8
Yellow maize (SAFEX)	R/ton	1966.8	1885.4	1644.3	1709.7
Sorghum	R/ton	1692.1	1486.5	1361.3	1417.8
Wheat (SAFEX)	R/ton	3871.2	3350.0	3487.0	3636.9
Canola	R/ton	4091.6	3794.6	4277.3	4638.2
Sunflower (SAFEX)	R/ton	4652.7	4213.9	4216.9	4607.6
Soybeans (SAFEX)	R/ton	3818.4	4002.8	3783.0	3994.0

Source: BFAP Sector Model

The main trends in the scenario projections can be summarized as follows:

- *Due to the general slow down in the economy, world commodity prices decrease rapidly in 2009 and 2010. This does, however, not imply that prices pull back to historical levels. Commodity prices still remain relatively high.*
- *Commodity prices in the local market are expected to decrease in 2009 and 2010. As a result, farmers will respond to the lower commodity prices by reducing the area planted to field crops, especially on the back of high input costs, which are in general sticky and therefore do not decrease at the same rate as commodity prices. This causes pressure on profit margins and also increases the risk of production significantly. The decrease in area (and supply), causes prices to rise again by 2010."*

From the scenario structures and results presented above, it is clear that the financial market meltdown as well as the economic meltdown that is currently being experienced, were captured in the decision process as early as February and April 2008. Although the simulated price levels based on the scenario structure are still higher compared to what is happening in the market at the moment, the occurrence of risky and unexpected events, the order of event occurrence, and the resulting implications in terms of decreasing

prices, were captured and communicated to the decision-makers via the reports fairly correctly.

Following the scenario thinking process, the various steps of executing the stochastic modelling process were followed, as stipulated by the framework presented in chapter four. During each of these steps, the information and insights gained from the opposing step in the scenario thinking process were used to guide the process on how to set up the model and simulate the maize prices. Concurrently, by going through the modelling steps in terms of quantifying the trends and inter-relationships, some objective and quantitative information was added to the thinking process. This in turn assisted the bank's decision-makers to form more objective perceptions on some of the variables and players thought to influence the market situation. As a result of following the stochastic modelling process, a probability distribution were calculated indicating that maize prices (both white and yellow), were likely to stay above R2000/ton for the 2008/09 season as well as for the 2009/10 season. This concurred with the initial expectations of the bank's decision-makers.

However, by comparing the scenario results with the stochastic modelling results generated by applying the framework correctly, it was possible for the bank's decision-makers to understand that a situation wherein the global economy could almost implode was quite possible, although highly improbable. From the scenario results it was also gathered that, should the economy implode, an unexpected decrease in agricultural commodity prices was quite possible and plausible. At the point of developing these scenarios, the possibility for scenario one to play out was deemed "unthinkable" as all opinions, views, forecasts, and technical reports pointed to a situation in which the market would and "could" only increase from the levels of April 2008. Hence, a meltdown was thought to be a totally crazy idea.

The application of the proposed framework of this study, however, clearly pointed to such a "crazy" possibility, and in fact quite accurately captured most of the dynamics that eventually caused the meltdown. Hence, as a result of presenting the scenario results, the

decision-makers within the commercial bank realised that such a crazy and unthinkable event was quite possible and plausible. This resulted in them starting to question their initial assumptions and therefore expectations, and hence forced them to change their perceptions as to the potential outcome of the market. As a result, the bank's decision-makers were in a position to realise that such an event is possible and plausible, and hence re-perceived reality in terms of the actual risks and uncertainties faced at the stage of taking a decision. Consequently, the bank decided to adjust their credit provision and management strategy, which ultimately enabled them to withstand the onslaught of the eventual risks and unexpected events that led to the current market turmoil. This means that they adjusted their approach towards analysing and financing clients, specifically with respect to the criteria used to analyse a business as well as the type of product used to finance the business[10].

Based on the adjusted credit provision and management strategy, the bank thus far appears to be riding out the storm quite successfully. Hence, through making these decisions based on the results of applying the framework proposed by this thesis, they have been able to limit debt write-offs as a result of the current financial and economic conditions. This shows that the decisions made in April 2008 regarding the situation that is playing out now, were good decisions. Therefore, one can conclude that by using the proposed framework of this thesis, the commercial bank was able to learn and accurately perceive the true nature of the risks and uncertainties they were faced with in the beginning of 2008, and as a result, they were able to make good decisions in terms of credit provision.

6.4 Application of the stochastic model

In order to test whether the application of the framework would have led to better decisions compared to only using stochastic modelling, it is important to again do a "back-in-time" exercise in the sense of doing only a stochastic modelling exercise, then deducing what the decisions would have been based on the modelling results, and then

[10] Due to the confidential nature of credit provision policy and credit provision strategies, no details can be supplied in terms of the exact nature of the changes that occurred with respect to credit provision and management as this might convey, knowingly or unknowingly, sensitive information to competitors in the market.

comparing it to the decisions that were made by applying the proposed framework of this thesis.

Therefore, in this section, the stochastic model is applied on its own to test whether it would have sufficiently captured risks and uncertainties which would have led to the market situation that appears to be playing out at the time of writing this thesis. Hence, the model is applied from the perspective that the bank's decision-makers would have used the model in April 2008 to run a stochastic simulation on white and yellow maize in order to develop a view of the risks and uncertainties that could potentially result in different outcomes for the maize market for the 2008/09 and 2009/10 maize production seasons. Based on these gained insights from the modelling exercise on risk and uncertainty, it is assumed that the decision-makers would have developed specific strategies to provide and manage credit and simultaneously minimise the chance of write-offs based on the possibility of farmers making losses. Hence, the question is: given the view on risk and uncertainty that could have been developed through applying the stochastic model, would the eventual strategies have been robust enough to withstand the risks and uncertainties that are currently causing the turmoil in the financial markets and the global and domestic economy?

To apply the model, the key trends and inter-relationships for the period before 2008 are analysed and assumptions are made on the exogenous variables, in terms of trends and probability distributions for 2008 and 2009. This ensures that a logical and scientific view is taken on the potential market outcome for the 2008/09 and 2009/10 maize seasons. The trends for the period 1998 to 2007 are presented in Tables 6.1 to 6.4 to serve as background on how the assumptions are developed with regard to the values of the different exogenous variables for 2008 and 2009. Also, since the model of Meyer *et al.* (2006) is used, and since it already exists and is based on the historical trends and inter-relationships presented in tables 6.1 to 6.4, no new model or new functions are estimated for the sake of this modelling exercise. The correlation matrix used in the simulations to correlate the different exogenous variables are presented in Appendix E, as well as the

resulting probability distributions of the exogenous variables and hence assumed values for 2008 and 2009.

In terms of domestic maize market trends, it is clear from Tables 6.1 and 6.2 that price increases occurred from 2006 onwards. The reason for these increases was mainly attributed to increasing world maize, grain and livestock prices (as presented in Table 6.3), an increase in crude oil prices due to a tightening supply and demand situation for crude oil, a decrease in maize plantings in 2005/06 season, as well as dry weather conditions during the 2006/07 season which led to below-average maize yields. Apart from these factors, bio-ethanol production from maize was introduced in the USA in 2006 on a major scale, while biodiesel production from oilseeds was also introduced in the EU and other parts of the world in 2006. The introduction of biofuels was mostly in response to significantly increasing crude oil prices and uncertainty with respect to future supply of crude oil due to the perceived unsustainable exploitation of crude oil reserves in the world. The US$ was also depreciating against other major currencies, and since most commodities are quoted in US$, it led investors to invest in commodities to serve as a natural hedge against a weakening US$. The result was significant increases in global commodity prices, including maize prices (IFPRI, 2007, USDA, 2008).

Table 6.1: White maize trends

Variable	2000	2001	2002	2003	2004	2005	2006	2007
Area harvested (1000 ha)	2003	1596	1842	2083	1842	1700	1033	1625
Yield (t/ha)	3.22	2.9	2.99	3.06	3.15	3.59	4.25	2.66
Production (1000 tons)	6440	4636	5576	6366	5805	6108	4392	4315
Feed consumption (1000 tons)	783	446	105	641	733	543	787	1100
Human consumption (1000 tons)	3473	3858	3643	3687	3766	3731	3718	3715
Ending stocks (1000 tons)	1273	559	1718	2123	2402	2301	1630	690
Imports (1000 tons)	0	47	274	33	0	0	0	50
Exports (1000 tons)	861	812	817	1069	712	1844	480	370
Producer price (R/t)	672	1303	1539	1004	823	854	1422	1798

Source: BFAP, 2008

Table 6.2: Yellow maize trends

Variable	2000	2001	2002	2003	2004	2005	2006	2007
Area harvested (1000 ha)	1227	1111	1174	1017	1001	1110	567	927
Yield (t/ha)	3.23	2.97	3.07	3.1	3.67	3.56	4.08	3.03
Production (1000 tons)	3969	3300	3734	3026	3677	3947	2315	2810
Feed consumption (1000 tons)	2456	3011	3373	3078	3012	3468	3260	3280
Human consumption (1000 tons)	212	247	249	245	262	251	290	260
Ending stocks (1000 tons)	842	643	992	501	746	868	440	369
Imports (1000 tons)	0	348	651	408	219	360	930	1100
Exports (1000 tons)	627	523	371	116	120	402	117	106
Producer price (R/t)	691	1168	1293	1047	863	794	1414	1852

Source: BFAP, 2008

As explained, the South African economy and maize industry is small and open in comparison to other major global economies and maize producing countries. Because of this, a change in the world price can have a very direct impact on domestic maize prices, depending in the domestic supply and demand situation. Should there be a domestic shortage or oversupply of maize, the South African maize market is directly integrated with world markets, and hence global price variations are transmitted directly into the domestic maize market (Meyer *et al.*, 2006). The result is that domestic maize prices will be closely linked to world market price movements. Since South Africa was in an oversupply situation in terms of maize during the 2004/05 season, and suddenly in an undersupply situation in the 2005/06 season, it meant that the increase in global commodity prices since 2006 (Table 6.3) had a very direct impact on domestic prices. As a result, domestic maize prices increased to historically high levels, and remained there during 2006 and 2007.

Table 6.3: World grain and livestock price trends

Variable		2001	2002	2003	2004	2005	2006	2007
Yellow maize, Argentinean Rosario	US$/t	89	102	109	89	84	148	152
Yellow maize, US No. 2	US$/t	92	102	104	96	90	159	164
Wheat US No. 2 HRW	US$/t	125	162	151	152	160	208	215
Sorghum US No. 2	US$/t	92	102	111	94	93	164	162
Sunflower seed, EU, CIF, Lower Rhine	US$/t	287	300	285	275	281	326	401
Sunflower cake (pell 37/38%), Argentinean CIF Rotterdam	US$/t	110	110	166	105	113	128	178
Sunflower oil, EU NW Europe	US$/t	587	650	660	675	637	693	846
Soybean seed, Arg. CIF Rotterdam	US$/t	203	240	312	233	247	287	335

Variable		2001	2002	2003	2004	2005	2006	2007
Soybean cake, (pell 44/45%), Arg CIF Rotterdam	US$/t	174	183	275	195	197	224	276
Soybean oil Arg. FOB	US$/t	412	585	630	530	555	645	684
Nebraska, direct steer fed	US$/t	1294	1169	1867	1868	1924	1882	2024
Chicken, US 12-city wholesale	US$/t	1303	1225	1366	1634	1561	1419	1684
Hogs, US 51 – 52%	US$/t	954	714	869	1157	1103	1041	1038

Source: FAPRI, 2008

As oil prices increased further during the early part of 2008 (Table 6.4), at the time the commercial bank had to make the decision in terms of financing provision and management, market expectations were that commodity prices would only increase in the future. Hence, it was expected that domestic maize prices would remain high during the 2008/09 maize season as well as in the 2009/10 season. In addition to this, expectations were that international and therefore domestic commodity prices would remain high for a much longer period than just two years, since global stock levels were low, economic growth was strong, and hence demand for commodities was growing significantly (IFPRI, 2007, USDA, 2008, FAPRI, 2008, FAO, 2008).

Table 6.4: Macro-economic trends

Variable	Unit	2001	2002	2003	2004	2005	2006	2007
Oil price	$/barrel	22	24	28	36	50	60	68
SA population	Millions	44.5	45.4	46.4	46.5	46.8	47.3	47.45
Exchange rate	SA cents/$	977	943	707	622	639	676	709
Real GDP per capita	Rands	14321	14772	14996	15499	16069	16653	17492
Disposable income of households	R million	645521	727116	791972	874566	964520	1075127	1064765
Disposable income of household per capita	Rands	14500	16016	17068	18808	20609	22730	22441
GDP deflator	Index '95	157	174	182	193	202	216	235
CPI food	Index '95	147	170	184	188	193	206	224
Average annual prime interest rate	%	13.77	15.75	14.95	11.29	10.62	11.16	12.5
PPI agricultural goods	Index '95	139	180	192	184	169	200	218
Freight rate (Arg to SA)	US$/ton	24	22.24	24.14	43.85	45.3	53	95
Discharge costs	R/ton	66	66.56	92	104	110	117	127
Maize transport costs (harbour to Randfontein)	R/ton	118	130	139	168	172	185	201
Fuel	Index '95	241	256	256	278	294	363	395

Variable	Unit	2001	2002	2003	2004	2005	2006	2007
Fertiliser	Index '95	200	240	234	234	255	270	294
Requisites	Index '95	182	218	231	239	245	256	278
Intermediate goods	Index '95	186	222	233	242	246	261	283

Sources: FAPRI, Absa Bank, Actuarial Association, Prof. F Smit, 2008

Based on the historical trends and inter-relationships presented in Tables 6.1 to 6.4, a correlation matrix and probability distributions were estimated and set up to generate assumed values for 2008/09 and 2009/10 seasons for key exogenous variables to be used in the model of Meyer *et al.*(2006). The correlation matrix and estimated probability distributions are presented in Appendix E. Based on the correlation matrix and probability distributions of the key exogenous variables, the following probability distributions for white and yellow maize prices for the 2008/09 and 2009/10 seasons were generated by means of the Latin Hypercube stochastic process, as well as through running 500 iterations in the model in order to obtain stable probability distributions for the key output variables. The resulting probability distributions are compared to price levels and expectations in the market at the time of writing this thesis, namely, December 2008, to test to what extent the current market situation and expectations have been captured in the modelling results (Table 6.5):

Table 6.5: Maize price simulated probability distributions

Variable	**Stochastic model simulation results**						**Average Price levels on 5/12/2008 for 2008/09**	**Spot Price on 5/12/2008**	**Futures Price levels on 5/12/2008**
	Unit	**Mean**	**Min**	**Max**	**Std Dev**	**CV**	*		**
White maize price 2008/09	R/ton	2082	1257	3969	429	20.61	1856	1561	
White maize price 2009/10	R/ton	2042	1472	3617	300	14.7			1655
Yellow maize price 2008/09	R/ton	1935	1291	3627	307	15.88	1855	1530	
Yellow maize price 2009/10	R/ton	2076	1416	3665	336	16.21			1670

** These are the average SAFEX prices for 2008/09 season from 1/5/2008 to 5/12/2008*

*** These are the SAFEX futures prices for July 2009 contracts on both white and yellow maize*

From the simulation results, it is abundantly clear that the market situation currently playing out in terms of price levels, would have been captured in the probability distributions as simulated by the stochastic model. Calculations based on the simulated probability distributions would have indicated that the probability for an average white maize price for the 2007/08 season of R1856/ton or lower to occur was 34%, while for yellow maize priced at R1855/ton or lower, the probability was 43%. Hence, the probability distributions would have indicated that the probability was fairly high for prices to decrease.

However, given the expected prices simulated by the model, namely R2082/ton for white maize and R1935/ton for yellow maize, and comparing these simulated expected prices with current spot prices and futures prices, it is clear that the average price for 2008/09 is expected to decrease to levels much lower than what was simulated by the model and what the average price for the 2008/09 is at the moment. Given the simulated probability distributions, the probability for the annual average white maize price to move to an average level of R1561/ton or lower for 2008 would have been indicated as 8%, while the probability for the average annual yellow maize price to move to levels of R1530/ton or lower for 2008 would have been indicated as 6% (Figure 6.1).

These probabilities imply that should the decision-makers have used only the probability distributions to inform them of potential risks and uncertainties and hence the potential market situation that could play out, the possibility of prices moving to the current levels and expected levels, would have been deemed highly improbable. This point is based on the argument that the probability distributions would have indicated that the market prices would have remained at much higher levels with a high probability. This would have led decision-makers to believe that the probability of farmers incurring a loss on crops due to decreasing commodity prices is very small, and therefore that finance could be provided to farmers at a fairly low risk of loan default.

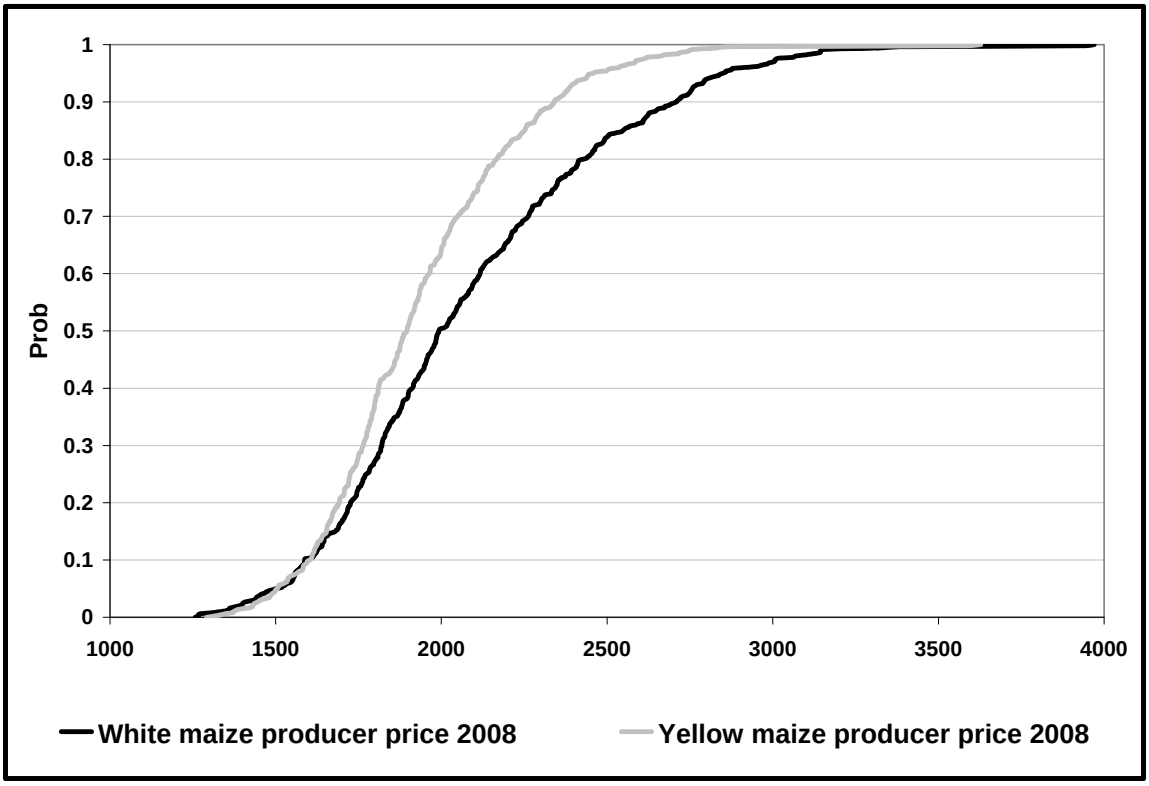


Figure 6.1: Simulated cumulative distribution functions of white and yellow maize for 2008/09 season

The reality, however, was that, as the market situation turned around and commodity prices started dropping from July 2008 and onwards, the probability of loan defaults and hence write-offs increased significantly. The problem is that once the finance has been provided to the farmer, the bank is locked in and hence has to "ride out the storm." Therefore, the argument can be made that if the bank had used the stochastic simulation outputs as a basis to develop their strategy for the 2008/09 season, they would likely have developed a strategy that would not have been robust enough to handle the risky and unexpected events that are causing the current financial, economic and grain market turmoil. This argument is based on the point that, since the simulated probably distributions would have indicated that only very small probabilities existed for the current market situation to play out, the decision-makers would most probably have used the range in which prices were expected to move to base their strategy development on. This implies that developing the strategies would not have included thinking about the risks and uncertainties that occurred, implying that the strategies would most probably

not have been successful given the current market situation. Hence, the strategies would most probably not have been robust enough to lead to success.

In terms of the view for the 2009/10 season, it is evident from Table 6.5 that current futures market prices, which indicate market expectations, are much lower than the simulated, expected prices of the model. Although current futures market prices were captured in the probability distributions, the probability of current expectations playing out were assigned low probabilities. In the case of white maize, the probability of a market price of R1655/ton or lower occurring is only 6%, while for yellow maize the probability of a market price of R1670/ton or lower occurring is only 8.5% (Figure 6.2).

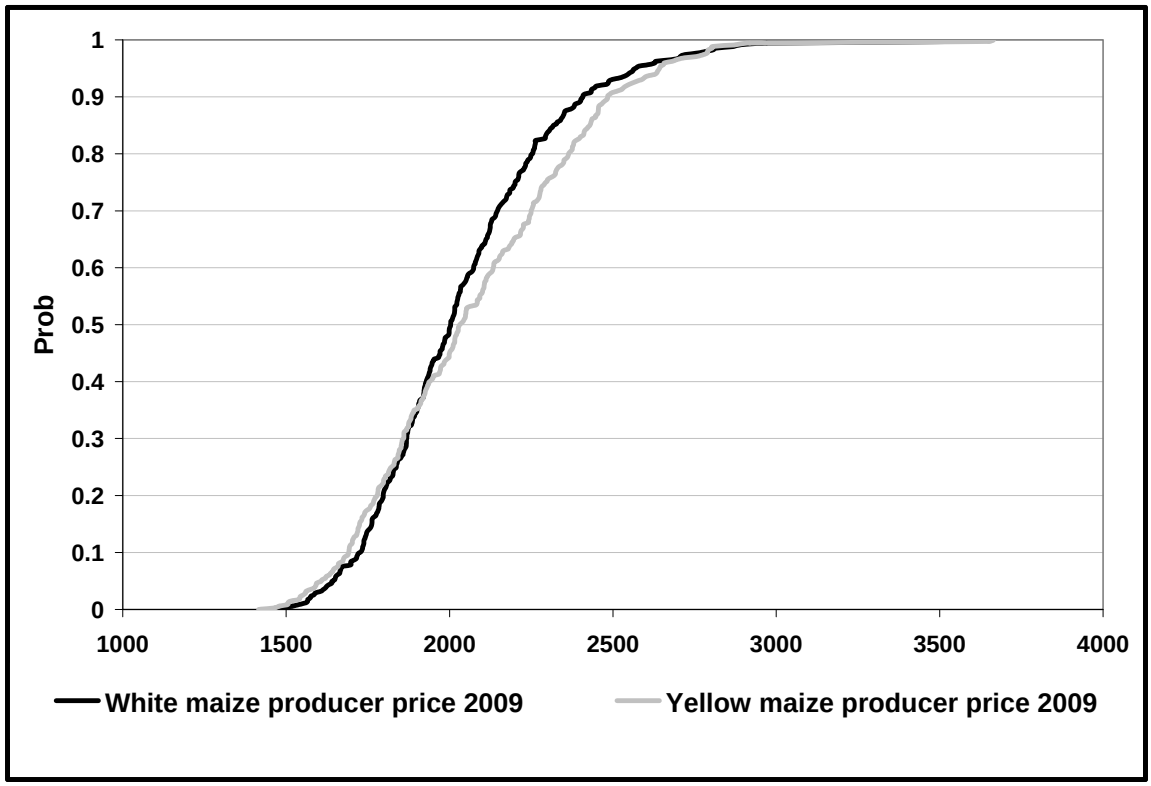


Figure 6.2: Simulated cumulative distribution functions for white and yellow maize 2009/10 season

Since finance is already provided between August and September of each year for the coming production season, it meant that finance would have been provided to farmers for the 2008/09 season when prices were still at very high levels and were expected to remain there. Hence, using only the probability distributions to develop a financing

strategy for the 2008/09, would have led the decision-makers to believe that prices were likely to remain high. Hence, the bank would have been locked into a situation in which huge amounts of finance would have been provided to plant maize, while prices are dropping and are expected to drop to levels where maize production is not viable at all, given the cost of inputs at the time the inputs were bought and crops were planted.

It must be noted that the simulated prices of the model are annual averages, and that it is not entirely correct to compare the simulation results to current market expectations with respect to futures prices on the day. However, futures market expectations do give an indication of what is expected in future, and can therefore provide some indication as to what the potential annual average price could be for the 2009/10 season. As the July 2009 futures contract is the contract furthest into the future available on the futures market as on 5/12/2008, it is the only contract available to form a picture of what the expectations are in terms of the 2009/10 season. Therefore, the modelling results are only compared to the July futures prices.

Based on the model results as well as the market expectations as presented through the futures prices, it is clear that by just using the modelling results, the decision-makers would have come to the conclusion that market prices as low as either occurring or expected to occur, had a very low probability of occurring. The argument can therefore be made that the decision-makers would have made a decision based on a view that commodity prices were likely to stay higher than what is playing out and could potentially occur during the 2008/09 and 2009/10 seasons, and that the probability of loan default is therefore much lower than what it in fact is now. Hence, the strategy that would have been developed based on the view of a low probability of low prices, could likely have been unsuccessful, given the way the market appears to be playing out at present. Therefore, the conclusion can be drawn that just using the stochastic model would not have sufficiently captured the risks and uncertainties of both the 2007/08 and 2008/09 seasons, and hence that it would not have assisted the decision-maker in developing adequately robust strategies that would have led to success during both seasons.

6.5 Stochastic model versus framework

Comparing the results of using only the stochastic model versus applying the proposed framework, clearly indicates that the framework has captured risk and uncertainty much more sufficiently thus far, given the way the market is playing out and is expected to play out. It can therefore be argued that the framework is an improvement on using only a stochastic model, in the sense that it led the bank to make **better decisions** compared to what would have been decided if only the stochastic model was used. Hence, the conclusion can be drawn that, although the market situation in which this case study and using the proposed framework is still playing out, the application of the framework did result in the bank's decision-makers re-perceiving the reality of what the risks and uncertainties really were in developing the financing strategy for the 2008/09 and 2009/10 seasons. Therefore, using the framework did lead to a more robust decision based on a better and more complete understanding of both risk and uncertainty, but this also occurred because of a much more complete learning process that led the decision-makers to understand reality better. The framework thus far reflects how the market is playing out and has made a significant difference the bank's ability to develop a robust financing strategy, given the current market situation.

6.6 Summary and Conclusion

The third case study presented in this chapter, serves the purpose of providing an actual and "live" situation in which the proposed framework of this study is applied, and where the results are presently being used to make decisions on future market situations. The case study is on a commercial bank active in the South African agricultural market and which had to develop financing strategies for the 2008/09 and 2009/10 maize seasons in the beginning of 2008. Hence, the framework was applied to assist the bank to develop views on risks and uncertainties that could potentially cause a market outcome significantly and unexpectedly different from what was expected in the beginning of 2008. The result was the development of three different scenarios, one of which was identified as the most threatening and was therefore simulated by means of the model of Meyer *et al.* (2006), without including probabilities. This was done to ensure that uncertainty is captured and communicated correctly, but also to ensure that the scenario

results are in a useful format for the decision-makers in terms of yields, quantities and therefore prices.

The scenario that was selected was a scenario in which the global economy moved into a deep recession, causing commodity prices, including maize prices, to decline sharply. At the time of writing and simulating this scenario, namely April 2008, a situation as described in the scenario was thought to be impossible. However, as it turned out, the impossible became the probable, which became the reality. At the time of writing this thesis, the US, EU, and Japan were already in a recession, while Chinese, Indian, Russian and Brazilian economic growth (along with South African economic growth) were declining rapidly — something unthinkable just eight months before.

Based on the scenarios developed and the modelling results, it was possible to indicate to the bank's decision-makers that such a situation was indeed possible and plausible, and hence put the bank's decision-makers in a position to re-perceive reality in terms of the actual risks and uncertainties being faced at the time of making the decision on the financing strategy. As a result, a more robust financing strategy was developed, and it appears as if the bank is riding out the storm quite successfully at the moment in terms of its agricultural finance.

This chapter also indicated that using only the stochastic model would most likely not have put the decision-makers in a position to understand the actual risks and uncertainties that were faced in April 2008, and hence might have misled them into developing less robust financing strategies. Should this have happened, it is highly likely that the financing strategy would not have been robust enough to withstand the risks and uncertainties that led to the current market situation, and hence might have resulted in the bank not being able to ride out the storm safely in terms of the 2008/09 season. With regards to the 2009/10 season, the same argument can be made. However, only time will tell whether this argument proves to be correct.

CHAPTER 7: Summary and Conclusions

"Likeness to truth is not the same as truth."
Bernstein, 1998

7.1 Introduction

Since the beginning of time, human beings have always wanted to get to know the truth, but have always struggled. The reason for struggling, is because truth has many dimensions and therefore always presents itself in many different "shapes and sizes," which often seem to contradict each other. This makes it very difficult, confusing, and almost impossible for us humans to get to know the full truth. One of the dimensions of the truth is the future. The future is often like the past and present. However, in some situations the future is not like the past or the present, as a result of change. Therefore, the problem is that in our search for the truth, and hence in attempting to understand the future, we as humans almost never know whether the future will be like the past and present, or whether it will in fact be a totally "new" future which will be unlike the past and/or present.

As a result of this problem, humans have devised methods whereby the past and present is analysed in great detail in order to understand it. Based on the understanding of the past and present, view(s) on the future are then developed. The logic behind this lies in the idea that, since we believe we understand the past and present based on our in-depth analysis, we then believe we can understand the future better as we mostly work with the assumption that the future will be similar to the past and present. The reasons for working with this assumption are because we firstly "know" the past and present and hence the "facts," and secondly, because we "know" the past and present, we already think and believe we "know" at least a part of the future and hence part of the truth. Hence, we reason that by knowing the past and present and using that to explain a view of the future, it is easier to defend that view of the future, since we can defend the view of the past and present because it is based on perceived "facts."

As a result of using the assumption that the future is like the past and present, we are often quite correct, since the future is often like the past and present. However, during some stages in human history, as is currently occurring in the world and in agriculture as argued in chapter one, changes take place at a rate and magnitude "never" witnessed before in human memory, resulting in a future that is not at all like the past or the present. Situations like these then lead to a total breakdown in views of the future, since the assumption that the future is like the past and present doesn't hold anymore. This results in all our techniques and methods based on this assumption becoming obsolete, even if it is just for a short period in time. The result is then confusion and helplessness in the face of the sudden "inexplicable unknown," which leads to bad decisions.

7.2 The proposed framework of this thesis

The proposed solution to this problem and therefore the idea offered by this thesis is to work with two hypotheses when developing a view of the future, and hence developing a view of that dimension of the truth. The two hypotheses that are used are: the future is like the past and present, and that the future is not like the past and present but is a result of combining current and unexpectedly new forces or factors. The idea behind this stems from the philosophy of Socrates, whereby he postulated that the truth can never be fully known and therefore, when working with the truth, one needs to work with multi-hypotheses about the truth until all but one hypothesis can be discarded. This will then bring one closer to the truth, but never lead you to know the truth in full, since the truth can't be known in full.

Applying this idea means conjunctively using two techniques which are based on the two hypotheses about the future. From a literature review it was realised that two such techniques existed, namely, stochastic modelling and scenario thinking. Stochastic modelling, by its very nature, is based on the assumption that the future is like the past and present since historical data, historical inter-relationships, experience, and modelling techniques are used to develop the model, apply it, and to interpret its results. Scenario thinking on the other hand, and specifically intuitive logics scenario thinking, is based on

the notion that the future is not like the past or present, but is rather a combination of existing and new and unknown factors and forces.

At first the perceived problem with this idea was thought to exist in the problem of using both techniques in combination, since the two techniques are fundamentally different because of the fundamentally different assumptions on which they are based. The question and challenge was therefore whether these two techniques could be used in combination, and how? However, the solution to this problem was more elementary than what was initially thought. As the two techniques are fundamentally different, it implies that the two techniques can't be combined because the two underlying assumptions can't be combined. However, what is possible is to use it in conjunction without adjusting either technique. Rather, one would allow each technique to run its course, which at the same time leads to cross-pollination in terms of ideas and perspectives, where possible and applicable. The cross-pollination of ideas and perspectives will then create a process whereby ideas regarding the two basic assumptions on the future are crystallised and refined through a learning process, hence resulting in clearer perspectives on both hypotheses about whether the future will be like the past and present, or whether the future will be a combination of existing and new but unknown factors and forces. These clearer perspectives provide a framework to the decision-maker whereby the two basic hypotheses on the future can be applied simultaneously to develop strategies and policies that are likely robust enough to be successful in both instances. It also provides a framework whereby reality can be interpreted as it unfolds, which signals to the decision-maker which of the two hypotheses is playing out. This will assist the decision-maker in better perceiving what is in fact happening, hence what the newly perceived truth is in terms of the future, and therefore what needs to be done in order to survive and grow within this newly developing future, reality, or truth.

The presentation of the three case studies in chapter five and six provided support to the before-mentioned argument. Applying the proposed framework did indeed lead to more robust and therefore better decisions in the face of risk and uncertainty due to conjunctively using the two techniques, but also due to the cross-pollination and learning

processes that took place when the framework was applied. In addition to this, as indicated through the presentation of case study three, the results of applying the framework provided a framework for the bank's decision-makers in which to interpret unfolding present events, as well as what the implications could be for the 2009/10 maize season. This provided the bank's decision-makers with a platform to interpret events, and hence develop and adjust strategies to ensure success would be obtained through the strategies. Although the future did not turn out or seem to turn out to be like the past and present in any of the three case studies, it could very well have happened and could very well still happen in case study three. Should this have happened, or still happen in case study three, the decision-makers would still have had the results of the stochastic model which would have indicated to them that the future is going to be much like the past and present. Hence, it is important to use both techniques in conjunction, since it is important to develop strategies that are robust and hence lead to success regardless of whether the future is like the past and present, or not.

The presentation of the case studies also assisted in testing the hypothesis of this thesis as presented in chapter one, and found that it can't be rejected. Hence, through the presentation of the case studies it was found that using scenario thinking in conjunction with stochastic modelling does indeed facilitate a more complete understanding of the risks and uncertainties pertaining to policy and strategic business decisions in agricultural commodity markets, through fostering a more complete learning experience. It therefore does facilitate better decision-making in an increasingly turbulent and uncertain environment. However, based on the presentation of the case studies and testing of the hypothesis of this thesis, it became clear what the strengths, weaknesses and contribution of this proposed framework are in terms of analysing risk and uncertainty in agriculture.

7.3 Strengths, weaknesses, and contribution of the proposed framework

The strengths of this proposed framework, relative to just using either stochastic modelling or scenario thinking, is that the weakness of stochastic modelling (namely the assumption that the future is like the past and present) is mitigated by using scenario

thinking in conjunction. This provides an alternative hypothesis to what stochastic modelling is based on. The opposite is also true in terms of scenario thinking. Its weakness is that it is based on the assumption that the future is not like the past and present. Since the future is often like the past and present, using just scenario thinking to develop views of the future could be misleading. Therefore, the strength of this proposed framework lies in the fact that the weaknesses of each of the respective techniques are mitigated by the strength of each of the respective techniques.

The weakness of the proposed framework is that part of it relies on human intuition, knowledge, experience, and the ability to perceive reality. However, due to bounded rationality, it implies that including the human element can result in a situation in which factors are not thought of or comprehended well enough to be included when following the framework. This could lead to results that do not capture the true risks and uncertainties that are faced, given the decision context and decision that needs to be made, and hence could lead to decisions that are not robust enough to handle the eventual outcome. Using the proposed framework does facilitate more robust and therefore better decisions, but does not guarantee robust and good decisions.

The contribution of this proposed framework towards the field of agricultural economics lies in the fact that a tried-and-tested framework now exists, whereby risk and uncertainty can be captured in a technically correct manner and also in a more sufficient manner compared with just using stochastic modelling. Thus, although stochastic modelling by means of objective and/or subjective probabilities does provide some platform to understand risk and uncertainty, the proposed framework of this thesis provides a much improved and much more solid and sound framework to analyse and understand risk and uncertainty in agricultural economics. Therefore, it is believed that the correct application of this framework in agricultural economics will provide agricultural economists with a much more solid platform to study and communicate risk and uncertainty, and thereby assist decision-makers in either the private sector or the public sector to develop much more robust and therefore better business strategies and policies.

The agricultural sector is experiencing turbulent times, and the possibility that the volatility and uncertainty could only increase in future is becoming bigger and bigger by the day. This is due to the increasing inter-connectedness between the various macro and micro forces that drive agriculture in a global and domestic context. Since the agricultural sector is critical to the survival and growth of a country's economy, especially in an increasingly global society, it is imperative that robust business strategies and policies are developed to ensure the survival and growth of the agricultural sector. In this regard, agricultural economists have played and should play a key role, since agricultural economists are the link between the agricultural sector and the rest of the economy. Hence, developing and applying such a framework as proposed by this study to assist the development of business strategies and policies in the agricultural sector, is key to the continued relevance of agricultural economists in the economy and in society.

7.4 Applying the framework in practice

The aim of this thesis was to propose an approach towards decision-making in agriculture with respect to policy and business strategy, given that risk and (especially) uncertainty is likely to increase in future. Hence, the goal was to put a framework on the table that encapsulates this approach, and which can be applied in practice, as with the presented case studies, in order to facilitate better policy and strategic business decisions. Therefore, what does it take to apply the proposed framework of this thesis in practice?

Firstly, skills and knowledge are needed by the facilitator who will apply this framework in collaboration with decision-makers, which entails an in-depth knowledge and understanding of intuitive logic scenario thinking as well as stochastic modelling. If the decision-maker wants to apply the framework without having a facilitator, it is important for him/her to also have these skills and knowledge. The skills and knowledge are needed simply because, in applying the framework and the two techniques constituting the framework, one needs to understand the fundamental differences between the two techniques, and hence understand the small but important nuances attached to each technique to ensure that they are applied correctly in conjunction. Examples of nuances include: the difference in how to think about risk versus uncertainty; the difference in

understanding the "players and rules of the game" and just analysing hard data on the specific industry or system; and the differences in perspectives between the history of the game from the decision-makers' perspective, and the history of the game as presented through hard data.

Secondly, the preparation process before applying the framework in collaboration with decision-makers, entails a process whereby a first meeting is held with the respective decision-makers. The aim of this meeting should be to ask exploratory questions in order to gain insight on their initial expectations and aims with respect to the decisions that have to be made. This will indicate to the person facilitating the application process how much time is available in terms of applying the framework, who needs to be part of the session, in what format the final results should be presented, by when the final results should be presented, and hence how much time would be available to digest and capture the final results before presenting it. The issue of who needs to be part of the session is essential to the success of applying the framework. The reason is that often knowledge on some of the factors or issues to be discussed are not internalised by either the facilitator or the decision-maker. This implies that it might be necessary, in order to have a meaningful discussion on that poorly understood issue, to either involve an expert on the issue during the whole of the session, or to invite an expert to do a presentation during part of the session. This will give the decision-maker and facilitator an opportunity to question the experts, and hence have a much better view on the specific issue. However, what is important is that the number of participants and experts are limited, as too many people lead to too many opinions without ever getting to any point in terms of finalising a discussion around an issue.

It was found that, in applying this framework, the optimal amount of people involved in a session, excluding the facilitator, is between three and eight. With more than eight, it becomes tricky to have a meaningful and in-depth discussion on an issue, while less than three tends to lead to a very shallow thinking process. The "mix" of people attending the session is also important in the sense that not too many similar thinkers should be in the session as this leads to "group thinking," implying that the discussions will not be very

rich or varied. Along with this, not too many of the people should be from the same field or sector e.g. academics, as it often leads to theoretical arguments on definitions, resulting in a "loss of interest" by some participants as well as delaying getting to any point in terms of the discussion. The same can be said of people from the same sector within the private sector, as they could start arguing about internal issues specifically related to the industry. Lastly, it is important to have a mix of people who are positive, critical, and "out-of-the-box" thinkers who can add value in terms of their ideas on issues but who are also willing to entertain ideas that oppose their own. By having such a group, it is possible to get excellent insights and eventually get to solutions without having to manage major conflicts between participants which ultimately threaten to derail the process totally.

The time-length for applying the framework depends on how quickly the decision-makers want answers to make decisions, and also on how deep the decision-makers want the discussions and analysis to be. Referring to case study two, the total time needed to meet the co-operative, apply the framework, present the results orally, and compile a report was a week. One day was spent on applying the framework and presenting the results orally, while another five days were spent in writing the report. Other users of the framework have used more or less time, depending on their needs. It was found that organisations representing a specific industry and who need to report to its members, especially needed a sound scientific basis. In one instance, the total exercise (of applying the framework until presenting the final results) took eight months in total. This included an initial meeting to understand expectations and goals; an intensive one day session during which the framework was applied, and which was attended by five experts along with the decision-makers and the facilitator; and a third meeting with only the decision-makers and facilitator present, during which the results were reviewed and further discussed in detail. The final results were presented in a report of roughly sixty pages, which contained scientificly based information and detailed results.

The ideal setting for running an exercise of applying the framework is a room containing either a round table or a large enough board table that avoids "ranking" sitting positions

around the table. Ideally, the room should have a large board which can be written on with non-permanent markers, a flip chart, as well as a screen on which images, data, or other information from a computer can be presented. Preferably, the venue should not be at the office of the decision-maker so as to avoid distractions due to telephone calls that need to be taken etc. This will ensure a smooth and continuous conversation without any interruptions. Because of this, it is important to keep the sessions to only one day at a time, as most people in both the public or private sector can't be out of office for more than one day at a time.

Lastly, in the case of the facilitator, it is important for the person to be well prepared when walking into the session. The facilitator needs to know what the decisions are that need to be made based on the results and insights gained from applying the framework, who the people are that will be involved in the session, what their backgrounds are, skills and knowledge, and lastly, what their intentions are in terms of being involved in the session. People with hidden agendas who are not managed correctly could potentially and easily derail the whole process. Hence, it is important for the facilitator to manage such persons in such a way that they contribute positively without creating too much frustration for the other participants. Frustration is a normal emotion during the process of applying the framework, especially on the side of the decision-maker, due to "not having answers" to the questions or "not seeing eye-to-eye" on certain issues. It is important for the facilitator to manage these periods of frustration very carefully, since these periods often serve the purpose of providing an "incubator" for brilliant insights. However, it can also be the incubator for dissent and deep frustration, leading to a derailment of the process. The facilitator therefore need to realise that a fine balance exists during these periods, in terms of either getting brilliant insights from the participants or merely creating frustration amongst the participants. The only way to manage this successfully, is to understand in which direction the conversation needs to be guided (as indicated by the ultimate goals of the session in terms of the decisions that need to be made), and also by understanding each participants' intentions regarding their involvement in the process.

7.5 Additional research and concluding comments

The proposed framework of this thesis does provide an improved platform for the analysis and communication of risk and uncertainty in agriculture, and should the framework be applied correctly, it should facilitate more robust decisions in terms of business strategy and policy. The proposed framework, however, is not the "be all, end all" of risk and uncertainty analysis in agriculture, and it is certain that new techniques will be developed in future that will create a better understanding of the future, and hence a better understanding of truth in terms of the future. One area where additional research is needed in terms of risk, uncertainty and this framework, is the learning process that takes place when applying this framework. Some light has been shed on this aspect through this thesis, but much more needs to be explored about the learning that takes place, since learning is the key to understanding how to adopt to change, expected or unexpected. Another area of research based on this proposed framework that is worth developing, is how to incorporate game theory and new institutional economics into this framework, along with scenario thinking and stochastic modelling. It is believed that strong links exist between the steps of scenario thinking set out in this thesis and game theory and new institutional economics, specifically pertaining to the steps of "rule of the game" and "players of the game." Hence, by linking game theory and institutional economics to scenario thinking, a link can be created between stochastic modelling, game theory, and institutional economics.

However, given all that is written in this thesis and given future research that will take place, it is certain that there is only one Truth, and until He doesn't come, the search for understanding the truth from a human perspective will be never ending. Until then, enjoy and make the most of the adventure of searching for the truth!