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BUSINESS GROWTH IN AGRICULTURE IV : ELEMENTS OF THE STOCHASTIC MODEL

by

A. LOUW

University of South Africa

1. INTRODUCTION

In this and the following article the effects of growth strategies on business growth under conditions of risk and uncertainty are, amongst other things, determined. A more realistic picture of the factors influencing growth is obtained by taking into account the variability of factors such as price and yield. In this way the model becomes stochastic and probability distributions are generated for certain variables.

The importance of land acquisition strategies, loan restrictions, beginning situations and inflation will subsequently be analysed within a stochastic framework. Prices and yields of individual products will vary randomly around their expected values. A distribution of results is obtained by repeating each case 20 times.

The average manager (management 2) is ignored and attention is given only to the above-average entrepreneur. Results are based on a 15 year period and a variance analysis was done on the results of the 15th year in order to facilitate the interpretation of the results.

2. VARIANCE ANALYSIS

"The analysis of variance is a statistical technique of analysing measurements depending on several kinds of effects operating simultaneously, to decide which kinds of effects are important and to estimate the effects".¹

The results of the variance analysis in respect of end net values in the 15th year are shown in Table 1. From this Table it is clear that highly significant differences were obtained throughout (except in the I x L interaction) owing to the variables and their interactions. This facilitates the interpretation of the variances since there is greater certainty in respect of the differences between variables from the highest-order interaction to the main effects. The significant highest-order interaction can therefore be explained by lower-order interactions.

In the interpretation of a variance analysis, however, the stress must fall on the most significant set of highest-order interactions.² A significant interaction indicates that the factors and their effects are interdependent and that the effects of one factor differ at various levels of the other factors. In general, more emphasis should be placed on the highest-order interaction, whether it is

significant or not. It is, however, possible to refer back to lower-order interactions which may serve as guidelines for possible explanations. Interpretation of the results therefore occurs by first looking at the highest-order interaction and then, if certain aspects (such as the effect of inflation) require closer attention, at lower order interactions.

2.1 Four-factor interaction (S x I x L x B)

Tables 2 and 3 show the average (X), standard deviation (SD) and coefficient of variation (CV) of the four-factor interaction S x I x L x B for every situation simulated in the stochastic model. In these cases there is no combination of any effects as in the lower-order interactions and only the calculations (in respect of) the 20 repetitions simulated for each case appear in the tables. For purposes of comparison the results of the deterministic model are also given in each case.

It appears that better as well as more stable results are consistently obtained in the moderate inflation condition. The high inflation condition consistently produces the poorest and most unstable results. This is a logical result since the relative price movements benefit moderate inflation more than they do high inflation. High inflation therefore accentuates the effects of the other factors (management and beginning situation) and consequently a higher variability is obtained.

So far as beginning situations are concerned, it appears to be impossible to arrive at conclusions on the basis of average results. In both the no and the moderate inflation conditions the established undertaking obtains better and more stable results. The opposite appears to be the case in the high inflation condition.

Under all inflation conditions the established entrepreneur (Table 2) obtains the best results with strategy 2 and loan restriction 1 (approximately R1 209 800). In the case of the beginner farmer the same strategy produces the best results under the no and moderate inflation conditions (about R1 051 800) while strategy 4 and loan restriction 1 produce the best results under high inflation. Strategies 3 and 5 with loan restriction 1 fared somewhat poorer than the best combination. In all cases strategy 2 with loan restriction restriction 1 was associated with the lowest coefficient of variation. The higher value is therefore also more

TABLE 1: Variance analysis of factors that influence business growth in the stochastic model

Source of variance		Degrees of freedom	F-value
Main effects		8	526,024
Beginning situation	(B)	1	45,546
Inflation rates	(I)	2	1 807,154
Loan restriction	(L)	1	3,786
Strategy*	(S)	4	136,139
Two-factor interactions		21	21,724
B x I		2	89,802
B x L		1	24,797
B x S		4	18,013
I x L		2	0,124**
I x S		8	18,398
L x S		4	8,082
Three-factor interactions		22	9,936
B x I x L		2	17,570
B x I x S		8	11,623
B x L x S		4	6,457
I x L x S		8	8,679
Four-factor interaction		8	5,064
B x I x L x S		8	5,064
Error		59	83,449
Residue		1 140	
Total		1 199	

* The five different land acquisition strategies can be summarised as follows:

1. Only leases land beyond fixed beginning amount.
2. Only purchases of land for each. May, however, lease additional land.
3. Purchases and leases land at every opportunity.
4. Purchases land only every 5th year. May, however, lease additional land.
5. Purchases land only when liabilities: assets ratio is smaller than 0,5. Otherwise may lease additional land.

** This was the only interaction that was not significant. All other interactions were significant at a minimum of $P < 0,001$. Except for loan restrictions, the main effects were all significant at a level of $P < 0,001$. Loan restrictions were significant at $P < 0,052$.

predictable and more certain than is the case with other combinations. In the case of the beginner farmer and with high inflation, there was virtually no difference in the coefficients of variation of the three situations with the highest averages.

The coefficients of variation of the cases with smaller averages were considerably higher.

In the deterministic model strategy 2 also produced the best results. Under this strategy all land purchases were on a cash basis. External financing was used only for the purchase of machinery, equipment and buildings. It appears, in addition, that the more conservative loan restriction 1 produced more favourable results here. The controlled variables in the stochastic model are discussed next.

2.2 Beginning situation

According to Table 4 the established entrepreneur (beginning situation 1), irrespective of the strategy followed under the no and moderate inflation conditions showed better business growth over a period of 15 years than the beginner. However, the relative variability in net value (as expressed by the coefficient of variation) is less in the case of the beginner farmer (130,3 % as against 72,4 %). On the other hand, under high inflation conditions the beginner farmer fares considerably better than the established entrepreneur.* The negative average net values under high inflation conditions exceed the positive net values of the other inflation conditions. At the same time the sum of the negative net values results in greater

instability for the established farmer *vis-a-vis* the beginner farmer.

In the high inflation condition where the beginner farmer achieves more success, the average farm sizes of the established entrepreneurs were bigger. Farms were purchased at an early stage by established entrepreneurs (in contrast with the beginner who could not afford it) with a reasonable debt burden. The broader base resulting from this and the continuous high inflation began is harmed the established farmer, who bought early, seriously after the 10th year.

2.3 Land acquisition strategies

The four-factor interactions, as set out earlier, give the most complete and most useful evaluation of how various factors influence business growth. Owing to the significant differences between strategies in lower order interactions, a study of these can also provide an important explanatory contribution.

In Table 5 the effect of loan restrictions is ignored and the various strategies are evaluated with respect to their performance under various inflation conditions and with different beginning situations.

It appears that a clear pattern in respect of the end net value emerges for each of the beginning situations. The different inflation rates again have extensive and important effects. On the whole the moderate inflation condition produces higher average net values which are also considerably more stable than under other inflation conditions.

TABLE 2: Average net values with variations in four-factor interaction SxIxLxB in the case of the established entrepreneur (beginning situation 1), as well as results of the deterministic model

Strategy	L	X* SD CV Det.	Inflation condition			Average
			No	Moderate	High	
1	1	X	552,0	899,7	-507,4	314,8
		SD	242,2	229,0	648,0	731,6
		CV	43,9	25,5	127,7	232,4
	2	Det.	683,9	2 171,2	788,0	1 214,4
		X	567,0	880,4	-836,2	203,7
		SD	234,0	180,4	655,3	856,1
	3	CV	41,3	20,5	78,4	420,3
		Det.	569,3	2 064,2	696,8	1 110,1
		X	1 036,1	2 003,2	590,1	1 209,8
	4	SD	141,2	202,8	128,7	615,5
2	1	CV	13,6	10,1	21,8	50,9
		Det.	1 147,0	3 094,8	3 262,5	2 501,5
		X	1 015,3	1 949,3	463,8	1 142,8
	2	SD	154,2	237,8	213,5	650,3
		CV	15,2	12,2	46,0	56,9
		Det.	1 123,8	3 098,0	2 605,0	2 275,6
	3	X	865,3	1 653,0	-741,5	592,6
		SD	192,5	369,6	936,5	1 161,4
		CV	22,2	22,4	126,3	196,0
	4	Det.	985,6	3 486,2	2 458,3	2 310,0
3	1	X	832,9	1 655,6	347,8	945,5
		SD	200,5	246,7	412,1	619,3
		CV	24,1	14,9	118,5	65,5
	2	Det.	1 028,1	3 330,0	2 924,0	2 427,4
		X	719,2	1 245,0	-525,5	479,5
		SD	168,6	218,6	629,0	844,1
	3	CV	23,4	17,6	119,7	176,0
		Det.	682,7	2 466,1	1 930,4	1 693,1
		X	753,0	1 249,1	244,5	748,9
	4	SD	181,5	270,6	442,7	518,0
4	1	CV	24,1	21,7	181,1	69,2
		Det.	796,8	2 553,7	1 064,0	1 471,5
		X	865,3	1 675,7	-508,9	677,4
	2	SD	192,6	327,0	630,0	1 000,5
		CV	22,3	19,5	123,8	147,7
		Det.	985,6	3 486,2	2 458,3	2 310,0
	3	X	818,9	1 634,3	-864,6	965,2
		SD	202,7	264,1	659,3	632,9
		CV	24,8	16,2	76,3	55,2
	4	Det.	967,5	3 206,7	1 871,6	2 015,3

* X = Average net value in R1 000
SD = Standard deviation in R1 000
CV = Coefficient of variation in %
Det. = Deterministic models result in R1 000
L = Borrowing restriction

It also appears that under conditions of no and moderate inflation (that is to say, no relative price changes or price changes favouring the producer), strategy 2 again yields the highest and most stable average net values for both beginning situations. The moderate inflation condition is characterised by price movements that favour the producer; broadly speaking, it can be expected that the more adventurous strategy 3 (leasing and purchasing at every opportunity) would result in the most rapid business growth in such a situation. These results prove the opposite - the more moderate strategy 2 still produces better results; furthermore, there is little difference between the end results of strategy 3 and strategy 5, which must also be regarded as relatively consistent.

The established entrepreneur also achieves the best results with strategy 2 in the case of high

TABLE 3: Average net values with variations in four-factor interaction SxIxLxB in the case of the beginner entrepreneur (beginning situation 2), as well as results of deterministic model

Strategy	L	X* SD CV Det.	Inflation condition			Average
			No	Moderate	High	
1	1	X	554,3	868,6	376,6**	596,8
		SD	233,2	190,3	220,4	297,1
		CV	42,1	21,9	60,0	49,8
	2	Det.	594,2	1 865,2	1 503,2	1 321,5
		X	512,5	864,4	- 104,7	424,0
		SD	187,7	190,2	633,7	651,7
	3	CV	36,6	22,0	605,3	132,5
		Det.	530,3	2 004,2	371,2	968,6
		X	949,7	1 804,0	401,7**	1 051,8
	4	SD	167,3	174,4	187,1	607,2
2	1	CV	17,6	9,6	46,6	57,7
		Det.	924,4	2 736,0	2 823,9	2 161,4
		X	918,8	1 777,9	123,8	904,2
	2	SD	180,5	191,2	233,6	709,8
		CV	19,6	10,8	188,7	75,5
		Det.	870,3	2 981,9	2 535,7	2 129,3
	3	X	860,4	1 624,8	446,6**	977,3
		SD	205,0	266,1	239,7	545,0
		CV	23,8	16,4	53,7	55,8
	4	Det.	780,4	2 782,6	1 498,8	1 687,3
3	1	X	803,2	1 530,8	233,5	855,8
		SD	195,3	192,8	552,6	639,7
		CV	24,3	12,6	236,7	74,7
	2	Det.	833,3	3 033,4	1 676,5	1 847,7
		X	727,3	1 303,7	448,3**	826,4
		SD	180,0	194,2	240,3	412,6
	3	CV	24,7	14,9	53,6	49,9
		Det.	691,3	2 187,9	1 498,8	1 459,3
		X	694,0	1 253,2	163,4	703,5
	4	SD	123,9	187,8	467,8	536,7
4	1	CV	17,9	15,0	286,3	76,3
		Det.	653,6	2 379,1	1 676,5	1 569,7
		X	847,5	1 601,5	446,6**	965,2
	2	SD	207,5	239,9	239,7	532,9
		CV	24,5	15,0	53,7	55,2
		Det.	780,4	2 782,6	1 498,8	1 687,3
	3	X	791,3	1 526,9	139,1	819,1
		SD	200,0	195,6	626,5	691,7
		CV	25,3	12,8	450,4	84,4
	4	Det.	761,7	3 182,3	1 697,1	1 880,4

* X = Average net value in R1 000
SD = Standard deviation in R1 000
CV = Coefficient of variation in %
Det. = Deterministic model's results in R1 000
L = Loan restriction

** Extrapolated averages and should be interpreted with care.

inflation. The beginner entrepreneur, on the other hand, achieves better results (according to the averages) with strategies 3, 4 and 5 (in this order) under the high inflation rate conditions. The predictability of these averages is lower than that of strategy 2, judged by standard deviations and coefficients of variation.

The above shows once again that where inflation has a cost push effect, the results are poorer and unstable. This makes advance planning difficult and with a cost squeeze of the order dealt with here, a growth target changes into one of to survival.

2.4 Loan restrictions

The variance analysis in Table 1 shows, amongst others, a significant S x I x L interaction.

Table 6 further analyses the results of this interaction.

With the no as well as the moderate inflation condition loan restriction 1 consistently produces better results than loan restriction 2 (although the differences were relatively small). However, the results were not consistently stabler. In the moderate inflation condition loan restriction 2 showed greater stability in strategies 1, 3 and 5 (CV of 21,0; 14,3 and 14,9 % respectively). In the no inflation condition only loan restriction 2 of strategy 1 showed a slightly greater stability.

In all cases instability under high inflation conditions is considerably greater than under the other inflation conditions. Nevertheless, it appears that under both loan restrictions strategy 2 produced, on the one hand, the highest net value ($X_1 = R495\ 900$ and $X_2 = R293\ 800$) and, on the other, the most stable net value ($CV_1 = 37,3\%$; $SD = R185\ 000$ and $CV_2 = 95,3\%$; $SD = R280\ 000$).

When all the inflation conditions are considered, strategy 2 with loan restriction 1 produces the best results ($X = R1\ 130\ 800$ with $CV = 54,3\%$). It appears, however, that loan restriction 2 produced better results in the case of strategies 3 and 4 than the more conservative borrowing restrictions ($X = R900\ 600$ with $CV = 69,8\%$ and $X = R726\ 200$ with $CV = 72,4\%$ for strategies 3 and 4 respectively, as against $X = R784\ 900$ with $CV = 117,7\%$ and $X = R653\ 000$ with $104,8\%$). This can perhaps be ascribed to the particularly poor and dominant showing of loan restriction 1 during high inflation. On the whole it would appear that, when a specific loan restriction produces better results than another, the results are also more stable. This is associated with the fact that a high net value goes hand in hand with higher stability.

* An important limitation of the results of the stochastic model should, however, be kept in mind here. In 8 out of the 30 cases the beginner entrepreneur sold his land. In order to make the results more complete, extrapolation was used: if the farm was sold in the 12th year of the difference of the previous 2 years was extended to the 15th year. The result was that, where farms were sold, the extrapolation probably underestimated the deterioration in the actual situation and therefore benefited that particular case and the variable that was tested. Judging by the results obtained by the established entrepreneur, it would appear that the extrapolated results of the firm that was sold over-estimated the results in the case of the beginner farmer.

It is, therefore, essential that, especially in those cases where farms were sold, the results should be carefully interpreted. For example, the fact that borrowing restriction 2 fared better or worse than loan restriction 1 under high inflation conditions should be approached with care.

TABLE 4: Effect of inflation conditions on beginning situations, as measured in terms of net value ($B \times I$)

Beginning situation	X* SD CV	Inflation condition			Average
		No	Moderate	High	
1	X	802,5	1 484,6	- 233,8	684,4
	SD	243,9	455,6	789,3	892,0
	CV	30,4	30,7	337,6	130,3
2	X	765,9	1 415,6	266,6	816,0
	SD	231,6	378,2	432,4	590,8
	CV	30,2	26,7	162,2	72,4
Average	X	784,2	1 450,1	16,4	
	SD	238,2	419,6	683,2	
	CV	30,4	28,9	4 165,8	

* X = Average net value in R1 000
SD = Standard deviation in R1 000
CV = Coefficient of variation in %

TABLE 5: Effect of inflation, strategies and beginning situations on net values under stochastic conditions ($B \times S \times I$)

Strategy	X B*SD CV	Inflation condition			Average
		No	Moderate	High	
1	X	559,5	890,1	-671,8	259,3
	SD	235,2	203,7	664,4	794,9
	CV	42,0	22,9	98,9	306,6
	X	533,4	866,5	131,5	510,4
	SD	210,1	187,8	525,9	455,8
	CV	39,4	21,7	399,9	89,3
2	X	1 025,7	1 976,3	526,9	1 176,3
	SD	146,3	219,8	185,4	631,3
	CV	14,3	11,1	35,2	53,7
	X	934,2	1 790,9	262,8	996,0
	SD	172,5	181,1	251,9	660,1
	CV	18,5	10,1	95,9	66,3
3	X	849,1	1 654,8	-196,9	769,0
	SD	194,7	310,2	902,3	943,5
	CV	22,9	18,7	458,3	122,7
	X	831,8	1 577,8	340,0	916,5
	SD	199,7	234,2	434,0	594,9
	CV	24,0	14,8	127,6	64,9
4	X	736,1	1 247,0	-140,5	614,2
	SD	173,7	242,8	663,5	710,3
	CV	23,6	19,5	472,2	115,6
	X	710,6	1 278,5	305,9	765,0
	SD	153,4	190,3	394,4	480,7
	CV	21,6	14,9	128,9	62,8
5	X	842,1	1 655,0	-686,7	603,4
	SD	196,5	294,1	661,5	1 065,3
	CV	23,3	17,8	96,3	176,5
	X	819,4	1 564,2	292,9	892,1
	SD	203,1	219,3	493,4	619,2
	CV	24,8	14,0	168,5	69,4

*B = Beginning situation
X = Average net values in R1 000
SD = Standard deviation in R1 000
CV = Coefficient of variation in %

3. COMPARISON OF RESULTS OF STOCHASTIC AND DETERMINISTIC MODELS

The results of the deterministic model are shown in Tables 2 and 3 and are used as a control factor in the stochastic analyses. By comparing the final net values of the deterministic model with the net values of the stochastic model, the effect of varying prices and yields on business growth can be determined. Should two strategies in the stochastic model have similar averages but differing standard deviations, it may be desirable for the

TABLE 6: Effect of inflation, loan restrictions and strategies on net values in the stochastic model (S x L x I)

Strategy	L	X* SD CV	Inflation condition			Average
			No	Moderate	High	
1	1	X	553,2	884,2	-69,9	455,8
		SD	234,7	208,4	651,6	573,8
		CV	42,4	23,6	932,2	125,9
	2	X	539,7	872,4	-470,5	313,9
		SD	211,2	183,1	736,2	729,4
		CV	39,1	21,0	156,5	232,4
2	1	X	992,9	1 903,6	495,9	1 130,8
		SD	158,9	212,2	185,0	613,9
		CV	16,0	11,1	37,3	54,3
	2	X	967,0	1 863,6	293,8	1 041,5
		SD	172,8	230,0	280,0	685,4
		CV	17,9	12,3	95,3	65,8
3	1	X	862,9	1 639,4	-147,5	784,9
		SD	196,3	318,2	904,0	923,7
		CV	22,7	19,4	612,9	117,7
	2	X	818,0	1 593,2	290,6	900,6
		SD	196,0	227,5	484,6	628,6
		CV	24,0	14,3	166,8	69,8
4	1	X	723,2	1 274,4	-38,6	653,0
		SD	172,2	206,3	681,2	684,1
		CV	23,8	16,2	1 764,8	104,8
	2	X	723,5	1 251,2	204,0	726,2
		SD	156,2	229,9	451,4	525,7
		CV	21,6	18,4	221,3	72,4
5	1	X	856,4	1 638,6	-31,1	821,3
		SD	197,8	285,6	674,8	811,2
		CV	23,1	17,4	2 170,0	98,8
	2	X	805,1	1 580,6	-362,8	674,3
		SD	199,2	235,8	813,2	944,1
		CV	24,7	14,9	224,1	140,0

*X = Average net values in R1 000

SD = Standard deviation in R1 000

CV = Coefficient of variation in %

L = Loan restriction

decision-maker to follow a direction completely different from that suggested by the deterministic model. The coefficient of obvariation was calculated in order to pinpoint the relative variability between the different distributions.

In the no inflation condition (Tables 2 and 3) average net values for different strategies and loan restrictions in the stochastic and deterministic models produce virtually identical rankings. On the whole, however, net values in the stochastic model are generally lower than in the deterministic model.

In the moderate inflation cases in Table 2 the above-average established entrepreneur obtained the best results by means of strategy 2 in the stochastic model as against strategies 3 and 5 in the deterministic model. In Table 3 (above-average beginner farmer) strategy 5 (R3 182 000) produced the best results in the deterministic model as against strategy 2 (R1 804 000) in the stochastic model. It appears, however, that the average deterministic results completely overestimated the stochastic results (by about 100 %).

In the high inflation condition (Tables 2 and 3) the results are considerably less consistent with respect to rankings of net values, and the average level of the stochastic results are considerably lower than those of the deterministic cases.

On the whole, deterministic models, compared with stochastic models, over-estimate business

growth, since unpredictable price and yield variations do not play any role in the deterministic models. According to Harshbarger³ restrictions on land purchases, the availability of capital and the borrower's attitude to loans and the avoidance of risk received relatively little attention in previous studies. From this and other studies^{4,5,6} it appears that growth rates decline in proportion to the incorporation of socio-economic factors into the growth model.

The deterministic model would therefore represent the 'ideal' condition while the stochastic model is more 'realistic' and incorporates shortcomings that occurs in practice.

When a comparison is made between the deterministic and stochastic results in Table 2 in the case of the high inflation rate for the established entrepreneur, loan restriction 2 in the deterministic model produces poorer results in four out of the five strategies than loan restriction 1. In the stochastic results the second loan restriction led to survival as against considerable land sales in the case of the first loan restriction. It appears, however, that there is nevertheless a clear measure of superiority in the case of strategy 2 with loan restriction 1 in both the deterministic and stochastic models.

In die deterministic model, strategy 3 (moderate inflation, Table 2) produced the most favourable results for the established entrepreneur (beginning situation 1) under both loan restrictions (R3,49 and R3,33 million). It appears that in the stochastic model strategy 2 produced the best results (R2,0 and R1,95 million) for the same entrepreneur under both loan restrictions. To a certain extent this type of contradiction can be ascribed to price and yield variability and the risk attached to it. Since land purchase and land lease can take place at every opportunity in strategy 3 at a fixed predetermined series of yields and prices, it is to be expected that these results will be more favourable in the deterministic model. As soon as variability is introduced, this action becomes more risky and more judicious borrowing purchasing and leasing practices becomes necessary, even under favourable inflation conditions.

In both models the lease strategy, strategy 1, is identified as the poorest strategy. This illustrates the important role in net value accumulation of land-ownership. In times of inflation a measure of net value increase is obtained by means of capital appreciation of land. As long as land is leased, this appreciation is not part of the entrepreneur's unrealised compensation for the capital invested in the land. Increased lease rates may, in fact, have the opposite effect.

* Farm income is defined as the amount left over after provision has been made for all operating expenses, capital and interest redemption, taxation and personal expenses.

4. CHANGES IN VALUES OVER A PERIOD OF TIME

In a stochastic model the pattern of a specific variable over a period of time will contain a distribution of results for every period of planning. In this section the characteristics of two variables, namely farm income* and net value, are investigated. Only two cases in each of the beginning situations were investigated. The choice fell on strategy 2 with loan restriction 2 owing to the fact that few or no farms were sold. In Tables 7 and 8 the results for every inflation condition and beginning situation at four moments in time are given.

TABLE 7: Net value and farm income over a period of time for the stochastic model in the case of strategy 2, loan restriction 2, beginning situation 1

Net value Inflation condition	X* SD CV	Year			
		1	5	10	15
No	X	199,2	279,9	554,8	1 015,3
	SD	11,5	32,0	73,2	150,3
	CV	5,8	11,4	13,2	14,8
Moderate	X	212,2	391,4	901,0	1 949,3
	SD	11,2	44,9	132,0	237,8
	CV	5,3	11,5	14,7	12,2
High	X	209,6	489,7	801,0	463,8
	SD	11,2	54,5	106,6	213,5
	CV	5,3	11,1	13,3	46,0
Farm income					
No	X	-17,2	13,5	72,0	135,7
	SD	12,9	20,6	24,4	36,9
	CV	75,0	152,6	33,9	27,2
Moderate	X	-39,8	34,2	112,0	291,7
	SD	11,0	18,4	39,5	66,6
	CV	27,6	53,8	35,3	22,8
High	X	-42,4	12,9	-126,7	-1 507,9
	SD	11,0	27,8	76,2	272,0
	CV	25,9	215,5	60,1	18,0

*X = Average net value in R1 000
SD = Standard deviation in R1 000
CV = Coefficient of variation in %

Over a period of time the net values were generally more stable than farm incomes. In the no inflation condition variability consistently increased in all the cases over a period of time. Apparently this variability was related to the time at which land was purchased, as well as with the amount that was purchased.

Generally, lower variability (as measured by the coefficient of variation) was found for each of the given years in the moderate inflation condition than under the no inflation conditions. There are no consistent differences in the standard deviations. This has already been observed previously. The exception is, however, the case of the established entrepreneur (Table 8), who had a slightly higher variability in net value (according to coefficient of variation) in the 5th and 10th years with moderate inflation than with no inflation. It is probable that land purchases after the relatively inactive first five years were responsible for the relatively greater instability.

TABLE 8: Net value and farm income over a period of time for the stochastic model in the case of strategy 2, loan restriction 2, beginning situation 2

Net value Inflation condition	X* SD CV	Year			
		1	5	10	15
No	X	147,6	223,0	479,8	918,8
	SD	11,2	38,0	90,4	180,5
	CV	7,6	17,0	18,8	19,6
Moderate	X	147,6	316,3	781,7	1 777,9
	SD	11,2	27,6	88,6	191,2
	CV	7,6	8,7	11,3	10,8
High	X	140,4	377,8	617,5	123,8
	SD	11,0	51,1	113,1	233,6
	CV	7,8	13,5	18,3	188,7
Farm income					
No	X	-16,0	10,0	65,3	134,8
	SD	11,0	20,2	20,2	48,1
	CV	68,8	202,0	30,9	35,7
Moderate	X	-16,4	26,4	100,3	262,4
	SD	11,0	11,1	31,9	64,8
	CV	67,1	42,0	31,8	24,7
High	X	-18,9	-4,3	-201,7	-1 766,1
	SD	11,0	41,7	93,1	244,8
	CV	58,2	969,8	46,2	13,9

*X = Average net value in R1 000
SD = Standard deviation in R1 000
CV = Coefficient of variation in %

Under high inflation conditions instability and unpredictability of net values continuously increase. This may be observed in all the cases and can perhaps be ascribed to a fluctuating debt burden and to cash flow problems as the effect of negative inflation becomes greater. This effect is not necessarily the same in all the cases owing to the random figures that are used.

In all the cases the distribution patterns of farm incomes pointed to relative instability. In both the beginning situations for the no as well as the moderate inflation conditions farm incomes increased. It also appears that after an initial increase in variability in farm income up to the 5th year farm income after that increased while variability (measured according to coefficient of variation) decreased. This may possibly be ascribed to the more difficult financial position during the first years resulting from the relatively small volume of business and the critical ratio between debt burden and gross income. It is difficult to make new investments together with consumption withdrawals and the firm is more vulnerable to unfavourable events. On the whole, land purchases took place from about the 6th and 7th years which greater stability was experienced.

It was found that under high inflation conditions farm income was initially negative; it then reached its peak (although still negative in strategy 2, beginning situation 1) in the 5th year (R12 900), after which it consistently became negative and declined uninterruptedly. At the same time the variability in farm income (measured by coefficient of variation) increased considerably up to the 5th year (CV = 215,5 %) after which, with a negative farm income in the 10th year (CV = 60,1 %), it began to decrease. However, the

standard deviation increased throughout. In the case of strategy 2, land was seldom purchased and the maximum size was 600 ha. The rate at which the farm income becomes more negative is considerable and this can largely be ascribed to the fact that the break-even point is already reached with the negative inflation rate. After this break-even point an operating loss is experienced which has to be financed from some other source. In the third article of this series⁷ the effect of cost push inflation, which, in agriculture, goes hand in hand with unfavourable price movements, was stressed. It was found that if inputs show average price increases of 16,9 % over a certain period while the prices of products increase at 9,4 %, an entrepreneur who originally operates on a 40 % gross margin will break even after 8 years. This means that up to the 8th year he will show a positive gross margin, after which he will suffer an annual loss at the gross margin level.

5. CONCLUSION

More realistic and useful results are obtained with the stochastic model. In the following and last article further attention will be given to the riskiness of alternative land acquisition strategies as well as to the validation of the model.

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