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A comparison of whole farm budgets versus farm accounts and suggestions for future planning of farm expansion and economic management

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ABSTRACT

For the farming family, planners, banks and other lending institutions it is crucial to know how reliable whole- farm budgets are, and what the pitfalls are. We explore how well whole- farm budgets match with the accounts in the first years after investment in a new cowshed. We explain what causes the discrepancies and suggest how budgeting can be improved. We follow a panel of 36 dairy farms in Norway over a period of three to five years. All farms have undertaken large investments in cowsheds. We merge the interview data with a database on herd data, whole- farm budgets and accounts data. There are significant discrepancies between whole- farm budgets and accounts, particularly when it comes to fixed costs, investments and debt. Milk production well beyond budgets, deviation from estimated building cost, unplanned investments and poor budgeting practices are some of the reasons for the discrepancies. Farmers struggle with transition problems when the new cowshed is put into use. Recommendations to improve the process of farm expansion and managing the economy after the expansion are provided.

KEYWORDS: farm expansion; dairy farming; transition problems; beyond budgeting; fixed costs

1. Introduction

To get funding for new cowsheds farmers usually need to submit a whole- farm budget. Such an investment has important financial impacts, and farmers use whole farm budgets to become confident that the investment is prudent. Also for planners and lending institutions it is crucial to know how reliable the budgets are, what the pitfalls are, and how they function as a management tool. Few studies have explored the reliability of whole-farm budgets in retrospect. This study addresses how well whole- farm budgets match with farm accounts, proposes suggestions to improve the whole budgeting and planning process, and discusses new tools to manage farm economics after investment in a new cowshed. The remainder of the paper is organized as follows. After reviewing theory and literature we present the material and methods used. Then follow results, discussion and conclusion.

Literature review and theory

Budgeting is the process by which companies project revenues, expenses, profits, and cash flows for the upcoming accounting periods. Thus, the budget shows the financial impacts of the plans for the period and aims to help the company to manage and dispose of financial resources in the best possible way (Anthony and Govindarajan, 2007). The budget traditionally has been, and still is, the dominant tool for management accounting and control. Budgeting is used as a *planning tool*, a plan for the total activities of the company, to give the manager a complete overview and make sure that the company is moving in the right direction (Bergstrand, 2009). Budgets also function as a basis for *performance evaluation.* By investigating the reasons why the variations occur during the budget period, actions can be taken (Anthony and Govindarajan, 2007). Finally, budgets can create motivation among managers and employees by setting clear and defined targets (Bergstrand, 2009).

Despite the advantages offered by budgets as a tool of management, both practitioners and scholars have expressed their concern about the possible disadvantages of traditional budgeting. First, budgets are criticized for being time consuming and costly to make, with a high level of details representing uncertain expectations in an increasingly dynamic environment (Otley, 2003; Bogsnes, 2009). Second, the budgeting process takes too long compared to the movements in the environment, and budgets become

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rapidly out- dated during the course of a budget year (Otley, 2003; Bergstrand, 2009). Third, the fixed budget does not allow for the identification of new risks and opportunities due to its fixed and unchanging representation of the business plan at the time the budget is set (DeLeon, Rafferty and Herschel, 2012). Thus budgets prevent managers from responding quickly to changes and are often a barrier to change (Bergstrand, 2009). Fourth, budgets are decoupled from strategy and focus on cost reduction, rather than value creation and strategically important issues (Hope and Fraser, 2003; Bogsnes, 2009). Thus, inspired by Wallander (1999), Hope and Fraser (2003) introduced a new approach to management control; Beyond Budgeting (BB). In short, BB is about replacing command-and-control with a management model that is more empowered and adaptive (Hope and Fraser, 2003; Bogsnes, 2009). Within the BB concept The Balanced Scorecard (Kaplan and Norton, 1992) (BSC) and rolling forecasts (Hope and Fraser, 2003) (RF) are two of the most known.

In a review of the performance effects of BSC use, Madsen and Stenheim (2015) did not find any effect of BSC use on financial performance. A similar result was found by Bjørnenak (2013). Therefore, we do not focus on BSC in this paper, but rather on RF. Bergstrand (2009) defines RF as projections of a small number of key variables that are updated on a rolling basis. As opposed to budgets, RF aims to represent an unbiased, expected outcome; they typically have less line items, shorter time horizon, and more frequent updates (Goyagina and Valuckas, 2012). The RF approach differs from the traditional fixed budget in that it eliminates the constraints of a set forecast period with a defined and unchanging end point (De Leon *et al*., 2012). The forecasts are frequently updated, typically each quarter or month, and the updates consist of re-forecasting for at least the upcoming year (Libby and Lindsay, 2003a). As one month or quarter ends, it is simply dropped from the forecast and a new month or quarter is added (De Leon *et al*., 2012).

In a literature review of RF Golyagina and Valuckas (2012) found few academic articles. However, a few promising results exist. Clarke (2007) claims that companies are willing to adopt RF since they are more accurate than budgets, assist in achieving company objectives, and supply useful information for risk-management. Similarly, Ton- Nu (2014) found that implementation of RF mitigated the dysfunctional and gaming behaviour caused by the budgeting process. Managers also had a positive attitude towards RF. However, to be of use RF must be simple and focus on the critical key performance indicators (Bjørnenak, 2014). Otherwise, the preparation process can become costly, complex and time consuming, and the potential positive effect may vanish (Bjørnenak, 2014; Lorain, 2010). Finally it is noteworthy that Bjørnenak (2013) found a positive effect of benchmarking on profitability.

Previous studies in agriculture

Nergaard (1988) found that farms in need of governmental refinancing did not achive their budgeted results for crops, yield and operating profits. The farms also exceeded their upgrading expenditures more than other farms. In a one- year study of 19 Norwegian dairy farms (Haukås and Solberg, 2010), the milk quota, dairy income, variable and fixed costs were significantly higher than budgeted on farms that had invested. The farm net income was on target. The high fixed costs were due to additional investments after the main investment, and general underestimation. Similar results were found in Haukås (2012). The farm net result exceeded budgets, but varied a lot between farms. Ruud- Wethal *et al*. (2012) studied farm accounts the year before and after investment, and found lower gross margins, lower farm net results, and higher fixed costs than budgeted. Davey and Nettle (1997) suggest farm expansion should be guided by more relevant management accounting and careful budgeting to succeed in terms of profit and personal satisfaction. As pointed out by Davidsson *et al*. (2008), MacPherson (2005) and Alvarez and Arias (2004) growth faces managers with challenges, and not all farmers master these challenges equally well. Thus, Hansen and Jervell (2014) showed that new technologies and farming systems can be introduced on similar farms with very different results, dependent among other factors on the farmer's change capacity. Firms that grow successfully do so by first securing profitability, and then grow (Davidsson *et al*., 2005). In the short run adjustment costs from affecting ongoing production negatively (Nilsen *et al*., 2007) and managerial challenges are likely to reduce the short term gains from augmented volume. The key point is that adaptation to a larger herd, new routines and new cowshed takes some time (Sipiläinen, 2008). Finally, Tanewski *et al*. (2000) claim that the main reason why budgets and accounts differ, is that business planning in agriculture is mainly due to lender requirements.

Few studies have analyzed a panel of dairy farms covering both the years before and after farm expansion, and conducted longitudinal statistical analysis to explore the causes of discrepancies between accounts and budgets. Further, few studies have combined financial data with herd recordings and interviews with farmers to gain a deeper understanding of why these discrepancies occur. To help both planners and farmers counteract the problems facing farmers through farm expansion, such detailed knowledge is crucial.

Three research hypotheses are posed in light of our theory and literature review: (1) discrepancies between whole-farm budgets and accounts occur early in the budget period due to underestimated fixed costs and additional investments; (2) transition problems can partly explain the discrepancies between whole-farm budgets and accounts; (3) whole- farm budgets are to a small extent used as a management tool after investment, and new tools are required.

2. Materials And Methods

Respondents and sampling

This study was conducted in Rogaland, one of the main milk producing counties in Norway. We divided the county in four regions. In each region we selected a number of respondents randomly, according to the regions' share of the total milk production. One requirement was that the farms should have three full years of operation after the farm expansion. After we had collected the herd data from 30 farms we realized that only 24 of the 30 farms had both complete herd recordings and budgets. To get sufficient

data we therefore added six more farms which had both budget and herd data, according to the procedure described above. We analyse two datasets, one with herd data only, and one with accounts and budget data. Both datasets contain 30 farms, and 24 of the 30 farms are included in both datasets. The remaining six are included in one of the sets only. In total, we interviewed 36 farmers. In this study our main interest is the accounts and budget dataset, and approximately 80 percent of our results relates to this dataset. Therefore, we use interview data from the 30 farmers in the accounts and budget set only. The two datasets are unbalanced (Table 1) because not all farms had more than three fiscal years. Only one farmer refused to participate in the study, and no farmers withdrew from the study. Nothing suggests that the probability of missing a farm or a single variable on a farm depends on the potentially observed values. Thus it is fair to claim that both farms and variables are missing at random.

Women are the main practitioners on three farms, both genders are involved in farming on nine farms, and men are the main practitioners on 24 farms. The mean age of the farmers is 47 years. Two thirds of the farmers are educated agronomists, and two thirds also have high school education. In total 19 farms are joint operations, and typically one active farmer rents milk quota, farmland and cows from the other participants, who are passive. In year one 21 farms had a milking robot.

In year three after investment the mean quota was 388,792 litres of milk, ranging from 169,850 to 795,100 litres. One year before investment the average number of cows was 31.1, and by year three it had increased to 48.9, or approximately twice the average herd size in Norway in 2014 (Tine, 2014). On average the farms increased their milk quotas by 79%. Eighteen of the farmers also have sheep, eight have pigs and four have poultry.

The herd dataset

The recordings are made regularly by farmers and veterinarians every second month, and contain data on feeding, animal health, herd fertility, milk quality etc. They cover the period up to three years ahead of, and five years after investment (Table 1). We number the years relative to year zero, the year when the new cowshed was put into use.

The accounts and budget dataset

The accounts were kept by local accountant offices. Fifty- eight percent of the budgets were made by accountants, and the remaining by different actors. The budgets were prepared using different tools. Many budgets contained very little information about the underlying assumptions, e.g. the number of cows. Thus, comparing accounts and budgets was a daunting task, and some of the reported differences may therefore be due to method ological issues. Joint farming operations were particularly challenging, and we collected account data from both each partner and the joint operation as a whole. While other farm production may have influenced the figures, milk is the main output on most of the farms.

Table 1: Number of farms in the herd dataset and the accounts- and budget dataset in the years before, during and after the investment

	Year relative to investment year zero								
Dataset	**-3**	**-2**	**-1**	**0**	**1**	**2**	**3**	**4**	**5**
Herd dataset	1	29	29	30	30	30	28	20	5
Accounts- and budget dataset					30	30	30	20	4

Dependent variables

Hansen *et al.* (2005) showed that in order to fill the milk quota it is important to be economically efficient. Milk quota filling is the percentage of the quota the farmer manages to deliver to the dairy. Short term debt is the difference between total debt and long term debt. The remaining dependent variables are calculated by dividing the accounts values by the budget values. Summary statistics are given in Table 2.

Other fixed costs is a denominator for different costs including rent of land and milk quota, administration, insurance, accounting, energy, maintenance of fields and soil etc. Machinery costs include maintenance, fuel, leasing, contracting etc. Farm net result includes all farm income minus variable and fixed costs. We use the result before depreciation to make it easier to compare farms. In addition, we use the percentage culled cows of all cows in year zero in Tukey's HSD test. The mean percentage culled cows was 50.7%, with a standard deviation of 15.5%.

Independent variables

The variable named ''Milk beyond average'' means that the farmer delivers more milk than average compared to the budget in the last fiscal year. Thirty-seven percent of the farmers told us that their debt level worried them, or that they think about it; we refer to them as risk adverse. The rest do not bother much about their debt. Further we divide the farmers own effort in the building process as either straightforward or too extensive, based on their own judgements.

Method

We chose a mix of quantitative and qualitative methods. To check the deviations between accounts and budgets we used paired t- tests for variables that are approximately normally distributed. All our dependent variables are continuous. To explore the reasons for the discrepancies we applied one way analysis of variance, Tukey's HSD (honest significance difference) test, linear mixed models (LMM) and generalized linear mixed models (GLMM) (Fitzmaurice *et al.*, 2004). In building the statistical models we first checked the distribution of the dependent variables by plotting empirical quantiles of the variables against theoretical quantiles of a comparison distribution. Density plots and quantile plots revealed that other fixed costs fit well with a gamma distribution, while machinery costs fit better with an inverse Gaussian distribution. All other dependent variables are approximately normally distributed. In this study the number of measurement occasions is relatively small, and all farm results are measured at the same set of occasions. It is then reasonable to allow the covariance matrix to be unconstrained (Fitzmaurice *et al.*, 2004). We started with as many explanatory variables and interaction effects as possible. Then we applied REML (Restricted Maximum Likelihood) to determine an optimum structure of the random effects. Next we determined an optimum

Table 2: Descriptive data for the dependent variables in the regression models, account values divided by budget values

	Mean	Std. dev.	Min	Max
Quota filling	0.957	0.100	0.430	1.170
Other fixed costs	3.072	2.506	0.463	13.017
Machinery costs	2.433	1.669	0.204	8.823
Farm net result before depreciation	0.853	0.435	-0.404	2.103
Share of short term debt of total debt	0.254	1.343	-0.178	14.430
Total farm debt	1.217	0.421	-0.040	2.775

structure for the fixed effects by the use of ML (Maximum Likelihood). Finally, we estimated the chosen model by REML. To determine which variables to include in the final model we used Aikaikes Information Criteria (AIC) and Bayes Information Criteria (BIC) for non- nested models. For nested models we also applied hypothesis testing on parameters using Wald- test, F- test and Likelihood ratio test. To validate the models we plotted the deviance residuals, the Pearson's residuals, and the residuals against the fitted values. A major finding is that inclusion of a random intercept for farmer improves the explanatory power in all our models. For LMM we applied the lme- procedure in R, and for GLMM we applied the glmmPQL (Penalized Quasi Likelihood) procedure. PQL estimates are less precise than maximum likelihood estimates. However, the software for this procedure is perhaps the most robust one. A test of the GLMM- models applying the glmer- procedure in the lme4 package did not yield significantly different results as compared to the glmmPQL- procedure. The glmer- procedure applies the Gauss Hermite approximation to the log likelihood. This approximation is closely linked to the Gaussian distribution and demands that data can be grouped in clusters. As link function for the GLMM-models we used log link, as this is usually the preferred one for Gamma and Inverse Gaussian distributions (de Jong and Heller, 2009).

We visited and interviewed the farmers late autumn 2014, and asked them about their experiences before, during and after the transition period. We used a largely unstructured interview to capture the respondents' thought processes, the frame of reference, and feelings about an incident or set of incidents, which had a meaning to the respondent. The farmers talked about how they run their farm and the challenges they faced in their own words, and appreciated talking about their farming in a natural setting. We promised the farmers not to quote them in such a way that they could be identified. After transcribing the interviews we used HyperResearch to code and analyse them. The coding reflected the variables used in the quantitative analysis. Next, codes were transferred to the two data sheets, the herd data, and the accounts- and budget data.

3. Results

In Table 3 we compare accounts and budgets. We do not show data for year five, as we have data for five farmers only. Further, we do not perform t- tests for variables which are strongly right- skewed, such as investment variables, hired labour costs, other fixed costs and machinery costs.

From Table 3 we can see that from year two onwards there are many significant discrepancies between the accounts and the budgets. The farther away from year zero we move, the larger the differences. On average the farmers exceed their milk production target in year three and four. This contributes to a positive deviation in total gross margin in the same period. However, the gross margin per litre milk does not deviate significantly from the budgets. Estimated yearly building costs also match well with the accounts, while other fixed costs, labour costs and machinery costs are significantly underestimated. In total, the negative deviations in fixed costs more than outweigh the positive deviations in gross margins. The result is a farm net result before depreciation significantly below budget for the whole period.

Farmers have invested more than budgeted, or in other words, the budgets have not taken necessary future investments into account. Negative values for building investments indicate that the planned investment has been postponed from one year to the next, while negative values for machinery means that the farmers have redeemed machines. The distributions, particularly for investments in farmland and milk quotas, are highly right-skewed. Thus a few farmers have invested large amounts. On the other hand, many farmers have invested more than budgeted in farm machinery. With higher fixed costs and larger investments than budgeted, it is no surprise that both long term debt and total debt is significantly higher than budgeted from year two on. Already in year two the difference is more than one million NOK, and increases to two million in year four.

In the following statistical analyses we use the accounts- and budget dataset. Other fixed costs differ significantly from the budgets, and in Table 5 we show which factors can explain the deviations.

The random intercept for farmer is 0.6454, corresponding to an intra-class correlation of 11.2%. From Table 5 we notice that milk delivery beyond budget contributes to higher other fixed costs than budgeted. For example, if the farmer produces 12% more than budgeted, other fixed costs are approximately 1.8 times the budgeted costs. However, if the farmer belongs to the group which produces beyond average, e.g. 25% more, other fixed costs become 3.4 times the budgeted amount. Thus, we see that milk delivery beyond average triggers a strong increase in other fixed costs, because it also entails milk delivery beyond budget.

Now we explain why the machinery costs also differ significantly from the budgets (Table 6).

The random intercept for farmer has a standard deviation of 0.358, corresponding to an intra-class correlation of 3.7%, which is low. The machinery costs in the accounts increase compared to budgets as farmers produce more milk than budgeted, and decrease the more farmers they discuss their farming with. As an example, consider a farmer who has milk delivery on target and four discussion partners. The machinery cost becomes 1.7 times the budgeted amount. If the farmer delivers 1.2 times the planned amount, this ratio increases to 2.1, given the same number of discussion partners. Increasing the number of discussion

Table 3: Mean differences between accounts and budgets in NOK[3] for each year and on average, except from litres of milk delivered*

	Year				
Variable	**1**	**2**	**3**	**4**	**Average**
Litres of milk delivered	-9223	14961	39 802[2]	61606[2]	29 545[2]
Gross margin per litre milk	-0.302	0.218	0.220[1]	0.301	0.119
Overall farm gross margin	-87191	187 495[2]	283342[2]	273671[2]	178 450[2]
Hired labour costs	55 562	50 302	64962	124689	81 520
Other fixed costs	185 005	214 303	248593	333607	239 554
Machinery costs	129270	155192	155482	202849	169 318
Building costs	-31455	-4868	38275	16491	10101
Farm net result before depreciation	-351 653[2]	-135 253[2]	-110393[2]	-189335	-193 214[2]
Long term debt	-24549	681 645[2]	733172[2]	1294254[2]	666 336[2]
Total debt	457456	1 332 222[2]	1306826[2]	2188773[2]	1 315 756[2]
Investments					
Farm land and milk quota	111504	66103	44175	208910	98136
	4824	4908	5527	5528	4908
	-595176	0	0	0	0
	2100000	1321293	361503	3222707	3222707
Farm buildings	389459	186427	119972	444315	297098
	74987	21531	0	36250	38200
	-726955	0	-1495643	0	-1495643
	2580898	1870227	1734262	5552405	5552405
Farm machinery	86784	192902	117869	70797	118696
	34750	117716	59603	11895	47600
	-90492	-217250	-106750	-33900	-217250
	468377	1015492	735300	557000	1015492

*For the investment variables we show the mean, the median, and minimum/ maximum values of the differences. Significant p- values from the t- tests are marked for variables which are approximately normally distributed.
[1] $p < 0.1$
[2] $p < 0.05$
[3] At the time of writing (end-November 2015), NOK1 was approximately equivalent to £0.077, $US0.12, and €0.11.

Table 5: Other fixed costs in the accounts divided by other fixed costs in the budgets, regressed on milk delivered to dairy in accounts versus budgets, and milk delivery beyond average*

Dependent variable: Other fixed costs in the accountancy versus budget				
Explanatory Variables	**Parameter estimates**	**Standard error**	**t-value**	**p-value**
Milk delivery in account vs budget	0.4127	0.1589	2.5981	0.0110
Milk delivery beyond average	0.5902	0.2552	2.3125	0.0283
Intercept	0.1239	0.2220	0.5582	0.5781

*Fixed effects estimates from fitting a generalized linear mixed model with random intercept and gamma response, link =log, n=119.

Table 6: Machinery costs in the accounts divided by budgeted costs, regressed on milk delivery in the accountancy versus budget and number of network members*

Dependent variable: Machinery costs in the accountancy versus budget				
Explanatory Variables	**Parameter estimates**	**Standard error**	**t- value**	**p-value**
Milk delivery in account vs budget	0.9076	0.1815	4.9994	<0.0001
No of discussion partners	-0.0794	0.0262	-3.0330	0.0056
Intercept	-0.0529	0.2237	-0.2363	0.8138

*Fixed effect estimates from fitting a generalized linear mixed model with random intercept and inverse Gaussian response, link=log, n=106.

partners for the last farmer to eight, reduces the ratio to 1.5, given the same milk delivery.

A male farmer in his fifties and a couple in their forties gave us a clue why the fixed costs in the accounts differ so much from the budgets:

> *"The challenge of growth is to provide enough machinery; mowers, tractors, manure wagons, yes it's about transportation, and about workload. We feel that the forage production is far more costly than we had anticipated. Machinery, contractors and so on are more expensive than we had thought of."*

> *"You have to make some compromises here and there. During the building period we were offered many things which are nice to have, and many have built more expensive and finer than us, but we did not want that much debt on this project."*

These statements indicate that the budgets do not take all costs due to increased volume into account, and that

it pays off to be sober and stick to the plan during the building process. A couple in their forties also stressed the importance of sticking to the plan:

> *"I think it was a good thing to avoid changing anything after we decided on the cowshed drawings. I have seen that before during a hectic building period. You suddenly get a 'good' idea, and afterwards you realize it is was not that good after all."*

Strong growth beyond budgets entails high fixed costs which can hamper profitability. In Table 7 we show which factors predict the deviations in farm net result before depreciation.

The random intercept for farmer has a standard deviation of 0.203, corresponding to an intra- class correlation of 1.25, which is remarkably low. However, a likelihood ratio test revealed that the random effect is significant ($p<0.05$) and yields a large decrease in the AIC and BIC values. For example, if the farmer manages to produce a gross margin which is 20% higher than the average as compared to budgets, and the machinery costs are on average, the farm net result ends up 29% beyond average. If the gross margin is on average as compared to budget, and the machinery costs are 20% below average, the farm net result ends up six percent higher than average as compared to budgets. This result shows that to achieve a high farm net result before depreciation it is particularly important to run the farm well, and then comes controlling machinery costs.

Short term debt is an indicator of strained liquidity, and therefore we are interested in which factors can explain the level of short term debt (Table 8).

The random intercept for farmer has a standard deviation of 0.692, corresponding to an intra-class correlation of 12.7%. Short term debt increases with investments in farm machinery and deviation from estimated building costs. For each percent deviation in building costs, short term debt increases by four percent, which is significant. If a farmer with one percent deviation in addition invests 100,000 in machinery, short term debt becomes 25.8% of total debt, which is high. Thus, it is crucial to keep both building costs and machinery investments under control to avoid liquidity problems.

In Table 9 we show which variables predict the level of total debt in accounts versus budgets.

In Table 9 the difference in building investment between accountancy and plan are divided by 1 million. The random intercept is calculated to 0.318, corresponding to an intra-class correlation of 3.0%, which is low. The deviation in total debt increases every year from year one on, in line with the findings in Table 3. Higher milk delivery than planned increases total farm debt, and the effect is stronger if it also entails building investments. Such investments beyond year zero are only occasionally included in the budgets. All other factors kept constant, risk takers have 34% higher debt than risk adverse farmers, which is significant. Thus, farmers' risk perception has a significant influence on the level of debt as compared to budgets. Taken together our findings support hypothesis one, that whole farm budgets quickly become out- dated due to underestimated fixed costs and additional investments. In addition we have also identified several other causes why budgets and accounts differ.

In the following we analyse the transition problems during farm expansion. We use the herd dataset to explore the quota filling (Table 10).

The random intercept term for farmer has a standard deviation of 2.513, which corresponds to an intra- class correlation, or the between farmer variation, of 65.7% of the total variation. This is remarkably high. There is a tendency that if farmers think their own effort in the building process was straightforward, the quota filling increases by 3.5% in each year. A farmer in his forties explained:

> *"It costs in terms of health, I felt totally exhausted when the building period was finished… But the real work starts afterwards you know, when you need to follow up the herd. So it's not just building. I had not done this again."*

Thus if farmers feel worn out when the building period is over, it affects subsequent milk production negatively.

Table 7: Farm net result before depreciation in the accounts divided by result in the budgets, and regressed on total gross margins and machinery costs in NOK in accounts versus budgets*

Dependent variable: Farm net result before depreciation in accounts versus budget				
Explanatory Variables	**Parameter estimates**	**Standard error**	**t-value**	**p-value**
Total gross margin in account vs budget	1.5010	0.2170	6.9158	<0.0001
(Total gross margin in account vs budget)^2	-0.2036	0.0801	-2.5435	0.0128
Machinery costs in account vs budget	-0.0916	0.0248	-3.7000	0.0004
Intercept	-0.3985	0.1582	-2.5194	0.0136

*Fixed effects estimates from fitting a linear mixed model with random intercept, n=119.

Table 8: Short term debt divided by total debt, and regressed on machinery investment in NOK and deviation from estimated building cost in percent*

Dependent variable: Short term debt divided by total debt				
Explanatory Variables	**Parameter estimates**	**Standard error**	**t-value**	**p-value**
Machinery investment	$0.2 \cdot 10^{-6}$	$0.7 \cdot 10^{-7}$	3.2338	0.0018
Deviation from building cost in percent	0.0404	0.2150	1.8796	0.0710
Intercept	-4.2935	2.3132	-1.8561	0.0670

*Fixed effects estimates from fitting a linear mixed model with random intercept, n= 113.

Table 9: Total debt in accounts divided by total debt in budgets, regressed on planning year, milk delivered in accounts compared to budgets, farmers' attitude towards risk, and differences in building investments in accounts vs budgets*

Dependent variable: Total debt in accounts vs budgets				
Explanatory Variables	**Parameter estimates**	**Standard error**	**t-value**	**p-value**
Year	0.0587	0.0165	3.5475	0.0006
Milk delivery in account vs budget	0.2808	0.1110	2.5302	0.0133
Risk adverse farmer	-0.3397	0.1254	-2.7098	0.0114
Building investment	-0.1556	0.0772	-2.0169	0.0470
Milk delivery in account vs budget · Building investment	0.2034	0.0500	4.0704	0.0001
Intercept	0.9313	0.1440	6.4690	<0.0001

*Fixed effects estimates from fitting a linear mixed model with random intercept, n=116.

Table 10: Milk quota filling regressed on quota size in litres, number of cows, milk yield per cow and own effort during building new cowshed*

Dependent variable: Milk quota filling				
Explanatory Variables	**Parameter Estimates**	**Standard error**	**t- value**	**p-value**
Milk quota	-0.00041	0.00004	-10.934	<0.0001
No of cows	2.6644	0.393	6.785	<0.0001
(No of cows) ^{2}	-0.0363	0.0076	-4.7682	<0.0001
Milk yield per cow	0.0071	0.0008	8.415	<0.0001
No of cows · Milk quota · 10^{-4}	0.00001	0.000001	6.1213	<0.0001
Own effort straightforward	3.4979	2.0334	1.7202	<0.0988
Intercept	47.7401	7.6034	6.2788	<0.0001

*Fixed effect estimates from fitting a linear mixed model with random intercept, n=166.

Quota filling decreases with quota size, and increases with milk yield per cow and number of cows, but the increase is gradually offset by the negative quadratic term. This means that for large herds the net effect from increased number of cows is negative. Thus, in large herds it is more efficient to increase the milk yield. However, for a medium size farmer it is important to increase both the milk yield and the number of cows simultaneously. Take the example of a farmer who has a milk quota of 150 000 litres one year ahead of investment and increases the quota by 100%. If the farmer only manages to increase the number of cows by 60% and maintains the same milk yield, the quota filling becomes 91.2%. Similarly, if the farmer manages to increase the milk yield by 60%, but maintains the same number of cows, the quota filling is only 87.6%.

The interviews revealed that 16 of 36 farmers experienced different operating problems related to cows and milk yield during the transition. The most common problem was lack of cows and heifers. Many farmers also realized that they should have raised more heifers and calves in the years before the transition. Cows were culled due to health problems, or problems with adapting to new routines and to the milking robot. Tukey's HSD test shows that the percentage of culled cows was significantly higher in year zero than later ($p<0.05$). While the average farmer culled 59.5% of the cows in year zero, one quarter of the farmers culled more than 69%. In comparison, the average culling rate in Norway in 2014 was 43% (Tine, 2014). It is also noteworthy that one quarter of the farms still had a low milk yield in year two, between 6,013 and 7,375 kg. Contrary, one quarter of the farmers managed to reach a milk yield of between 8,444 and 10,937 kg. Problems with culling and low milk yield of course affects the gross margin, and thus the farm net result negatively. Two male farmers in their thirties gave us an insight into what the problems in year zero are about:

> *"I my opinion one should not increase by more than 100.000 litres at a time, then you can fill in with your own heifers. Otherwise you easily make mistakes…. Buy too many cows which you should not have bought because they're the only ones you get hold of, slaughter too many cows....."*
>
> *"We have increased the production tenfold over the last 10 years, but it's not without pain you know, both in terms of costs of livestock and quota filling. The more gradually you can increase the production, the better."*

Our findings in this section supports hypothesis two that transition problems can explain discrepancies between budgets and accounts.

To sum up, milk delivery well beyond budgets, number of discussion partners, total gross margin, machinery costs and investment in machinery and buildings, deviation from building costs, farmers' risk perception, transition problems and too much effort in the building process, can explain the differences between the accounts and the budgets in this study.

The interviews revealed that 33 of 36 farmers think lender requirements was the main reason why they needed a whole farm budget. For 17 farmers another important reason was to feel confident that the investment was prudent. While 24 farmers felt they were involved in the budget process, only 10 had looked at the budget after year zero, and other family members were involved in the budgeting process on only half of the farms. Taken together our findings from the interviews and the differences reported earlier support hypothesis three, that whole- farm budgets to a small degree serve as a management tool, and that new tools are required.

4. Discussion And Conclusion

This study contributes to literature by identifying the causes of discrepancies between whole-farm budgets and accounts, and particularly the importance of managing the transition phase to avoid financial strain. Thus, our study differs from studies which are content to conclude that there are discrepancies, without explaining why and how they come about. Like Tanewski *et al.* (2000) we find that whole- farm budgets are conducted mainly due to lender requirements, and this can explain why they are rapidly out-dated and of little relevance as management tools. Thus, our findings are in line with some of the criticism against budgets common in the business literature (Bergstrand, 2009; Bogsnes, 2009, Hope and Fraser, 2003; Otley, 2003). However, it is likely that financing institutions will continue to demand whole- farm budgets also in the future. In line with Nergaard (1988) we therefore call for more careful budgeting processes, particularly more empirical data on fixed costs based on analyses of farm accounts. The discrepancies in fixed costs reported here are in line with the findings of Solberg and Haukås (2010) and Ruud- Wethal *et al.* (2012). In this setting it is noteworthy that the farmer's social network influences the level of machinery costs. This indicates that farmers discuss and learn about farm machinery and machinery costs from each other.

Our study also calls for more involvement from the whole farmer family in the budgeting process. Thus whole-farm budgets should include a verbal section where the family's goals and vision for the future are clearly stated. Beyond budgeting per se, we think RF can play a role as a new management tool to follow up the budgets in the critical first years after the investment. To be efficient, RF must be simple and implemented only for a handful of the most critical whole farm budget assumptions. The forecasts must also be relevant for the farmer at an operational level. Thus, RF can include e.g. milk yield per cow and milk income per month, quota filling, feed amounts needed and feed costs. RF can also be made for fixed costs, e.g. machinery costs. Combined with benchmarking with other farms, and quarterly updated accounts, we think this will increase the probability that the budget targets are achieved.

According to our findings there is reason to caution against a strong expansion of milk production beyond budgets, particularly when the expansion involves building investment. It is paradoxical that while the main investment in a cowshed is calculated in detail, subsequent investments take place more or less without any kind of budgeting. This may incur liquidity problems. To make budgets more realistic, a suggestion may be to allocate a fixed annual amount in the budgets for future unspecified investments, a practice already in use among some planners. Budgeting investments relates to our finding that the farmers' risk perception strongly influences the debt level. An interesting topic is how planners can take farmers' risk perception into account in practice, and here our findings call for more research. Models for farm stochastic budgeting takes risk into account (see Lien 2001, for an overview). While such models are not commonly used in practice in Norway, we think they can assist in making farmers more aware of the critical budget assumptions. Together with farmers the planners can enter the most likely range of e.g. the milk yield per cow, and show the effects on the gross margin for the whole range. This can help avoiding transition problems.

This study shows that many farmers struggle to grow and increase the milk yield and the number of cows simultaneously, supporting the findings of Davey and Nettle (1997), Alvarez and Arias (2004), Davidsson *et al.* (2008) and Sipiläinen (2008). We add to this literature by showing that if farmers spend too much effort on building the cowshed, this hampers the milk production in subsequent years, and thus increases the financial strain. Therefore, farmers should consider carefully whether they should participate in the building process themselves, and if so, by how much. For farmers with little experience with building processes, it might be a better idea to hire a construction manager to manage the process. This might also reduce the risk of increase in short term debt due to budget overrun. To deal with the challenges in the transition phase a mentoring program could be set up, allowing farmers who have undertaken investments to guide other farmers. Thus many farmers can benefit from increasing their social network, both to avoid transition problems and to keep machinery costs under control.

Based on Hansen and Jervell (2014) and our findings, we suggest dividing farm expansion into three phases: I) planning II) transition, and III) a new-operational phase. In the new-operational phase, practical implementation of and further development of new routines to meet the production targets are important tasks. These are quite different tasks compared to the more abstract planning phase. In the planning phase focus should be on e.g. involving the whole family and a decision on own efforts in the building process. Further, thorough planning of all necessary investments included outdoor machinery is necessary to avoid budget overruns and increase of short term debt. Similarly, concrete plans should be made for how to increase milk yield, how to get enough forage, cows and milk quota, and which cows to cull. Thus, the planning phase needs to start approximately two years ahead of the investment. In the transition phase, working on and monitoring building of the cowshed, smooth introduction of the cows to the new environment, e.g. directly from pasture, and developing new routines are important managerial tasks. Looking for cows which do not get milked or do not visit the feeding stations regularly are practical examples. Changing focus from looking at individual cows to looking also at herd averages is a challenging task for many farmers in this period. We think this tripartite division will put both farmers and planners in a better position to deal with the different challenges reported here.

The farms in this study are larger than today's average farms in Austria and Switzerland, as well as in many countries in Eastern Europe, Latin America and Asia (IFCN, 2015). Thus, our results should be of interest also to an international audience of farmers, planners and lending institutions. The study was conducted in Norway only, and future studies should therefore include farms in wider geographical area. Future research could also explore more in-depth what characterizes farmers who manage large changes well.

To conclude there are huge discrepancies between budgets and accounts after only two years, particularly in fixed costs, investments and debt. Little ownership of the budget, increase in milk production beyond budget, transition problems, too much effort in the building

process, unplanned machinery and building investments, deviation from building cost estimates, number of discussion partners, gross margins and farmers' risk perception can explain the discrepancies. To secure a financial viable farm expansion we suggest dividing the expansion process in three different phases, and the implementation of mentoring schemes. More empirical accounts data for budgeting are also called for. According to this study whole farm budgets are not commonly used by farmers as a management tool. Rolling forecasts represent a promising tool to follow up whole-farm budgets, combined with benchmarking and quarterly updates of the accounts.

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