# AN ANALYSIS OF FULL-TIME AND PART-TIME FARMERS: DIFFERENCES IN AGRICULTURAL LAND USE**

by

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## ABSTRACT

A good deal of attention devoted to part-time farming studies has been in the determination of cause. This study departs from the question of determinants and attempts, using multivariate statistical methods, to determine whether full-time and part-time farmers differ in their agricultural land use.

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# AN ANALYSIS OF FULL-TIME AND PART-TIME FARMERS: DIFFERENCES IN AGRICULTURAL LAND USE

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## Introduction

A good deal of the attention devoted to part-time farming studies has been in the determination of cause. It is the purpose of this study to depart from the question of the determinants and attempt to answer the question: Do full-time and part-time farmers in Saskatchewan use their agricultural land differently?

## Theoretical Framework

The return to labour as an input to production can be expressed in the form of a value of marginal product of labour curve (VMPL). A typical farm produces a combination of several outputs, each generating a unique schedule of returns to labour. The summation of all VMPL curves represents the family's marginal return, that is, the farm's derived demand, for their labour.

In a simplified case, assume the farm family may allocate its labour and all other inputs to the production of output X and output Y. When off-farm employment (OFE) becomes an alternative source of income to the farm family, the family faces an altered demand curve for its labour. The total demand for the family's labour is now the VMPL for X plus the VMPL for Y plus the VMPL for OFE. The applicable VMPL for OFE is the wage rate for OFE adjusted for any travel expenses and any disutility experienced by the family in taking up OFE. When the off-farm wage rate (see figure 1) is below Wage 1, the profit maximizing family will work $1_6$ hours per year on

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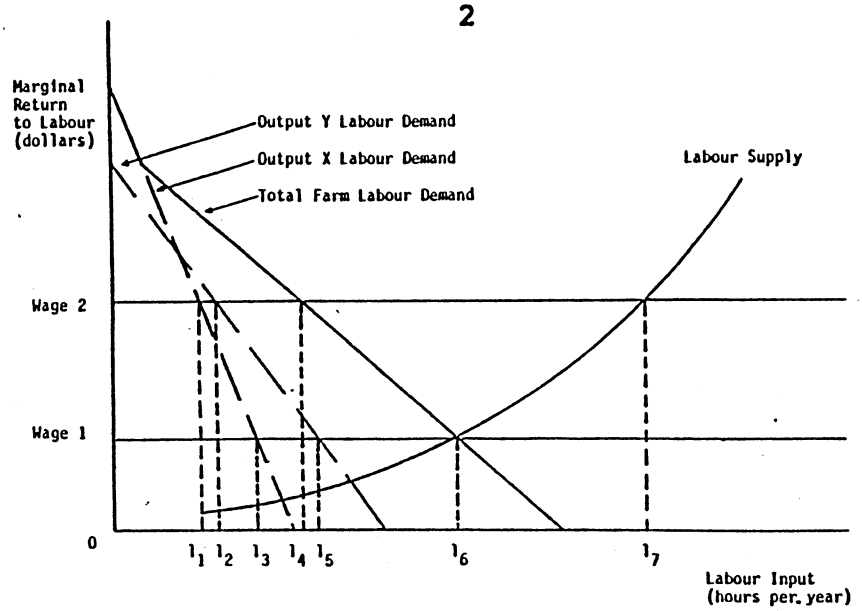


Figure 1 Changes in the Amount of Labour Devoted to Total and Individual Farm Production Processes, Given Changes in the Off-Farm Wage Rate.

the farm undertaking no OFE. $l_5$ hours per year will be employed to produce Y and $l_3$ hours per year will be used to produce X ($l_3 + l_5 = l_6$). When the off-farm wage rate rises to Wage 2, the family will increase its offer of labour to $l_7$ hours per year, where $l_4$ hours per year are employed on the farm and $l_7$ minus $l_4$ hours per year are devoted to OFE. $l_1$ hours per year are used to produce X and $l_2$ hours per year are used to produce Y ($l_1 + l_2 = l_4$). The amount of labour employed on the farm has decreased and there has been a change in the proportion of on-farm labour devoted to each output, X and Y.[1]

The theory of the firm indicates that a profit maximizing producer will seek to maximize the difference between the return to production and the cost of production. A change in the off-farm wage rate is, in essence, a change in the opportunity cost of labour (Johnson and O'Grady, 1981). As the opprtunity cost to labour changes, the once optimal combination of inputs and outputs will generally become suboptimal. Assuming that labour is a normal input, it can be expected that as the amount of OFE increases, the farm operator will undertake those on-farm enterprises which demand

less labour intensive activity. Due to the varying degrees of input substitutability, output complementarity, relative input and output prices, as well as the wide choice of outputs available to the Saskatchewan farmer (see Heady, 1952, ch. 7), it is not always possible to determine a priori the precise changes in input mix or output mix (land use) which may occur when one input (labour) is reduced. However, it is hypothesized that a rise in OFE will lead to a decrease in summerfallow since summerfallow typically requires a relatively large labour input during the summer months compared to that required for cropped land. Similarly, it is hypothesized that the proportion of non-crop land would increase with a rise in OFE. Non-crop land, largely composed of grazing land, requires relatively little labour input.[2]

A number of other factors might be expected to have an effect on agricultural land use. Labour and management are, typically, major inputs in the production process. For this reason, factors affecting management ability, labour quality, and labour quantity could be expected to affect the farm family's decisions on land use.

Ciriacy-Wantrup (1968) has suggested that tenancy characteristics will affect the perceptions of farm decision makers with respect to optimal input allocation and output choice. On this hypothesis, it could be expected that various forms of tenancy would affect agricultural land use.

The size of farm and quality of land could be expected to be major factors in the decisions affecting land use. Land quality would be somewhat of a restriction on the choice of certain outputs making other outputs the preferred choice. The size of farm is a major factor in the degree of competition or complementarity between various outputs, hence, affecting the use of land (Heady, 1952, ch. 7).

Many farm families choose to produce livestock, usually in addition to crop production. Depending on the intensity of the operation and the availability of other inputs, the livestock operation may be in competition with some outputs and complementary to others.

## Hypotheses

It is hypothesized that the part-time farm family will use their land differently than will full-time farm families. Furthermore, it is hypothesized that there will be a reduction in labour intensive land uses (such as summerfallowing) and an increase in non-labour intensive land uses (non-cropped land) as the amount of time devoted to OFE increases. In addition to this, it is hypothesized that those factors affecting labour quantity, labour quality, and management ability, as well as tenancy arrangements, farm size, land quality and the intensity of the livestock operation, will have an effect on agricultural land use.

## Data and Methodology

The data for this study were obtained from the 1981 Farm and Household Survey conducted by the Department of Agricultural Economics at the University of Saskatchewan. The sampling areas covered Saskatchewan Crop Districts Five and Seven in the East Central and West Central regions of the province. Each farm unit observed was associated with and defined as a farm by the Western Grain Stabilization Program. In total, 456 observations were used in this analysis.

The precise definitions of full-time and part-time farming employed here were identical to those used in a separate study by Johnson and O'Grady (1981). Johnson and O'Grady chose to define three separate groups of part-time farmers as they felt these farmers were not a homogenous group. Full-time farm families were defined as farm families where all

labour by all family members was employed on the farm (category I). Part-time farm families (category II) included all farms where the operator was fully employed on the farm but the spouse and/or children were engaged in some off-farm employment. Part-time farm families (category III) included all farms where the operator was engaged in off-farm work for less than 600 hours per year. Part-time farm families (category IV) were defined as all farms where the operator was employed for 600 or more hours per year off the farm. In categories III and IV, off-farm employment by the spouse and/or children may have occurred.

For the purposes of this study, multivariate analysis was deemed to be more appropriate than the traditional univariate analysis. Univariate anlaysis considers only one dependent variable at a time while multivariate anlaysis, as its title suggests, considers more than one dependent variable. Because of the many interdependent uses of Saskatchewan agricultural land, a single multivariate analysis of several dependent variables will expose the analytical decisions to much less risk of Type I Error than would several univariate analyses of various dependent variables. For an introduction to multivariate methods, see Harris (1975).

In the design of this analysis, eleven land uses were considered, accounting for 100 percent of the total acres operated for each farm. In order to obtain a meaningful measure of land use patterns, the percentage of total acres devoted to each land use was considered. The land uses were: 1) spring wheat, 2) durum wheat, 3) oats, 4) barley, 5) rapeseed, 6) flax, 7) rye, 8) mixed crops, 9) other crops, 10) summerfallow, and 11) non-crop land. The independent variables included in the analysis included three binary variables representing the full-time and part-time farming categories as well as several other variables which may have had an effect

on land use. These variables are listed in Table 1. The livestock per acre variables were used to account for the intensity of the livestock operation. As the data source did not indicate which family member could be considered the operator on each farm, it was assumed that the husband was the operator.

Table 1 Reported F-Values and Prob-Values Associated With Multivariate Analysis of Covariance, Fifteen Covariates, Fourteen Covariates, and Seven Covariates.

| Covariates | Fifteen Covariates | | Fourteen Covariates | | Seven Covariates | |
|---|---|---|---|---|---|---|
| | F-Value | Prob-Value | F-Value | Prob-Value | F-Value | Prob-Value |
| Husband Age (years) | 0.97 | 0.4768 | 2.06 | 0.0223 | 2.04 | 0.0237 |
| Husband Age Squared | 0.62 | 0.8136 | ----- | ------ | ---- | ------ |
| Husband Experience (years) | 1.68 | 0.0750 | 1.82 | 0.0485 | 1.86 | 0.0420 |
| Husband Education (years) | 1.35 | 0.1910 | 1.39 | 0.1719 | ---- | ------ |
| Wife Education (years) | 1.56 | 0.1069 | 1.54 | 0.1154 | ---- | ------ |
| Number of Dependant Children | 0.74 | 0.7053 | 0.74 | 0.7002 | ---- | ------ |
| Proportion of Farm Share-Rented (%) | 1.44 | 0.1532 | 1.33 | 0.2056 | ---- | ------ |
| Proportion of Farm Cash-Rented (%) | 2.36 | 0.0080 | 2.39 | 0.0070 | 2.27 | 0.0106 |
| Farm Size (acres) | 3.23 | 0.0003 | 3.02 | 0.0007 | 3.13 | 0.0005 |
| Average Assessed Land Value ($/160 acres) | 11.34 | 0.0001 | 11.49 | 0.0001 | 12.98 | 0.0001 |
| Number of Cattle per acre | 40.69 | 0.0001 | 40.96 | 0.0001 | 41.80 | 0.0001 |
| Number of Hogs per acre | 0.43 | 0.9424 | 0.43 | 0.9431 | ---- | ------ |
| Number of Sheep per acre | 0.65 | 0.7882 | 0.64 | 0.7911 | ---- | ------ |
| Number of Poultry per acre | 1.20 | 0.2875 | 1.15 | 0.3173 | ---- | ------ |
| Number of Other Animals per acre* | 4.27 | 0.0001 | 4.28 | 0.0001 | 4.70 | 0.0001 |

* Bees not included.

Canonical Correlation was used to test the null hypothesis that the independent variables have no significant effect upon the dependent land use variables. Canonical correlation accomplishes this by searching for the linear combination of dependent variables and the linear combination of independent variables which yield the highest correlation coefficient (termed $R_c$, the square of which is the canonical R-squared). Should this $R_c$ be insignificant, it follows that nowhere in the system of variables does a significant relationship exist between the dependent and independent variables.

Should the $R_c$ be significant, further testing is required to determine which of the independent variables give rise to this significance. To this

end, multivariate analysis of covariance may be employed. MANCOVA, which is a specialization of canonical correlation, performs a series of multivariate regressions on the independent variables to test the null hypothesis that each individual independent variable has no significant overall effect on the dependent variables.

The canonical correlation and MANCOVA above, determine the significance of the differences between the four groups of farm families. However, this does not indicate the significance of differences between any particular pair of groups. To this end, simultaneous multivariate multiple comparisons are made. This technique facilitates a comparison of any two of the full-time and part-time farming categories by performing three MANCOVAs, each time removing a different binary variable, making it implicit. Three MANCOVAs are sufficient to test the six null hypotheses that each farming category is not significantly different from any one of the other three categories, in their effect on the land use variables.

It may be of interest to carry this analyis further to determine if the relationships between any two farming categories change when the variance in land use due to the covariates is not accounted for. To this end, another simultaneous multivariate multiple comparison may be performed using multivariate analysis of variance (MANOVA). In MANOVA, the covariates are not isolated and the land use variables are explained as a function of labour allocation only.

The multiple comparisons described above determine whether there are any differences between any two of the four farming categories. The multiple comparisons, however, where differences between farming categories do exist, do not pinpoint precisely which land use or uses give rise to the differences between the categories. To this end, multivariate range tests

may be used. These tests construct a multivariate confidence interval around the means associated with any two of the farming categories in question, for each of the land uses. If the difference between the two means is greater than the multivariate confidence interval, then it can be concluded that the land use considered does contribute to the difference between the farming categories. This is done for each land use for any two farming categories where a significant difference was determined by the multiple comparison tests done previously. The multivariate confidence interval is determined using a formula set forth by Morrison (1967) and Heck (1960).

## Results of Multivariate Analyses

The overall canonical correlation of eleven dependent and seventeen independent (fourteen covariates plus three binary) variables resulted in an F-value of 4.182, a prob-value of less than 0.0001, and a canonical R-squared of .569. The prob-value indicates that there is a confidence level greater than 99.99 percent associated with the calculatd F-value. This leads to a rejection of the null hypothesis that the full-time and part-time farming categories and the covariates have no significant overall effect on the land use variables.

The MANCOVA was designed to determine the significance of the effect that each of the independent variables had on land use. Table 1 reports that F-values and prob-values associated with three MANCOVA tests. The first test considered fifteen covariates, the second test, fourteen covariates, and the third test, seven covariates. The first MANCOVA included the fourteen covariates described earlier plus a fifteenth covariate, husband age squared, in order to account for the possible existence of a non-linear relationship between husband age and land use

(Thurmeier, 1981). The second MANCOVA consisted of only the original fourteen covariates, in order to determine whether husband age was linearly related to land use. The third MANCOVA included only those covariates from the second MANCOVA which had a significant effect upon land use at the 95 percent confidence level.

In the three MANCOVAs there existed the possibility of multicollinearity between the variables of husband age and husband experience. For this reason, a simple linear regression was performed with husband experience as the dependent variable. The regression R-squared was greater than 79 percent indicating a high degree of multicollinearity. The inclusion of both variables would reduce their significance but to remove one of the variables from the analysis would tend to bias the results. Therefore, both husband age and husband experience remain in the final MANCOVA despite the multicollinearity existing between them.

The simultaneous multivariate multiple comparisons were designed to determine if there was any significant difference between any two of the full-time and part-time farming categories in the way in which they used their land. Table 2 reports the F-values and prob-values associated with the MANCOVA and MANOVA comparisons. At the 95 percent confidence level, the null hypothesis that there is no significant difference in land use between any two of the farming categories can be rejected only for category III and category IV farms. This is the case for both MANCOVA and MANOVA comparisons.

The multivariate range tests were designed to determine precisely which land uses gave rise to any overall differences between farm family categories. At the 95 percent confidence level the multivariate range tests could discern no significant difference between categories III and IV

Table 2: Reported F-Values and Prob-Values Associated with Simultaneous Multivariate Multiple Comparisons: MANCOVA (Seven Covariates) and MANOVA*

| | MANCOVA | | | | MANOVA | | |
|---|---|---|---|---|---|---|---|
| | Labour Allocation Categories | | | | Labour Allocation Categories | | |
| | I | II | III | | I | II | III |
| II | 0.5550 | | | II | 0.1947 | | |
| | (0.89) | | | | (1.35) | | |
| III | 0.2839 | 0.3903 | | III | 0.2607 | 0.5111 | |
| | (1.20) | (1.06) | | | (1.23) | (0.093) | |
| IV | 0.5400 | 0.2802 | 0.0338 | IV | 0.2937 | 0.1119 | 0.0226 |
| | (0.90) | (1.21) | (1.93) | | (1.19) | (1.55) | (2.05) |

* Bracketed numbers indicate F-Values.

in any of the land uses. The results of the multiple comparisons indicate that there was indeed a difference between categories III and IV but this difference was too weak for the multiple range rests to determine precisely which land uses gave rise to this overall category difference.

## Conclusions

The preceeding analysis does not permit us to reject the null hypothesis of no overall difference between full-time and part-time farm families in their use of agricultural land. However, the data does permit us to reject the null hypothesis of no difference in land use between those farm families where the operator worked between zero and 600 hours per year off the farm and those farm families where the operator worked 600 or more hours per year off the farm (categories III and IV, respectively). This study was unable to determine, with 95 percent confidence, which land use or uses gave rise to the difference between categories III and IV farm families, the individual land use differences being too weak to be statistically discernable. Because of this, there is no statistical support for the hypothesis that an increase in the amount of off-farm

employment will lead to a decrease in the proportion of summerfallow and an increase in the proportion of cropped land and grazing land in these regions.

Of the covariates included in the analysis the data supports the null hypothesis of no overall effect on land use for eight of the covariates. These eight are: (1) husband age squared, (2) husband education, (3) wife education, (4) number of dependent children, (5) proportion of farm share-rented, (6) intensity of hog production, (7) intensity of sheep production, and (8) intensity of poultry production. For the remaining covariates, the data allows us to reject the null hypothesis of no overall effect on land use. These covariates are: (1) husband age, (2) husband education, (3) proportion of farm cash-rented, (4) farm size, (5) average assessed land value, (6) intensity of cattle production, and (7) intensity of other animal production.

This study has shown that in two rural regions of Saskatchewan, there is no difference in land use patterns between full-time farm families and those farm families who undertake off-farm employment. The only difference between the farming categories appeared between those farms where the operator devoted relatively little (but significant) time to OFE and those farms where the operator devoted a large portion of this time to off-farm employment.

To determine that there are not significant differences between full-time and part-time farmers in agricultural land use should be as important to the policy maker as the determination that differences do exist.

## LIST OF NOTES

1 A similar discussion of the relationship between the amount of OFE and the off-farm wage rate can be found in Thurmeier (1981).

2 The above discussion is treated somewhat more rigorously in Johnson and O'Grady (1981).

## LIST OF REFERENCES

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