ECONOMETRIC MODELS OF WESTERN CANADA CROP ACREAGE DEMAND AND YIELD RESPONSE UNDER RISK AND UNCERTAINTY

BY
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A Thesis
Submitted to The Faculty of Graduate Studies
in Partial Fulfillment of the Requirements
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MASTER OF SCIENCE

Department of Agricultural Economics and Farm Management
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ABSTRACT

This study has modelled an alternative approach to systems of supply response by decomposing it into acreage and yield responses for Western Canada grains, using aggregate data across provinces for 1961 - 1995. This study follows a similar study for Manitoba by Mundang (1996).

Acreage demands are estimated by employing duality models and allowing risk aversion. Econometric results are presented for a four-crop model using level and first differenced data. Estimates for models incorporating risk aversion generally have more significant coefficients for expected revenues or expected prices (under price uncertainty). Results for models assuming yield uncertainty and nonlinear estimations are less satisfactory than in earlier studies. This may be due to difficulties in consistent aggregation across provinces and that the model does not capture changes in agricultural policies that may influence acreage demand decisions.

The yield responses to price are specified assuming price uncertainty, risk aversion, and distributed lags. Under static models, the expected price coefficients are always insignificant, however, price variances are often significant (wheat). In contrast, under distributed lag models, both expected prices and price variances are often significant. This results suggest that it is important to incorporate risk aversion and dynamics into crop yield response models.

For further research, it would be interesting to specify a model for each province and to incorporate changes in agricultural policies more explicitly into the model.

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I. INTRODUCTION

BACKGROUND

Empirical studies in crop supply response have estimated either acreage demands (Just; Chavas and Holt; Chambers and Just; Coyle 1993) or yield responses (Menz and Pardey; Choi and Helmberger; Houck and Gallagher), but seldom both acreage and yield responses. However, in order to understand and model crop supply response, it is important to estimate both the acreage and yield components. In a multiple product firm, changes in crop acreage correspond to changes in enterprise mix, and changes in crop yields may largely reflect factor substitution within an enterprise. In addition, lags in response may be quite different for acreage and yield decisions (e.g., many acreage demand studies assume that yields are predetermined). Thus, empirical crop supply response models should be decomposed into acreage and yield components rather than being specified as a reduced form of these components. Such decomposition should lead to a greater understanding and more precise estimates of crop supply response.

The major sources of risk and uncertainty in agricultural production can be classified into production and market uncertainty. Production uncertainty includes all those risks related to variations in yield and acreage such as weather, diseases, and pests. Whereas market uncertainty contributes to risks mainly because of the variability of output and input prices.

This study follows a similar study by Mundang (1996) but for a broader area. Mundang discussed Manitoba crops, while this study considers crops throughout Western Canada.

The thesis consists of two parts: a study of crop acreage demand using static duality models and a study of crop yield response with distributed lag models

Systems of acreage demand equations are specified as conditional on crop revenues per acre and on expected output prices with emphasis on the first model. The model will then be extended to incorporate risk aversion, price uncertainty, and yield uncertainty. In this case, risk preferences are specified by mean-variance approach. Models for grain yield response emphasize distributed lags, price uncertainty, and risk aversion.

OBJECTIVES

The objectives of the thesis are to develop and to estimate econometric models of crop supply response for Western Canada allowing for risk aversion. In this case, crop supply response is decomposed into acreage and yield responses.

II. DUALITY MODELS OF CROP ACREAGE DEMANDS

Crop production decisions were usually estimated in terms of acreage response instead of output supplies (e.g., Nerlove 1956, 1972; Askari and Cummings; Houck and Ryan; Just; Chavas and Holt, Choi and Helmberger). The argument is that acreage planted is essentially independent of subsequent weather conditions and hence may provide a better proxy to planned output than does observed output. Moreover, crop acreage demands are often modelled by assuming that crop yield is predetermined.

However, duality was usually employed to estimate crop decision in terms of output supply (Ball 1988; Just, Zilberman, and Hochman 1983). It is only recently that duality model is used for estimating acreage demands (Chambers and Just 1989; Coyle 1993; Moore, Gollehon and Carey 1994; Coyle and Mundang 1997). The model is usually applied to a multiple product farm with acreage decisions conditional on quasi-fixed inputs.

In this study, crop acreage demands for Western Canada are estimated using a duality approach. As in Mundang (1996), this study also incorporates the models with predetermined yield and risk preferences. The assumption of a predetermined yield simplifies the specification of duality models of acreage allocations. Risk preferences are modelled as linear and nonlinear mean-variance utility functions. In addition, proxies for price uncertainty are also emphasized. Derived demands for acreage of individual crops will be specified as conditional on crop revenues per acre, a total crop acreage and its rate of change.

THEORETICAL FRAMEWORK

1. Yields are Predetermined

Consider a multiple product firm with a fixed total land Z which is allocated among M crops. Also assume that net revenue per acre r^j is predetermined for all enterprises $j = 1,..,M$. In this case yields and input levels per acre are predetermined, except from the effects of weather changes. This assumption requires either (a) kinked yield functions, (b) disjoint technologies and constant returns to scale, or (c) crop yields adjustment is slower than crop acreage (Coyle and Mundang, 1997). Therefore, it may be appropriate here to specify acreage demands as conditional on crop net revenues per acre.

Although the mean-variance assumption is restrictive, it has been adopted in many production studies (e.g., Chavas and Pope 1982; Coyle 1992; Saha). The mean-variance model has been commonly employed in the linear case (a constant coefficient of absolute risk aversion), which is consistent with expected utility maximization assuming constant absolute risk aversion and normality of returns in wealth (e.g., Chavas and Pope 1982; Just and Zilberman).

The certainty-equivalent specification of a nonlinear mean-variance indirect utility function can be specified as (1).

$$(1) \qquad V = W_0 + ER - \frac{1}{2}\alpha(W_0 + ER,\ VR)\ VR$$

where W_0 : initial wealth

ER,VR : mean and variance of the firm's subjective probability distribution for net revenues of crop production

α : coefficient of risk aversion

Uncertainty in net revenues per acre r may reflect yield or price uncertainty. Assuming that yields are predetermined (aside from the impact of current weather), the firm's indirect utility maximization problem is:

$$(2)\quad V^*(W_0,Er,Vr,Z) = \max_{z\geq 0} V \equiv W_0 + \sum_{j=1}^{M} Er^j z^j - \frac{1}{2}\alpha\left(W_0 + \sum_{j=1}^{M} Er^j z^j, \sum_{i=1}^{M}\sum_{j=1}^{M} Vr_{ij} z^i z^j\right)\sum_{i=1}^{M}\sum_{j=1}^{M} Vr_{ij} z^i z^j$$

$$\text{s.t.} \sum_{j=1}^{M} z^j = Z$$

where $Er = (Er^i,..., Er^M)$ is the vector of expected net revenues per acre, Vr is the vector of the distinct covariances $cov(r^i,r^j)$ between net revenue per acre for M enterprises (i,j=1,...,M), and $z = (z^i,...,z^M)$ is the vector of crop acreage.

The homogeneity property of the dual $V^*(.)$ under constant relative risk aversion (CRRA) is $V^*(\lambda W_0,\lambda Er,\lambda^2 Vr,Z) = \lambda V^*(W_0,Er,Vr,Z)$, for scalar $\lambda > 0$, (Coyle and Mundang 1997). Given V strictly increasing in W_0 and Er, $V^*(.)$ is quasi convex in (Er,W_0). The following relations for acreage demand z^j, analogous to Roy's theorem, are satisfied.

$$z^j(W_0,Er,Vr,Z) = \frac{\partial V^*(W_0,Er,Vr,Z)/\partial Er^j}{\partial V^*(W_0,Er,Vr,Z)/\partial W_0} \qquad j=1,\dots,M \tag{3}$$

and,

$$\partial V^*(W_0,Er,Vr,Z)/\partial W_0 = 1 - \frac{1}{2}\frac{\partial\alpha(W_0 + ER,VR)}{\partial(W_0 + ER)} VR \tag{4}$$

An alternative to model (1) would use a linear mean-variance approach, in this case the coefficient of risk averse α is constant. This means that α does not vary with $(W_0 + ER)$ and VR, and the model is called CARA (constant absolute risk aversion). Then the firm's indirect utility maximization problem can be modelled as:

$$V^*(Er,Vr,Z) = \max_{z\geq 0} V \equiv \sum_{j=1}^{M} Er^j z^j - \frac{1}{2}\alpha \sum_{i=1}^{M}\sum_{j=1}^{M} Vr_{ij} z^i z^j \quad s.t. \sum_{j=1}^{M} z^j = Z \tag{5}$$

Here, $V^*(Er,Vr,Z)$ is linear homogenous and convex in (Er,Vr), so $V^*(\lambda Er,\lambda Vr,Z) = \lambda V^*(Er,Vr,Z)$, for $\lambda > 0$. Furthermore, the following equations for acreage demand analogous to Hotelling's Lemma are satisfied (Coyle, 1992).

$$z^j(Er,Vr,Z) = \partial V^*(Er,Vr,Z)/\partial Er^j \qquad j = 1,\dots,M \tag{6}$$

Equations (6) are homogenous of degree zero in (Er,Vr) and satisfy standard reciprocity conditions. The difference between equations (3) and (6) is that acreage demands in (3) depend upon initial wealth W_0 but those in (6) do not (since W_0 is exogenous and does not influence an exogenous α, W_0 does not influence production decisions and hence can be dropped from model 6). In addition, it means that (3) is nonlinear in parameters and (6) is linear in parameters (coefficients) to be estimated. Functional forms for these models will be specified as in Coyle and Mundang (1997).

When α equals zero, farmers are assumed to be risk-neutral. Therefore model (2) reduces to:

$$(7) \qquad \max_{z \geq 0} V \equiv \sum_{j=1}^{M} Er^j z^j \quad s.t. \sum_{j=1}^{M} z^j = Z$$

Since the risk-neutral firm's indirect utility function is independent of α, the maximization of this function is the same as the maximization of total expected revenues R(Er,Z), which is linear homogenous and convex in Er. The maximization problem of R^* is:

$$(8) \qquad R^*(Er,Z) = \max_{z \geq 0} \sum_{j=1}^{M} Er^j z^j \quad s.t. \sum_{j=1}^{M} z^j = Z$$

Therefore the Hotelling's Lemma for acreage demands of this functional form of dual utility or net revenues are:

$$(9) \quad z^j(Er,Z) = \partial V^*(Er,Z)/\partial Er^j \qquad j = 1,\ldots,M$$

or:

$$(10) \quad z^j(Er,Z) = \partial R^*(Er,Z)/\partial Er^j \qquad j = 1,\ldots,M$$

Equations (9) and (10) satisfy the standard homogeneity, reciprocity, and curvature conditions.

2. Yields are not Predetermined

Acreage demand models are more complex when they cannot be specified as conditional on Er and Vr. Then the static risk-neutral model of Chambers and Just (1989) can be extended to mean-variance risk preferences as follows (Coyle and Mundang, 1997). First we define the problem (ignoring yield uncertainty).

$$(11) \quad V^*(W_0, Ep, Vp, w, K, z) = \max_{(y,x)\in T(z,K)} W_0 + E\pi - \frac{1}{2}\alpha(W_0 + E\pi, V\pi)\ V\pi$$

$$\text{s.t. } E\pi \equiv \sum_{j=1}^{M} Ep^j y^j - \sum_{i=1}^{N} w^i x^i$$

$$V\pi \equiv \sum_{i=1}^{M} \sum_{j=1}^{M} Vp_{ij}\, y^i y^j$$

where K is the level of quasi-fixed input (capital), Ep and Vp denote means and variance for output prices. Here output (y) and the maximization problem is specified as conditional on the vector $z = (z^i \ldots z^M)$ of crop acreage allocations, and variable input (x) decisions are specified as conditional on acreage allocation decisions (z).

Properties of the conditional dual $V^*(W_0,Ep,Vp,w,K,z)$ are analogous to model (2), e.g., $V^*(\lambda W_0,\lambda Ep,\lambda^2 Vp,\lambda w,K,z) = \lambda V(W_0,Ep,Vp,w,K,z)$ under CRRA. In addition (assuming at solution that $z^{i*} \neq 0$ and $z^{j*} \neq 0$) the following first order conditions for an optimal (interior) crop acreage allocation z^* are satisfied,

$$(12) \quad \partial V^*(W_0,Ep,Vp,w,K,z^*)/\partial z^i = \partial V^*(W_0,Ep,Vp,w,K,z^*)/\partial z^j$$

Equation (12) means that at an (interior) equilibrium allocation z^* the marginal return of land for crop i equals to that for crop j. These equations (12) plus the constraint $\Sigma_{i=1}^{M} z^i = Z$ can under suitable regulatory conditions implicitly determine z^*.

This specification of acreage allocation decisions is more complex than model (3) or (6) where yields are predetermined. Moreover the complexity of the acreage demands model will increase substantially when yield uncertainty is incorporated (Coyle and Mundang, 1995).

In the case of linear mean-variance risk preferences (when α is constant) and price uncertainty (without yield uncertainty), the problem (11) can be respecified as (13), where the optimum crop acreage decision satisfies (12).

$$(13) \quad V^*(Ep,Vp,w,K,z) = \max_{(y,x)\in T(z,K)} \sum_{j=1}^{M} Ep^j y^j - \sum_{i=1}^{N} w^i x^i - \frac{1}{2}\alpha \sum_{i=1}^{M}\sum_{j=1}^{M} Vp_{ij}\, y^i y^j$$

Assuming farmers are risk-neutral (α equals to zero), equation (13) can be respecified as (14):

$$(14)\quad \pi(Ep,w,K,z) = \max_{(y,x)\in T(z,K)} \sum_{j=1}^{M} Ep^{j}\, y^{j} - \sum_{i=1}^{N} w^{i}\, x^{i}$$

This conditional profit function $\pi(Ep,w,K,z)$ is linear homogenous and convex in (Ep,w). By assuming (14) has an interior solution z^{*}, the solution satisfies the following conditions, which are analogous to (12).

$$(15)\quad \partial\pi(Ep,w,K,z^{*})/\partial z^{i} = \partial\pi(Ep,w,K,z^{*})/\partial z^{j} \qquad i,j = 1,\ldots,M$$

Then assuming a normalized quadratic conditional profit function $\pi(Ep,w,K,z)$, acreage demands z(Ep,w,K,z) as well as output supplies y(Ep,w,K,z) and variable input demands x(Ep,w,K,z) are homogeneous of degree zero in exogenous variables, but acreage demand equations implicit in (15) are often nonlinear in parameters of the dual.

MODEL SPECIFICATION AND ESTIMATION

I. LINEAR MODELS

A. Risk Neutral under Price Uncertainty

1. Yields are predetermined

Assume predetermined yields and a generalization of a normalized quadratic functional form $R^*(r^*,Z)$ for the dual net revenue model (8):

$$(16)\quad R_t^* = \beta_0 + \sum_{i=1}^{3} \beta_i \, Er_t^{*i} + 0.5 \sum_{i=1}^{3}\sum_{j=1}^{3} \beta_{ij} \, Er_t^{*i} \, Er_t^{*j} + \sum_{i=1}^{3} \beta_{i4} \, Er_t^{*i} \, Z_t + \sum_{i=1}^{3} \beta_{i5} \, Er_t^{*i} (Z_t - Z_{t-1}) + \sum_{i=1}^{3} \beta_{i6} \, Er_t^{*i} \, Er_t^{4} + \sum_{i=1}^{3} \beta_{i7} \, Er_t^{*i} \, d + \beta_{i8} \, Er_t^{*i} \, t$$

where $R^* \equiv R/(Er^4 Z)$

$Er^{*i} \equiv Er^i / Er^4$

$Er_t^i = Ep_t^i \, yld_{t-1}^i$

Er^4 : a Tornqvist approximation to a Divisia "price" index for oats, flax, and rye

i = 1,2,3 denote wheat, barley, and canola

A four crop model is specified here using the Divisia price index as numeraire; the four crops are wheat, barley, canola, and others (oats, flax, and rye). Five crop models are also considered, wheat, barley, canola, oats, and others (flax and rye). Applying Hotelling's Lemma (9) to (16),

$$(17)\quad sz_t^i = \beta_i + \sum_{j=1}^{3} \beta_{ij} Er_t^{*j} + \beta_{i4} Z_t + \beta_{i5} (Z_t - Z_{t-1}) + \beta_{i6} Er_t^4 + \beta_{i7} d + \beta_{i8} t + e_t^i \qquad i = 1,2,3$$

where $sz^i \equiv z^i / Z$.

The static risk-neutral model (8) implies that R is linear homogenous in Er, in this case $\beta_{i6} = 0$ for (i = 1,2,3). Constant returns to scale assumption in production means that $\beta_{i4} = 0$ (i= 1,2,3). The rate of change in total crop acreage $(Z_t - Z_{t-1})$ is included in the model. The assumption is that crop acreage allocation is affected by lags in adjustment of the overall crop rotation (Coyle, 1993). Variable d is a dummy for LIFT program applied in 1970. The acreage demand equations (17) are consistent with the dual revenue function (16) if the following reciprocity (symmetry) conditions for integrability are satisfied,

$$(18)\quad \beta_{12} = \beta_{21} \qquad \beta_{13} = \beta_{31} \qquad \beta_{23} = \beta_{32}$$

Several simplifying assumptions are adopted in the models, as in Mundang (1995):

a. The requirements of capital and labour per acre are essentially the same for different crops, i.e., in Manitoba (Manitoba Agriculture). Therefore, measures of capital stock and labour wage are not considered in the models.

b. Total costs per acre for other variable inputs (such as fertilizers, insecticide, etc.) are relatively similar for different crops over data period. Also the input costs usually are known at the time of decision making, so that they have no effect on risk (Just, 1974). Therefore, these variables are also not included in the models.

c. Er is defined as expected revenue per acre. It is measured as the product of expected output price and one year lag of yields: $Er_t^i = Ep_t^i\,(y_{t-1}^i / z_{t-1}^i)$.

2. Yields are not predetermined

In the model with yield not predetermined, the farmers' input decision can influence probability distribution of yield (and hence the expected revenue per acre). In other words, in this model the probability distribution of yield is treated as endogenous. Then, the acreage demand model can be specified implicitly by M-1 first order conditions (15) in terms of conditional dual $\pi(p,w,K,z)$ and the constraint $\Sigma^m_{j=1} z^j = Z$. Solving these first order conditions generally lead to acreage demand equations that are nonlinear in coefficients. Alternatively, rather than specifying a functional form for $\pi(p,w,K,z)$, we can specify functional forms for the reduced form acreage demands $z(p,w,K,z)$ that are analogous to (17).

$$\text{(19)} \quad sz_t^i = \beta_i + \sum_{j=1}^{3} \beta_{ij}\, Ep_t^{*j} + \beta_{i4}\, Z_t + \beta_{i5}\,(Z_t - Z_{t-1}) + \beta_{i6}\, Ep_t^4 + \beta_{i7}\, d + \beta_{i8}\, t + \beta_{i9}\, w_t^* + e_t^i \qquad i=1,2,3$$

where $p^{*i} \equiv p^i / p^4$ (i=1,2,3) and p^4 is a Tornqvist approximation to a Divisia price index for oats, flax, and rye. A normalized input price index $w^* = w/Ep^4$ for crop variable inputs (e.g. fertilizer, seed, and pesticides) is included here because it influences endogenous yields and in turn acreage allocations. Symmetry conditions analogous to (18) do not generally apply here.

B. Linear Models with Price Uncertainty

Here the initial wealth, mean and variance of revenue per acre are normalized as follows:

$W^*_0 \equiv W_0 / Er^4$

$Er^{*j} \equiv Er^j / Er^4$

$Ep^{*j} \equiv Ep^j / Ep^4$

$Vr_{jj}^* \equiv Vr_{jj} / Er^4$ in CARA models

$Vr_{jj}^{**} \equiv Vr_{jj}/(Er^4)^2$ in CRRA models

$Er_t^j \equiv Ep_t^j \, yld^j_{t-1}$ yld denotes as yield per acre

$Vr_{jjt} \equiv Vp_{jjt} \, (yld^j_{t-1})^2$

1. Yields are predetermined

Assuming constant absolute risk aversion (CARA), i.e., linear mean-variance risk preferences, equations (17) can be generalized as:

$$(20) \quad sz_t^i = \beta_i + \sum_{j=1}^{3} \beta_{ij} Er_t^{*j} + \beta_{i4} Z_t + \beta_{i5} (Z_t - Z_{t-1}) + \beta_{i6} Er_t^4 + \beta_{i7} d + \beta_{i8} t + \sum_{j=1}^{4} \gamma_{ij} Vr_{jjt}^* + e_t^i \qquad i=1,2,3$$

Equation (20) will be referred as a CARA model, although it satisfies CARA only under homogeneity conditions. Under CARA the coefficients (β,γ) in (20) can be interpreted as coefficients of the derivatives $\delta V^*(.)/\delta Er^i$ (i=1,2,3) of the dual, as in equations (6).

In principle each equation depends upon the four variances Vr_{jj}^* as well as six covariances Vr_{ij}^*. However those covariances are excluded in order to keep estimation of the model tractable and to reduce multicollinearity in the equations. The homogeneity and symmetry restrictions on acreage demands (20) that are implied by the linear mean-variance model (5) are $\beta_{i6} = 0$ (i=1,2,3) and (18), respectively, as in the risk-neutral model (e.g., Pope 1980, Coyle, 1992). Risk neutrality in this case will imply (21). Then acreage demands (20) reduce to (17).

$$(21) \quad \gamma_{ij} = 0 \qquad\qquad i,j = 1,2,3$$

Alternatively, equations (17) can be generalized as (22) by assuming predetermined yields and CRRA.

$$(22) \quad sz_t^i = \beta_i + \sum_{j=1}^{3} \beta_{ij}\, Er_t^{*j} + \beta_{i4}\, Z_t + \beta_{i5}\,(Z_t - Z_{t-1}) + \beta_{i6}\, Er_t^4 + \beta_{i7}\, d + \beta_{i8}\, t + \gamma_{i0}\, W_{0t}^* + \sum_{j=1}^{4} \gamma_{ij}\, Vr_{jjt}^{**} + e_t^i \qquad i=1,2,3$$

This equation will be referred to as a CRRA model, although as in CARA model, it also satisfies CRRA only under homogeneity conditions. Note that from the envelope relations (3) the coefficients (β,γ) cannot be interpreted as coefficients of the dual $V^*(.)$. This is because (22) is an approximation to a reduced form for a structural model (3). Unlike the risk-neutral and linear mean-variance models with predetermined yields, reciprocity does not generally apply to the acreage demands (22) (Pope 1980, Coyle 1995). CRRA implies the homogeneity restrictions $\beta_{i6} = 0$ (i = 1,2,3) for (22) (Pope 1988, Coyle 1995).

Risk neutrality implies $\gamma_{i0} = 0$ (i=1,2,3), i.e., initial wealth W_0^* does not influence acreage decisions, as in (20). Besides it also implies that $\gamma_{ij} = 0$, or the Vr terms are excluded from the model.

2. *Yields are not Predetermined*

In cases where crop yields are not predetermined, analogous acreage demands can be defined by replacing the mean and variance of revenues per acre by the mean and variance of price. Therefore model (20) can be respecified as the following acreage demand equations:

$$(23) \quad sz_t^i = \beta_i + \sum_{j=1}^{3} \beta_{ij}\, Ep_t^{*j} + \beta_{i4}\, Z_t + \beta_{i5}\,(Z_t - Z_{t-1}) + \beta_{i6}\, Ep_t^4 + \beta_{i7}\, d + \beta_{i8}\, t + \beta_{i9}\, w_t^* + \sum_{j=1}^{4} \gamma_{ij}\, Vp_{jjt}^* + e_t^i \qquad i = 1,2,3$$

Here, symmetry does not apply (Coyle 1993). However the restrictions for homogeneity and risk neutrality are similar to restrictions for the analogous models with predetermined yields (20), i.e., $\beta_{i6} = 0$ (i = 1,2,3) and (21) respectively.

In case of CRRA, equation (22) can be modified as:

$$(24)\quad sz_t^i = \beta_i + \sum_{j=1}^{3} \beta_{ij}\, Ep_t^{*j} + \beta_{i4}\, Z_t + \beta_{i5}\,(Z_t - Z_{t-1}) + \beta_{i6}\, Ep_t^{4} + \beta_{i7}\, d + \beta_{i8}\, t + \beta_{i9}\, w_t^{*} + \gamma_{i0}\, W_{0t}^{*} + \sum_{j=1}^{4} \gamma_{ij}\, Vp_{ijt}^{**} + e_t^i \qquad i = 1,2,3$$

As in CARA, reciprocity does not apply here (Coyle 1993). The homogeneity restriction is $\beta_{i6} = 0$ (i = 1,2,3), while risk neutrality restriction implies (21) which is similar to that for the analogous models with predetermined yields (22).

C. Linear Models with Yield Uncertainty

Here, acreage demands are not conditional on moments of Er, then demand equations (20) and (22) are modified to include the mean and variance of weather. Assuming independent distributions for yields and using a one year lag of yields as a proxy for expected yields, the means and variances of revenues used in these models are:

$Er_t^j \equiv Ep_t^j\, yld_{t-1}^j$

$Vr_{ijt} \equiv Vyld_{ijt}\, (Ep_t^j)^2$

1. Yields are Predetermined

In case of CARA and CRRA, equations to be estimated are:

$$(25)\quad sz_t^i = \beta_i + \sum_{j=1}^{3} \beta_{ij} Er_t^{*j} + \beta_{i4} Z_t + \beta_{i5}(Z_t - Z_{t-1}) + \beta_{i6} Er_t^{4} + \beta_{i7}\, d + \beta_{i8}\, t + \sum_{j=1}^{4} \gamma_{ij}\, Vr_{ijt}^{*} + e_t^i \qquad i = 1,2,3$$

$$(26)\quad sz_t^i = \beta_i + \sum_{j=1}^{3} \beta_{ij} Er_t^{*j} + \beta_{i4} Z_t + \beta_{i5}(Z_t - Z_{t-1}) + \beta_{i6} Er_t^4 + \beta_{i7}\, d + \beta_{i8}\, t + \gamma_{i0} W_{0t}^{*} + \sum_{j=1}^{4} \gamma_{ij} Vr_{jjt}^{**} + e_t^i \qquad i=1,2,3$$

These equations are similar to equation (20) and (22) but differ in measuring variances of revenues per acre (Vr_{jjt}). The homogeneity restrictions are $\beta_{i6} = 0$ (i = 1,2,3). Symmetry (18) applies for CARA only. The risk neutral restrictions imply that variables Vr_{jj}^{*}, W_0^{*}, and Vr_{jj}^{**} are omitted.

2. Yields are not Predetermined

In this case, for linear and nonlinear mean-variance approach, symmetry condition (18) does not apply. Homogeneity restriction for both models is $\beta_{i6} = 0$ (i = 1,2,3). For risk neutral, the restrictions are $\gamma_{i0} = 0$ (i = 1,..,6). Then the model under CARA and CRRA are specified as in (27) and (28).

$$(27)\quad sz_t^i = \beta_i + \sum_{j=1}^{3} \beta_{ij}\, Ep_t^{*j} + \beta_{i4}\, Z_t + \beta_{i5}\,(Z_t - Z_{t-1}) + \beta_{i6}\, Ep_t^4 + \beta_{i7}\, d + \beta_{i8}\, t + \beta_{i9}\, w_t^{*} + \sum_{j=1}^{4} \gamma_{ij}\, Vp_{jjt}^{**} + \gamma_{i5}\, E\omega_t + \gamma_{i6}\, V\omega_t + e_t^i \qquad i=1,2,3$$

$$(28)\quad sz_t^i = \beta_i + \sum_{j=1}^{3} \beta_{ij} Ep_t^{*j} + \beta_{i4} Z_t + \beta_{i5}(Z_t - Z_{t-1}) + \beta_{i6} Ep_t^4 + \beta_{i7}\, d +$$

$$\beta_{i8}\, t + \gamma_{i0}\, W_{0t}^{*} + \beta_{i9}\, w_t^{*} + \sum_{j=1}^{4} \gamma_{ij}\, Vp_{ijt}^{**} +$$

$$\gamma_{i5}\, E\omega_t + \gamma_{i6}\, V\omega_t + e_t^i \qquad i=1,2,3$$

ESTIMATION

Linear models will be estimated by Ordinary Least Square and Seemingly Unrelated Regression with autocorrelation degree 1 (OLS-AR(1) and SUR-AR(1)). For SUR-AR(1), models will be estimated using Generalized Least Square (GLS) transformations prior to the estimation where appropriate.

II. NONLINEAR MODEL

By assuming a nonlinear mean-variance risk preference, in fact the parameters of the dual cannot be estimated by linear methods. In this section nonlinear method is used to estimate those parameters of the dual. Models to be estimated here are those with nonlinear risk preferences, predetermined yields, and price uncertainty. Models with mean and variance of yields determined jointly with acreage demands are not considered due to the complexity of the models (e.g., Coyle, and Mundang, 1997).

Assuming no yield uncertainty and a normalized quadratic dual $V^{**}(.)$(V^{**} is normalized by total crop acreage Z and Er^4), acreage demand equations for wheat, barley, and canola can be specified as:

$$(29)\quad z_t^i = \left[\beta_i + \sum_{j=1}^{3} \beta_{ij}\, Er_t^{*j} + \beta_{i4}\, Z_t + \beta_{i5}\left(Z_t - Z_{t-1}\right) + \beta_{i6}\, Er_t^4 + \beta_{i7} d + \beta_{i8} t + \gamma_{i0}\, W_{0t}^* + \sum_{j=1}^{4} \gamma_{ij}\, Vr_{jit}^{**}\right] \Big/ \left[\beta_5 + \sum_{j=1}^{3} \beta_{5j}\, Er_t^{*j} + \beta_{54}\, Z_t + \beta_{55}\left(Z_t - Z_{t-1}\right) + \beta_{56}\, Er_t^4 + \beta_{57}\, d + \beta_{58}\, t + \gamma_{50}\, W_{0t}^* + \sum_{j=1}^{4} \gamma_{5j}\, Vr_{jit}^{**}\right] + e_t^i \qquad i = 1,2,3.$$

Equations (29) are highly nonlinear in coefficients. However, attempts to estimate these equations in Manitoba study were unsuccessful. Alternatively, Coyle and Mundang (1997) suggest specifying the following system (by substituting (4) into (3)):

$$(30)\quad z^i = \frac{\partial V^*(W_0, Er, Vr, Z)/\partial Er^i}{1 - \frac{1}{2}\left[\partial\alpha(W_0+ER, VR)/\partial(W_0+ER)\right]VR} \qquad i=1,2,3$$

$$(31)\quad \frac{1}{2}\,\frac{\partial\alpha(W_0+ER, VR)}{\partial(W_0+ER)}VR = 1 - \frac{\partial V^*(W_0, Er, Vr, Z)}{\partial W_0}$$

These equations can be estimated given functional forms for $\alpha(.)$ as well as $V^*(.)$. CRRA implies $\alpha(\lambda EW, \lambda^2 VW) = \lambda^{-1}\alpha(EW, VW)$ (e.g., Coyle, 1995), so $\lambda \equiv (VW)^{-0.5}$ yields $\alpha(EW/VW^{0.5}, 1) = VW^{0.5}\,\alpha$, i.e., $\alpha = VW^{-0.5}\, g(EW/VW^{0.5})$. Thus, assuming CRRA, a quadratic approximation to g(.) can be specified as follows:

$$(32) \quad g(ER/VR^{-0.5}) = c_0 + c_1\frac{(W_0 + ER)}{VR^{0.5}} + c_2\frac{(W_0 + ER)^2}{VR}$$

then,

$$(33) \quad \alpha = VR^{-0.5}\, g(.) = \frac{c_0}{VR^{0.5}} + c_1\frac{(W_0 + ER)}{VR} + c_2\frac{(W_0 + ER)^2}{VR^{1.5}}$$

where $ER \equiv \Sigma^4_{i=1} Er^j z^j$, $VR \equiv \Sigma^4_{i=1} Vr^j (z^j)^2$, (c_0, c_1, c_2) are coefficients, and in turn $\delta\alpha(.)/\delta EW = c_1/VR + 2\,c_2(W_0 + ER)/VR^{1.5}$. Given (33) and a normalized quadratic dual, equations (30) can be modified as:

$$(34) \quad sz_t^i = \left[\beta_i + \sum_{j=1}^{3} \beta_{ij} Er_t^{*j} + \beta_{i4} Z_t + \beta_{i5}\left(Z_t - Z_{t-1}\right) + \beta_{i6} Er_t^4 + \beta_{i7}\, d + \beta_{i8}\, t + \gamma_{i0}\, W_{0t}^{*} + \sum_{j=1}^{4} \gamma_{ij}\, Vr_{jjt}^{**}\right] \Bigg/ \left[1 - \left(\frac{c_1}{VR} + 2c_2\frac{(W_0 + ER)}{VR^{1.5}}\right)\frac{VR}{2}\right] + e_t^i \qquad i = 1,2,3.$$

Similarly, solving (31) for VR given a normalized quadratic dual and $\alpha(.)$ satisfying (33),

$$(35) \quad \frac{(W_0 + ER)}{VR^{0.5}} = \frac{1}{c_2} - Z_t\left[\beta_5 + \sum_{j=1}^{3} \beta_{5j}\, Er_t^{*j} + \beta_{54} Z_t + \beta_{55}\left(Z_t - Z_{t-1}\right) + \beta_{56}\, Er_t^4 + \beta_{57} d + \beta_{58} t + \gamma_{50} W_{0t}^{*} + \sum_{j=1}^{4} \gamma_{5j} Vr_{jjt}^{**}\right] \Bigg/ c_2 - \frac{c_1}{2\, c_2}$$

The reduced form for this equation is:

$$\text{(36)}\quad \frac{(W_0 + ER)}{VR^{0.5}} = \rho_0 - Z_t\left[\rho_{50} + \sum_{j=1}^{3}\rho_{5j}\, Er_t^{*j} + \rho_{54}Z_t + \rho_{55}\left(Z_t - Z_{t-1}\right) + \right.$$
$$\left. \rho_{56}\, Er_t^{4} + \rho_{57}\, d + \rho_{58}\, t + \tau_{50}\, W_{0t}^{*} + \sum_{j=1}^{4}\tau_{5j}\, Vr_{jjt}^{**}\right]$$

where $\rho_5 = (2 - c_1)/2c_2$; $\rho_5 = \beta_5/c_2$; $\rho_{5j} = \beta_{5j}/c_2$ (j = 1,...,7); $\tau_{5j} = \gamma_{5j}/c_2$ (j = 0,..,4). Note that by specifying (34) and (36) rather than (29), the degree of nonlinearity of coefficients has been substantially reduced.

ESTIMATION

As in Mundang (1996), the nonlinear system will be estimated in the following steps. (a) acreage demand equations (34) will be estimated jointly by nonlinear methods, and (b) the reduced form equation (36) will be estimated by linear methods. The estimation of (c_1,c_2) from (34) and the results of (36) provide parameter estimates for $\delta V^*(.)/\delta W_0$. Davidon-Fletcher-Powell (DFP) and Broyden-Fletcher-Goldfarb-Shanno (BFGS) quasi-Newton algorithm encoded in Shazam 7.0 were used for maximum likelihood estimation of a nonlinear seemingly unrelated regression system for (34).

One approach for calculating starting value for coefficients in the nonlinear system is: (a) Estimate the linear approximation to $W_0 + ER = V^*(.) + ½\ \alpha(.)VR$ (2) to obtain starting values for c_1 and c_2; (b) Then individual acreage demand equations (34) will be estimated by nonlinear methods using these starting values for (c_1, c_2) and results from CRRA linear models as starting values for coefficients of $\delta V^*(.)/\delta Er^i$; and (c) estimates of ($c_1$,$c_2$) from (a) and coefficient estimates of $\delta V^*(.)/\delta Er^i$ from (b) are used as starting values in nonlinear estimation of the joint system of acreage demands (34). Another alternative for starting values is to use results from Manitoba study to estimate equation (34).

DATA AND MEASUREMENT

Data

Time series data for 1961 - 1995 were used to estimate the acreage demand and yield response models. This period corresponds to that for which a weather index is available for Western Canada. Models are specified for the major crops in Western Canada, e.g., wheat, barley, oats, canola, flax, and rye.

Expected output prices are modelled using the CWB price for period 1948 - 1995 (CWB Annual Reports); CANSIM price for 1948 - 1984 period (which is an average market price obtained from CANSIM Database); average price (Statistics Canada: 1981 - 1995); and market price (1956 - 1995) for each particular type of crops considered, i.e., #2CWRS (wheat), #3CW (oats), #1CW (barley), #2CW (rye), #2Cw(flax), and #1CAN (canola). Since not all data sets are complete over this time period, the price data set will be combined from those four data sets.

Alternative measures of expected crop prices are:

a. a previous year of market prices

b. CWB price expectation for CWB crops (wheat, barley, and oats), which is the sum of the most recently observed components of CWB payments at planting time, i.e., current initial payments, plus adjustment and interim payments for crops marketed in the previous year, plus final payments for crops marketed two years previously (Coyle and Mundang, 1995 and 1997). Alternative proxies for variances of crop prices and yields were calculated using equations (37).

Time series data is usually collected by national or state level. This data is highly aggregated over individuals and regions. Prices faced by different firms are highly correlated over time. The variation over time in aggregate prices may give a reasonable measure of price uncertainty at the firm level.

A proxy for price variance Vp_t^i will be calculated as in Coyle, 1992.

$$(37) \qquad Vp_t^i = 0.50\left(p_{t-1}^i - E_{t-2}\, p_{t-1}^i\right)^2 + 0.33\left(p_{t-2}^i - E_{t-3}\, p_{t-2}^i\right)^2 + 0.17\left(p_{t-3}^i - E_{t-4}\, p_{t-3}^i\right)^2$$

where Vp_t^i is a price variance at time t for commodity i which equals to the sum of squares of prediction errors of the previous three years, with declining weights 0.50, 0.33, and 0.17.

As in Mundang (1996), input price indexes are obtained for variable inputs (e.g., fertilizer), machinery and equipment, and hired labour. Those data are collected from Farm Input Price Index 62-004 (Statistics Canada a and CANSIM). Crop acreages used are the harvested areas (CANSIM). Data on yield and production are also obtained from CANSIM. Initial stock of wealth is proxied as the value of land and buildings plus machinery and equipment (CANSIM).

Weather is proxied by a crop growth index (GRODEX) for 1961-1987 (Dyer, Narayanan, and Murray) and a CWB drought index for 1981-1995 (G.K. Walker). Since these weather indexes were measured differently and are not perfectly correlated for overlapping years (1981-1987), they were treated as two separate variables. Weather 1 is a GRODEX index from 1961 to 1980 with zero observation for the rest of period (1981-1995), then weather 2 is a CWB drought index (1981-1995) with zero value on a previous year. Another possibility was also considered by defining weather 1 for GRODEX (1961-1987) and weather 2 for CWB drought index (1988-1995) with zero value of observation for later and previous years respectively. Both a weather 1 and a weather 2 are included in models.

Uncertainty Measurement

Consider a production function with a single output, $y = f(x,\omega)$, where output y is a function of input level x and a stochastic weather variable ω. A first order approximation to output variance Vy conditional on x is:

$$(38)\quad Vy(x) = \left(\partial f(x, E\omega)/\partial\omega\right)^2 V\omega$$

where $(E\omega, V\omega)$ are the mean and variance of the distribution for ω. This approximation is exact if the production function is a Gorman Polar Form in terms of ω, $y = a(x) + \omega\, b(x)$, and the approximation generalizes to a vector ω of weather variables. This approach to measuring output variances can be generalized to a second order approximation to $f(x,\omega)$ (Coyle and Mundang, 1997). Note that this approach to measuring output variances from aggregate time series production data (y,x) does not necessarily underestimate output uncertainty at the farm level, in contrast to the variance of the aggregate production data y.

Time series data on a crop-specific weather index is available for several weather stations within a region, e.g., 34 stations for 1961-1987 period (GRODEX), and 174 stations for CWB drought index (1987-1995).[1]

Let ω_t^s be the level of the weather variable at time t at station s, then for each weather station, the weather variance can be defined as:

$$(39)\quad V\omega_t^s = 0.50\left(\omega_{t-1}^s - E_{t-2}\omega_{t-1}^s\right)^2 + 0.33\left(\omega_{t-2}^s - E_{t-3}\omega_{t-2}^s\right)^2 + 0.17\left(\omega_{t-3}^s - E_{t-4}\omega_{t-3}^s\right)^2 \qquad s = 1,\ldots,S$$

Then the variance averaged over S stations is:

$$(40)\quad V\omega_t = \sum_{s=1}^{S} V\omega_t^s / S$$

Aggregate production data (y,x) and the average of weather data over the stations, e.g., $E\omega_t = \Sigma^S_{s=1}\, \omega_t^s/S$ will be used to estimate the production function $y = f(x,\omega)$. Then

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[1] V_ω for 1988 - 1995 period are calculated from 78 weather stations due to incomplete data.

estimates of the production function $y = f(x,E\omega)$ can be used to calculate the marginal impact of weather on production $\partial f(x,E\omega)/\partial\omega$. This production function implies that the expected values of output y depend on nonstochastic inputs x and the first moment of stochastic weather variance ω. To measure yield uncertainty, aggregate production data will be combined with weather station data using (38).

The following production function is specified for each grain crop:

$$(41)\qquad yld_t^i = a_{i0} + a_{i1}(x/Z_t) + a_{i2} z_t^i + a_{i3} t + \omega_{1t}\left[b_{i0} + b_{i1}(x/Z_t) + b_{i2} z_t^i + b_{i3} t\right] + \omega_{2t}\left[d_{i0} + d_{i1}(x/Z_t) + d_{i2} z_t^i + d_{i3} t\right] + e_t^i \quad i = 1,..,6$$

where yld_t^i is yield of crop i, x is an implicit input quantity index which is calculated from farm operating expenses for fertilizer, seed, and pesticides divided by input price index for crop production, Z is total crop acreage, z^i acres of crop i, ω_1 is average of weather data for 1961 - 1987 (GRODEX), and ω_2 is average of CWB drought index (1988 - 1995). A quadratic model in weather ω_1 and ω_2 of production function (42) are also considered.

$$(42)\qquad yld_t^i = a_{i0} + a_{i1}(x/Z_t) + a_{i2} z_t^i + a_{i3} t + \omega_{1t}\left[b_{i0} + b_{i1}(x/Z_t) + b_{i2} z_t^i + b_{i3} t\right] + \omega_{2t}\left[c_{i0} + c_{i1}(x/Z_t) + c_{i2} z_t^i + c_{i3} t\right] + \omega_{1t}^2\left[d_{i0} + d_{i1}(x/Z_t) + d_{i2} z_t^i + d_{i3} t\right] + \omega_{2t}^2\left[f_{i0} + f_{i1}(x/Z_t) + f_{i2} z_t^i + f_{i3} t\right] + e_t^i \qquad i= 1,..,6$$

Then in the linear case (41), the marginal impacts of weather on yields for each period are:

$$(43)\quad \partial yld^i/\partial\omega_1 = b_{i0} + b_{i1}(x/Z_t) + b_{i2} z_t^i + b_{i3} t + e_t^i$$

$$(44)\quad \partial yld^{i}/\partial\omega_2 = d_{i0} + d_{i1}\,(x_t/Z_t) + d_{i2}\,z_t^{i} + d_{i3}\,t + e_t^{i}$$

Using the marginal impact of weather on yield (43-44) and (39), the variance of yield (38) can be calculated. On the other hand, if yield is quadratic in weather ω, then an alternative formula can be used to measure variances of yield (Coyle and Mundang, 1997).

RESULTS

A. Linear Model under Price Uncertainty

Diagnostic tests were conducted for the unit roots and cointegration using standard unit root tests (e.g., Dickey-Fuller and Phillips-Perron) and trend stationary tests (Kwiatkowski et al.). Results from the standard unit root tests (a unit root is the null hypothesis) conclude that data used for yield predetermined models (especially the variances of revenues) and yields not predetermined often have a unit root (90% confidence intervals). However, it is well known that the Dickey-Fuller and Phillips-Perron tests have a low power since they may often accept the null hypothesis although it is false (DeJong et al. 1992, Kwiatkowski et al. 1992). Therefore, a trend stationary test was also used as an alternative method. In this test, the null hypothesis is that data is stationary around a linear trend and the alternative hypothesis is a unit root. The result of the test is that the data used for both yield predetermined and not predetermined models often have no unit root. Based on those test results, which are quite different, there is not enough evidence for unit roots.[2]

Durbin Watson statistics (d) also can be used as a rough indicator of a unit root problem. The value of d is likely to be low (d approaches zero asymptotically) in models with data generated by random walks (Phillips; Durlauf and Phillips, Maddala). OLS estimate for the risk neutral model (17) and (19) show quite low d values (0.6 - 1.6). Therefore, models using first differenced data are also considered in this chapter. The J-test result concludes that both level (estimation using the original data) and first difference models are comparable.

Equations (17) and (19) are estimated using three sets of price data: i.e., average price, market price, and CWB price. Since results of estimates using average and market price are similar, a J-test was conducted between these prices for three major crops: wheat, barley, and canola. The J-test results are inconclusive, but market price was chosen in order to facilitate comparison with the next chapter. Another J-test was also conducted between 4 crop model and 5 crop models, which concludes that the 5 crop model is preferred. This is understandable since the 5 crop model has more explanatory variables (not much data aggregation), but it also has more multicollinearity problems than the 4 crop model. Therefore, the 4 crop model was chosen to be reported.

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[2]Shazam 7.0 is used throughout this study.

1. Risk Neutral Models

Estimates of equations (17) and (19) are presented in table 2.1 (OLS and first order autocorrelation). For level equations, own prices are positive, except for barley (yield predetermined) and wheat (yield not predetermined, market price), and they are significant for canola (all cases) and wheat (yield predetermined, CWB price). The standard significance used here is 0.05 level, unless indicated otherwise. The cross price effects are often negative and some are significant. The numeraire is insignificant in every equation. The total acreage Z has a positive impact and is significant for wheat share (0.05 level using CWB price, 0.1 level on other cases), but negative and insignificant on barley and canola. This different impact of Z on crop acreage demands are similar to other study (Coyle, 1993) on Western Canada Grain (1961-1984), although the model specification is somewhat different. The coefficient of crop acreage adjustment $DZ = Z_t - Z_{t-1}$ is negative for wheat and positive for barley and canola. DZ is significant on both wheat and barley (0.1 level on barley for yields predetermined models). DZ has a different impact on each acreage allocation since some crops may be substituted into rotation more easily than others (Coyle, 1993).

Table 2.2 shows the estimation results for (17) and (19) using first differenced data for both yield predetermined and not predetermined models. The effects of own prices are positive with exception for barley when yields are predetermined and they are significant on wheat and canola (except on wheat with yield not predetermined, market price). As in levels equations, the cross price effects are often negative and some are significant. In contrast to the level equations, the numeraire is significant on wheat when yields are predetermined.

As in Manitoba study, estimates of coefficients generally are more significant when yields are predetermined rather than not predetermined (especially own price of wheat). In contrast, this result somewhat differs from Coyle's study (1993) which concludes that "...*The significance of coefficients in wheat is substantially reduced by replacing prices with revenues per acre...*".[3] From tables 2.1 and 2.2, it can be seen that estimation using first difference data increases the DW statistics from 0.6 - 1.3 to 1.2 - 2.4 (OLS, yield predetermined) and from 0.7 - 1.6 to 1.3 - 2.2 (yield not predetermined).

Table 2.3 reports test results for risk neutral model which are estimated jointly using SUR (Seemingly Unrelated Regression) with AR(1) corrections where appropriate. Homogeneity ($\beta_{i6} = 0$, i=1,2,3) is not rejected in 7 out of 8 cases (it is rejected in the estimation using first differenced data when yields are predetermined using market price). Symmetry (18) is rejected in all 4 cases. This suggests that either the hypothesis of risk-neutral revenue maximization as in (8) is incorrect or there are errors in functional form. CRTS is accepted in 6 out of 8 cases (it is rejected only in first difference estimation using CWB price for both yield predetermined and not predetermined models). The hypothesis that acreage shares are not affected by the rate of change in total acreage DZ, is accepted in 6 out of 8 cases.

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[3]B.T. Coyle. On Modelling System of Crop Acreage Demands. *Journal of Agricultural Resource Economics*. 18 (1993):p.57-69.

2. Risk Averse Models

As in risk neutral models, the risk averse models are estimated using market price, CWB price and a hybrid price of the two (e.g., expected revenues and prices are measured by CWB price and the variances are estimated using market price). However the model applying the price variance formula (37) to CWB prices as defined here, does not seem to provide a reasonable measure of price uncertainty, and results were poor. In principal, the share equations of acreage demands (20), (22) - (24) are estimated in the same manner as in risk neutral models. Results for linear mean-variance model are presented in table 2.4 and 2.5, while the CRRA models are reported in table 2.6 and 2.7 for levels and first difference equations respectively.

In contrast to the Manitoba study (Mundang, 1996), where addition of price variances decreases the significance of expected revenues Er^* and expected prices Ep^*, here the CARA model often increases the significance of Er^* and Ep^* (compare tables 2.4 and 2.1). Furthermore, all the own price effects are positive, while the cross price effects are often negative (the positive effects of cross price usually are insignificant). The own price effects are significant for canola (all cases) and wheat (using hybrid price when yields are predetermined). The numeraire and total acreage Z are insignificant in all cases. DZ is significant and negative on wheat share and positive on barley and canola. It is also significant on barley (0.05 level for yield predetermined model and 0.1 level for yield not predetermined). All own variances have negative impacts and are significant for wheat (market price, yield not predetermined, 0.1 level). In addition, cross variances are often positive but insignificant.

As in level equations, estimates of CARA model using first difference data also improve the estimation of risk neutral models presented in table 2.2. Again, all own price impacts are positive and often significant (with exception for barley in all cases). Cross prices often have a negative impact and some are significant (i.e., canola price on wheat and barley share equations). The numeraire, total acreage Z and DZ are insignificant. The own variances are negative with exception of canola using hybrid price when yields are predetermined. This variable is significant only for wheat (0.1 level, yield not predetermined, market price). The cross variances are often positive and significant for wheat price variances on barley equation (yields predetermined). DW statistics on CARA OLS estimations using levels data are 0.6 - 2.5 and 0.8 - 1.9, while the d on estimations using first differenced data are 1.4 - 2.7 and 1.5 - 2.3 for yield predetermined and not predetermined models respectively.

Test results for risk averse CARA and CRRA models are summarized in table 2.8. For CARA, homogeneity is not rejected in all cases, while reciprocity is rejected in 1 out of 4 cases (first difference estimation). CRTS is rejected in 2 out of 8 cases, while risk neutrality hypotheses are not rejected in all cases (F-tests are insignificant). The hypothesis of zero adjustment cost (related to DZ) is rejected in 2 out of 8 cases (both are first difference estimations when yields are predetermined).

Table 2.6 and 2.7 present CRRA estimates for levels and first difference equations respectively. For levels equations (table 2.6), all own variances are negative. These own variances are significant only on wheat (2 out of 4 cases, 0.1 and 0.05 level). Compared to CARA estimates, there is a decrease in the significance of Er^* and Ep^* (except for canola), but an increase in significance for revenue variances. The initial wealth variable W_0 generally has a positive impact on wheat and negative on the other two crops (except for barley with yield predetermined, hybrid price). W_0 is significant on canola only (yield predetermined, on 0.05 and 0.1 level).

As in levels equations, in comparison to CARA (2.7 and 2.5), the CRRA estimation using first differenced data shows a decrease in significance of Er^* and Ep^* and an increase in significance of Vr^* and Vp^*. All own variances have negative impacts on acreage demands, except for canola (hybrid price). Own variances are only significant for wheat (yield not predetermined using market price) and barley (yield predetermined, market price). Initial wealth W_0 is insignificant in each equation.

DW statistics for CRRA in levels estimates (OLS) are 0.8 - 2.0 and 1.5 - 1.8, while in first difference estimates are 1.4 - 2.5 and 1.5 - 2.3 for yield predetermined and not predetermined models, respectively. As in CARA case, estimates using first difference data seems to increase the significance of Er^* and Ep^* but decrease those of Vr^* and Vp^*. Moreover, replacing Er^* with Ep^*, generally decreases both the significance of own prices (wheat and barley), and the significance of own variances except on wheat using market price (levels and first differenced data).

From table 2.8, homogeneity is not rejected in all cases, while CRTS and zero adjustment cost are also accepted in 6 out of 8 cases. Those three test results are opposite to the results in Manitoba study (Coyle and Mundang, 1997). In addition, the F-tests for variances and W_0 are also insignificant, which means the model reduces to risk neutral.

Alternative models of acreage demands in terms of crop prices (yield predetermined) and crop revenues (yield not predetermined) are compared using a J-test (Davidson and MacKinnon, 1993), but results are ambiguous (as in the Manitoba study). Tests were conducted for all models under price uncertainty (risk neutral and averse) using market price, CWB price, and hybrid price for three major crops: wheat, barley, and canola, and two alternative data: level and first difference data (table 2.9). For risk neutrality, both model specification (yield predetermined and not predetermined) generally are accepted on wheat (first difference equations) and on barley (levels equations). However, the yield predetermined model is preferred for barley using first differenced data, while yield not predetermined model is preferred on canola and wheat (levels data). These results differ somewhat from Coyle (1993) where the yield not predetermined model is preferred. Wheat and canola have the same pattern for CARA and CRRA. For wheat, models are comparable using differenced data, but the yield not predetermined model is preferred in levels equations. The yield not predetermined is definitely preferred in canola. For barley, the yield predetermined model is preferred (differenced data) under CARA and CRRA. In levels equations, the yield predetermined is preferred (CARA) but it is less preferred under CRRA case.

B. Linear Models under Yield Uncertainty

Diagnostic tests for a unit root, as in previous model were also conducted, but the results are inconclusive. The standard unit root test (Dickey-Fuller) concludes that data often have unit roots, while Phillips-Perron and Kwiatkowski test results indicate that data often have no unit roots. In addition, weather data has unit roots (based on standard unit root tests Dickey-Fuller and Phillips-Perron), but often has no unit root using the trend stationary test.

The production functions (41) and (42) are estimated by SUR. The joint F-test for restrictions $c_{ij} = f_{ij} = 0$ (i= 1,.,6; j= 0,.,3),are not rejected at 0.05 level with the exception of rye. In this case model (42) reduces to (41). These production functions are estimated using combination weather data GRODEX (1961 - 1987) and CWB drought index (1988 - 1995) only. The second set of weather data (GRODEX: 1961 - 1980; CWB: 1981 - 1995) was not considered due to data limitation in calculating the variance of weather V_ω using (39) and (40).

The marginal physical product of weather on yield (43) and (44) using unrestricted aggregate production function (41) are negative for some years. However, calculation under restricted production function ($a_{i2} = b_{i1} = b_{i3} = d_{i1} = d_{i3} = 0$, as in Mundang, 1996) led to positive impact for all years.

In contrast to Manitoba results, estimates of acreage demand equations (25) - (28) assuming yield predetermined and not predetermined under CARA and CRRA model led to poor results, especially using level data. Estimation using first difference data often led to lower standard errors of estimates for expected revenues and expected prices, although sometimes there is an increase in standard errors for variances. In these estimates, signs for coefficients of own prices and own variances are as expected (positive and negative respectively), with exception for barley with yield predetermined (see appendixes). In addition, models combining price and yield uncertainty are not considered in this study due to the poor results on yield uncertainty model.

These poor results in estimating acreage demands under yield uncertainty may be due to a poor approximation to the production function over Western Canada. Since weather varies over provinces, the error in data aggregation is relatively greater here than in aggregation for one province. However, smaller errors in data aggregation should occur to price variables because there is less variation in price across provinces. Thus poor estimates for production functions may be due to impossibility in aggregation of weather data, errors in other aggregation of other inputs, or of course omitted variables (e.g. capital inputs).

C. Nonlinear Model

As in Manitoba study, attempts to estimate the nonlinear equation (29) were unsuccessful. Alternatively, model (34) and (36) are estimated as approximation of (29). SUR results of these two models using both market and hybrid prices are summarized in table 2.10. Starting values for c_1 and c_2 are obtained from estimation of W_0+ER = $V^*(.)$ + $1/2\alpha(.)$VR, while starting values for betas are the results from Manitoba study (Mundang 1996). Estimates using c_1, c_2, and betas from Manitoba results as starting values give a similar result. Nonlinear estimations for first difference data were not considered since $(sz_t^i - (sz)_{t-1}^i) \neq [(\delta V/\delta Er^i)_t - (\delta V/\delta Er^i)_{t-1}] / [(-\alpha_1 VR/2)_t + (\alpha_1 VR/2)_{t-1}]$.

Table 2.10 shows that all own expected revenues (Er^*) are positive with the exception of barley (market price), and only canola has a significant coefficient. This means that the numerator, $\delta V/\delta Er^i$, is increasing in Er^i. In addition, canola is also the only crop that has negative and significant (market price) own variances. This result differs from the Manitoba study where all own price and own variances are significant. Initial wealth is positive for wheat and barley and negative for canola. This variable is always significant on canola and barley (0.1 level on barley using hybrid price). C_1 is negative and always significant while c_2 is positive and significant using market price only (0.1 level). These are relatively poor estimates in comparison to the Manitoba study. The d statistics are very low, i.e., 0.8 - 1.3 in wheat and barley estimations. In addition, as in the Manitoba study, the own price and variances in reduced form $\delta V/\delta W_0$ estimations, are insignificant with exception of canola (hybrid price).

CONCLUSION

This study of crop acreage demands in Western Canada is developed from a similar study using Manitoba data. However, results in this study are less satisfactory. One major reason may be due to difficulties in estimating the crop production functions, which is also a constraint in the Manitoba study. A plausible explanation is that there are substantial errors in weather aggregation over regions.

In addition, compared to another study on Western Canada grain (Coyle, 1993), results in this study are also less satisfactory. The explanation may be that the model here is estimated using a longer time period (1961 - 1995), while the other study using a shorter period (1961-1984). In this case, the model may need to incorporate changes in agricultural policy programs over 1984-1995.

TABLE 2.1. Estimates of Risk-Neutral Acreage Demands (Levels Data)

a. Yield Predetermined, market price

	Wheat--AR(1)			Barley--AR(1)			Canola--AR(1)		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Er1	0.000819	1.220	0.131	0.000388	1.070	0.178	-0.000506	-1.164	-0.471
Er2	-3.23E-05	-1.245	-0.006	-3.09E-05	-2.246	-0.016	4.98E-05	2.716	0.051
Er3	-0.000607	-1.274	-0.099	-0.000544	-2.132	-0.254	0.001014	3.199	0.958
Er4	-0.056653	-1.552	-0.096	0.0046297	0.234	0.023	0.012812	0.564	0.126
Z	1.23E-05	1.966	1.055	-5.19E-06	-1.456	-1.275	-4.27E-06	-1.277	-2.121
DZ	-6.68E-06	-2.311	-0.005	3.69E-06	2.331	0.008	1.88E-06	1.034	0.009
D	-0.110680	-2.019	-0.006	0.017235	0.573	0.003	0.030206	0.877	0.009
T	-0.006767	-1.632	-0.214	0.004028	1.479	0.366	0.006123	2.909	1.125
Constant	0.132530	0.498	0.233	0.376930	2.436	1.902	0.130800	0.935	1.335
Rho	0.773510	7.220	-	0.891330	11.632	-	0.518500	3.587	-
R2 / DW		*0.808*	*1.621*		*0.835*	*1.765*		*0.887*	*1.735*

b. Yield Predetermined, Expected CWB price

	Wheat--AR(1)			Barley--AR(1)			Canola--AR(1)		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Er1	0.000600	2.075	0.115	-4.25E-05	-0.246	-0.023	-0.000399	-2.087	-0.443
Er2	-2.01E-05	-1.257	-0.005	-1.93E-05	-2.031	-0.013	2.98E-05	2.754	0.041
Er3	-0.000745	-1.584	-0.124	-0.000493	-1.758	-0.236	0.001240	4.010	1.199
Er4	-0.062034	-1.592	-0.101	0.000773	0.033	0.004	0.035930	1.428	0.339
Z	1.29E-05	2.102	1.107	-6.08E-06	-1.632	-1.494	-4.80E-06	-1.264	-2.389
DZ	-6.56E-06	-2.418	-0.005	3.50E-06	2.150	0.008	1.66E-06	0.949	0.008
D	-0.112140	-2.262	-0.006	0.009266	0.312	0.001	0.018476	0.572	0.005
T	-0.008183	-1.778	-0.259	0.005316	1.775	0.483	0.005343	2.051	0.982
Constant	0.151740	0.585	0.267	0.437090	2.749	2.205	0.128990	0.812	1.317
Rho	0.848330	9.479	-	0.893510	11.772	-	0.732680	6.369	-
R2 / DW		*0.827*	*1.308*		*0.825*	*1.829*		*0.896*	*1.906*

TABLE 2.1. Cont...
(Levels Data)

c. Yield not Predetermined, market price

	Wheat--AR(1)			Barley--AR(1)			Canola--OLS		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Ep1	-0.001132	-0.041	-0.006	-0.013003	-0.800	-0.195	0.033262	2.072	1.010
Ep2	0.026607	0.647	0.072	0.015070	0.620	0.116	-0.077828	-3.022	-1.217
Ep3	-0.022219	-1.856	-0.183	-0.007967	-1.106	-0.189	0.025763	4.136	1.234
Ep4	-0.001378	-0.024	-0.003	0.032445	0.908	0.167	-0.031210	-1.186	-0.326
Pi1	0.001423	0.945	0.157	0.000908	0.996	0.288	-0.001266	-1.587	-0.812
Z	1.24E-05	2.012	1.065	-5.40E-06	-1.324	-1.326	-2.86E-06	-1.425	-1.420
DZ	-6.38E-06	-2.250	-0.005	3.46E-06	1.995	0.008	1.49E-06	0.857	0.007
D	-0.096663	-1.668	-0.005	0.017109	0.475	0.003	0.026654	0.863	0.008
T	-0.009499	-1.841	-0.301	0.002515	0.702	0.228	0.007335	3.639	1.348
Constant	0.116630	0.437	0.205	0.367760	2.061	1.855	0.114450	1.351	1.169
Rho	0.707150	5.917	-	0.865300	10.213	-	-	-	-
R2 / DW		*0.811*	*1.654*		*0.795*	*1.648*		*0.911*	*1.596*

d. Yield not Predetermined, Expected CWB price

	Wheat--AR(1)			Barley--AR(1)			Canola--AR(1)		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Ep1	0.007276	0.599	0.046	-0.010536	-1.368	-0.190	-0.001227	-0.155	-0.045
Ep2	0.015005	0.811	0.051	0.007713	0.665	0.075	-0.009242	-0.736	-0.182
Ep3	-0.027880	-2.444	-0.238	-0.010611	-1.458	-0.260	0.032010	4.541	1.585
Ep4	0.029337	0.512	0.051	0.035446	0.938	0.176	-0.048339	-1.535	-0.485
Pi1	0.001804	1.533	0.207	0.000983	1.292	0.324	-0.001551	-2.180	-1.033
Z	1.36E-05	2.169	1.169	-5.53E-06	-1.283	-1.359	-2.59E-06	-0.820	-1.287
DZ	-6.44E-06	-2.443	-0.005	3.43E-06	2.029	0.008	1.43E-06	0.860	0.006
D	-0.087381	-1.550	-0.004	0.019762	0.533	0.003	0.018834	0.565	0.006
T	-0.011729	-2.328	-0.372	0.003462	0.921	0.314	0.007382	2.944	1.357
Constant	0.050116	0.186	0.088	0.367690	1.954	1.855	0.107680	0.805	1.099
Rho	0.756500	6.843	-	0.894660	11.847	-	0.495030	3.371	-
R2 / DW		*0.834*	*1.408*		*0.801*	*1.637*		*0.907*	*1.653*

TABLE 2.2. Estimates of Risk-Neutral Acreage Demands (First Difference Data)

a. Yield Predetermined, market price

	Wheat--OLS		Barley--AR(1)		Canola--OLS	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
Er1	0.001339	2.191	0.000222	0.803	-0.000797	-1.998
Er2	-2.71E-05	-1.115	-4.29E-05	-3.286	4.95E-05	3.118
Er3	-0.000782	-1.724	-0.000599	-2.920	0.001262	4.259
Er4	-0.072072	-2.053	-0.0045017	-0.295	0.037604	1.640
Z	7.12E-06	1.020	-9.74E-07	-0.342	-1.18E-06	-0.259
DZ	-1.66E-06	-0.474	1.74E-06	1.073	-3.87E-07	-0.169
D	-0.155010	-2.495	0.079626	2.987	0.055678	1.372
T	-0.000644	-0.920	-0.000256	-1.025	0.000574	1.256
Constant	0.010747	0.647	0.005192	0.841	-0.008133	-0.750
Rho	-	-	-0.380720	-2.401	-	-
R2 / DW	***0.633***	***1.635***	***0.59***	***1.920***	***0.597***	***2.078***

b. Yield Predetermined, Expected CWB price

	Wheat--AR(1)		Barley--AR(1)		Canola--OLS	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
Er1	0.000896	3.716	5.14E-05	0.373	-0.000455	-2.557
Er2	-1.38E-05	-1.236	-2.43E-05	-2.643	2.96E-05	3.014
Er3	-0.000849	-2.141	-0.000634	-2.907	0.001399	4.797
Er4	-0.073197	-2.090	-0.006774	-0.391	0.048752	2.009
Z	1.07E-05	1.680	-1.16E-06	-0.413	-2.55E-06	-0.609
DZ	-2.67E-06	-0.899	1.74E-06	1.082	1.50E-07	0.073
D	-0.137260	-2.578	0.083363	3.140	0.040262	1.078
T	-0.000617	-0.618	-0.000267	-1.082	0.000576	1.371
Constant	0.004968	0.224	0.005924	0.969	-0.007293	-0.729
Rho	0.451280	2.949	-0.403700	-2.573	-	-
R2 / DW	***0.724***	***1.833***	***0.587***	***1.899***	***0.658***	***2.224***

TABLE 2.2. Cont...
(First Difference Data)

c. Yield not Predetermined, market price

	Wheat--OLS		Barley--OLS		Canola--OLS	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
Ep1	0.015851	0.580	-0.022299	-1.549	0.015147	0.929
Ep2	0.030554	0.785	0.019803	0.966	-0.049600	-2.134
Ep3	-0.021028	-1.785	-0.010519	-1.694	0.034329	4.877
Ep4	-0.031999	-0.545	0.042667	1.378	-0.003335	-0.095
Pi1	0.000775	0.519	0.001434	1.822	-0.001397	-1.566
Z	8.31E-06	1.135	1.20E-06	0.310	-3.78E-06	-0.865
DZ	-2.57E-06	-0.743	6.34E-07	0.347	1.09E-06	0.529
D	-0.126420	-1.839	0.097650	2.696	0.005575	0.136
T	-0.000509	-0.687	-5.82E-05	-0.149	0.000292	0.659
Constant	0.004782	0.267	-0.002438	-0.259	0.001124	0.105
R2 / DW	***0.609***	***1.597***	***0.454***	***2.150***	***0.641***	***1.961***

d. Yield not Predetermined, Expected CWB price

	Wheat--AR(1)		Barley--OLS		Canola--OLS	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
Ep1	0.020394	2.136	-0.011823	-1.803	-0.003843	-0.528
Ep2	0.008858	0.726	0.011083	1.200	-0.009309	-0.908
Ep3	-0.027342	-2.743	-0.014206	-2.258	0.037783	5.409
Ep4	-0.020293	-0.367	0.042583	1.283	-0.045020	-1.222
Pi1	0.000970	0.942	0.001245	1.910	-0.001907	-2.634
Z	1.08E-05	1.663	1.39E-07	0.037	-4.00E-06	-0.950
DZ	-3.11E-06	-1.081	8.37E-07	0.467	1.44E-06	0.725
D	-0.108780	-1.889	0.091942	2.594	0.004710	0.120
T	-0.000521	-0.512	-9.84E-05	-0.257	0.000430	1.011
Constant	0.001033	0.046	0.000323	0.035	3.87E-05	0.004
Rho	0.439590	2.854	-	-	-	-
R2 / DW	***0.716***	***1.746***	***0.467***	***2.088***	***0.664***	***1.954***

Table 2.3 Test Results for Risk-Neutral Acreage Demands Under Price Uncertainty

	Homogeneity		Symmetry		CRTS		Zero Adj. Cost	
	F-Stat	Prob.	F-Stat	Prob.	F-Stat	Prob.	F-Stat	Prob.
A. Level Equation[a]								
Yields are Predetermined								
a. Market price	1.617	0.192	3.148	0.030	0.462	0.710	0.150	0.929
b. CWB price	1.340	0.268	2.942	0.038	0.835	0.479	0.128	0.943
Yields are not Predetermined								
a. Market price	0.466	0.707	-	-	0.670	0.573	0.045	0.987
b. CWB price	0.456	0.714	-	-	0.981	0.407	0.321	0.810
B. First Difference Equation[b]								
Yields are Predetermined								
a. Market price	2.937	0.039	4.963	0.003	0.836	0.478	2.871	0.042
b. CWB price	1.505	0.221	4.345	0.007	4.648	0.005	3.743	0.015
Yields are not Predetermined								
a. Market price	0.673	0.571	-	-	0.847	0.473	0.186	0.906
b. CWB price	1.366	0.260	-	-	5.762	0.001	2.045	0.116

a) Degrees of freedom for F-Statistics are (3,75) for level equations

b) Degrees of freedom for F-Statistics are (3,72) for first difference equations

TABLE 2.4. Estimates of Acreage Demands under Price Uncertainty CARA (Levels Data)

a. Yield Predetermined, Ep market, Vp market

	Wheat--AR(1)			Barley--AR(1)			Canola--OLS		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Er1	0.000923	1.201	0.148	0.000294	0.721	0.135	-0.000460	-0.951	-0.428
Er2	-0.000259	-0.528	-0.046	0.000284	1.108	0.144	-0.000220	-0.749	-0.226
Er3	-0.000647	-1.255	-0.105	-0.000499	-1.869	-0.233	0.000859	2.421	0.811
Er4	-0.028847	-0.619	-0.049	-0.01118	-0.449	-0.054	-0.015063	-0.585	-0.149
Z	1.06E-05	1.573	0.911	-3.67E-06	-0.965	-0.902	-3.73E-06	-1.300	-1.855
DZ	-6.57E-06	-2.147	-0.005	3.57E-06	2.181	0.008	1.67E-06	0.822	0.008
D	-0.128880	-2.120	-0.007	0.034578	1.058	0.005	0.032504	0.856	0.010
T	-0.006958	-1.650	-0.220	0.0034021	1.148	0.309	0.008037	4.945	1.477
Vr1	-6.27E-05	-1.009	-0.039	5.12E-05	1.556	0.091	-1.12E-05	-0.313	-0.040
Vr2	1.97E-05	0.477	0.025	-2.68E-05	-1.239	-0.099	2.27E-05	0.905	0.170
Vr3	6.46E-06	0.164	0.003	1.06E-05	0.513	0.014	-2.93E-05	-1.252	-0.080
Vr4	6.93E-05	1.465	0.037	-3.33E-05	-1.320	-0.052	-4.07E-05	-1.503	-0.127
Constant	0.19531	0.688	0.344	0.30736	1.860	1.551	0.14002	1.183	1.430
Rho	0.73221	6.360	-	0.91097	13.066	-	-	-	-
R2 / DW		*0.826*	*1.716*		*0.853*	*1.699*		*0.902*	*1.849*

b. Yield Predetermined, Ep CWB, Vp market

	Wheat--AR(1)			Barley--AR(1)			Canola--OLS		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Er1	0.000916	2.895	0.175	-0.000192	-1.000	-0.105	-0.000449	-1.781	-0.498
Er2	-0.000198	-0.814	-0.046	5.95E-05	0.404	0.040	2.78E-05	0.155	0.038
Er3	-0.000748	-1.649	-0.125	-0.000505	-1.821	-0.241	0.000874	2.590	0.845
Er4	-0.028780	-0.677	-0.047	-0.019323	-0.738	-0.090	-0.022476	-0.946	-0.212
Z	1.05E-05	1.683	0.902	-4.36E-06	-1.104	-1.072	-4.00E-06	-1.542	-1.989
DZ	-6.23E-06	-2.390	-0.005	3.35E-06	2.076	0.007	1.72E-06	0.881	0.008
D	-0.132630	-2.545	-0.007	0.024407	0.760	0.004	0.028266	0.772	0.008
T	-0.008427	-1.866	-0.267	0.005168	1.575	0.469	0.008044	5.116	1.478
Vr1	-7.18E-05	-1.780	-0.048	4.28E-05	1.744	0.083	1.69E-05	0.606	0.066
Vr2	1.97E-05	0.764	0.029	-8.84E-06	-0.565	-0.037	-7.70E-07	-0.040	-0.007
Vr3	1.17E-05	0.361	0.006	-8.44E-06	-0.425	-0.012	-1.74E-05	-0.863	-0.050
Vr4	8.88E-05	2.468	0.052	-3.61E-05	-1.642	-0.060	-5.58E-05	-2.234	-0.189
Constant	0.214000	0.821	0.377	0.382720	2.270	1.931	0.147000	1.394	1.501
Rho	0.822540	8.557	-	0.917210	13.620	-	-	-	-
R2 / DW		*0.866*	*1.430*		*0.853*	*1.693*		*0.908*	*1.736*

TABLE 2.4. Cont...
(Levels Data)

c. Yield not Predetermined, Ep market, Vp market

	Wheat--AR(1)			**Barley--AR(1)**			**Canola--OLS**		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Ep1	0.024709	0.792	0.129	-0.009827	-0.490	-0.148	0.015498	0.792	0.471
Ep2	0.037452	0.908	0.101	0.009994	0.381	0.077	-0.066704	-2.568	-1.043
Ep3	-0.030370	-2.487	-0.251	-0.008275	-1.046	-0.196	0.029564	4.459	1.416
Ep4	0.030313	0.388	0.055	0.071205	1.261	0.367	-0.033254	-1.179	-0.347
PI1	0.000983	0.592	0.109	0.001517	1.345	0.481	-0.000804	-0.991	-0.516
Z	4.86E-06	0.686	0.417	-6.43E-06	-1.314	-1.581	2.21E-07	0.083	0.110
DZ	-5.90E-06	-2.099	-0.005	3.77E-06	2.046	0.008	1.33E-06	0.795	0.006
D	-0.155890	-2.506	-0.008	0.013437	0.324	0.002	0.050391	1.532	0.015
T	-0.005669	-1.010	-0.180	0.001133	0.260	0.103	0.005599	2.439	1.029
Vp1	-0.123070	-2.049	-0.086	0.022674	0.582	0.045	0.051439	1.790	0.208
Vp2	0.070373	0.733	0.023	-0.074178	-1.159	-0.069	-0.017600	-0.405	-0.033
Vp3	0.001524	0.103	0.002	0.004349	0.449	0.016	-0.002992	-0.400	-0.022
Vp4	0.048495	2.201	0.052	0.003741	0.260	0.012	-0.029187	-2.630	-0.182
Constant	0.362950	1.282	0.639	0.359860	1.777	1.816	-0.010822	-0.102	-0.111
Rho	0.720600	6.149	-	0.900160	12.227	-	-	-	-
R2 / DW		***0.850***	***1.633***		***0.809***	***1.542***		***0.933***	***1.589***

d. Yield not Predetermined, Ep CWB, Vp market

	Wheat--AR(1)			**Barley--AR(1)**			**Canola--OLS**		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Ep1	0.019970	1.673	0.126	-0.011907	-1.367	-0.215	-0.009028	-0.920	-0.330
Ep2	0.026108	1.505	0.089	0.009062	0.716	0.088	-0.018698	-1.273	-0.368
Ep3	-0.034070	-3.157	-0.291	-0.011761	-1.438	-0.288	0.030485	4.853	1.509
Ep4	0.080324	1.162	0.139	0.029988	0.516	0.149	-0.046685	-1.912	-0.469
PI1	0.001900	1.545	0.218	0.001006	1.015	0.331	-1.21E-06	-0.506	-0.601
Z	9.10E-06	1.574	0.780	-4.64E-06	-0.985	-1.139	-0.000851	-1.421	-0.567
DZ	-6.44E-06	-2.705	-0.005	3.60E-06	2.010	0.008	1.20E-06	0.679	0.005
D	-0.128930	-2.430	-0.007	0.031734	0.775	0.005	0.027934	0.849	0.008
T	-0.011765	-2.394	-0.373	0.003107	0.685	0.282	0.007108	3.948	1.306
Vp1	-0.065751	-1.617	-0.050	0.030138	1.001	0.066	0.034755	1.425	0.154
Vp2	-0.009917	-0.128	-0.004	-0.034898	-0.590	-0.036	-0.005531	-0.135	-0.012
Vp3	0.007951	0.652	0.011	-0.000204	-0.022	-0.001	-0.006448	-0.921	-0.051
Vp4	0.055295	3.210	0.064	-0.004971	-0.396	-0.017	-0.034684	-2.862	-0.234
Constant	0.168790	0.701	0.297	0.337860	1.655	1.705	0.063441	0.672	0.648
Rho	0.720840	6.153	-	0.906650	12.714	-	-	-	-
R2 / DW	***0.888***	***1.573***		***0.814***	***1.489***		***0.929***	***1.494***	

TABLE 2.5. Estimates of Acreage Demands under Price Uncertainty CARA (First Difference Data)

a. Yield Predetermined, Ep market, Vp market

	Wheat--OLS		Barley--AR(1)		Canola--OLS	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
Er 1	0.001518	2.058	0.0001435	0.505	-0.000731	-1.487
Er2	-0.000199	-0.432	0.000269	1.566	-0.000150	-0.489
Er3	-0.000854	-1.727	-0.000547	-2.766	0.001241	3.767
Er4	-0.051597	-1.139	-0.019292	-1.142	0.040545	1.343
Z	6.06E-06	0.795	-5.13E-07	-0.194	-1.49E-06	-0.293
DZ	-1.27E-06	-0.336	1.38E-06	0.877	-2.91E-07	-0.116
D	-0.163640	-2.420	0.085468	3.539	0.049876	1.107
T	-0.000568	-0.758	-0.000346	-1.603	0.000569	1.140
Vr1	-5.08E-05	-0.858	5.06E-05	2.280	-2.19E-05	-0.555
Vr2	1.50E-05	0.386	-2.74E-05	-1.891	1.68E-05	0.652
Vr3	9.17E-06	0.244	2.05E-06	0.139	-8.36E-06	-0.334
Vr4	5.05E-05	1.097	-4.13E-05	-2.359	7.53E-06	0.246
Constant	0.009847	0.552	0.006599	1.225	-0.007528	-0.634
Rho	-	-	-0.543650	-3.777	-	-
R2 / DW	***0.655***	***1.694***	***0.702***	***2.011***	***0.606***	***2.101***

b. Yield Predetermined, Ep CWB, Vp market

	Wheat--AR(1)		Barley--AR(1)		Canola--OLS	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
Er 1	0.001042	3.856	-0.000167	-1.168	-0.000504	-2.434
Er2	-0.000118	-0.611	0.000105	1.041	0.000176	1.165
Er3	-0.000819	-1.975	-0.000577	-3.020	0.001394	4.652
Er4	-0.054448	-1.360	-0.022612	-1.326	0.054216	1.931
Z	1.04E-05	1.529	-8.02E-08	-0.033	-2.16E-06	-0.492
DZ	-2.84E-06	-0.907	1.06E-06	0.711	-1.21E-08	-0.006
D	-0.143560	-2.518	0.089489	3.913	0.043398	1.109
T	-0.000511	-0.528	-0.000350	-1.719	0.000551	1.264
Vr1	-4.31E-05	-1.323	4.53E-05	2.790	7.36E-06	0.294
Vr2	1.14E-05	0.556	-1.51E-05	-1.397	-1.55E-05	-0.965
Vr3	1.39E-05	0.456	-1.21E-05	-0.942	1.17E-05	0.550
Vr4	4.97E-05	1.562	-4.46E-05	-2.992	-7.45E-06	-0.316
Constant	0.003120	0.143	0.007225	1.412	-0.007458	-0.714
Rho	0.411620	2.634	-0.583340	-4.188	-	-
R2 / DW	***0.757***	***1.855***	***0.719***	***1.916***	***0.697***	***2.170***

TABLE 2.5. Cont...
(First Difference Data)

c. Yield not Predetermined, Ep market, Vp market

	Wheat--AR(1)		Barley--OLS		Canola--OLS	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
Ep1	0.060132	2.058	-0.022370	-1.252	-0.003291	-0.176
Ep2	0.032455	0.869	0.014729	0.663	-0.056077	-2.412
Ep3	-0.024249	-2.125	-0.009839	-1.461	0.038620	5.482
Ep4	0.004929	0.054	0.080762	1.641	-0.057141	-1.110
Pi1	0.000402	0.231	0.002114	2.165	-0.001777	-1.739
Z	1.68E-06	0.220	4.70E-07	0.108	1.78E-07	0.039
DZ	-9.68E-07	-0.292	1.00E-06	0.515	2.21E-07	0.109
D	-0.161350	-2.353	0.096785	2.492	0.030072	0.740
T	-0.000443	-0.391	-0.000145	-0.354	0.000348	0.810
Vp1	-0.110760	-1.963	0.034686	1.079	0.057509	1.710
Vp2	0.059981	0.569	-0.081897	-1.475	0.007684	0.132
Vp3	0.005946	0.426	0.001630	0.196	-0.003540	-0.407
Vp4	0.028910	1.537	-0.001047	-0.091	-0.029273	-2.428
Constant	0.007401	0.297	-0.002538	-0.259	-0.001165	-0.114
Rho	0.422480	2.718	-	-	-	-
R2 / DW	***0.703***	***1.594***	***0.514***	***2.016***	***0.728***	***1.961***

d. Yield not Predetermined, Ep CWB, Vp market

	Wheat--AR(1)		Barley--OLS		Canola--OLS	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
Ep1	0.024770	2.468	-0.012708	-1.759	-0.008659	-1.208
Ep2	0.021517	1.514	0.011457	1.121	-0.017832	-1.757
Ep3	-0.030913	-2.700	-0.014928	-2.122	0.043671	6.254
Ep4	0.030485	0.351	0.043224	0.847	-0.054099	-1.068
Pi1	0.001420	1.010	0.001301	1.505	-0.001825	-2.127
Z	1.06E-05	1.646	2.09E-07	0.053	-3.17E-06	-0.804
DZ	-3.64E-06	-1.266	1.00E-06	0.535	1.28E-06	0.687
D	-0.120530	-2.091	0.096045	2.591	0.006187	0.168
T	-0.0005196	-0.551	-0.000124	-0.307	0.000398	0.995
Vp1	-0.042820	-1.069	0.032745	1.277	0.008301	0.326
Vp2	-0.004924	-0.057	-0.042127	-0.815	0.026407	0.515
Vp3	0.010397	0.815	-0.001370	-0.174	-0.002836	-0.362
Vp4	0.032474	2.122	-0.004534	-0.431	-0.025491	-2.443
Constant	-0.000545	-0.026	0.000445	0.047	0.000341	0.036
Rho	0.387740	2.453	-	-	-	-
R2 / DW	***0.771***	***1.841***	***0.521***	***1.891***	***0.759***	***2.043***

TABLE 2.6. Estimates of Acreage Demands under Price Uncertainty CRRA (Levels Data)

a. Yield Predetermined, Ep market, Vp market

	Wheat--AR(1)			Barley--AR(1)			Canola--OLS		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Er1	0.000734	0.880	0.118	0.000375	0.813	0.172	-5.04E-05	-0.091	-0.047
Er2	-0.000337	-0.701	-0.060	0.000343	1.319	0.174	-0.000191	-0.675	-0.196
Er3	-0.000659	-1.328	-0.107	-0.000548	-2.039	-0.256	0.000948	2.784	0.895
Er4	0.027761	0.453	0.047	-0.026139	-0.621	-0.127	-0.025122	-1.120	-0.248
Z	8.14E-06	1.201	0.697	-3.28E-06	-0.843	-0.807	-2.94E-06	-1.070	-1.464
DZ	-6.11E-06	-2.031	-0.005	3.67E-06	2.213	0.008	1.47E-06	0.785	0.007
D	-0.149010	-2.462	-0.008	0.041588	1.240	0.006	0.044798	1.239	0.013
T	-0.009655	-1.954	-0.306	0.004348	1.193	0.395	0.008982	5.396	1.651
Vr1	-0.000102	-1.402	-0.055	6.73E-05	1.694	0.103	-2.10E-05	-0.499	-0.065
Vr2	2.96E-05	0.659	0.034	-3.53E-05	-1.452	-0.115	2.35E-05	0.883	0.155
Vr3	2.59E-05	0.610	0.011	1.06E-05	0.448	0.013	-3.31E-05	-1.263	-0.083
Vr4	9.60E-05	1.785	0.045	-4.39E-05	-1.497	-0.059	-3.42E-05	-1.067	-0.093
W01	1.28E-09	0.941	0.111	-3.17E-10	-0.338	-0.079	-8.63E-10	-1.709	-0.433
Constant	0.271840	0.966	0.478	0.291030	1.735	1.468	0.088961	0.765	0.908
Rho	0.754440	6.800	-	0.926670	14.585	-	-	-	-
R2 / DW		*0.844*	*1.664*		*0.858*	*1.717*		*00.920*	*2.019*

b. Yield Predetermined, Ep CWB, Vp market

	Wheat--AR(1)			Barley--AR(1)			Canola--OLS		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Er1	0.000785	2.266	0.150	-0.000216	-0.971	-0.118	-0.000192	-0.765	-0.213
Er2	-0.000153	-0.575	-0.036	4.32E-05	0.259	0.029	-7.65E-06	-0.043	-0.010
Er3	-0.000737	-1.623	-0.123	-0.000521	-1.817	-0.249	0.001160	3.674	1.121
Er4	0.022220	0.347	0.036	-0.000252	-0.005	-0.001	-0.035065	-1.682	-0.331
Z	9.46E-06	1.475	0.811	-4.91E-06	-1.167	-1.205	-2.11E-06	-0.858	-1.049
DZ	-6.25E-06	-2.350	-0.005	3.70E-06	2.174	0.008	8.55E-07	0.489	0.004
D	-0.142480	-2.692	-0.007	0.022473	0.662	0.003	0.039476	1.192	0.012
T	-0.010408	-2.144	-0.330	0.004370	1.198	0.397	0.008155	5.806	1.499
Vr1	-7.76E-05	-1.894	-0.048	3.91E-05	1.510	0.070	7.18E-06	0.264	0.026
Vr2	1.42E-05	0.538	0.021	-6.72E-06	-0.404	-0.028	3.64E-06	0.202	0.031
Vr3	2.79E-05	0.780	0.013	-5.13E-06	-0.220	-0.007	-2.45E-05	-1.246	-0.066
Vr4	9.61E-05	2.602	0.052	-3.73E-05	-1.602	-0.058	-4.40E-05	-1.686	-0.138
W01	7.47E-10	0.688	0.068	4.55E-10	0.573	0.119	-8.70E-10	-2.334	-0.460
Constant	0.225240	0.860	0.396	0.391660	2.244	1.976	0.056386	0.546	0.576
Rho	0.804990	8.027	-	0.903530	12.474	-	-	-	-
R2 / DW	*0.875*	*1.493*		*0.852*	*1.672*		*0.930*	*1.899*	

TABLE 2.6. Cont... (Levels Data)

c. Yield not Predetermined, Ep market, Vp market

	Wheat--AR(1)			Barley--AR(1)			Canola--OLS		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Ep1	0.013898	0.409	0.073	0.005740	0.276	0.086	0.018311	0.859	0.556
Ep2	0.042044	1.014	0.113	0.008596	0.339	0.066	-0.071533	-2.818	-1.118
Ep3	-0.029167	-2.338	-0.241	-0.012150	-1.537	-0.287	0.031226	4.795	1.495
Ep4	0.006344	0.085	0.011	0.070317	1.340	0.363	-0.010223	-0.320	-0.107
Pi1	-8.29E-05	-0.038	-0.009	0.002523	1.711	0.800	2.87E-05	0.029	0.018
Z	5.55E-06	0.764	0.475	-7.51E-06	-1.555	-1.846	2.16E-07	0.081	0.108
DZ	-6.10E-06	-2.134	-0.005	3.64E-06	2.018	0.008	1.36E-06	0.846	0.006
D	-0.158970	-2.491	-0.008	0.010522	0.255	0.002	0.053003	1.663	0.016
T	-0.005589	-0.975	-0.177	0.003161	0.691	0.287	0.004788	2.111	0.880
Vp1	-0.155120	-2.105	-0.091	0.004175	0.091	0.007	0.072875	2.058	0.248
Vp2	0.117500	0.969	0.031	-0.106930	-1.374	-0.080	-0.044609	-0.800	-0.068
Vp3	0.000760	0.043	0.001	0.006911	0.597	0.022	-0.005545	-0.630	-0.036
Vp4	0.051775	1.920	0.049	0.016220	0.976	0.044	-0.032002	-2.242	-0.175
W01	9.70E-10	0.560	0.082	-1.48E-09	-1.074	-0.357	-6.06E-10	-0.980	-0.296
Constant	0.395710	1.350	0.696	0.349500	1.715	1.763	-0.051558	-0.471	-0.526
Rho	0.731720	6.351	-	0.933060	15.346	-	-	-	-
R2 / DW		*0.854*	*1.644*		*0.825*	*1.663*		*0.941*	*1.720*

d. Yield not Predetermined, Ep CWB, Vp market

	Wheat--AR(1)			Barley--AR(1)			Canola--OLS		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Ep1	0.019624	1.491	0.124	-0.009225	-0.963	-0.166	-0.007513	-0.739	-0.274
Ep2	0.022711	1.288	0.077	0.008093	0.642	0.079	-0.018101	-1.252	-0.357
Ep3	-0.032321	-2.915	-0.276	-0.012612	-1.525	-0.309	0.031474	5.000	1.558
Ep4	0.057975	0.842	0.100	0.019535	0.361	0.097	-0.020216	-0.608	-0.203
Pi1	0.000485	0.250	0.056	0.002117	1.412	0.697	0.000363	0.365	0.242
Z	9.30E-06	1.535	0.797	-3.98E-06	-0.834	-0.979	-1.28E-06	-0.547	-0.636
DZ	-6.75E-06	-2.727	-0.005	3.26E-06	1.799	0.007	1.40E-06	0.815	0.006
D	-0.129150	-2.336	-0.007	0.033651	0.805	0.005	0.029013	0.902	0.009
T	-0.010357	-2.026	-0.328	0.003657	0.790	0.332	0.005405	2.629	0.993
Vp1	-0.070356	-1.576	-0.049	0.022689	0.701	0.045	0.046925	1.799	0.188
Vp2	0.012290	0.139	0.004	-0.022686	-0.349	-0.020	-0.034998	-0.748	-0.063
Vp3	0.008677	0.595	0.011	-0.004076	-0.366	-0.015	-0.008087	-1.056	-0.059
Vp4	0.047114	2.718	0.051	-0.0022059	-0.179	-0.007	-0.031402	-2.486	-0.197
W01	8.41E-10	0.578	0.075	-1.36E-09	-1.068	-0.349	-6.91E-10	-1.115	-0.358
Constant	0.208200	0.795	0.366	0.294530	1.389	1.486	0.014822	0.138	0.151
Rho	0.746400	6.635	-	0.927440	14.672	-	-	-	-
R2 / DW		*0.887*	*1.581*		*0.819*	*1.544*		*0.936*	*1.779*

TABLE 2.7. Estimates of Acreage Demands under Price Uncertainty CRRA (First Difference Data)

a. Yield Predetermined, Ep market, Vp market

	Wheat--OLS		Barley--AR(1)		Canola--OLS	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
Er1	0.001634	1.904	0.000278	0.841	-0.000759	-1.308
Er2	-0.000256	-0.553	0.000340	2.009	-0.000149	-0.477
Er3	-0.000863	-1.727	-0.000607	-3.111	0.001278	3.784
Er4	-0.021629	-0.264	-0.040476	-1.621	0.013264	0.239
Z	5.35E-06	0.702	-5.27E-07	-0.204	-9.83E-07	-0.191
DZ	-1.18E-06	-0.314	1.30E-06	0.842	-5.40E-07	-0.213
D	-0.169810	-2.471	0.083334	3.446	0.049268	1.060
T	-0.000515	-0.648	-0.000431	-1.888	0.000469	0.873
Vr1	-8.96E-05	-1.274	6.59E-05	2.500	-4.83E-06	-0.102
Vr2	2.25E-05	0.520	-3.71E-05	-2.348	1.81E-05	0.621
Vr3	2.43E-05	0.546	1.33E-06	0.079	-2.98E-05	-0.989
Vr4	7.97E-05	1.518	-5.18E-05	-2.587	-6.04E-06	-0.170
W01	3.55E-10	0.188	-4.91E-10	-0.838	-5.02E-10	-0.394
Constant	0.007829	0.383	0.009709	1.559	-0.004542	-0.329
Rho	-	-	-0.580600	-4.158	-	-
R2 / DW	***0.676***	***1.625***	***0.733***	***1.991***	***0.619***	***2.079***

b. Yield Predetermined, Ep CWB, Vp market

	Wheat--AR(1)		Barley--AR(1)		Canola--AR(1)	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
Er1	0.001253	4.211	-0.000154	-0.965	-0.000383	-1.583
Er2	-0.000150	-0.759	0.000103	0.925	0.000142	0.824
Er3	-0.000873	-2.134	-0.000596	-3.222	0.001425	4.922
Er4	-0.159640	-1.544	-0.039234	-1.525	0.017319	0.395
Z	1.10E-05	1.656	3.21E-07	0.136	-2.27E-06	-0.582
DZ	-3.24E-06	-1.062	7.51E-07	0.496	-2.34E-08	-0.011
D	-0.139310	-2.539	0.092097	4.136	0.039964	1.110
T	-0.000750	-0.638	-0.000378	-1.851	0.000493	1.382
Vr1	-3.25E-05	-1.068	5.03E-05	3.022	1.68E-05	0.659
Vr2	1.39E-05	0.710	-1.43E-05	-1.287	-1.09E-05	-0.632
Vr3	1.95E-06	0.053	-1.70E-05	-1.146	1.82E-06	0.077
Vr4	4.38E-05	1.494	-5.20E-05	-3.286	-2.45E-05	-1.012
W01	-2.04E-09	-1.219	-1.58E-10	-0.359	-3.40E-10	-0.449
Constant	0.011269	0.420	0.008223	1.531	-0.004850	-0.526
Rho	0.542080	3.761	-0.671350	-5.282	-0.341740	-2.120
R2 / DW	***0.776***	***1.816***	***0.734***	***1.871***	***0.713***	***2.033***

TABLE 2.7. Cont... (First Difference Data)

c. Yield not Predetermined, Ep market, Vp market

	Wheat--AR(1)		Barley--OLS		Canola--OLS	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
Ep1	0.053004	1.710	-0.003901	-0.205	-0.015467	-0.771
Ep2	0.038249	1.010	0.010034	0.473	-0.054035	-2.411
Ep3	-0.027288	-2.178	-0.014453	-2.158	0.041583	5.883
Ep4	-0.046899	-0.493	0.070979	1.598	-0.028561	-0.609
Pi1	0.000759	0.320	0.003578	2.757	-0.002745	-2.003
Z	9.59E-07	0.119	-1.55E-06	-0.357	1.84E-06	0.401
DZ	-7.88E-07	-0.230	1.30E-06	0.694	6.57E-08	0.033
D	-0.177420	-2.480	0.085397	2.212	0.048275	1.185
T	-0.000487	-0.420	-0.000446	-1.048	0.000584	1.301
Vp1	-0.150150	-2.224	0.028616	0.764	0.089047	2.252
Vp2	0.102540	0.755	-0.126020	-1.882	0.006396	0.091
Vp3	-0.001088	-0.061	0.001255	0.129	-0.002121	-0.207
Vp4	0.043984	1.928	0.009664	0.707	-0.043443	-3.010
W01	-1.19E-09	-0.431	-2.13E-09	-1.659	1.89E-09	1.399
Constant	0.012239	0.461	0.006223	0.594	-0.009420	-0.852
Rho	0.408850	2.612	-	-	-	-
R2 / DW	*0.711*	*1.573*	*0.579*	*2.295*	*0.760*	*2.054*

d. Yield not Predetermined, Ep CWB, Vp market

	Wheat--AR(1)		Barley--OLS		Canola--OLS	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
Ep1	0.028566	2.474	-0.008694	-1.087	-0.012186	-1.487
Ep2	0.019247	1.373	0.009629	0.964	-0.013757	-1.344
Ep3	-0.030700	-2.490	-0.016196	-2.324	0.043318	6.066
Ep4	0.012784	0.152	0.030050	0.650	-0.032883	-0.694
Pi1	0.001772	0.864	0.002818	2.099	-0.0028209	-2.050
Z	1.01E-05	1.524	3.83E-07	0.098	-3.57E-06	-0.887
DZ	-3.67E-06	-1.241	7.87E-07	0.426	1.72E-06	0.910
D	-0.127700	-2.142	0.093316	2.514	0.009932	0.261
T	-0.000661	-0.626	-0.000320	-0.756	0.000567	1.306
Vp1	-0.036063	-0.830	0.031178	1.147	0.013488	0.484
Vp2	-0.017911	-0.188	-0.041285	-0.732	0.007679	0.133
Vp3	0.007667	0.464	-0.007234	-0.763	0.004233	0.435
Vp4	0.030920	2.134	-0.001553	-0.153	-0.023708	-2.279
W01	-9.56E-10	-0.477	-1.82E-09	-1.538	1.60E-09	1.319
Constant	0.003353	0.144	0.004725	0.479	-0.004106	-0.406
Rho	0.433850	2.808	-	-	-	-
R2 / DW	*0.771*	*1.839*	*0.555*	*2.118*	*0.761*	*2.05*

Table 2.8 Test Results for Acreage Demands Under Price Uncertainty
I. C A R A

	Homogeneity		Reciprocity		CRTS		Zero Adj. Cost		Vp[b]	
	F-Stat	Prob.	F-Stat	Prob.	F-Stat	Prob.	F-Stat	Prob.	F-Stat	Prob.
A. Levels Equation[a]										
Yields are Predetermined										
a. market Ep, market Vp	1.915	0.136	0.960	0.417	0.491	0.690	0.641	0.591	1.210	0.297
b. CWB Ep, market VP	1.443	0.239	2.508	0.067	1.398	0.252	0.737	0.534	1.798	0.068
Yields are not Predetermined										
a. market Ep, market Vp	1.371	0.260	-	-	1.819	0.153	0.313	0.816	1.021	0.442
b. CWB Ep, market VP	1.122	0.348	-	-	0.930	0.432	0.383	0.766	1.019	0.444
B. First Difference Equationa[a]										
Yields are Predetermined										
a. market Ep, market Vp	2.534	0.065	0.614	0.609	0.398	0.755	4.430	0.007	0.887	0.564
b. CWB Ep, market VP	2.136	0.105	5.366	0.002	3.678	0.017	5.176	0.003	1.231	0.284
Yields are not Predetermined										
a. market Ep, market Vp	0.263	0.852	-	-	2.254	0.092	0.866	0.464	0.829	0.620
b. CWB Ep, market VP	2.031	0.120	-	-	4.871	0.004	2.009	0.123	1.462	0.166

a)Degrees of freedom for F-Statistic are (3,63) for level equations and (3,60) for first difference equations
b)Degrees of freedom for (Vp) F-Statistic are (12,63) for level equations and (12,60) for first difference equations

Table 2.8 Cont...

II. C R R A

	Homogeneity		CRTS		Zero Adj. Cost		Vp[b)]		W_0	
	F-Stat	Prob.	F-Stat	Prob.	F-Stat	Prob.	F-Stat	Prob.	F-Stat	Prob.
A. Levels Equation[a)]										
Yields are Predetermined										
a. market Ep, market Vp	1.948	0.131	0.375	0.771	0.717	0.546	1.210	0.298	1.650	0.187
b. CWB Ep, market VP	2.027	0.120	0.935	0.429	0.593	0.622	1.367	0.207	2.591	0.061
Yields are not Predetermined										
a. market Ep, market Vp	1.743	0.168	2.153	0.104	0.212	0.888	1.146	0.344	1.307	0.281
b. CWB Ep, market VP	0.743	0.531	0.651	0.586	0.196	0.898	0.696	0.749	0.204	0.893
B. First Difference Equation[a)]										
Yields are Predetermined										
a. market Ep, market Vp	2.257	0.092	0.316	0.814	4.403	0.007	0.960	0.497	0.824	0.486
b. CWB Ep, market VP	2.086	0.112	4.196	0.009	5.444	0.002	0.979	0.479	1.455	0.236
Yields are not Predetermined										
a. market Ep, market Vp	0.568	0.639	1.962	0.131	0.682	0.567	0.959	0.498	0.354	0.786
b. CWB Ep, market VP	0.697	0.558	4.441	0.007	1.804	0.157	1.204	0.304	0.123	0.946

a)Degrees of freedom for F-Statistic are (3,60) for level equations and (3,57) for first difference equations
b)Degrees of freedom for (Vp) F-Statistic are (12,60) for level equations and (12,57) for first difference equations

Table 2.9a. Significance of $Shat_p^{(1)}$ in $S_a^{(2)}$ Equation

		Level Equation			First Difference Equation		
		Coeff.	T-ratio	Prob.	Coeff.	T-ratio	Prob.
Risk Neutral							
Wheat	(a)	0.624	0.633	0.533	0.816	1.613	0.120
	(b)	-1.636	-1.168	0.254	0.660	0.991	0.332
Barley	(a)	1.588	1.255	0.222	0.911	2.569	0.017
	(b)	1.310	0.918	0.368	0.865	2.135	0.044
Canola	(a)	0.189	0.558	0.582	0.550	2.127	0.044
	(b)	0.310	0.799	0.432	0.590	2.101	0.047
CARA							
Wheat	(a)	0.308	0.364	0.720	0.643	1.051	0.307
	(b)	0.098	0.157	0.877	0.810	1.389	0.181
	(c)	-0.467	-0.637	0.531	0.326	0.365	0.719
Barley	(a)	1.955	1.455	0.161	0.999	3.236	0.004
	(b)	2.544	1.945	0.066	1.005	3.228	0.004
	(c)	1.962	1.336	0.197	0.922	2.941	0.008
Canola	(a)	0.156	0.411	0.686	0.372	1.353	0.192
	(b)	0.575	1.756	0.094	0.553	1.859	0.079
	(c)	0.191	0.378	0.710	0.419	1.373	0.186
CRRA							
Wheat	(a)	0.497	0.509	0.617	0.761	1.227	0.236
	(b)	-0.389	-0.663	0.515	0.693	1.046	0.309
	(c)	-0.142	-0.174	0.863	0.633	0.707	0.489
Barley	(a)	2.444	3.343	0.003	0.889	2.968	0.008
	(b)	1.931	2.665	0.015	0.956	3.041	0.007
	(c)	2.251	3.336	0.003	0.831	2.521	0.021
Canola	(a)	0.310	0.852	0.405	0.287	0.947	0.356
	(b)	0.755	2.327	0.031	0.535	1.692	0.108
	(c)	0.601	1.428	0.170	0.399	1.176	0.255

1) $Shat_p^i$: Predicted acreage share assuming yield is predetermined
2) S_a^i : Acreage demand equation assuming yield is not predetermined
a) Estimates using market price
b) Estimates using CWB price
c) Estimates using 'hybrid' price

Table 2.9b. Significance of $Shat_s^{(1)}$ in $S_p^{(2)}$ Equation

		Level Equation			First Difference Equation		
		Coeff.	T-ratio	Prob.	Coeff.	T-ratio	Prob.
Risk Neutral							
Wheat	(a)	1.185	2.979	0.006	0.564	0.976	0.339
	(b)	1.179	3.307	0.003	0.630	1.016	0.320
Barley	(a)	1.168	1.294	0.208	0.458	1.012	0.322
	(b)	1.234	1.316	0.200	0.495	1.052	0.303
Canola	(a)	1.146	4.400	0.000	0.931	3.592	0.001
	(b)	1.033	3.094	0.005	0.705	2.459	0.022
CARA							
Wheat	(a)	1.149	2.906	0.008	0.706	1.288	0.212
	(b)	0.966	1.935	0.067	0.561	1.116	0.278
	(c)	1.216	3.709	0.001	1.127	1.647	0.115
Barley	(a)	1.068	1.494	0.150	0.499	1.198	0.245
	(b)	0.791	0.699	0.493	0.683	1.834	0.082
	(c)	0.881	1.149	0.263	0.461	0.995	0.331
Canola	(a)	1.342	4.376	0.000	1.084	4.587	0.000
	(b)	0.812	2.491	0.021	0.947	3.280	0.004
	(c)	1.137	2.996	0.007	1.039	3.571	0.002
CRRA							
Wheat	(a)	1.189	2.989	0.007	0.657	1.174	0.255
	(b)	1.309	3.116	0.005	0.922	1.754	0.095
	(c)	1.234	3.705	0.001	0.971	1.386	0.182
Barley	(a)	1.132	3.095	0.006	0.555	1.592	0.128
	(b)	1.069	2.928	0.008	0.769	2.399	0.027
	(c)	1.039	3.382	0.003	0.659	1.522	0.145
Canola	(a)	1.423	4.446	0.000	1.035	4.291	0.000
	(b)	0.792	2.526	0.020	0.985	3.368	0.003
	(c)	0.877	2.243	0.036	0.999	3.191	0.005

1) $Shat_s^i$: Predicted acreage share assuming yield is not predetermined
2) S_p^i : Acreage demand equation assuming yield is predetermined
a) Estimates using market price
b) Estimates using CWB price
c) Estimates using 'hybrid' price

TABLE 2.10. Nonlinear SUR Estimates of Acreage Demands under Price Uncertainty (Levels Data)

a. Yield Predetermined, Ep market, Vp market

	Wheat		Barley		Canola		(Wo + ER)/VRSQ	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
Er1	0.007399	0.448	-0.006567	-0.473	-0.001046	-0.163	-9.42E-06	-0.445
Er2	0.009063	1.135	-0.003252	-0.504	-0.003446	-0.931	1.249E-05	1.160
Er3	-0.003541	-0.336	-0.014709	-1.732	0.017877	4.007	-2.14E-05	-1.654
Er4	0.533150	0.795	0.387760	0.704	-0.481510	-1.608	0.001044	1.223
Z	0.000294	3.415	-0.000242	-3.727	-5.67E-05	-1.653	-1.81E-07	-1.724
DZ	-0.000210	-3.784	0.000172	3.812	2.90E-05	1.202	9.65E-08	1.354
D	-3.456800	-3.232	0.610440	0.721	0.841520	1.850	-0.003490	-2.533
T	-0.243020	-4.678	0.089004	2.212	0.171230	7.582	7.35E-05	1.160
W01	5.49E-09	0.377	2.93E-08	2.441	-1.65E-08	-2.753	-8.08E-12	-0.420
Vr1	0.000275	0.216	0.000257	0.255	-0.000355	-0.627	2.17E-06	1.353
Vr2	-0.000898	-1.194	0.000252	0.416	0.000432	1.228	-1.05E-06	-1.037
Vr3	0.000522	0.709	0.000593	0.971	-0.000616	-2.068	1.33E-06	1.333
Vr4	0.001862	1.886	-0.000637	-0.828	-0.000655	-1.545	8.34E-07	0.685
Constant	-1.096000	-0.302	14.10300	5.074	1.724300	1.202	0.005172	1.169
C1	-36.64800	-33.265	-36.64800	-33.265	-36.64800	-33.265	-	-
C2	0.002106	1.742	0.002106	1.742	0.002106	1.742	-	-
R2 / DW	***0.737***	***1.247***	***0.557***	***0.790***	***0.922***	***2.023***	***0.773***	***1.747***

b. Yield Predetermined, Ep CWB, Vp market

	Wheat		Barley		Canola		(Wo + ER)/VRSQ	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
Er1	0.000229	0.046	0.002775	0.667	-0.002138	0.936	-5.86E-06	-0.581
Er2	0.003921	1.107	-0.001189	0.397	-5.87E-05	0.037	2.05E-06	0.287
Er3	-0.008018	-1.381	-0.005523	-1.114	0.012864	4.788	-2.95E-05	-2.334
Er4	0.877450	2.188	-0.142760	-0.408	-0.389810	-2.207	0.001540	1.843
Z	0.000150	3.143	-0.000126	-3.072	-2.43E-05	-1.192	-2.43E-07	-2.468
DZ	-0.000112	-3.225	9.96E-05	3.370	1.01E-05	0.663	1.31E-07	1.863
D	-2.104000	-3.302	0.552600	1.008	0.436620	1.498	-0.003389	-2.554
T	-0.142800	-5.132	0.055850	2.425	0.091583	7.146	0.000120	2.125
W01	5.77E-09	0.833	1.15E-08	1.922	-9.77E-09	-2.980	4.57E-12	0.306
Vr1	-0.000393	0.773	0.000337	0.764	8.58E-05	0.359	9.10E-07	0.834
Vr2	-0.000399	-1.125	9.56E-05	0.318	3.88E-05	0.241	-8.86E-08	-0.123
Vr3	0.000209	0.549	0.000466	1.418	-0.000270	-1.547	8.84E-07	1.121
Vr4	0.001414	2.928	-0.000438	-1.039	-0.000487	-2.195	8.38E-07	0.802
Constant	0.834660	0.419	6.966800	4.093	0.658430	0.759	0.007640	1.844
C1	-20.61700	-30.716	-20.61700	-30.716	-20.61700	-30.716	-	-
C2	0.000811	1.245	0.000811	1.245	0.000811	1.245	-	-
R2 / DW	***0.768***	***1.288***	***0.537***	***0.892***	***0.931***	***1.906***	***0.787***	***1.992***

*) Joint estimation using C1 and C2 from Western results and betas from Manitoba results

III. GRAIN YIELD RESPONSE TO PRICE

Studies of crop supply response have generally modelled crop acreage or crop output levels and only a few deal with crop yields. These crop acreage demand models ignored any economic impacts on crop yields, treating yields as predetermined (e.g., Just 1983, Coyle 1993; Villezca-Becerra and Shumway 1992). Moreover those crop output supply responses were not decomposed into acreage and yield components.

Crop yield response studies usually assumed a static risk-neutral model. These studies have generally concluded that price is insignificant in affecting yield (Menz and Pardey 1983, Reed and Riggins 1982, Choi and Helmberger 1993a); one exception is Houck and Gallagher (1976).

A study of Manitoba crop agriculture (Coyle and Mundang, 1995) also concludes that, within the framework of risk-neutral static models, price does not influence yield. However, for risk-neutral dynamic and risk-averse static and dynamic models, price and price variances often had a significant impact on yields.

This paper estimates yield response equations for major grain crops in Western Canada for 1961-1995. The models are similar to Coyle and Mundang (1995), which stressed distributed lags, price uncertainty, and risk aversion. An emphasis on risk and distributed lags follows from the assumptions that farmers are risk averse, crop yield does not respond instantaneously to price changes, and prices in the distant future are generally more uncertain than prices in the immediate future. Therefore gradual or dynamic responses such as changes in yields presumably are more sensitive to price uncertainty than are reallocations of land among crops.

MODEL SPECIFICATION

Models are specified for six major grain crops in Western Canada: wheat, barley, canola, oats, flax, and rye.

I. STATIC MODELS

In static models we will consider a linear and log linear specification for every case. A log linear versions are defined by replacing all the variables in the linear equations by their logarithms.

a. Risk Neutral Models

A static risk-neutral yield response equation for the major Canadian grain crops is specified as follows:

$$(1) \quad yld_t^i = \beta_{i0} + \beta_{i1}\, Ep_t^{*i} + \beta_{i2}\, w_t^{*2} + \beta_{i3}\, w_t^1 + \beta_{i4}\, K_t^* + \beta_{i5}\, z_t^i + \beta_{i6}\, \omega_t^1 + \beta_{i7}\, \omega_t^2 + \beta_{i8}\, d + \beta_{i9}\, t + e_t^i \qquad i=1,..,6;\ t=1,..,35$$

where

yld^i : yield of crop i

Ep^i : expected output price of crop i

$Ep^{*i} \equiv Ep^i/w^1$

w^1 : a wage rate for hired labour

w^2 : an aggregate price index for variable crop inputs (e.g., fertilizer,pesticide, seed)

$w^{*2} \equiv w^2/w^1$

K : an aggregate quantity index for the stock of farm physical capital

$K^* \equiv K/Z$

Z : total acreage of major crops

ω^1 : an average of a crop growth weather index (GRODEX)

ω^2 : an average of a CWB drought index

t : a time trend

d : LIFT programs

In equation (1), by assuming disjoint technologies, yield yld^i is specified as a function of own output price Ep^i but not of other output prices Ep^j. A standard assumption for risk-neutral models is only relative prices matter, i.e., output supplies and yields are homogeneous of degree zero in expected prices (Ep, w). The term $\beta_{i3}w_t^1$ is considered in this model because such homogeneity restrictions are often rejected in empirical research (e.g., Shumway 1995). Since capital requirements per acre essentially are identical for the major grain crop (e.g., Manitoba Agriculture), K/Z is used as a proxy for capital per acre for crop i. The term $\beta_{i5}\, z_t^i$ is included to allow for the possibility of nonconstant returns to scale or that the average quality of land varies with the quantity of land planted to a crop.

b. Risk Averse Models: Linear Mean-Variance Approach

In this case, model (1) incorporates risk preferences and price uncertainty by adding a proxy Vp^i for the price variance of crop i. This variance is also normalized by w^1 ($Vp_t^{*i} = Vp_t^i / w_t^i$).

$$(2)\quad yld_t^i = \beta_{i0} + \beta_{i1}\, Ep_t^{*i} + \beta_{i2}\, w_t^{*2} + \beta_{i3}\, w_t^1 + \beta_{i4}\, K_t^* + \beta_{i5}\, z_t^i + \beta_{i6}\, \omega_t^1 + \beta_{i7}\, \omega_t^2 + \beta_{i8}\, d + \beta_{i9}\, t + \beta_{i10}\, Vp_t^{*i} + e_t^i \qquad i=1,..,6 \quad t=1,..,35$$

Here, the homogeneity condition is $\beta_{i3} = 0$; i = 1,.,6, i.e., under CARA and price uncertainty, production decisions are homogeneous of degree zero in (Ep, w, Vp), (Coyle, 1992).

c. Risk Averse Models: Nonlinear Mean-Variance Approach

Here, the is model modified from (2) by adding initial wealth W_0 normalized by the numeraire w^1 ($W^*_{0t} = W_0/w^i$) and Vp^i normalized by the square of w^1 ($Vp_t^{**i} = Vp_t^i/(w_t^i)^2$).

$$(3)\quad yld_t^i = \beta_{i0} + \beta_{i1}\, Ep_t^{*i} + \beta_{i2}\, w_t^{*2} + \beta_{i3}\, w_t^1 + \beta_{i4}\, K_t^* + \beta_{i5}\, z_t^i + \beta_{i6}\, \omega_t^1 + \beta_{i7}\, \omega_t^2 + \beta_{i8}\, d + \beta_{i9}\, t + \beta_{i10}\, Vp_t^{**i} + \beta_{i11}\, W_{0t}^* + e_t^i \qquad i=1,...,6 \qquad t=1,...,35$$

In this model, the restriction $\beta_{i3} = 0$, i = 1,.,6 also implies the homogeneity conditions corresponding to constant relative risk aversion (CRRA). In this case, under CRRA, production decisions are homogeneous of degree zero in (Ep,w,Vp2,W_0) (Pope, 1988).

ESTIMATION

In results reported here, both risk neutral and risk averse models, are estimated using Ordinary Least Squares (OLS), omitting the term $\beta_{i5}\, z^i$ from the models. In addition models were estimated imposing homogeneity restriction $\beta_{i3} = 0$, excluding the factor price ratio, and using another input price as numeraire.

II. DISTRIBUTED LAG MODELS

This section considers unrestricted distributed lag (UDL) and polynomial distributed lag (PDL) models. Lags for expected prices and price variances are incorporated into the equations as in static models. In principal distributed lag should also be specified for other price-related variables, such as w^i/w^j, w^j, and W_0/w^i. However, to simplify the models, these variables are excluded. Moreover these variables generally are not significant in static models, besides models cannot be estimated with distributed lags for all of these variables. The lag length (S) is specified as eight years.

a. Risk Neutral Model

$$(4)\quad yld_t^i = \beta_{i0} + \sum_{s=0}^{S} \gamma_{is} \frac{Ep_{t-s}^i}{w_{t-s}^1} + \beta_{i4} \frac{K_t}{z_t} + \beta_{i5} z_t^i + \beta_{i6} \omega_t^1 + \beta_{i7} \omega_t^2 + \beta_{i8}\, t + e_t^i \qquad i=1,\ldots,6 \quad t=1,\ldots,35$$

b. Risk Averse Model: Linear Mean-Variance Approach

$$(5)\quad yld_t^i = \beta_{i0} + \sum_{s=0}^{S} \gamma_{is} \frac{Ep_{t-s}^i}{w_{t-s}^1} + \beta_{i4} \frac{K_t}{z_t} + \beta_{i5} z_t^i + \beta_{i6} \omega_t^1 + \beta_{i7} \omega_t^2 + \beta_{i8}\, t + \sum_{s=0}^{S} \theta_{is} \frac{Vp_{t-s}^i}{w_{t-s}^i} + e_t^i \qquad i=1,..,6 \qquad t=1,..,35$$

c. Risk Averse Model: Nonlinear Mean-Variance Approach

$$(6)\quad yld_t^i = \beta_{i0} + \sum_{s=0}^{S} \gamma_{is} \frac{Ep_{t-s}^i}{w_{t-s}^1} + \beta_{i4} \frac{K_t}{z_t} + \beta_{i5} z_t^i + \beta_{i6} \omega_t^1 + \beta_{i7} \omega_t^2 + \beta_{i8}\, t + \sum_{s=0}^{S} \theta_{is} \frac{Vp_{t-s}^i}{(w_{t-s}^i)^2} + e_t^i \qquad i=1,..,6 \qquad t=1,..,35$$

ESTIMATION

Restricted distributed lags are specified as a fourth degree polynomial with eight lag lengths in expected price and in expected price variance. Besides PDL model, estimates were also obtained for UDL models.

RESULTS

Some diagnostic tests were conducted and suggested that data for the crop yield models do not have unit roots. It has been argued that, in the presence of unit roots, the Durbin-Watson d-statistic asymptotically approaches zero; so d is likely to be low in the presence of unit roots (Phillips, 1986). Range of d value for regressions in this study is 1.5 to 3.0, but often above 2.0 (a low d, 1.3 to 1.4, occurred on canola and one case of rye estimations on static models). A high Durbin-Watson statistics suggests that there is no random walk on the data (Phillips, 1986).

Some of the Dickey-Fuller and Phillips-Perron unit root tests, allowing for the possibility of trend stationarity, accept that there is a unit root on a few of non-output price data. However, it is well known that this test has low power. In addition, Kwiatkowski trend stationary tests with no unit root as a null hypothesis, were also conducted. The result is that all data series do not have a unit root (95 percent confidence intervals). Since there is not enough evidence for unit roots, models are estimated using OLS. Data used in this chapter are the same data as in the previous chapter.

I. STATIC MODELS

Equation (1) and its corresponding log-linear models are estimated using three combinations of price data. Those alternative prices are: CANSIM plus average price, CANSIM plus market price, and CWB plus market price (for earlier price of barley and oats (1948-1952) and later oats price, i.e., 1988-1995). In estimating the models, two alternative weather data and two alternative input prices (the crop and labour price indexes) as numeraire were also considered.

a. Risk Neutral

Results of estimates using average and market prices are quite similar. However, based on the J-test for three major crops, wheat, barley, and oats, estimates using market price is better than that using average market price. Other J-tests were conducted to decide which combination of weather data index will be used throughout the estimation. The data set chosen is GRODEX index for 1961-1980 period (with zero observations for 1981-1995) plus CWB drought index for 1981-1995 (with zero observations for earlier period). However, since J-test results for models using either labour or crop price index as numeraire are inconclusive, estimates using a labour price index as numeraire are reported here in order to facilitate comparison with the rest of this chapter.

These models were estimated by OLS and AR(1). Models were estimated omitting crop acreage z^i as an explanatory variable, imposing a homogeneity restriction ($\beta_{i3} = 0$), and dropping the factor price ratio. These variables and a proxy for capital are often insignificant. Based on F-test results, these variables are omitted from the equations. The dummy variable also was dropped because it was always insignificant.

OLS results for three alternative prices for wheat, barley, and oats are summarized in table 3.1. Similarly to previous studies, expected prices are always insignificant (wheat), and sometimes even have a wrong sign (barley and oats). Coefficient estimates for rye, flax, and canola are also insignificant or negative with t-ratios 0.09, -2.85, and -1.07 respectively (using market price data). Since the Durbin-Watson (DW) statistics suggest autocorrelation for some crops, autocorrelation models of degree one AR(1) were considered. Estimation using AR(1) improves the DW statistics (1.9 - 2.0) but do not increase the significance of the explanatory variables.

b. Risk-Averse Models

A variance of crop expected price is incorporated in these models, as well as in nonlinear mean-variance models. Mean and variances of crop price expectations are measured using lagged market price, expected CWB price, and a "hybrid" of these two prices (expected price using CWB price and price variance using market price). Estimates using average market price and a hybrid model between CWB and average market prices were also considered. However, since results are quite similar and J-tests are inconclusive, models using market price were chosen in order to simplify comparison. Results for models omitting z^i, capital proxy, numeraire, and factor price ratio, are presented in table 3.2 (CARA) and table 3.3 (CRRA).

For both CARA and CRRA models, the expected price coefficients are more significant and have a positive sign (wheat), but the other five crops have a negative sign with exception of estimation using market price (barley and oats). The price variance always has the anticipated sign under risk aversion (negative) for all crops using all three alternative prices. These coefficients are more significant than price coefficients. In contrast to results of previous study using Manitoba data, here only wheat has a significant price variance. This may be due to the higher level of aggregation over regions and producers in the current study, since such aggregation inevitably leads to serious errors in model specification. The price variance coefficient using market price and a hybrid model are always more significant than that using a CWB price. A plausible explanation for this is that the measurement for uncertainty in the variance of price using CWB price might not be appropriate (Coyle and Mundang, 1995).

II. DISTRIBUTED LAG MODELS

a. Risk Neutral

The polynomial distributed model (PDL) and unrestricted distributed lag model (UDL) were estimated using eight period lag lengths and fourth degree polynomials. This choice of the degree of polynomial and lag lengths is based on three considerations. First, it is adapted from a previous study by Mundang (1996). Second, the third or fourth degree polynomials generally provide a sufficient approximation to the lag structure (Pyndick and Rubinfield, p.238). Third, attempts to select lag length requires sequential hypotheses testing, so that true distributions for test statistics are unknown.

As in the static models, three price data sets, two weather data sets, and two alternatives for input prices were considered. Results of estimates using average and market prices are quite similar. J-tests were conducted for three major crops (wheat, barley, and oats) with results that either both models are rejected (wheat) or both are accepted. In this case, estimates using market prices were chosen to be reported because they provide slightly higher R^2 and also in order to facilitate comparison with static models. The results are poorer in the log linear model than in linear model. Results of estimations using a crop index as a numeraire is also less satisfactory. This study reports estimates using labour wage index as a numeraire.

Estimated coefficients for crop acreage z^i are often positive and insignificant, while coefficients for capital per acre are always insignificant (although often positive). Insignificance of coefficients for capital presumably reflect data errors. For example, the study uses a measure of farm capital, which includes capital used for livestock production as well as for crops. Since these variables are not significant, model specification without them are stressed.[1]

OLS results for linear models of risk-neutral PDL without z^i and capital proxy, for wheat, barley, and oats, are summarized in table 3.4. All estimates are for the base case PDL (0.8,4) in order to facilitate comparison. P0 is a current period of expected price (i.e., one year lags on market price or a current of expected CWB price) and V0 is current period of expected price variance. P1 and V1 indicate a one year lag on expected price and price variance, etc. Sum of lagged coefficients and their t-ratios are reported for both PDL models and the corresponding UDL models.

The sums of the lagged coefficients for expected price are positive as expected, but insignificant. However there is some indication of significant 1-2 year (0.05 level) and 6-7 (0.1 level) lags (CWB price) on wheat. Insignificance with a correct sign in the sum of the

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[1]Coyle and Mundang (1995) exclude crop acreage z^i and capital per acre due to insignificance and a wrong sign on capital proxy. Houck and Gallagher also omitt capital proxy as explanatory variables from crop yield price response equation (1976)

lagged coefficient also holds for rye, but it is negative for canola and flax, with t-ratios 0.02, -0.26, and -0.94, respectively. The log linear model works better for flax and rye (in terms of increasing the significance of the sum of the lagged coefficients), but it gives a poorer result for canola and the CWB crops (using both CWB price and market price).

Result for analogous PDL (0.8,4) models, without omitting capital proxy and acreage z^i, are presented in table 3.5 (wheat, barley, oats). Here, the sums of lagged coefficients for expected price are less significant, and often even have a negative sign (oats, rye, flax, and canola). Estimation using a log linear model does not improve significance. The own price variables are negative for oats (CWB price), barley, rye, and canola (market price).

b. Risk-Averse Linear Mean-Variance Models

Here, estimates were conducted using five possibilities of price data as in static models. However based on J-test between average and market price models for three major crops, average price model is rejected for barley. J-test results between hybrid prices (CWB + average price and CWB + market price) are ambiguous (both models are either rejected or accepted). A corresponding log-linear model was also considered, but as in risk neutral model, the results are poor. Thus, this study will report estimates for PDL models using market price, CWB price, and a hybrid of those two.

Results for risk-averse linear mean-variance models (CARA) without capital and crop acreage are presented in table 3.6. It can be seen from this table that the sums of lagged coefficients for expected price are more significant when it is measured by CWB price, except for oats (which is better estimated using lagged market price). Especially for wheat, CARA estimation improves the significance of the sum of lagged coefficients for expected price. The sums of lagged coefficients for price variances are negative as expected, and generally are more significant when it is estimated using a hybrid model (except for barley).

One interesting result is that a weather proxy (GRODEX) is often significant for each crop, excluding barley estimation using a hybrid price (one out of nine cases). In contrast, this variable is never significant for risk-neutral models.

Estimates of CARA models including z^i and capital proxy, led to poor results, as in risk-neutral models. The sums of lagged coefficients for both expected prices and price variances often have wrong signs. Wheat is the only crop that has a significant t-ratio for the sum of lagged coefficients of expected price, i.e., 2.52 and 1.83 using CWB and hybrid prices respectively. In addition, there is no crop that has a significant t-ratio for its sum of lagged coefficients for price variance. However, as in models excluding z^i and capital proxy, there is an indication of significance of current price variance for wheat and oats.

Table 3.6 indicates relatively high Durbin-Watson d statistics (2.4 - 3.0) which suggests negative autocorrelation, but test results are inconclusive. The computed values of 4-d are located between the lower and upper bounds of critical values, and exact probabilities are not computed for PDL models.

Since test results for autocorrelation are inconclusive, results for AR(1) models are presented in table 3.7. This table suggests that AR(1) estimations improve the significance of the coefficients, both individual and the sum of coefficients, but Durbin-Watson test results are still inconclusive. AR(2) model was also considered, but results are less satisfactory, perhaps due in part to the more complex nonlinear estimation. In table 3.7, the sum of lagged coefficients for expected price is always significant for wheat, while the sum of lagged coefficients for price variances is often significant (wheat, oats). In contrast, AR(1) estimates for the other three crops are poorer and even have wrong signs, i.e., the t-ratios for the sum of lagged coefficients for both expected prices and price variances are -2.48 and 1.47 for flax, -1.01 and 1.26 for canola, and 0.41 and -1.33 for rye respectively (market price). Here, a current price variances are significant for wheat and oats (all alternative prices) and for flax (market price). The sum of elasticities (evaluated at mean data), which can be interpreted loosely as a long run impact of price on yield response, are always larger in magnitude for expected price than for price variances[2], except for oats which works in an opposite way (but the sign of expected prices are negative, using hybrid price).

Weather measured by GRODEX is always significant (again, with exception for barley in hybrid model), while weather measured by CWB drought index is sometimes significant in estimation using CWB and hybrid prices. These variables are always significant on flax.

c. Risk-Averse Non-Linear Mean-Variance Models

Estimation using CRRA models slightly improves results for barley as presented in table 3.8, but worsen the oats' model using every alternative price. A J-test result on CRRA models concludes that model using market price is better than model using average price (wheat), although for the other two crops, both models are accepted.

[2]Coyle and Mundang (1995) also have a similar result for each crop grain in Manitoba.

In contrast to previous results, there is one case for wheat (market price) where current price is significant. Regarding price variances, as in CARA model, there is indication that the current price variance is significant. The GRODEX weather proxy is significant in seven of nine cases.

Since the Durbin-Watson (DW) statistics in these cases also inconclusive, AR(1) models were also considered (table 3.9). Estimates improve for barley and wheat in the sense that sum of lagged coefficients for both expected prices and variances of price are significant for those crops using CWB price and using all alternative prices for wheat. However results for oats are less satisfactory, since the sum of lagged coefficients for expected price has the wrong signs. Results for flax, canola and rye are also poor with wrong signs. Here, again there is some indication of significance of current expected price for barley (market price) and wheat (CWB and market prices). The number of individual coefficients for expected price that are significant also increases up to four coefficients for barley and five for wheat. On the other hand the significance of individual coefficient for price variances does not increase as dramatically as for expected price, even though it still improves. Moreover, some of the current variances of price are as significant as in CARA results. As in CARA, the sums of elasticities for expected price are substantially larger in magnitude than the sum of elasticities for price variances.

The GRODEX weather proxy is significant in seven cases, but the CWB drought index for weather is never significant.

CONCLUSION

Results are reported for major grain crops in Western Canada for the 1961 - 1995 period. Expected prices, as in most crop yield studies, are insignificant in all static models. However, the variances of price in risk averse models are often significant (wheat) with a correct sign (negative) in all cases. This contrast in results for expected price and price variance in static models suggests that the true models are dynamic since the significance of current price variances may reflect its high correlation with a lagged price variance. The results of distributed lag models suggest that dynamics with an emphasis on risk aversion can better explain the yield crop response. The sum of elasticities is often significant for both expected price and price variances. Long run impacts on yield are substantially larger in magnitude for expected price than for price variance. These results suggest that incorporating risk aversion and dynamics into models of crop yield response is important.

Table 3.1. Estimates for One Period Risk-Neutral Models (Linear Models) -- OLS

	Wheat			Barley			Oats		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Lagged market price									
Ep	7.947400	0.215	0.016	-65.90600	-0.837	-0.047	-145.5400	-0.690	-0.053
ω1	0.025676	1.796	0.225	0.027314	1.315	0.165	0.035035	1.291	0.162
ω2	0.182820	1.402	0.145	0.193960	1.025	0.106	0.228790	0.929	0.096
T	0.433820	3.351	0.273	0.652350	3.789	0.283	0.578910	2.445	0.192
Constant	9.746000	1.451	0.341	20.47500	2.257	0.494	32.69700	2.466	0.603
R2 / DW	***0.681***	***1.889***		***0.764***	***2.398***		***0.575***	***2.374***	
CWB Expected Price									
Ep	26.02500	0.770	0.060	-88.04300	-1.115	-0.076	-41.82100	-0.369	-0.022
ω1	0.025109	1.775	0.220	0.026035	1.280	0.157	0.034442	1.261	0.159
ω2	0.177720	1.384	0.141	0.177120	0.961	0.097	0.228730	0.921	0.096
T	0.473620	3.885	0.299	0.625340	3.669	0.271	0.598750	2.054	0.199
Constant	8.034700	1.192	0.281	22.86900	2.400	0.551	30.83500	2.268	0.569
R2 / DW	***0.687***	***1.929***		***0.768***	***2.368***		***0.570***	***2.369***	
Lagged Average Price									
Ep	3.293200	0.091	0.006	-32.70300	-0.358	-0.025	-146.5800	-0.721	-0.056
ω1	0.025813	1.800	0.226	0.025730	1.223	0.155	0.036584	1.343	0.169
ω2	0.184960	1.413	0.147	0.178140	0.927	0.097	0.244890	0.987	0.102
T	0.423210	3.236	0.267	0.692740	3.673	0.301	0.55921	2.234	0.186
Constant	10.11900	1.523	0.354	19.57200	2.088	0.472	32.49000	2.502	0.599
R2 / DW	***0.680***	***1.883***		***0.760***	***2.370***		***0.575***	***2.380***	

Table 3.2. Estimates for One Period Linear Mean-Variance Models (Linear Models) -- OLS

	Wheat			Barley			Oats		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Lagged market price									
Ep	76.9960	1.498	0.152	47.7190	0.386	0.034	38.1190	0.148	0.014
ω1	0.02987	2.144	0.262	0.02999	1.444	0.181	0.03977	1.463	0.183
ω2	0.17204	1.371	0.136	0.18038	0.958	0.098	0.24746	1.012	0.103
T	0.66417	3.779	0.419	0.84593	3.576	0.367	0.77185	2.736	0.256
Vp	-93.5690	-1.857	-0.025	-152.950	-1.185	-0.015	-1034.90	-1.233	-0.019
Constant	1.62000	0.208	0.057	13.8790	1.310	0.335	25.0810	1.727	0.463
R2 / DW	***0.715***	***2.031***		***0.775***	***2.428***		***0.596***	***2.438***	
CWB Expected Price									
Ep	32.1210	0.920	0.074	-84.9000	-1.052	-0.074	-71.945	-0.642	-0.038
ω1	0.02848	1.911	0.249	0.02699	1.295	0.163	0.03965	1.478	0.183
ω2	0.19677	1.495	0.156	0.18428	0.979	0.101	0.30999	1.253	0.129
T	0.52052	3.798	0.328	0.64043	3.589	0.278	0.51681	1.790	0.172
Vp	-53.1450	-0.769	-0.017	-59.1280	-0.345	-0.006	-1031.40	-1.600	-0.030
Constant	6.00360	0.825	0.210	22.3270	2.278	0.538	31.6750	2.388	0.584
R2 / DW	***0.693***	***1.875***		***0.769***	***2.346***		***0.605***	***2.517***	
CWB Expected Price (Ep), Market Price (Vp)									
Ep	60.3500	1.592	0.138	-34.2510	-0.348	-0.030	-13.3140	-0.117	-0.007
ω1	0.02914	2.104	0.255	0.02978	1.432	0.180	0.03932	1.448	0.181
ω2	0.18470	1.489	0.146	0.19300	1.040	0.105	0.24965	1.018	0.104
T	0.60290	4.357	0.380	0.72221	3.599	0.313	0.71304	2.381	0.237
Vp	-71.5310	-1.778	-0.019	-93.4250	-0.921	-0.009	-947.740	-1.362	-0.018
Constant	2.85270	0.400	0.100	18.2780	1.696	0.441	27.2380	1.994	0.503
R2 / DW	***0.717***	***2.124***		***0.775***	***2.425***		***0.596***	***2.432***	

Table 3.3. **Estimates for One Period Non-Linear Mean-Variance Models (Linear Models) -- OLS**

		Wheat			Barley			Oats	
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Lagged market price									
Ep	83.70400	1.548	0.165	64.65500	0.474	0.046	62.48600	0.216	0.023
ω1	0.029497	2.129	0.258	0.029821	1.413	0.180	0.039589	1.420	0.183
ω2	0.166830	1.328	0.132	0.175750	0.916	0.096	0.232880	0.931	0.097
T	0.661410	3.727	0.417	0.864860	3.430	0.375	0.771070	2.551	0.256
Vp	-4541.700	-2.037	-0.023	-7478.500	-1.182	-0.015	-49603.00	-1.059	-0.015
Wo1	8.11E-08	0.031	0.002	-7.13E-07	-0.191	-0.013	6.31E-07	0.129	0.009
Constant	1.378800	0.182	0.048	13.68200	1.243	0.330	24.29900	1.534	0.448
R2 / DW	***0.725***	***2.078***		***0.775***	***2.446***		***0.591***	***2.412***	
CWB Expected Price									
Ep	30.38500	0.864	0.070	-83.24200	-1.004	-0.072	-40.66600	-0.331	-0.021
ω1	0.036467	2.311	0.319	0.028523	1.301	0.172	0.035014	1.287	0.162
ω2	0.235860	1.777	0.187	0.194040	0.994	0.106	0.240010	0.968	0.100
T	0.526880	3.957	0.332	0.637480	3.514	0.277	0.544290	1.811	0.181
Vp	-7886.800	-1.544	-0.038	-4037.200	-0.396	-0.006	-66647.00	-1.506	-0.033
Wo1	3.13E-06	1.081	0.080	3.85E-08	0.010	0.001	8.73E-07	0.166	0.012
Constant	1.419700	0.181	0.050	21.70300	2.084	0.523	32.52900	2.174	0.600
R2 / DW	***0.713***	***1.848***		***0.770***	***2.350***		***0.602***	***2.464***	
CWB Expected Price (Ep), Market Price (Vp)									
Ep	59.70000	1.516	0.137	-31.98100	-0.308	-0.028	-12.44100	-0.098	-0.007
ω1	0.028868	2.080	0.253	0.029625	1.398	0.179	0.038870	1.397	0.179
ω2	0.182500	1.463	0.145	0.191900	1.015	0.105	0.236610	0.941	0.099
T	0.584350	4.185	0.368	0.719780	3.461	0.312	0.696330	2.226	0.231
Vp	-3326.600	-1.905	-0.017	-4131.800	-0.868	-0.008	-42188.00	-1.193	-0.013
Wo1	3.11E-07	0.122	0.008	-2.16E-07	-0.058	-0.004	3.51E-07	0.066	0.005
Constant	3.047100	0.434	0.107	18.41300	1.652	0.444	27.39800	1.783	0.505
R2 / DW	***0.724***	***2.164***		***0.774***	***2.434***		***0.591***	***2.407***	

Table 3.4. Estimates of Risk-Neutral Polynomial Distributed Lag (Linear Models) -- OLS

	Wheat			Barley			Oats		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Lagged market price									
P0	8.04040	0.182	0.016	-47.0130	-0.524	-0.034	-268.480	-1.146	-0.097
P1	47.4830	1.697	0.096	26.1820	0.402	0.019	113.100	0.813	0.042
P2	37.6050	1.528	0.078	34.5640	0.586	0.026	90.9190	0.731	0.035
P3	15.2790	0.666	0.033	24.0680	0.455	0.019	-39.3890	-0.350	-0.016
P4	3.16020	0.119	0.007	21.8160	0.378	0.018	-97.9740	-0.734	-0.040
P5	9.68560	0.434	0.022	36.1200	0.705	0.030	-20.7580	-0.188	-0.009
P6	29.0760	1.249	0.068	56.4820	0.984	0.049	140.560	1.168	0.062
P7	41.3360	1.431	0.099	53.5890	0.741	0.048	218.510	1.438	0.099
P8	12.2530	0.231	0.030	-20.6790	-0.181	-0.019	-70.1570	-0.255	-0.033
ω1	0.02468	1.511	0.216	0.03255	1.409	0.196	0.03982	1.380	0.184
ω2	0.11786	0.809	0.093	0.22277	1.029	0.122	0.22558	0.857	0.094
T	0.91190	2.053	0.830	0.94632	1.535	0.593	0.83935	1.221	0.403
Constant	-16.7820	-0.669	-0.588	-2.77160	-0.088	-0.067	14.9330	0.410	0.276
Σ lag coef (PDL)	203.920	1.079	0.403	185.130	0.429	0.132	66.3260	0.087	0.024
Σ lag coef (UDL)	214.830	1.052	0.424	120.81	0.270	0.086	105.9	0.137	0.038
R2 / DW	***0.714***	***2.005***		***0.776***	***2.438***		***0.608***	***2.446***	

	Wheat			Barley			Oats		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Expected CWB Price									
P0	12.074	0.319	0.028	-65.567	-0.730	-0.057	-161.91	-0.945	-0.085
P1	57.077	2.374	0.133	77.379	1.182	0.069	124.81	1.121	0.069
P2	45.071	2.023	0.108	91.313	1.446	0.084	80.415	0.836	0.047
P3	19.724	0.878	0.049	61.744	1.014	0.059	-44.500	-0.749	-0.027
P4	7.4932	0.284	0.019	42.584	0.639	0.042	-99.448	-1.162	-0.064
P5	17.621	0.778	0.047	56.149	0.941	0.057	-34.050	-0.513	-0.023
P6	42.140	1.812	0.115	93.159	1.501	0.098	101.96	1.336	0.073
P7	55.866	1.985	0.156	112.74	1.512	0.123	158.72	1.534	0.120
P8	16.406	0.328	0.048	42.418	0.378	0.047	-113.70	-0.786	-0.089
ω1	0.0275	1.638	0.240	0.0272	1.217	0.164	0.0356	1.153	0.164
ω2	0.1229	0.889	0.097	0.1230	0.582	0.067	0.2081	0.744	0.087
T	1.1723	2.458	1.067	1.5827	2.062	0.992	0.7993	1.582	0.383
Constant	-31.611	-1.106	-1.107	-30.866	-0.769	-0.744	18.707	0.819	0.345
Σ lag coef (PDL)	273.47	1.540	0.626	511.92	1.072	0.443	12.297	0.065	0.006
Σ lag coef (UDL)	297.16	1.585	0.680	425.45	1.162	0.368	19.800	0.100	0.010
R2 / DW		***0.742***	***2.104***		***0.789***	***2.487***		***0.605***	***2.373***

Table 3.5. Estimates of Risk-Neutral Polynomial Distributed Lag (Linear Models) (with acreage and capital proxy) -- OLS

Variables	Wheat Coeff	Wheat T-ratio	Wheat Elas.	Barley Coeff	Barley T-ratio	Barley Elas.	Oats Coeff	Oats T-ratio	Oats Elas.
Lagged market price									
P0	-11.825	-0.222	-0.023	-67.588	-0.617	-0.048	-464.59	-1.993	-0.168
P1	38.316	1.070	0.077	3.2809	0.036	0.002	-83.971	-0.526	-0.031
P2	29.456	0.927	0.061	11.457	0.131	0.009	-94.796	-0.635	-0.036
P3	5.0589	0.170	0.011	1.5832	0.019	0.001	-209.98	-1.532	-0.083
P4	-8.1560	-0.254	-0.018	-0.0411	-0.000	0.000	-257.02	-1.724	-0.104
P5	-0.21272	-0.008	-0.001	14.536	0.185	0.012	-178.01	-1.363	-0.075
P6	22.120	0.857	0.052	34.920	0.428	0.030	-29.607	-0.213	-0.013
P7	35.329	1.174	0.084	32.371	0.349	0.029	16.926	0.102	0.008
P8	-0.84282	-0.015	-0.002	-40.198	-0.312	-0.038	-324.25	-1.168	-0.151
Capital	0.03073	0.909	0.179	0.02366	0.387	0.095	0.1401	1.895	0.431
Acreage	-8.9E-05	-0.460	-0.086	3.8E-05	0.076	0.009	0.0044	2.408	0.333
ω1	0.0251	1.429	0.219	0.0340	1.389	0.205	0.0313	1.127	0.144
ω2	0.1232	0.828	0.098	0.2290	1.016	0.125	0.1359	0.548	0.057
T	0.4555	0.642	0.415	0.5130	0.398	0.322	-1.1811	-0.977	-0.567
Constant	-1.8842	-0.064	-0.066	10.257	0.215	0.247	68.089	1.589	1.256
Σ lag coef (PDL)	109.24	0.460	0.216	-9.6794	-0.014	-0.007	-1625.3	-1.555	-0.586
Σ lag coef (UDL)	143.38	0.563	0.283	252.49	0.349	0.181	-1492.1	-1.366	-0.538
R2 / DW	***0.727***	***2.164***		***0.777***	***2.435***		***0.685***	***2.697***	

Variables	Wheat Coeff	Wheat T-ratio	Wheat Elas.	Barley Coeff	Barley T-ratio	Barley Elas.	Oats Coeff	Oats T-ratio	Oats Elas.
Expected CWB Price									
P0	3.0825	0.063	0.007	-72.914	-0.708	-0.063	-298.08	-1.702	-0.157
P1	50.766	1.596	0.118	71.695	0.891	0.064	64.441	0.557	0.036
P2	37.870	1.206	0.091	85.340	1.061	0.078	74.469	0.769	0.043
P3	10.919	0.320	0.027	55.121	0.690	0.052	-25.944	-0.460	-0.016
P4	-1.9703	-0.053	-0.005	35.960	0.424	0.035	-87.293	-1.069	-0.056
P5	8.9097	0.277	0.024	50.599	0.654	0.051	-52.621	-0.836	-0.036
P6	34.858	1.195	0.095	89.601	1.163	0.094	42.484	0.545	0.031
P7	48.764	1.491	0.136	111.35	1.287	0.122	69.880	0.666	0.053
P8	5.1111	0.090	0.015	42.054	0.348	0.047	-191.12	-1.171	-0.150
Capital	0.0160	0.418	0.093	0.0050	0.099	0.020	0.0879	1.386	0.270
Acreage	-4.8E-05	-0.284	-0.047	-6.9E-05	-0.139	-0.016	0.0049	2.343	0.369
ω1	0.0258	1.436	0.226	0.0278	1.184	0.168	0.0176	0.572	0.081
ω2	0.1155	0.801	0.092	0.1213	0.552	0.066	0.1148	0.433	0.048
T	0.8512	0.927	0.775	1.4999	1.210	0.940	-0.3914	-0.522	-0.188
Constant	-18.455	-0.444	-0.646	-27.290	-0.531	-0.658	36.347	1.577	0.671
Σ lag coef (PDL)	198.31	0.745	0.454	468.81	0.755	0.406	-403.79	-1.604	-0.212
Σ lag coef (UDL)	184.8	0.665	0.423	314.35	0.647	0.272	-400.83	-1.460	-0.211
R2 / DW	***0.745***	***2.182***		***0.789***	***2.502***		***0.679***	***2.525***	

Table 3.6. Estimates of Linear Mean-Variance Polynomial Distributed Lag (Linear Models)--OLS

	Wheat			Barley			Oats		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Lagged market price									
P0	141.09	1.619	0.279	212.11	1.207	0.152	28.469	0.096	0.010
P1	69.278	1.269	0.140	13.432	0.114	0.010	357.53	2.046	0.134
P2	6.4819	0.133	0.014	-26.148	-0.267	-0.020	222.94	1.413	0.086
P3	-22.972	-0.679	-0.049	27.622	0.319	0.022	-20.341	-0.133	-0.008
P4	-11.826	-0.280	-0.026	115.81	1.032	0.093	-156.94	-0.865	-0.064
P5	30.116	0.687	0.068	186.32	1.488	0.156	-111.06	-0.639	-0.047
P6	75.989	1.548	0.177	193.85	1.326	0.168	53.498	0.285	0.024
P7	81.863	1.486	0.195	99.939	0.667	0.089	133.37	0.694	0.060
P8	-13.252	-0.157	-0.033	-127.06	-0.772	-0.119	-214.41	-0.664	-0.100
ω1	0.0332	1.913	0.290	0.0479	1.836	0.289	0.0712	2.271	0.328
ω2	0.0924	0.600	0.073	0.1880	0.784	0.103	0.2898	1.088	0.121
T	1.4039	2.480	1.278	1.8443	1.943	1.156	1.6389	1.687	0.786
V0	-150.31	-2.202	-0.041	-244.97	-1.361	-0.024	-1831.6	-1.722	-0.034
V1	-18.241	-0.378	-0.005	84.696	0.730	0.008	-1498.4	-2.266	-0.028
V2	35.090	0.721	0.009	88.067	0.830	0.009	-1146.0	-1.843	-0.022
V3	33.650	0.821	0.009	-38.682	-0.417	-0.004	-874.20	-1.378	-0.016
V4	1.6694	0.038	0.000	-157.62	-1.451	-0.015	-706.07	-0.962	-0.013
V5	-36.355	-0.878	-0.009	-189.06	-1.769	-0.018	-587.64	-0.805	-0.010
V6	-55.666	-1.215	-0.014	-111.55	-0.965	-0.010	-388.03	-0.515	-0.006
V7	-31.244	-0.630	-0.007	38.105	0.327	0.004	100.62	0.153	0.001
V8	62.194	0.863	0.014	164.88	1.039	0.015	1163.1	0.849	0.015
Constant	-38.956	-1.222	-1.364	-44.073	-0.902	-1.063	-11.796	-0.259	-0.218
Σ lag Ep (PDL)	356.77	1.421	0.705	695.88	1.042	0.498	293.05	0.324	0.106
Vp (PDL)	-159.22	-1.359	-0.043	-366.14	-1.185	-0.036	-5768.2	-1.835	-0.108
Ep (UDL)	437.50	1.313	0.864	606.26	0.704	0.434	622.89	0.664	0.225
Vp (UDL)	-207.30	-1.259	-0.056	-336.72	-0.823	-0.033	-5568.0	-1.647	-0.105
R2 / DW		*0.779*	*2.514*		*0.810*	*2.451*		*0.706*	*2.831*

Table 3.6. Cont...

Variables	Wheat Coeff	Wheat T-ratio	Wheat Elas.	Barley Coeff	Barley T-ratio	Barley Elas.	Oats Coeff	Oats T-ratio	Oats Elas.
Expected CWB Price									
P0	78.732	1.629	0.180	-13.836	-0.130	-0.012	-190.69	-1.161	-0.100
P1	86.238	2.994	0.201	64.103	0.687	0.057	137.51	1.264	0.076
P2	68.052	2.452	0.163	70.863	0.856	0.065	66.703	0.709	0.039
P3	48.214	1.690	0.119	65.666	0.944	0.062	-92.062	-1.520	-0.056
P4	41.281	1.271	0.105	78.920	0.960	0.077	-154.32	-1.756	-0.099
P5	52.332	1.748	0.138	112.22	1.286	0.114	-62.186	-0.863	-0.042
P6	76.966	2.596	0.210	138.34	1.379	0.146	115.68	1.483	0.083
P7	101.30	2.919	0.283	101.25	0.863	0.111	184.03	1.802	0.139
P8	101.98	1.596	0.296	-83.909	-0.593	-0.094	-178.94	-1.139	-0.140
ω1	0.0388	2.031	0.340	0.0545	2.030	0.328	0.0598	1.883	0.276
ω2	0.1160	0.806	0.092	0.3064	1.259	0.167	0.5182	1.766	0.216
T	2.2603	3.322	2.058	1.8245	1.672	1.144	0.1945	0.280	0.093
V0	-199.61	-2.048	-0.064	-83.330	-0.326	-0.008	-1167.0	-1.362	-0.034
V1	36.946	0.614	0.012	72.876	0.474	0.007	-157.54	-0.301	-0.005
V2	93.274	1.638	0.029	-71.807	-0.519	-0.007	523.05	1.178	0.016
V3	50.305	1.023	0.015	-248.49	-1.869	-0.023	732.67	1.714	0.022
V4	-26.399	-0.504	-0.008	-299.38	-1.901	-0.027	483.05	1.028	0.014
V5	-86.645	-1.580	-0.024	-177.80	-1.239	-0.016	-60.316	-0.170	-0.002
V6	-95.613	-1.471	-0.026	51.850	0.382	0.005	-578.09	-1.425	-0.016
V7	-33.854	-0.534	-0.009	214.06	1.509	0.018	-597.15	-1.182	-0.016
V8	102.71	1.122	0.026	22.212	0.108	0.002	509.44	0.498	0.014
Constant	-89.608	-2.344	-3.138	-46.200	-0.832	-1.114	28.295	0.911	0.522
Σ lag Ep (PDL)	655.10	2.651	1.499	533.62	0.824	0.462	-174.28	-0.678	-0.092
Vp (PDL)	-158.89	-1.058	-0.051	-519.82	-0.716	-0.052	-311.9	-0.108	-0.009
Ep (UDL)	613.49	1.698	1.403	-53.084	-0.101	-0.046	-185.79	-0.667	-0.098
Vp (UDL)	-153.05	-0.881	-0.049	147.80	0.258	0.015	-2115	-0.679	-0.062
R2 / DW	***0.800***	***2.435***		***0.830***	***2.850***		***0.718***	***2.935***	

Table 3.6. Cont...

Variables	Wheat Coeff	Wheat T-ratio	Wheat Elas.	Barley Coeff	Barley T-ratio	Barley Elas.	Oats Coeff	Oats T-ratio	Oats Elas.
Expected CWB (Ep), Market Price (Vp)									
P0	64.931	1.195	0.149	34.421	0.231	0.030	45.756	0.254	0.024
P1	103.99	2.758	0.242	135.05	1.255	0.120	253.72	2.252	0.140
P2	54.945	1.626	0.132	111.16	1.238	0.102	96.737	1.014	0.056
P3	-3.3412	-0.116	-0.008	66.865	0.717	0.063	-109.00	-1.523	-0.066
P4	-24.531	-0.641	-0.063	61.888	0.475	0.061	-183.23	-1.899	-0.117
P5	5.2125	0.122	0.014	111.61	0.725	0.113	-81.618	-1.067	-0.055
P6	67.218	1.488	0.183	187.06	1.074	0.197	104.25	1.320	0.075
P7	110.31	2.295	0.309	214.89	1.199	0.235	146.85	1.441	0.111
P8	50.802	0.881	0.147	77.416	0.452	0.087	-317.27	-1.903	-0.249
ω1	0.0342	2.000	0.299	0.0328	1.249	0.198	0.0767	2.331	0.353
ω2	0.1342	0.947	0.106	0.0910	0.381	0.050	0.2951	1.083	0.123
T	1.6229	2.630	1.478	2.4390	1.792	1.529	1.4329	2.234	0.687
V0	-99.028	-2.322	-0.027	-131.45	-0.912	-0.013	-2820.2	-2.737	-0.053
V1	-48.452	-1.295	-0.013	1.9758	0.017	0.000	-1266.3	-2.239	-0.024
V2	1.4262	0.036	0.000	38.437	0.341	0.004	-992.25	-1.899	-0.019
V3	32.102	0.831	0.008	18.064	0.179	0.002	-1193.3	-2.069	-0.022
V4	35.275	0.983	0.009	-25.357	-0.256	-0.002	-1322.0	-1.923	-0.024
V5	12.850	0.419	0.003	-64.383	-0.687	-0.006	-1087.9	-1.696	-0.018
V6	-23.060	-0.607	-0.006	-77.921	-0.700	-0.007	-457.80	-0.823	-0.007
V7	-50.141	-1.129	-0.012	-51.221	-0.438	-0.005	344.51	0.674	0.005
V8	-35.869	-0.673	-0.008	24.120	0.172	0.002	838.02	0.773	0.011
Constant	-55.513	-1.469	-1.944	-72.890	-0.980	-1.757	3.6982	0.148	0.068
Σ lag Ep (PDL)	429.53	1.726	0.983	1000.4	1.112	0.866	-43.811	-0.218	-0.023
Vp (PDL)	-174.90	-1.626	-0.047	-267.74	-1.018	-0.026	-7957.3	-2.369	-0.149
Ep (UDL)	338.15	0.918	0.774	880.59	1.092	0.763	-31.570	-0.162	-0.017
Vp (UDL)	-170.24	-1.190	-0.046	-125.04	-0.540	-0.012	-9794.6	-2.754	-0.184
R2 / DW	***0.809***	***2.591***		***0.805***	***2.619***		***0.734***	***3.008***	

Table 3.7. Estimates of Linear Mean-Variance Polynomial Distributed Lag (Linear Models) Corrected for First Order Autocorrelation

Variables	Wheat Coeff	Wheat T-ratio	Wheat Elas.	Barley Coeff	Barley T-ratio	Barley Elas.	Oats Coeff	Oats T-ratio	Oats Elas.
Lagged market price									
P0	174.26	2.306	0.344	181.23	1.123	0.130	18.344	0.080	0.007
P1	70.192	1.547	0.142	2.4467	0.025	0.002	383.26	2.868	0.143
P2	3.5997	0.087	0.008	-19.695	-0.234	-0.015	249.80	2.162	0.096
P3	-18.278	-0.662	-0.039	38.301	0.524	0.030	-10.085	-0.097	-0.004
P4	0.3917	0.011	0.001	115.29	1.185	0.093	-166.73	-1.287	-0.068
P5	44.041	1.147	0.100	165.50	1.486	0.139	-132.76	-1.077	-0.056
P6	85.694	2.102	0.200	158.50	1.240	0.138	36.933	0.278	0.016
P7	86.976	2.029	0.208	79.240	0.641	0.071	145.16	1.077	0.066
P8	-1.8971	-0.027	-0.005	-71.963	-0.475	-0.067	-147.56	-0.623	-0.069
ω1	0.0399	2.401	0.349	0.0454	1.833	0.274	0.0750	2.776	0.346
ω2	0.0928	0.651	0.074	0.1973	0.893	0.108	0.3057	1.438	0.128
T	1.6835	3.631	1.533	1.7284	2.081	1.083	1.7651	2.390	0.847
V0	-178.34	-3.033	-0.048	-210.71	-1.337	-0.021	-1901.0	-2.286	-0.036
V1	-18.140	-0.446	-0.005	86.893	0.890	0.009	-1573.2	-3.020	-0.030
V2	39.476	0.977	0.011	80.580	0.906	0.008	-1244.7	-2.601	-0.023
V3	30.886	0.985	0.008	-38.762	-0.535	-0.004	-964.43	-2.048	-0.018
V4	-10.094	-0.291	-0.003	-140.98	-1.540	-0.014	-739.71	-1.335	-0.013
V5	-52.216	-1.438	-0.013	-156.64	-1.600	-0.015	-535.98	-0.955	-0.009
V6	-66.802	-1.676	-0.016	-77.073	-0.746	-0.007	-276.95	-0.483	-0.004
V7	-27.739	-0.713	-0.006	45.695	0.484	0.004	155.45	0.331	0.002
V8	88.515	1.391	0.020	98.888	0.673	0.009	921.03	0.857	0.012
Constant	-53.170	-2.014	-1.862	-39.578	-0.922	-0.954	-17.979	-0.522	-0.332
Rho	-0.3688	-2.347	-	-0.3273	-2.049	-	-0.4567	-3.037	-
Σ lag Ep (PDL)	444.98	2.249	0.879	648.85	1.141	0.464	376.36	0.592	0.136
Vp (PDL)	-194.46	-2.071	-0.053	-312.11	-1.231	-0.031	-6159.5	-2.578	-0.116
Ep (UDL)	495.32	1.806	0.979	546.39	0.807	0.391	572.60	0.795	0.207
Vp (UDL)	-201.74	-1.508	-0.055	-249.72	-0.815	-0.025	-5431.0	-2.006	-0.102
R2 / DW	***0.803***	***2.293***		***0.827***	***1.975***		***0.764***	***2.235***	

Table 3.7. Cont...

	Wheat			Barley			Oats		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Expected CWB Price									
P0	94.511	2.105	0.216	-15.534	-0.187	-0.014	-182.95	-1.484	-0.096
P1	93.677	3.731	0.218	-7.1600	-0.110	-0.006	123.17	1.450	0.068
P2	76.724	3.282	0.184	6.2497	0.112	0.006	61.365	0.847	0.036
P3	59.632	2.397	0.147	33.095	0.684	0.031	-83.579	-2.093	-0.051
P4	52.785	1.828	0.134	69.693	1.156	0.068	-142.42	-2.208	-0.091
P5	60.973	2.378	0.161	100.28	1.581	0.102	-61.463	-1.202	-0.042
P6	83.390	3.390	0.227	97.005	1.370	0.102	97.439	1.672	0.070
P7	113.63	3.721	0.318	19.939	0.243	0.022	156.88	1.998	0.118
P8	139.71	2.279	0.405	-182.93	-1.732	-0.205	-176.08	-1.560	-0.138
ω1	0.0449	2.380	0.393	0.0571	2.591	0.344	0.0618	2.468	0.285
ω2	0.1175	0.854	0.093	0.4212	2.215	0.230	0.5800	2.534	0.242
T	2.6274	4.085	2.392	0.9481	1.125	0.594	0.0762	0.157	0.037
V0	-246.31	-2.600	-0.079	126.96	0.655	0.013	-1424.4	-2.164	-0.042
V1	33.466	0.660	0.011	119.18	1.182	0.012	-153.75	-0.433	-0.005
V2	105.64	2.055	0.033	-74.538	-0.852	-0.007	507.49	1.682	0.016
V3	62.433	1.412	0.019	-238.60	-2.754	-0.022	633.74	1.904	0.019
V4	-21.522	-0.497	-0.006	-256.45	-2.178	-0.023	360.92	0.955	0.011
V5	-89.200	-1.940	-0.025	-110.61	-1.016	-0.010	-113.56	-0.455	-0.003
V6	-101.17	-1.743	-0.027	117.36	1.279	0.010	-530.82	-1.936	-0.015
V7	-35.610	-0.659	-0.009	246.84	2.703	0.020	-570.51	-1.619	-0.016
V8	111.72	1.294	0.029	-1.8569	-0.012	-0.000	149.20	0.169	0.004
Constant	-109.52	-3.003	-3.835	-11.122	-0.256	-0.268	32.133	1.513	0.593
Rho	-0.3086	-1.919	-	-0.5841	-4.257	-	-0.5102	-3.509	-
Σ lag Ep (PDL)	775.04	3.405	1.773	120.64	0.251	0.104	-207.64	-1.212	-0.109
Vp (PDL)	-180.56	-1.554	-0.058	-71.72	-0.143	-0.007	-1141.8	-0.500	-0.034
Ep (UDL)	743.01	2.128	1.700	-43.773	-0.083	-0.038	-278.34	-1.611	-0.146
Vp (UDL)	-177.14	-1.190	-0.057	136.82	0.237	0.014	-1676.7	-0.703	-0.049
R2 / DW		***0.815***	***2.134***		***0.876***	***2.198***		***0.789***	***2.459***

Table 3.7. Cont...

Variables	Wheat Coeff	Wheat T-ratio	Wheat Elas.	Barley Coeff	Barley T-ratio	Barley Elas.	Oats Coeff	Oats T-ratio	Oats Elas.
Expected CWB (Ep), Market Price (Vp)									
P0	78.691	1.593	0.180	31.449	0.225	0.027	88.928	0.675	0.047
P1	99.339	3.200	0.232	118.13	1.378	0.105	302.61	3.558	0.167
P2	51.689	1.853	0.124	90.253	1.312	0.083	109.68	1.602	0.064
P3	1.4265	0.059	0.004	48.710	0.652	0.046	-126.43	-2.879	-0.076
P4	-13.668	-0.399	-0.035	49.941	0.451	0.049	-201.99	-3.025	-0.129
P5	16.276	0.433	0.043	105.93	0.791	0.108	-73.049	-1.413	-0.050
P6	73.224	1.989	0.200	184.19	1.229	0.194	144.65	2.569	0.104
P7	111.23	2.973	0.311	207.81	1.405	0.227	175.59	2.408	0.132
P8	56.455	1.136	0.164	55.399	0.393	0.062	-415.46	-3.279	-0.325
ω1	0.0377	2.226	0.330	0.0278	1.187	0.168	0.0969	3.690	0.447
ω2	0.1359	1.022	0.108	0.0826	0.401	0.045	0.3426	1.729	0.143
T	1.7778	3.301	1.619	2.2103	1.828	1.386	1.8495	4.156	0.887
V0	-106.09	-2.916	-0.029	-128.03	-1.069	-0.013	-3459.8	-4.538	-0.065
V1	-45.952	-1.521	-0.012	20.591	0.227	0.002	-1553.5	-3.877	-0.029
V2	4.3887	0.138	0.001	57.727	0.642	0.006	-1259.7	-3.521	-0.024
V3	30.571	1.033	0.008	31.945	0.424	0.003	-1574.8	-3.905	-0.030
V4	28.080	1.011	0.007	-17.330	-0.227	-0.002	-1802.3	-3.612	-0.033
V5	2.2523	0.085	0.001	-59.812	-0.728	-0.006	-1552.5	-3.210	-0.026
V6	-31.724	-0.961	-0.008	-74.357	-0.758	-0.007	-742.78	-1.837	-0.011
V7	-48.812	-1.405	-0.011	-48.963	-0.535	-0.005	402.48	1.254	0.005
V8	-14.122	-0.301	-0.003	19.232	0.157	0.002	1351.9	1.729	0.018
Constant	-63.754	-1.885	-2.232	-61.401	-0.927	-1.480	-11.673	-0.682	-0.215
Rho	-0.3479	-2.195	-	-0.3974	-2.562	-	-0.5904	-4.328	-
Σ lag Ep (PDL)	474.67	2.233	1.086	891.82	1.140	0.772	4.5158	0.038	0.002
Vp (PDL)	-181.40	-2.133	-0.049	-199.00	-1.046	-0.020	-10191.	-4.229	-0.191
Ep (UDL)	398.09	1.210	0.911	894.52	1.090	0.775	0.4703	0.004	0.000
Vp (UDL)	-159.92	-1.412	-0.043	-135.11	-0.531	-0.013	-9000.6	-3.829	-0.169
R2 / DW		*0.829*	*2.311*		*0.832*	*2.101*		*0.816*	*2.541*

Table 3.8. Estimates of Non-Linear mean-Variance Polynomial Distributed Lag (Linear Models)--OLS

	Wheat			Barley			Oats		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Lagged market price									
P0	143.25	1.744	0.283	269.58	1.543	0.193	123.64	0.388	0.045
P1	68.618	1.283	0.139	-7.7076	-0.066	-0.006	338.57	1.610	0.126
P2	4.2821	0.091	0.009	-60.351	-0.612	-0.046	105.9	0.560	0.041
P3	-26.543	-0.795	-0.057	17.338	0.201	0.014	-205.17	-1.069	-0.081
P4	-16.868	-0.408	-0.037	141.76	1.261	0.114	-371.73	-1.544	-0.151
P5	24.070	0.575	0.055	240.01	1.909	0.201	-317.14	-1.352	-0.134
P6	70.807	1.534	0.165	249.90	1.718	0.217	-111.08	-0.509	-0.049
P7	81.654	1.530	0.195	119.95	0.801	0.107	30.516	0.141	0.014
P8	-1.3073	-0.016	-0.003	-190.63	-1.133	-0.179	-254.59	-0.768	-0.119
$\omega 1$	0.0301	1.807	0.264	0.0457	1.881	0.276	0.0602	1.929	0.278
$\omega 2$	0.0887	0.574	0.070	0.1583	0.684	0.086	0.1991	0.695	0.083
T	1.3141	2.494	1.196	1.9290	2.150	1.209	0.6981	0.827	0.335
V0	-6498.4	-2.357	-0.033	-11687.	-1.476	-0.023	-110130	-1.792	-0.034
V1	-1185.4	-0.563	-0.006	5083.9	0.946	0.010	-84359.	-1.831	-0.026
V2	1433.4	0.666	0.007	5865.3	1.177	0.011	-54507.	-1.355	-0.017
V3	1820.6	0.946	0.009	-533.68	-0.120	-0.001	-29234.	-0.852	-0.009
V4	658.95	0.346	0.003	-7540.8	-1.533	-0.015	-12744.	-0.367	-0.004
V5	-1148.9	-0.679	-0.006	-10821.	-2.251	-0.021	-4784.9	-0.147	-0.002
V6	-2480.6	-1.307	-0.013	-8274.7	-1.579	-0.016	-644.72	-0.021	-0.000
V7	-1993.7	-0.917	-0.011	-41.035	-0.008	-0.000	8843.3	0.292	0.003
V8	1873.8	0.632	0.010	11505.	1.610	0.024	37303	0.626	0.012
Constant	-35.413	-1.157	-1.240	-47.943	-1.032	-1.156	37.441	0.870	0.691
Σ lag Ep (PDL)	347.96	1.441	0.687	779.84	1.207	0.558	-661.09	-0.701	-0.238
Vp (PDL)	-7520.3	-1.374	-0.038	-16443.	-1.137	-0.032	-250260	-1.804	-0.076
Ep (UDL)	434.18	1.352	0.858	863.76	1.102	0.618	-350.92	-0.330	-0.127
Vp (UDL)	-8739.4	-1.145	-0.044	-15235.	-0.820	-0.029	-185760	-1.110	-0.057
R2 / DW	***0.783***	***2.495***		***0.824***	***2.599***		***0.681***	***2.667***	

Table 3.8. Cont...

Variables	Wheat Coeff	Wheat T-ratio	Wheat Elas.	Barley Coeff	Barley T-ratio	Barley Elas.	Oats Coeff	Oats T-ratio	Oats Elas.
Expected CWB Price									
P0	62.638	1.385	0.143	7.1582	0.068	0.006	-115.61	-0.635	-0.061
P1	79.492	2.767	0.185	116.51	1.436	0.103	180.21	1.375	0.100
P2	60.940	2.186	0.146	117.78	1.663	0.108	71.430	0.698	0.041
P3	37.958	1.447	0.094	97.402	1.559	0.092	-108.77	-1.533	-0.066
P4	29.073	0.968	0.074	102.43	1.247	0.100	-168.52	-1.687	-0.108
P5	40.360	1.384	0.107	140.51	1.488	0.143	-57.299	-0.761	-0.039
P6	65.442	2.220	0.179	179.87	1.668	0.189	134.14	1.649	0.096
P7	85.492	2.650	0.239	149.35	1.345	0.163	173.70	1.628	0.131
P8	69.230	1.129	0.201	-61.619	-0.513	-0.069	-312.00	-1.520	-0.244
ω1	0.0443	1.972	0.388	0.0498	2.178	0.300	0.0430	1.346	0.198
ω2	0.1484	0.980	0.118	0.1417	0.672	0.077	0.3654	1.220	0.153
T	1.9764	3.290	1.799	2.5015	2.689	1.568	-0.0212	-0.029	-0.010
V0	-10677.	-1.672	-0.051	-4383.9	-0.315	-0.007	-111620	-1.673	-0.055
V1	719.81	0.156	0.003	2224.8	0.215	0.003	-31330	-0.776	-0.017
V2	2712.5	0.830	0.013	-7856.5	-0.867	-0.012	2875.3	0.083	0.002
V3	516.61	0.201	0.002	-19023.	-2.341	-0.029	6079.8	0.194	0.004
V4	-2158.2	-0.650	-0.010	-22140.	-2.643	-0.034	-7885.8	-0.234	-0.005
V5	-3108.0	-0.858	-0.015	-14542.	-2.101	-0.023	-26448.	-0.804	-0.016
V6	-1635.1	-0.458	-0.008	-32.209	-0.006	-0.000	-38291.	-1.087	-0.025
V7	1452.6	0.448	0.007	11116.	2.117	0.023	-33354	-0.906	-0.021
V8	3840.9	0.916	0.021	2159.0	0.288	0.005	-2836.3	-0.068	-0.002
Constant	-75.257	-2.145	-2.635	-70.822	-1.427	-1.707	51.163	1.503	0.944
Σ lag Ep (PDL)	530.62	2.423	1.214	849.38	1.443	0.736	-202.72	-0.892	-0.107
Vp (PDL)	-8336.2	-1.081	-0.040	-52478.	-1.532	-0.081	-242810	-0.914	-0.120
Ep (UDL)	567.88	2.142	1.299	689.79	1.456	0.597	-273.04	-1.071	-0.143
Vp (UDL)	-12888.	-1.416	-0.062	-39715.	-1.457	-0.061	-217470	-0.718	-0.107
R2 / DW	***0.802.***	***2.482***		***0.847***	***3.086***		***0.685***	***2.625***	

Table 3.8. Cont...

Variables	Wheat Coeff	Wheat T-ratio	Wheat Elas.	Barley Coeff	Barley T-ratio	Barley Elas.	Oats Coeff	Oats T-ratio	Oats Elas.
Expected CWB (Ep), Market Price (Vp)									
P0	65.729	1.280	0.150	62.124	0.435	0.054	87.089	0.471	0.046
P1	97.400	2.685	0.227	134.11	1.280	0.119	273.39	2.229	0.151
P2	48.746	1.493	0.117	106.81	1.183	0.098	65.583	0.647	0.038
P3	-6.8325	-0.236	-0.017	74.451	0.797	0.071	-179.28	-2.106	-0.108
P4	-26.481	-0.715	-0.067	87.506	0.681	0.086	-260.54	-2.402	-0.167
P5	2.1092	0.054	0.006	152.71	1.017	0.155	-133.91	-1.625	-0.091
P6	60.698	1.500	0.166	233.04	1.384	0.245	88.485	1.106	0.064
P7	100.50	2.270	0.281	247.73	1.426	0.270	138.13	1.318	0.104
P8	42.182	0.763	0.122	72.268	0.417	0.081	-409.87	-2.204	-0.321
ω1	0.0347	2.038	0.304	0.0335	1.342	0.202	0.0698	2.167	0.322
ω2	0.1512	1.046	0.120	0.0975	0.419	0.053	0.2046	0.717	0.085
T	1.4628	2.481	1.332	2.6524	2.039	1.663	0.5929	1.003	0.284
V0	-4338.9	-2.399	-0.022	-5411.9	-0.867	-0.011	-152910	-2.842	-0.047
V1	-2294.5	-1.438	-0.012	923.50	0.176	0.002	-71817.	-2.165	-0.022
V2	-142.33	-0.087	-0.001	2834.1	0.553	0.006	-52326.	-1.772	-0.017
V3	1257.3	0.752	0.006	1746.0	0.375	0.003	-57389.	-1.958	-0.019
V4	1493.5	0.943	0.008	-902.22	-0.203	-0.002	-61580.	-1.956	-0.020
V5	604.41	0.478	0.003	-3659.4	-0.901	-0.007	-51097.	-1.816	-0.016
V6	-922.64	-0.630	-0.005	-5061.9	-1.056	-0.010	-23765.	-1.003	-0.007
V7	-2151.0	-1.186	-0.011	-3633.3	-0.696	-0.007	10968.	0.496	0.003
V8	-1694.9	-0.766	-0.009	2115.3	0.334	0.004	32028.	0.694	0.010
Constant	-48.483	-1.338	-1.698	-86.045	-1.206	-2.074	39.393	1.609	0.727
Σ lag Ep (PDL)	384.05	1.620	0.879	1170.8	1.341	1.014	-330.91	-1.416	-0.174
Vp (PDL)	-8189.0	-1.632	-0.041	-11050.	-0.872	-0.021	-427890	-2.483	-0.131
Ep (UDL)	339.46	0.894	0.777	1176.6	1.528	1.019	-433.70	-1.825	-0.228
Vp (UDL)	-8224.1	-1.213	-0.042	-4358.9	-0.389	-0.008	-578160	-2.910	-0.177
R2 / DW	***0.810***	***2.533***		***0.808***	***2.712***		***0.724***	***2.879***	

Table 3.9. Estimates of Non-Linear mean-Variance Polynomial Distributed Lag (Linear Models) Corrected for First Order Autocorrelation

	Wheat			Barley			Oats		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Lagged market price									
P0	168.32	2.363	0.333	277.33	1.784	0.198	113.84	0.433	0.041
P1	63.002	1.422	0.127	-15.652	-0.168	-0.012	350.93	1.959	0.131
P2	-0.8626	-0.022	-0.002	-60.050	-0.743	-0.045	107.17	0.701	0.041
P3	-20.704	-0.758	-0.044	28.325	0.406	0.022	-224.43	-1.536	-0.089
P4	-2.8729	-0.080	-0.006	154.30	1.648	0.124	-404.80	-2.092	-0.164
P5	37.364	1.022	0.085	243.32	2.249	0.204	-348.78	-1.856	-0.148
P6	75.823	1.993	0.177	241.49	1.973	0.210	-125.14	-0.740	-0.055
P7	79.399	1.920	0.190	115.52	0.993	0.103	43.411	0.263	0.020
P8	6.0736	0.091	0.015	-147.22	-0.986	-0.138	-219.74	-0.821	-0.102
ω1	0.0344	2.208	0.301	0.0485	2.208	0.292	0.0584	2.097	0.270
ω2	0.0764	0.538	0.061	0.1880	0.923	0.103	0.1868	0.766	0.078
T	1.5150	3.483	1.379	1.9766	2.599	1.239	0.6719	1.038	0.322
V0	-7385.1	-3.129	-0.037	-11380.	-1.711	-0.022	-116800	-2.259	-0.036
V1	-1043.8	-0.590	-0.005	5523.2	1.296	0.011	-85694.	-2.180	-0.027
V2	1595.7	0.887	0.008	6068.8	1.537	0.012	-54258.	-1.594	-0.017
V3	1579.6	1.052	0.008	-505.52	-0.154	-0.001	-28248.	-1.032	-0.009
V4	23.769	0.016	0.000	-7435.9	-1.888	-0.014	-10465.	-0.389	-0.003
V5	-1886.7	-1.287	-0.010	-10432.	-2.419	-0.020	-753.34	-0.030	-0.000
V6	-2896.9	-1.744	-0.015	-7678.6	-1.659	-0.015	3998.9	0.161	0.001
V7	-1682.8	-0.985	-0.009	168.32	0.041	0.000	9857.5	0.420	0.003
V8	3149.4	1.207	0.017	9977.6	1.516	0.020	25844	0.521	0.008
Constant	-44.884	-1.759	-1.572	-52.764	-1.346	-1.272	39.872	1.235	0.736
Rho	-0.3567	-2.259	-	-0.3762	-2.402	-	-0.3537	-2.237	-
Σ lag Ep (PDL)	405.54	2.104	0.801	837.36	1.590	0.599	-707.53	-1.003	-0.255
Vp (PDL)	-8546.8	-1.930	-0.043	-15694.	-1.362	-0.030	-256520	-2.205	-0.078
Ep (UDL)	487.60	1.764	0.963	905.60	1.438	0.648	-402.14	-0.443	-0.145
Vp (UDL)	-8071.6	-1.280	-0.041	-14022.	-0.986	-0.027	-187000	-1.242	-0.057
R2 / DW	***0.804***	***2.311***		***0.847***	***2.017***		***0.719***	***2.171***	

Table 3.9. Cont...

Variables	Wheat Coeff	Wheat T-ratio	Wheat Elas.	Barley Coeff	Barley T-ratio	Barley Elas.	Oats Coeff	Oats T-ratio	Oats Elas.
Expected CWB Price									
P0	70.857	1.868	0.162	27.662	0.370	0.024	-119.80	-0.759	-0.063
P1	91.173	3.692	0.213	100.56	1.811	0.089	171.61	1.426	0.095
P2	76.120	3.137	0.182	97.250	2.075	0.089	71.800	0.779	0.042
P3	52.971	2.326	0.131	89.249	2.200	0.085	-99.806	-1.788	-0.060
P4	39.623	1.567	0.101	110.97	1.997	0.109	-158.74	-1.809	-0.102
P5	44.595	1.925	0.118	159.72	2.530	0.162	-55.492	-0.865	-0.038
P6	67.031	2.957	0.183	195.71	2.710	0.206	124.46	1.745	0.089
P7	96.697	3.676	0.271	142.08	1.894	0.155	160.7 0	1.672	0.121
P8	113.98	1.955	0.331	-115.15	-1.401	-0.129	-302.18	-1.696	-0.237
ω1	0.0619	2.627	0.542	0.0495	2.953	0.298	0.039075	1.392	0.180
ω2	0.2114	1.467	0.168	0.1736	1.164	0.095	0.34796	1.317	0.145
T	2.4120	4.311	2.196	2.3630	3.489	1.481	-0.0685	-0.118	-0.033
V0	-14974	-2.393	-0.072	1991.6	0.217	0.003	-111090	-1.909	-0.055
V1	-1914.8	-0.454	-0.009	5390.3	0.861	0.008	-29205.	-0.885	-0.016
V2	1639.8	0.605	0.008	-6765.3	-1.258	-0.010	3026.6	0.108	0.002
V3	724.42	0.359	0.003	-19089.	-3.744	-0.029	4216.2	0.166	0.003
V4	-1076.5	-0.386	-0.005	-22660.	-3.907	-0.034	-9967.5	-0.359	-0.006
V5	-1628.8	-0.521	-0.008	-15020.	-3.000	-0.024	-26795.	-1.010	-0.016
V6	-248.43	-0.081	-0.001	-177.27	-0.048	-0.000	-36476.	-1.282	-0.023
V7	2298.5	0.893	0.012	11398.	3.311	0.023	-32159.	-1.057	-0.021
V8	3795.9	1.062	0.021	2768.6	0.534	0.006	-9933.6	-0.270	-0.006
Constant	-101.25	-3.018	-3.546	-66.639	-1.851	-1.607	54.156	1.962	0.999
Rho	-0.3770	-2.408	-	-0.5860	-4.278	-	-0.3392	-2.133	-
Σ lag Ep (PDL)	653.05	3.433	1.494	808.04	1.995	0.700	-207.43	-1.182	-0.109
Vp (PDL)	-11384.	-1.843	-0.054	-42164.	-1.973	-0.065	-248380	-1.125	-0.123
Ep (UDL)	634.04	2.512	1.450	734.33	1.808	0.636	-242.70	-1.310	-0.128
Vp (UDL)	-13808.	-1.649	-0.066	-34493.	-1.554	-0.053	-158380	-0.615	-0.078
R2 / DW	***0.822***	***2.110***		***0.897***	***2.468***		***0.720***	***2.185***	

Table 3.9. Cont...

Variables	Wheat Coeff	Wheat T-ratio	Wheat Elas.	Barley Coeff	Barley T-ratio	Barley Elas.	Oats Coeff	Oats T-ratio	Oats Elas.
Expected CWB (Ep), Market Price (Vp)									
P0	76.924	1.658	0.176	87.426	0.681	0.076	118.8	0.835	0.062
P1	90.957	3.007	0.212	119.66	1.508	0.106	333.42	3.215	0.184
P2	45.045	1.652	0.108	82.8	1.249	0.076	78.131	0.992	0.045
P3	-1.7292	-0.070	-0.004	59.578	0.826	0.056	-215.53	-3.527	-0.130
P4	-15.591	-0.475	-0.040	89.894	0.861	0.088	-307.26	-3.578	-0.197
P5	11.927	0.350	0.032	170.82	1.378	0.174	-147.91	-2.435	-0.100
P6	63.981	1.935	0.175	256.62	1.874	0.270	120.45	2.043	0.087
P7	98.423	2.784	0.275	258.7	1.923	0.282	164.58	2.060	0.124
P8	47.793	0.972	0.139	45.661	0.334	0.051	-539.97	-3.415	-0.423
ω1	0.0372	2.234	0.326	0.0306	1.444	0.185	0.0848	3.140	0.391
ω2	0.1469	1.092	0.116	0.0935	0.485	0.051	0.2251	1.020	0.094
T	1.5861	3.028	1.444	2.6051	2.364	1.633	0.6498	1.644	0.312
V0	-4560.6	-2.920	-0.023	-5943.5	-1.187	-0.012	-186290	-4.287	-0.057
V1	-2147.2	-1.670	-0.011	2236.4	0.579	0.004	-87958.	-3.381	-0.027
V2	-27.624	-0.021	-0.000	4397.1	1.149	0.009	-65992.	-2.922	-0.021
V3	1148.8	0.877	0.006	2707.4	0.822	0.005	-74494.	-3.318	-0.024
V4	1148.3	0.918	0.006	-797.27	-0.247	-0.002	-81654.	-3.345	-0.027
V5	152.52	0.141	0.001	-4215.0	-1.240	-0.008	-69747.	-3.122	-0.022
V6	-1241.1	-0.972	-0.007	-5777.3	-1.407	-0.011	-35130.	-1.918	-0.011
V7	-2019.7	-1.392	-0.011	-3849.1	-0.986	-0.008	11753	0.787	0.004
V8	-754.74	-0.385	-0.004	3071.1	0.573	0.006	46375	1.340	0.015
Constant	-54.713	-1.664	-1.916	-84.301	-1.399	-2.032	39.137	2.524	0.722
Rho	-0.3250	-2.033	-	-0.4336	-2.847	-	-0.5135	-3.540	-
Σ lag Ep (PDL)	417.73	2.025	0.956	1171.2	1.628	1.014	-395.29	-2.491	-0.208
Vp (PDL)	-8301.3	-2.055	-0.042	-8170.2	-0.921	-0.016	-543130	-3.897	-0.166
Ep (UDL)	396.56	1.143	0.907	1172.6	1.495	1.015	-388.46	-2.210	-0.204
Vp (UDL)	-7604.7	-1.390	-0.039	-4652.5	-0.388	-0.009	-523030	-3.259	-0.160
R2 / DW	***0.828***	***2.254***		***0.841***	***2.203***		***0.789***	***2.318***	

IV. CONCLUSION

This study has modeled an alternative approach to systems of supply response by decomposing it into acreage and yield components. Chapter two illustrates crop acreage demands for major grains in Western Canada employing duality models. The demand equations are estimated under two different assumptions, i.e., yield predetermined and yield not predetermined. Derived demands for acreage of individual crops are specified as a function of expected revenues per acre or expected prices, total crop acreage, rate of change of total acreage, numeraire, and variances of revenues per acre or variances of prices. The discussion emphasizes results for models assuming predetermined yields, risk aversion, and price uncertainty.

Econometric results are presented for a four-crop model of acreage demands for Western Canada, 1961-1995. Models are estimated using both level and first difference data. Models were estimated using market, CWB, and 'hybrid' prices. Unlike an earlier Manitoba study, estimates for models incorporating risk aversion generally have more significant coefficients (under price uncertainty assumptions). In comparison to results for linear mean-variance models, the nonlinear mean-variance models also have more significant coefficients for own expected revenue or price, but less significant coefficients for variances of revenue or price. In addition, use of first difference data substantially decreases standard errors for coefficients of expected price or revenues, but increases standard errors of coefficients for variances of revenue or price to some extent. Based on the J-test results, model specification of acreage demands in terms of revenue per acre or expected output prices are comparable.

Tests for homogeneity are not rejected in all cases under CARA and CRRA, and in seven out of eight cases under risk neutral models. This means that the acreage demand specified is linear homogeneous in expected revenue or price. Moreover, CRTS and zero adjustment cost hypotheses are also often accepted. Symmetry is rejected in all risk neutral cases but often accepted under CARA (75%). The acceptance of symmetry conditions in CARA suggests that the models specified under CARA can be integrated up into an indirect utility macro function of V(.). However, the F-tests for exclusion of price variances (CARA and CRRA) and exclusion of initial wealth (CRRA), often are not rejected (87.5%).

Results under yield uncertainty are less satisfactory than in a study using Manitoba data (1961-1987). This may be due to difficulties in consistent aggregation of weather across provinces.

Results assuming risk neutrality under price uncertainty are also less satisfactory than in an earlier study on Western Canada grains (1961-1984). A plausible explanation is that the model does not capture changes in policies after 1984 that may influence acreage demand decisions. Due to these weaknesses, it would be interesting to specify a model for each province and variable time periods in further research. In addition, changes in agricultural policy should be incorporated more explicitly into the model (here it is assumed that these policies can be modeled solely in terms of mean and variance of distributions for prices).

In chapter three, models of yield responses to price are specified assuming distributed lags, risk aversion, and price uncertainty. As in other studies, expected prices are insignificant in static models. However, the variances of price in risk averse models are often significant (at least for wheat) and have a correct sign (negative) in all cases. These results suggest that the true models are dynamic since the significance of current price variances may reflect high correlations with lagged price variances.

Results of distributed lag models show that dynamic models emphasizing risk aversion may explain crop yield response better than do static models. The sum of elasticities is often significant for both expected price and price variances. These long run impacts of price on yields are substantially larger in magnitude than that of price variances on yields for both CARA and CRRA models. This result suggests that it is important to incorporate risk aversion and dynamics into crop yield response models.

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APPENDIXES

Table A.1. CWB Crop Price ($/bushel)

Year	Barley[a)]	Oats[a,b)]	Wheat	Year	Barley	Oats	Wheat
1949	1.111	1.024	2.034	1973	1.490	1.276	2.686
1950	1.490	1.113	1.484	1974	2.815	1.501	4.144
1951	1.279	1.080	1.684	1975	2.642	1.924	4.578
1952	1.259	1.072	1.858	1976	2.231	1.865	5.224
1953	0.870	1.002	1.956	1977	2.116	1.664	3.231
1954	1.011	1.143	1.599	1978	1.897	1.342	3.188
1955	0.975	1.195	1.564	1979	2.004	1.049	4.274
1956	0.917	1.137	1.651	1980	3.148	1.220	5.869
1957	1.004	1.154	1.609	1981	3.242	2.005	6.943
1958	0.933	0.925	1.588	1982	2.734	1.963	5.446
1959	0.946	1.039	1.621	1983	2.222	1.157	5.310
1960	0.919	1.072	1.596	1984	2.722	2.074	5.112
1961	0.893	1.189	1.590	1985	3.332	1.644	5.007
1962	0.959	1.144	1.895	1986	1.879	1.490	3.984
1963	1.205	1.191	1.910	1987	1.306	1.325	2.994
1964	1.050	1.107	1.874	1988	2.722	1.764	4.354
1965	1.098	1.067	1.974	1989	2.048	2.267	5.552
1966	1.185	0.865	1.887	1990	2.639	1.550	4.277
1967	1.299	1.028	2.197	1991	1.794	1.341	2.779
1968	1.308	0.883	2.187	1992	2.460	1.562	3.674
1969	0.848	0.774	1.614	1993	1.907	1.707	4.032
1970	0.810	0.600	1.573	1994	2.274	1.676	4.594
1971	0.932	0.699	1.567	1995	3.265	1.692	6.940
1972	0.860	0.680	1.631				

Sources: CWB Annual Report. Various Issues

[a)] 1948-1952 are converted average price (CANSIM) using regression (oats and barley)

[b)] 1988-1995 are converted market price using regression (oats)

Table A.2. Crop Market Price ($/bushel) *)

Year	Barley #1 CW	Canola #1 CAN	Flaxseed #2 CW	Oats #3 CW	Rye #2 CW	Wheat #2 CWRS
1948	0.894	-0.017	3.888	0.591	1.335	1.637
1949	1.248	2.521	3.414	0.699	1.232	1.607
1950	1.051	2.521	3.565	0.658	1.356	1.527
1951	1.032	1.760	3.962	0.649	1.602	1.538
1952	0.992	1.730	3.261	0.561	1.417	1.586
1953	0.795	1.791	2.574	0.522	0.820	1.329
1954	0.824	1.679	2.679	0.561	0.933	1.239
1955	0.814	1.780	2.898	0.581	0.943	1.378
1956	0.751	1.827	2.560	0.482	1.026	1.250
1957	0.728	1.523	2.503	0.466	0.869	1.290
1958	0.732	1.520	2.623	0.512	0.864	1.333
1959	0.709	1.496	3.053	0.578	0.896	1.322
1960	0.765	1.668	3.092	0.571	0.880	1.583
1961	0.987	1.782	3.380	0.589	1.121	1.754
1962	0.877	1.989	3.425	0.546	1.113	1.676
1963	0.882	2.497	3.173	0.507	1.269	1.752
1964	0.930	2.756	3.124	0.566	1.087	1.604
1965	0.970	2.432	3.022	0.623	1.097	1.672
1966	0.976	2.514	3.016	0.639	1.142	1.772
1967	0.797	2.129	3.134	0.603	1.137	1.634
1968	0.750	1.858	2.917	0.457	1.076	1.340
1969	0.607	2.164	2.911	0.496	0.925	1.265
1970	0.690	2.388	2.209	0.489	0.938	1.430
1971	0.627	2.194	2.215	0.473	0.843	1.342
1972	1.100	3.249	3.871	0.857	1.503	1.943
1973	2.987	5.657	8.659	1.521	2.712	4.435
1974	2.091	7.231	9.448	1.425	2.396	3.920
1975	1.986	5.283	6.548	1.331	2.654	3.615
1976	1.780	6.120	6.708	1.100	2.267	2.741
1977	1.574	6.385	5.457	0.937	2.291	2.836
1978	1.594	6.391	6.714	1.031	2.532	3.860
1979	2.143	6.380	7.193	1.330	3.702	4.833
1980	2.906	6.535	8.436	1.742	4.961	5.631
1981	2.534	6.498	8.185	1.489	3.793	5.050
1982	2.021	6.377	6.195	1.217	2.162	4.770
1983	2.585	8.634	8.052	1.519	2.721	4.834
1984	2.540	7.979	7.941	1.561	2.364	4.611
1985	2.069	6.063	6.585	1.309	2.063	3.832
1986	1.413	4.620	4.393	1.116	1.522	3.010
1987	1.336	5.897	5.047	1.526	2.034	3.099

Table A.2. Cont... [*]

1988	2.329	6.769	9.155	2.139	2.729	4.767
1989	2.181	6.027	8.833	1.265	1.905	4.078
1990	1.540	5.785	5.482	1.010	1.402	2.958
1991	1.732	5.356	3.782	1.280	1.587	2.889
1992	1.712	6.325	5.290	1.457	2.040	3.496
1993	1.652	7.052	5.615	1.419	2.167	3.644
1994	2.037	7.992	6.537	1.438	2.300	4.568
1995	3.145	8.447	7.443	2.288	3.392	5.699

Source: Statistics Canada

[*] 1948-1955 are converted average price (CANSIM) using regression

Table A.3. Crop Average Price ($/bushel) *)

Year	Barley	Canola	Flaxseed	Oats	Rye	Wheat
1948	0.950	0.000	3.810	0.631	1.290	1.630
1949	1.309	2.500	3.312	0.742	1.190	1.601
1950	1.110	2.500	3.471	0.700	1.311	1.520
1951	1.090	1.750	3.888	0.691	1.550	1.531
1952	1.050	1.720	3.151	0.601	1.370	1.580
1953	0.850	1.780	2.429	0.561	0.790	1.320
1954	0.880	1.670	2.539	0.600	0.900	1.231
1955	0.870	1.770	2.769	0.621	0.910	1.370
1956	0.780	1.750	2.560	0.502	0.939	1.240
1957	0.760	1.580	2.530	0.511	0.829	1.280
1958	0.760	1.260	2.620	0.551	0.839	1.320
1959	0.740	2.000	3.070	0.630	0.859	1.310
1960	0.800	1.630	2.750	0.601	0.840	1.569
1961	1.058	1.800	3.330	0.641	1.060	1.737
1962	0.940	2.040	3.060	0.590	1.060	1.659
1963	0.940	2.520	2.910	0.541	1.200	1.739
1964	0.999	2.740	2.940	0.630	1.030	1.589
1965	1.029	2.410	2.710	0.690	1.050	1.679
1966	1.039	2.470	2.720	0.690	1.080	1.759
1967	0.850	1.920	3.080	0.661	1.070	1.620
1968	0.800	1.830	2.870	0.513	1.020	1.331
1969	0.640	2.290	2.570	0.529	0.860	1.260
1970	0.731	2.330	2.210	0.550	0.880	1.419
1971	0.671	2.160	2.200	0.520	0.800	1.339
1972	1.249	3.159	4.020	0.869	1.490	1.869
1973	2.510	5.720	9.310	1.574	2.590	4.480
1974	2.200	7.058	9.490	1.500	2.220	4.209
1975	2.310	5.090	6.550	1.410	2.590	3.620
1976	1.920	6.066	6.800	1.121	2.150	2.870
1977	1.640	6.386	5.370	0.960	2.270	2.810
1978	1.740	6.359	6.990	1.013	2.636	3.779
1979	2.329	6.142	7.340	1.398	3.776	4.839
1980	3.068	6.379	8.360	1.806	4.483	5.589
1981	2.619	6.330	8.050	1.605	3.629	5.037
1982	2.080	6.182	6.250	1.242	2.190	4.622
1983	2.590	8.655	8.190	1.586	2.785	4.808
1984	2.660	7.958	8.020	1.641	2.432	4.688
1985	2.376	6.005	6.749	1.424	1.955	4.068
1986	1.791	4.542	4.414	1.073	1.587	3.114
1987	1.514	5.795	5.156	1.282	2.105	2.780

Table A.3. Cont...[*]

1988	2.716	6.796	9.206	2.340	2.664	4.380
1989	2.182	6.053	8.698	1.354	1.949	4.081
1990	1.860	5.802	5.054	1.076	1.454	3.455
1991	1.624	5.392	3.907	1.358	1.689	2.397
1992	1.748	5.864	5.398	1.566	2.036	2.483
1993	1.604	6.890	5.666	1.456	2.075	2.499
1994	2.358	7.951	6.840	1.491	2.221	3.741
1995	3.332	8.364	7.535	2.400	3.163	4.979

Sources: CANSIM Database: D230191, D230966, D230535, D230131, D230243, D230044 (1948 - 1984)

[*] 1985-1995 are converted market price using price ratio

Table A.4. Crop Harvested Acreage (000 acres)

Year	Barley	Canola	Flaxseed	Oats	Rye	Wheat
1960	6743.00	763.00	2487.50	6430.70	491.50	23976.00
1961	5424.40	710.30	2054.10	5210.50	494.70	24716.30
1962	5176.90	371.20	1398.20	7240.10	570.90	26330.50
1963	6042.00	478.00	1630.40	6337.80	633.50	27090.30
1964	5325.00	791.00	1918.30	5136.00	636.80	29200.00
1965	5893.00	1435.00	2266.70	5705.00	744.90	27892.00
1966	7160.00	1525.00	1884.70	5490.70	673.80	29293.00
1967	7780.00	1635.00	999.40	5157.10	631.40	29671.00
1968	8500.00	1056.00	1502.80	5417.90	622.40	29018.00
1969	8970.00	2022.00	2320.90	5506.00	785.50	24550.00
1970	9480.00	4074.00	3300.30	5320.00	767.00	12075.00
1971	13508.00	5341.00	1762.30	5404.60	907.10	18994.00
1972	12050.00	3318.00	1320.00	4723.00	582.50	20915.00
1973	11520.00	3205.00	1450.00	5370.00	583.50	23215.00
1974	11370.00	3160.00	1450.00	4865.00	804.00	21570.00
1975	10590.00	4520.00	1400.00	4710.00	746.50	22855.00
1976	10302.00	1778.00	800.00	4738.00	550.00	27165.00
1977	11330.00	3590.00	1475.00	4220.00	566.00	24275.00
1978	10060.00	6980.00	1300.00	3460.00	733.00	25670.00
1979	8730.00	8420.00	2300.00	2750.00	745.00	25380.00
1980	10950.00	5140.00	1370.00	2706.00	686.00	27060.00
1981	12730.00	3463.00	1150.00	3068.00	999.20	30056.00
1982	11775.00	4370.00	1560.00	3120.00	1027.00	30520.00
1983	9780.00	5700.00	1060.00	2620.00	956.50	33120.00
1984	10370.00	7560.00	1780.00	2510.00	815.00	31870.00
1985	10775.00	6820.00	1830.00	2390.00	803.00	33230.00
1986	10810.00	6405.00	1860.00	2609.00	611.00	34288.00
1987	11240.00	6420.00	1395.00	2535.00	590.00	32580.00
1988	9325.00	9125.00	1100.00	2765.00	586.00	31025.00
1989	10725.00	7170.00	1475.00	3310.00	1078.00	33030.00
1990	10265.00	6200.00	1715.00	2365.00	793.00	33865.00
1991	9450.00	7696.06	1233.09	1685.00	389.00	34433.02
1992	8415.00	7490.00	630.00	2590.00	328.00	33330.00
1993	10320.00	10140.00	1250.00	3800.00	372.00	29979.00
1994	9855.00	14165.00	1790.00	4140.00	418.00	25750.00
1995	10715.00	12940.00	2125.00	3525.00	348.00	26640.00
1996	12340.00	8547.00	1420.00	4785.00	377.00	30352.00

Sources: CANSIM Database : D230155, D230159, D207216, D207220, D207200, D207204, D230095, D230099, D207137, D207141,D207074, D207078 , and Handbook of Field Crop Statistics 1960 - 1989, Agricultural Statistics Division, Crop Section, Statistics Canada. 1989.

Table A.5. Input Price Index (Base year: 1986)

Year	Capital[a)]	Crop[b)]	Labour[c)]
1953	19.7281	24.7971	13.5501
1954	19.8778	26.4523	13.3098
1955	19.9477	25.4235	13.0018
1956	20.9456	25.2744	13.8055
1957	22.3027	25.1253	14.6543
1958	23.5401	25.8708	15.2927
1959	24.6477	26.1241	15.9612
1960	25.2265	25.5870	16.4720
1961	25.9250	24.9842	16.8250
1962	26.3000	25.8461	17.2000
1963	26.9250	26.3280	17.6250
1964	27.5000	26.9589	18.4750
1965	27.8750	27.0154	19.7000
1966	28.6250	27.2595	21.7250
1967	29.5500	28.2439	23.6000
1968	30.7250	28.9129	24.9500
1969	31.4000	27.9923	26.1750
1970	32.0250	26.6601	26.8250
1971	33.0250	27.2750	28.2250
1972	34.2250	28.2750	30.6250
1973	35.6250	32.6750	35.0500
1975	46.3500	64.5750	49.7750
1976	50.5500	62.6000	57.4250
1977	54.4250	59.9250	63.7000
1978	58.2750	62.0500	67.6750
1979	64.0750	68.5750	71.7250
1980	73.3000	85.6000	76.8750
1981	85.7500	99.4000	82.2250
1982	93.7750	97.6250	87.4000
1983	97.9750	94.9750	90.5500
1984	100.9500	98.0500	94.3500
1985	101.9000	100.0000	97.3750
1986	100.0000	100.0000	99.9750
1987	99.0250	93.4500	102.4250
1988	100.5500	92.1000	107.0000
1989	102.9000	98.9750	112.4500
1990	106.9250	99.1750	116.3250
1991	110.6250	92.7250	121.0250
1992	110.8750	94.8250	122.2500
1993	114.7000	99.7	123.0500
1994	120.4250	105.9000	125.6250
1995	127.0250	118.9000	129.45

Sources: CANSIM Database: D605092, D605402, D605900 and Farm Input Price Index 62-004

a) Input price index for capital (machinery and motor vehicles)

b) Input price index for crop production

c) Input price index for hired labour

Table A.6. Capital Values and Expenses on Crop Input (000 $)

Year	L&B[a)]	I&M[b)]	ECI[c)]
1959	5287473	1527443	36022
1960	5801988	1580241	40871
1961	6006872	1596209	47543
1962	6359330	1644518	51998
1963	7068875	1744769	60593
1964	8008287	1898626	74961
1965	9316180	2089798	84272
1966	10410090	2309548	109438
1967	11944600	2426057	131804
1968	13057150	2518371	150272
1969	12495460	2534513	113453
1970	12351270	2498839	93823
1971	12302830	2468580	116164
1972	13701470	2577926	134131
1973	16763050	2813371	174809
1974	22102080	3626442	253048
1975	28278110	4894004	372613
1976	33760820	5991531	409369
1977	39484550	6757542	454009
1978	47587310	7733966	623287
1979	63672220	9043455	800040
1980	82820660	10452840	879288
1981	92806320	11796106	1104116
1982	93747310	13071189	1173916
1983	88585460	13752806	1337541
1984	82756990	14111660	1491521
1985	76385930	14112780	1542256
1986	69961280	14483861	1516229
1987	65359790	14617906	1407610
1988	62998550	14886143	1442453
1989	67331980	15310277	1480525
1990	70008830	15750070	1463038
1991	66986190	15758448	1405641
1992	64183190	15743561	1538242
1993	63821690	16260110	1708645
1994	67599260	17339406	2151652
1995	74622000	18523910	2486922

Sources: CANSIM Database and Agriculture Economic Statistics 21-603E

[a)] L&B: Value of land and building : D202237, D202241, D202245, D202249

[b)] I&M: Value of implements and Machinery: D202238, D202242, D202246, D202250

[c)] ECI: Expenses on crop input (fertilizer & lime, seed, pesticides): 21-603E

Table A.7. Crop Yields (bushels/acre)

Year	Barley	Canola	Flaxseed	Oats	Rye	Wheat
1959	28.35	16.70	8.90	41.60	24.50	21.35
1960	29.90	14.60	8.85	42.85	26.25	22.80
1961	28.55	15.80	9.30	38.05	19.15	19.50
1962	34.90	15.80	10.75	50.30	24.90	25.35
1963	28.25	17.50	10.20	44.20	23.35	22.55
1964	32.95	16.70	9.20	46.60	22.95	23.85
1965	35.75	15.70	12.15	49.10	28.15	25.35
1966	37.55	16.90	11.75	50.60	29.50	27.55
1967	25.95	12.60	9.15	37.80	23.85	20.10
1968	36.30	16.70	11.95	51.55	25.45	25.15
1969	35.30	14.30	11.55	49.05	28.55	24.70
1970	37.20	17.25	13.90	51.35	29.90	25.65
1971	40.25	16.10	12.15	56.00	31.65	28.70
1972	36.00	17.10	13.30	49.35	25.25	23.65
1973	37.20	15.35	13.40	53.60	29.70	25.45
1974	35.70	15.65	9.50	47.50	29.80	24.35
1975	37.30	16.85	12.50	51.40	27.25	26.80
1976	43.05	19.35	13.60	60.60	31.65	32.30
1977	44.45	21.65	17.40	56.75	27.75	30.30
1978	39.15	18.65	17.30	48.70	32.05	27.60
1979	43.05	18.90	14.00	57.80	28.80	30.55
1980	47.55	19.65	12.70	61.20	27.00	32.00
1981	40.80	19.80	16.00	50.90	31.35	29.70
1982	44.35	20.40	19.00	60.15	28.25	29.95
1983	45.35	18.40	16.50	57.80	33.10	33.75
1984	39.45	17.75	15.30	50.75	32.25	27.50
1985	38.85	16.65	19.30	47.45	27.25	24.30
1986	53.00	22.10	21.00	64.75	31.75	31.60
1987	48.25	23.70	19.80	62.15	27.40	31.85
1988	48.80	22.10	11.70	63.90	24.15	29.65
1989	47.35	19.80	13.30	58.40	32.70	31.05
1990	52.20	19.65	20.40	61.45	32.50	36.55
1991	48.50	20.25	20.30	58.90	32.10	34.95
1992	40.80	19.35	21.00	46.90	25.15	26.65
1993	57.00	21.45	19.80	70.95	30.40	34.10
1994	49.80	21.65	21.30	63.55	41.50	36.85
1995	60.85	22.60	20.50	67.75	33.15	39.65

Source: CANSIM Database: D230167, D230171, D230964, D230969, D230519, D230523, D230107, D230111, D230223, D230227, D230020, D230024.

Table A.8. Crop Production (000 bushels)

Year	Barley	Canola	Flaxseed	Oats	Rye	Wheat
1956	264147	5996	34764	347532	6388	552153
1957	211072	8661	18960	175616	6351	372201
1958	232746	7762	22058	190000	5644	373269
1959	210746	3560	16957	195400	6822	431612
1960	189003	11120	22057	248092	8612	499885
1961	108365	11220	13937	133505	4893	262479
1962	161100	5860	15323	326900	10650	548800
1963	215460	8360	20311	307100	12127	704800
1964	160866	13230	19419	210300	10855	581336
1965	207518	22600	28420	275000	16465	634856
1966	283310	25800	22020	257737	15796	810480
1967	237800	24850	9013	197500	10563	576100
1968	307200	19460	19309	253400	11510	633500
1969	352300	33520	27810	271700	13508	655400
1970	388000	72600	47804	280000	17113	314400
1971	577389	95500	22303	293179	20577	513314
1972	496600	58100	17600	241000	11970	515600
1973	450000	53960	19400	276900	12921	577000
1974	385400	51300	13800	201500	17785	466900
1975	415700	81100	17500	233200	19130	601500
1976	463300	36900	10900	262800	15250	838200
1977	522700	87000	25700	232100	14480	694400
1978	452300	154200	22500	180700	22270	757800
1979	362800	150400	32100	137300	18380	601000
1980	489100	109500	17400	143900	14750	676250
1981	588100	81500	18400	167200	32775	879000
1982	586700	97800	29600	188200	33090	963400
1983	426500	114000	17500	140361	29190	939000
1984	421500	149500	27300	121200	22530	742700
1985	507300	152300	35300	130400	19690	847300
1986	604000	160500	39000	176750	18460	1106700
1987	577800	162700	27600	159000	14700	920800
1988	422500	184800	12900	158950	9850	535800
1989	484200	140400	19600	174550	30200	864550

Table A.8. Cont ...

1990	561700	142100	35000	142450	21900	1120700
1991	481100	184250	25000	93825	11375	1146000
1992	442450	169440	13250	149400	9910	1043280
1993	545900	241900	24700	204150	11460	970040
1994	494550	316900	38100	215000	13850	790630
1995	556300	280800	43500	166150	10310	863270
1996	688750	220070	33180	266550	10985	1082650

Sources: Canadian grains Industry, Statistical Handbook. Various Issues.
CANSIM Database: D230179, D230183, D230965, D230969, D230527, D230531, D230119, D230123, D230233, D230237, D230032, D230036

Table A.9. Weather Index (GRODEX)

Year	Beaver-lodge Alberta	Brooks Ahrc Alberta	Calgary Alberta	Lethbridge Alberta	Medicine Hat Alberta	Red Deer Alberta	Vegreville Alberta	Agassiz Alberta
1961	286.325	77.547	246.322	149.691	115.108	256.764	209.969	92.072
1962	309.336	137.917	188.266	144.143	123.550	306.629	341.440	176.641
1963	231.201	233.488	299.305	266.862	229.590	310.105	256.322	414.946
1964	406.103	175.535	236.001	230.231	134.493	216.234	143.926	322.563
1965	317.227	231.628	366.237	312.293	284.774	372.849	277.031	373.751
1966	311.949	253.178	344.590	381.276	225.778	365.079	60.423	471.680
1967	205.153	247.103	175.425	291.086	178.897	251.758	150.795	66.260
1968	354.136	187.350	195.932	169.300	184.389	234.981	123.665	143.589
1969	188.086	134.497	216.739	205.578	150.588	245.508	10.484	400.743
1970	213.041	215.775	235.214	160.347	210.510	336.753	251.568	385.600
1971	352.697	187.099	258.405	181.604	153.207	265.117	257.561	410.932
1972	241.535	137.893	292.810	158.884	159.550	287.158	246.634	397.185
1973	185.741	177.195	229.010	130.255	140.671	361.135	240.837	392.931
1974	220.528	150.648	217.217	209.200	206.949	261.848	243.111	354.843
1975	250.200	347.126	239.553	347.968	298.300	286.479	282.555	375.190
1976	378.846	222.532	308.362	232.302	204.658	296.336	255.461	461.749
1977	389.085	154.320	245.553	138.743	179.185	218.305	247.571	424.527
1978	261.430	350.175	389.702	416.132	285.013	362.370	139.600	391.315
1979	322.053	196.911	192.124	105.903	212.198	256.763	236.129	424.188
1980	281.353	151.939	310.257	263.528	197.786	368.783	184.047	468.564
1981	295.215	269.710	365.085	298.978	207.039	414.316	203.918	322.275
1982	273.638	185.309	282.370	194.803	266.551	360.459	243.239	385.911
1983	416.491	192.156	171.557	140.951	157.078	230.018	218.091	512.417
1984	257.271	131.681	165.989	112.956	122.827	115.372	241.525	412.403
1985	192.861	166.402	226.601	150.653	157.288	224.458	248.530	357.108
1986	259.038	149.799	266.765	223.310	240.932	367.981	263.428	390.124
1987	355.168	188.539	272.843	223.555	198.572	221.991	196.858	473.693

Source: Agriculture Canada, Soil and Climate Section

Table A.9. Cont...

	Creston BC	Dawson Creek BC	Kamploops BC	Prince George BC	Saanichton BC	Summerland BC	Vancouver (A) BC
1961	347.080	238.125	149.841	266.476	286.411	236.509	100.984
1962	324.882	171.192	231.112	287.903	301.594	227.657	373.674
1963	430.697	153.879	153.832	278.092	297.386	272.100	325.639
1964	327.905	344.465	128.344	395.037	287.311	244.939	262.995
1965	348.928	312.409	144.970	282.123	292.561	240.900	326.395
1966	329.466	275.556	155.105	337.821	312.360	167.691	380.127
1967	317.729	204.101	104.600	256.045	67.676	126.211	52.714
1968	374.106	244.574	148.306	274.863	314.072	233.045	109.141
1969	316.296	129.256	226.988	207.449	274.459	186.500	272.472
1970	285.650	231.359	108.072	303.586	286.162	136.494	328.371
1971	347.132	309.597	135.077	258.987	299.129	257.738	90.398
1972	312.558	76.848	163.152	295.376	280.280	243.548	335.239
1973	268.041	107.128	41.305	269.355	235.709	150.274	308.553
1974	379.414	225.239	116.537	375.773	294.611	249.661	356.551
1975	320.399	265.687	152.243	356.592	86.571	218.230	97.230
1976	388.050	379.660	220.950	456.416	307.920	303.731	390.297
1977	229.046	345.908	160.600	364.035	255.352	177.918	89.940
1978	376.677	284.979	215.765	199.792	247.091	305.789	329.964
1979	312.729	403.151	89.650	144.567	273.966	171.969	326.385
1980	424.698	303.013	227.591	306.474	356.646	277.578	434.775
1981	454.171	254.380	195.264	282.786	231.087	260.444	65.548
1982	343.458	263.355	177.565	382.034	273.936	282.295	345.411
1983	362.798	292.800	188.321	349.186	306.534	328.004	401.908
1984	378.823	257.174	165.410	325.820	315.802	260.026	344.445
1985	238.995	137.335	200.884	222.629	273.270	186.830	309.075
1986	305.872	249.750	201.398	266.845	263.145	262.253	325.973
1987	335.057	306.384	120.626	259.813	289.487	202.617	370.113

Source: Agriculture Canada, Soil and Climate Section

Table A.9. Cont...

	Brandon Manitoba	Dauphin Man	Gimli Man	Morden Man	The Pas Man	Winnipeg Man
1961	158.663	92.743	236.194	152.080	184.685	190.390
1962	371.456	310.789	434.857	417.557	294.893	251.636
1963	277.205	322.797	402.871	344.651	267.287	389.067
1964	189.207	198.391	338.966	343.625	389.555	307.656
1965	296.396	269.112	328.469	317.436	216.071	291.940
1966	254.246	265.386	373.456	364.638	387.360	253.260
1967	185.093	267.605	279.361	258.412	170.753	180.993
1968	210.924	137.818	407.952	436.367	392.054	138.556
1969	273.531	222.219	313.078	325.317	217.245	258.044
1970	308.646	282.503	330.704	410.004	328.302	298.367
1971	403.567	344.184	388.297	453.519	249.871	274.351
1972	284.924	264.515	268.137	365.840	234.009	367.422
1973	290.264	269.591	359.350	331.014	267.134	271.487
1974	247.282	264.683	286.626	349.154	245.453	259.067
1975	407.575	389.347	400.487	345.647	389.473	354.152
1976	281.240	317.816	288.786	214.694	339.805	372.158
1977	250.402	389.406	346.458	334.605	273.292	227.511
1978	305.047	376.302	399.849	427.108	301.680	355.332
1979	193.390	297.518	363.789	373.598	297.477	189.268
1980	300.482	380.029	292.570	239.270	158.073	269.937
1981	303.390	304.424	90.968	374.624	304.689	186.070
1982	313.693	277.258	381.280	324.776	210.495	249.137
1983	273.349	292.663	222.750	211.905	360.627	194.868
1984	155.069	287.331	329.595	307.811	294.424	134.674
1985	279.678	366.913	401.624	431.738	382.930	316.024
1986	318.704	315.247	320.902	337.963	356.235	330.989
1987	251.327	246.631	370.202	363.306	271.718	280.881

Source: Agriculture Canada, Soil and Climate Section

Table A.9. Cont...

	Carlyle Sask	Estavan Sask	Hudson Bay Sask	Kindersley Sask	Meadow Lake Sask	Melfort CDA Sask	North Battleford Sask
1961	190.390	112.366	92.648	99.328	165.553	93.902	126.346
1962	251.636	247.710	225.502	201.262	200.051	158.604	191.120
1963	389.067	371.189	197.099	165.451	234.475	244.808	317.497
1964	307.656	300.547	236.442	174.307	143.545	97.164	238.313
1965	291.940	301.902	331.349	208.909	217.585	285.065	317.450
1966	253.260	183.734	426.319	200.812	234.143	349.986	251.508
1967	180.993	125.920	208.362	134.921	191.115	166.728	214.412
1968	138.556	235.717	229.607	115.170	224.553	208.974	236.957
1969	258.044	211.074	198.071	110.201	243.943	138.218	254.048
1970	298.367	403.132	346.704	240.109	401.639	310.245	304.955
1971	274.351	315.055	227.090	234.538	416.914	293.121	272.275
1972	367.422	375.981	285.395	157.971	285.540	269.524	210.392
1973	271.487	173.714	253.319	223.505	432.781	377.470	260.328
1974	259.067	312.658	278.973	287.748	321.466	323.978	276.062
1975	354.152	434.692	365.845	270.505	479.042	364.989	293.137
1976	372.158	304.064	373.701	257.919	354.360	312.197	258.454
1977	227.511	196.134	285.966	192.437	271.077	273.356	198.748
1978	355.332	470.615	385.482	208.914	273.647	354.064	191.245
1979	189.268	240.203	264.986	197.113	205.352	282.225	281.485
1980	269.937	213.682	229.602	180.505	184.606	267.273	319.696
1981	186.070	232.423	241.115	208.938	216.380	157.948	183.398
1982	249.137	271.889	322.920	210.520	253.572	272.704	251.634
1983	194.868	176.227	352.728	224.815	171.363	275.111	237.888
1984	134.674	132.928	267.895	171.047	294.258	272.638	283.386
1985	316.024	237.912	295.641	201.623	314.601	365.439	322.678
1986	330.989	315.200	230.607	200.113	304.308	286.333	312.769
1987	280.881	260.463	248.596	146.939	201.665	206.654	328.195

Source: Agriculture Canada, Soil and Climate Section

Table A.9. Cont...

	Prince Albert Sask	Regina Sask	Saskatoon Sask SRC	Swift Current CDA Sask	Swift Current A Sask	Yorkton Sask
1961	151.779	88.781	94.216	131.989	161.957	119.689
1962	164.101	230.521	177.224	203.523	247.010	272.394
1963	268.561	337.475	283.372	202.979	215.593	291.724
1964	52.414	232.945	148.165	203.841	155.269	313.308
1965	227.621	295.781	209.735	235.383	357.331	297.263
1966	288.188	167.996	262.745	261.038	299.019	280.213
1967	141.104	77.713	150.645	196.427	210.400	173.788
1968	267.992	146.812	254.804	123.360	177.743	265.363
1969	145.997	136.743	168.294	119.846	136.643	218.131
1970	292.771	270.995	332.787	314.184	358.974	349.292
1971	287.677	140.337	270.786	181.257	162.960	292.752
1972	168.421	192.834	242.259	153.560	175.231	214.778
1973	249.494	191.878	233.338	149.593	159.730	317.335
1974	339.136	207.803	325.520	282.734	231.083	275.734
1975	340.116	180.225	224.307	264.669	247.869	358.038
1976	238.340	277.966	200.968	253.048	278.972	302.022
1977	256.338	181.521	217.557	210.675	230.768	266.547
1978	293.110	156.994	248.458	182.226	235.578	339.142
1979	279.633	148.323	212.184	213.625	218.288	174.763
1980	206.153	167.395	156.232	198.448	197.155	321.596
1981	149.712	163.911	143.581	201.680	240.265	346.584
1982	262.950	254.065	271.296	289.051	293.223	304.296
1983	195.249	275.307	267.195	208.090	211.138	352.945
1984	281.812	128.744	121.641	99.412	119.847	236.234
1985	374.782	246.710	159.711	86.635	85.211	377.439
1986	250.105	206.646	268.590	220.490	273.801	351.213
1987	273.785	185.536	134.322	242.995	302.003	238.904

Source: Agriculture Canada, Soil and Climate Section

Table A.10. CWB Drought Index

Year	MB 71140	MB 71148	MB 71441	MB 71851	MB 71852	MB 71855	MB 71856	MB 74137	MB 74138
1981	51.200	53.700	47.800	54.200	50.000	54.900	51.200	n.a.	46.200
1982	61.100	59.400	61.965	58.700	56.100	56.800	61.200	n.a.	50.800
1983	47.400	44.900	48.600	46.300	47.900	50.600	48.500	n.a.	49.200
1984	42.600	47.300	49.200	45.900	53.900	52.200	49.500	n.a.	43.300
1985	55.300	61.615	61.778	57.700	58.000	60.947	60.554	n.a.	53.200
1986	57.400	59.900	n.a.	56.600	56.500	59.700	57.500	n.a.	57.900
1987	46.700	n.a.	n.a.	49.400	47.900	50.700	50.200	n.a.	55.100
1988	31.064	36.055	n.a.	n.a.	45.700	49.200	45.600	n.a.	43.000
1989	39.864	42.900	n.a.	n.a.	50.200	51.700	55.800	n.a.	47.700
1990	51.500	55.500	n.a.	51.600	50.400	57.900	55.200	n.a.	52.100
1991	54.700	55.400	n.a.	52.100	52.600	57.000	55.300	n.a.	53.600
1992	61.440	58.547	n.a.	61.855	59.422	56.848	57.646	n.a.	61.485
1993	59.347	60.053	n.a.	61.615	61.300	59.920	61.104	59.347	61.738
1994	57.100	60.600	n.a.	55.300	58.300	61.855	60.100	62.000	52.600
1995	48.800	55.000	n.a.	46.200	48.300	47.700	46.000	56.200	49.700

Year	MB 74139	MB 74140	MB 74141	MB 74142	MB 74143	MB 74144	MB 74147	MB 74148	MB 74149
1981	52.900	55.800	47.000	54.900	56.800	53.100	n.a.	n.a.	n.a.
1982	57.600	57.900	56.300	59.600	59.900	61.200	n.a.	n.a.	n.a.
1983	45.800	48.500	44.800	45.500	49.100	51.200	n.a.	n.a.	n.a.
1984	50.900	n.a.	43.300	48.800	46.300	51.300	n.a.	n.a.	n.a.
1985	58.300	n.a.	55.100	60.600	61.615	60.119	n.a.	n.a.	n.a.
1986	54.000	n.a.	59.300	57.400	61.204	61.600	n.a.	n.a.	n.a.
1987	50.700	53.700	53.700	49.000	58.100	59.600	56.300	59.400	59.100
1988	29.618	36.432	39.287	45.900	48.500	50.200	42.500	51.400	49.900
1989	41.805	n.a.	43.900	48.100	50.200	48.100	47.300	55.600	55.300
1990	54.000	n.a.	57.800	56.300	61.400	58.800	58.200	61.573	58.300
1991	54.100	53.900	54.600	55.500	n.a.	52.900	55.700	n.a.	55.100
1992	60.613	60.373	60.728	60.184	n.a.	60.554	n.a.	n.a.	58.461
1993	62.000	59.800	60.839	60.613	n.a.	58.959	n.a.	n.a.	61.204
1994	56.800	57.200	53.400	55.900	n.a.	59.195	n.a.	n.a.	n.a.
1995	50.600	53.200	49.000	53.300	n.a.	57.300	n.a.	n.a.	57.100

Source: Canadian Wheat Board, Weather and Crop Surveillance Depatment

Table A.10. Cont...

Year	MB 74150	MB 74153	MB 74154	MB 74155	MB 74156	MB 74157	MB 74158	MB 74159	MB 74160
1981	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1982	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1983	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1984	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1985	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1986	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1987	52.800	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1988	51.300	52.800	39.287	n.a.	37.567	39.479	46.800	n.a.	n.a.
1989	55.200	53.100	53.900	56.000	52.700	51.500	53.300	44.400	56.700
1990	57.100	58.800	56.500	56.500	55.300	56.900	56.900	59.500	61.778
1991	n.a.	58.100	55.400	55.800	54.500	54.700	57.800	55.900	57.600
1992	n.a.	61.253	58.287	56.952	58.199	59.039	61.855	n.a.	58.287
1993	n.a.	59.347	60.839	61.301	61.817	61.698	61.440	n.a.	58.019
1994	n.a.	61.394	60.100	60.000	59.000	54.100	59.700	n.a.	58.631
1995	n.a.	55.500	51.900	52.800	47.300	55.700	48.200	n.a.	60.100

Year	MB 74161	MB 74162	MB 74163	MB 74165	MB 74166	MB 74170	MB 74171	MB 74174	MB 74175
1981	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1982	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1983	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1984	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1985	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1986	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1987	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1988	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
1989	53.100	51.900	46.300	54.700	55.900	n.a.	n.a.	n.a.	n.a.
1990	55.900	53.900	55.700	56.800	56.500	n.a.	n.a.	n.a.	n.a.
1991	54.700	54.800	56.000	56.700	56.200	55.200	49.700	n.a.	n.a.
1992	61.778	n.a.	n.a.	58.109	56.952	57.927	n.a.	52.400	60.053
1993	61.817	n.a.	n.a.	61.440	61.000	62.000	n.a.	54.200	59.272
1994	51.400	n.a.	n.a.	61.700	61.600	58.000	n.a.	47.600	59.700
1995	51.900	n.a.	n.a.	55.000	55.500	53.300	n.a.	47.900	53.800

Source: Canadian Wheat Board, Weather and Crop Surveillance Depatment

Table A.10. Cont...

Year	MB 74176	MB 74177	MB 74178	MB 74179	MB 74183	MB 74501	MB 74503	MB 74506	MB 74508
1981	n.a.	n.a.	n.a.	n.a.	n.a.	53.300	53.500	57.200	n.a.
1982	n.a.	n.a.	n.a.	n.a.	n.a.	57.900	61.529	61.348	n.a.
1983	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	48.300	48.700	n.a.
1984	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	50.400	47.400	48.100
1985	n.a.	n.a.	n.a.	n.a.	n.a.	56.200	59.117	60.613	60.613
1986	n.a.	n.a.	n.a.	n.a.	n.a.	54.700	61.500	59.400	60.947
1987	n.a.	n.a.	n.a.	n.a.	n.a.	51.100	50.000	52.800	57.700
1988	n.a.	n.a.	n.a.	n.a.	n.a.	28.009	43.700	43.600	46.400
1989	n.a.	n.a.	n.a.	n.a.	n.a.	45.300	n.a.	45.100	46.100
1990	n.a.	n.a.	n.a.	n.a.	n.a.	54.400	n.a.	58.400	61.965
1991	n.a.	n.a.	n.a.	n.a.	n.a.	53.400	n.a.	56.100	59.300
1992	59.987	57.927	60.613	60.495	n.a.	59.782	n.a.	60.894	59.347
1993	61.657	59.039	60.434	61.052	58.900	60.300	60.894	59.851	58.547
1994	n.a.	60.894	57.741	57.646	54.400	53.900	59.200	n.a.	61.052
1995	51.500	53.200	56.800	55.800	50.100	48.900	46.500	n.a.	56.400

Year	MB 74529	MB 74531	MB 74533	MB 74545	MB 74546	MB 74548	MB 74554	MB 74555	MB 74562
1981	52.100	54.400	52.400	n.a.	51.700	54.500	53.200	52.900	57.500
1982	59.500	n.a.	58.200	53.700	60.100	n.a.	61.929	57.200	61.657
1983	48.000	n.a.	47.700	42.900	47.700	n.a.	47.000	43.400	51.400
1984	45.200	45.500	50.800	n.a.	44.400	45.900	53.300	46.100	56.400
1985	57.300	n.a.	61.300	n.a.	58.400	n.a.	61.892	60.800	59.782
1986	58.600	59.400	55.300	n.a.	59.600	61.800	59.600	54.200	59.500
1987	54.500	52.100	n.a.	n.a.	58.200	57.400	54.100	51.300	56.800
1988	41.805	39.864	45.000	n.a.	42.000	37.948	52.500	29.618	47.700
1989	51.500	50.200	n.a.	n.a.	49.900	47.900	55.200	43.700	55.900
1990	53.700	55.600	n.a.	n.a.	54.200	59.800	56.500	54.500	57.800
1991	54.700	55.300	n.a.	n.a.	53.800	57.900	55.900	53.500	55.700
1992	61.700	n.a.	n.a.	n.a.	59.569	60.434	58.375	60.311	58.109
1993	58.400	n.a.	n.a.	n.a.	60.947	59.347	61.529	60.900	61.698
1994	52.100	n.a.	n.a.	n.a.	61.100	57.700	54.900	56.100	60.100
1995	49.700	n.a.	n.a.	n.a.	53.300	55.200	54.300	50.600	55.200

Source: Canadian Wheat Board, Weather and Crop Surveillance Depatment

Table A.10. Cont...

Year	MB 74563	MB 74564	MB 74565	AB 71069	AB 71123	AB 71872	AB 71873	AB 71874	AB 71875
1981	55.200	55.400	n.a.	61.855	59.600	45.000	54.400	59.000	60.100
1982	60.600	59.800	n.a.	57.200	56.500	49.800	58.100	50.100	52.900
1983	49.500	51.000	n.a.	62.000	59.500	45.300	60.300	44.600	50.600
1984	55.200	54.600	n.a.	59.400	51.700	31.428	50.200	34.186	44.200
1985	60.119	61.394	57.900	56.900	58.200	28.187	55.500	40.444	47.200
1986	59.000	58.200	57.200	61.154	61.204	51.200	60.947	49.600	61.700
1987	54.400	55.300	n.a.	57.200	61.000	46.700	58.800	55.400	59.347
1988	37.188	44.100	44.900	57.355	61.657	23.634	50.000	31.064	44.500
1989	53.000	53.800	52.000	61.301	60.311	35.492	53.100	48.100	58.700
1990	56.200	57.400	55.400	60.495	59.920	39.479	58.700	50.800	58.800
1991	54.000	54.900	50.400	60.500	61.400	48.700	58.300	50.400	57.800
1992	57.155	60.248	60.184	59.900	59.600	51.500	61.200	60.400	57.646
1993	62.000	61.052	61.600	60.311	61.485	59.496	60.119	57.256	56.952
1994	59.900	61.900	59.800	61.900	60.311	45.900	48.900	57.900	57.700
1995	53.200	55.600	52.900	53.000	59.712	42.800	45.000	53.600	60.300

Year	AB 71877	AB 71878	AB 71881	AB 71928	AB 71930	AB 71931	AB 71940	AB 74112	AB 74114
1981	60.671	59.496	60.728	61.204	59.987	n.a.	50.400	55.600	54.900
1982	61.400	61.104	60.100	59.300	60.613	n.a.	59.600	49.400	53.800
1983	51.800	61.253	61.394	61.204	59.712	n.a.	58.199	49.700	52.000
1984	46.000	54.100	57.200	53.500	58.600	n.a.	57.500	44.200	50.900
1985	50.100	55.800	61.000	60.839	57.453	n.a.	53.100	44.400	58.400
1986	60.784	57.054	61.573	60.434	58.797	n.a.	60.000	47.100	61.301
1987	60.300	58.109	59.712	60.311	56.312	n.a.	61.657	44.100	57.100
1988	54.900	59.039	58.715	58.199	56.848	n.a.	60.373	44.900	60.495
1989	57.900	61.000	60.000	59.500	60.053	59.100	60.613	26.946	51.700
1990	61.300	61.052	61.400	59.600	59.039	n.a.	60.947	32.708	58.100
1991	58.200	61.104	61.394	60.700	59.920	n.a.	59.600	47.600	49.100
1992	59.422	61.698	61.100	60.400	60.495	n.a.	58.700	38.903	53.100
1993	56.952	57.453	61.965	57.646	56.743	n.a.	59.195	47.300	60.000
1994	55.900	59.920	60.400	61.052	58.631	n.a.	61.394	45.500	61.800
1995	61.104	59.496	61.394	n.a.	57.155	n.a.	55.273	41.220	53.300

Source: Canadian Wheat Board, Weather and Crop Surveillance Depatment

Table A.10. Cont...

Year	AB 74115	AB 74116	AB 74117	AB 74119	AB 74120	AB 74121	AB 74145	AB 74151	AB 74172
1981	51.200	60.500	59.600	56.100	59.900	55.900	n.a.	n.a.	n.a.
1982	49.400	56.400	51.600	61.738	62.000	59.347	n.a.	n.a.	n.a.
1983	46.300	54.500	51.700	61.500	59.400	61.817	n.a.	n.a.	n.a.
1984	31.610	48.900	48.800	59.500	50.100	52.400	n.a.	n.a.	n.a.
1985	33.446	46.100	42.400	61.600	n.a.	61.817	n.a.	n.a.	n.a.
1986	52.500	61.300	57.700	60.311	n.a.	58.287	n.a.	n.a.	n.a.
1987	48.700	60.613	58.200	50.200	n.a.	53.900	n.a.	n.a.	n.a.
1988	n.a.	48.200	n.a.	59.500	n.a.	58.400	n.a.	36.809	n.a.
1989	50.700	61.698	n.a.	57.500	n.a.	60.400	52.400	49.500	n.a.
1990	52.200	57.700	n.a.	61.154	n.a.	60.184	54.800	52.400	n.a.
1991	51.000	58.200	n.a.	51.500	n.a.	61.529	n.a.	54.400	53.300
1992	n.a.	59.117	n.a.	53.800	n.a.	61.800	n.a.	61.778	47.000
1993	n.a.	56.952	n.a.	60.311	n.a.	57.834	n.a.	n.a.	60.200
1994	n.a.	57.600	n.a.	59.920	n.a.	61.738	n.a.	n.a.	48.000
1995	n.a.	61.700	n.a.	61.400	n.a.	61.104	n.a.	n.a.	46.400

Year	AB 74173	AB 74180	AB 74184	AB 74507	AB 74509	AB 74510	AB 74515	AB 74522	AB 74525
1981	n.a.	n.a.	n.a.	57.500	54.600	n.a.	58.000	n.a.	49.800
1982	n.a.	n.a.	n.a.	60.894	60.671	n.a.	52.600	n.a.	46.400
1983	n.a.	n.a.	n.a.	58.879	61.800	59.496	47.800	n.a.	44.500
1984	n.a.	n.a.	n.a.	52.100	55.500	61.000	47.800	55.700	41.415
1985	n.a.	n.a.	n.a.	51.700	61.394	57.355	38.139	59.800	29.978
1986	n.a.	n.a.	n.a.	62.000	58.631	57.741	57.400	59.117	39.864
1987	n.a.	n.a.	n.a.	60.053	58.100	60.373	57.100	52.800	31.975
1988	n.a.	n.a.	n.a.	61.892	61.200	58.547	38.139	58.700	22.091
1989	n.a.	n.a.	n.a.	60.728	59.600	60.784	50.300	59.800	28.365
1990	n.a.	n.a.	n.a.	60.728	59.496	60.184	60.000	62.000	34.372
1991	55.300	n.a.	n.a.	58.300	61.657	61.500	59.700	49.000	49.000
1992	58.900	50.800	n.a.	50.700	61.529	54.400	61.738	52.200	45.600
1993	61.204	57.256	56.530	58.019	56.312	57.453	56.743	55.800	60.700
1994	56.600	46.500	46.000	60.248	60.839	59.117	54.000	60.800	48.900
1995	49.300	57.500	59.500	55.631	55.400	60.894	61.300	52.800	44.800

Source: Canadian Wheat Board, Weather and Crop Surveillance Depatment

Table A.10. Cont...

Year	AB 74530	AB 74534	AB 74536	AB 74539	AB 74542	AB 74549	AB 74557	SK 71125	SK 71129
1981	61.929	n.a.	60.300	60.311	46.900	61.000	59.400	57.800	45.400
1982	50.400	n.a.	57.700	60.311	47.800	60.900	n.a.	55.700	45.500
1983	48.800	n.a.	57.400	61.000	43.900	58.500	50.500	51.200	48.500
1984	49.400	n.a.	53.700	53.900	23.806	48.200	47.900	58.300	45.200
1985	46.200	n.a.	56.100	60.600	37.948	58.300	50.800	61.855	42.900
1986	51.500	n.a.	58.715	57.054	56.000	58.959	57.100	57.054	47.900
1987	52.900	55.028	56.530	61.394	49.700	56.952	52.200	61.400	40.057
1988	49.500	61.104	58.000	61.301	16.719	57.550	45.300	61.500	36.809
1989	38.903	58.900	n.a.	61.615	47.100	61.394	44.700	56.700	44.500
1990	46.400	58.879	59.300	60.311	44.900	60.700	53.300	55.700	46.100
1991	48.300	61.615	57.100	60.728	51.600	61.892	55.800	53.700	56.600
1992	52.200	61.000	60.900	56.700	48.100	60.500	58.109	56.900	51.600
1993	61.817	59.987	58.287	n.a.	57.355	57.453	60.947	54.400	58.797
1994	51.000	61.900	61.778	n.a.	46.100	61.657	n.a.	53.000	49.500
1995	60.600	60.373	59.300	n.a.	56.400	60.119	58.500	50.900	43.100

Year	SK 71130	SK 71131	SK 71138	SK 71450	SK 71861	SK 71862	SK 71863	SK 71864	SK 71865
1981	56.700	n.a.	58.700	n.a.	46.100	46.000	43.100	37.378	58.000
1982	60.700	n.a.	61.154	n.a.	50.000	51.000	53.900	48.700	54.500
1983	53.700	n.a.	51.900	49.800	44.400	42.100	52.400	44.100	53.100
1984	53.200	n.a.	50.000	37.567	40.251	40.832	38.329	28.365	46.400
1985	57.453	35.118	60.894	38.520	58.500	40.832	45.100	41.610	61.929
1986	55.100	51.000	61.301	45.200	61.394	56.200	53.600	42.800	53.400
1987	54.600	51.400	54.500	48.600	58.600	46.700	51.300	51.000	51.400
1988	39.864	31.975	45.200	22.946	47.700	30.882	26.418	21.410	32.158
1989	50.500	44.900	51.600	43.800	44.700	37.567	45.200	43.600	49.100
1990	58.100	50.400	54.600	59.400	58.200	51.000	51.600	51.700	52.400
1991	51.300	n.a.	58.500	57.300	58.700	55.400	55.100	53.900	50.000
1992	53.600	n.a.	57.646	53.800	58.547	58.300	51.600	49.300	54.900
1993	57.256	n.a.	58.959	57.500	61.000	59.272	59.039	60.900	56.743
1994	59.987	n.a.	61.529	55.600	61.778	56.600	58.100	51.300	61.615
1995	52.000	n.a.	54.100	42.400	53.600	50.500	48.200	43.300	55.400

Source: Canadian Wheat Board, Weather and Crop Surveillance Depatment

Table A.10. Cont...

Year	SK 71866	SK 71868	SK 71869	SK 71870	SK 71876	SK 74122	SK 74123	SK 74124	SK 74125
1981	45.000	55.500	47.700	55.500	50.400	52.800	48.700	56.100	49.500
1982	52.000	61.485	55.500	59.000	49.900	51.300	n.a.	60.100	54.000
1983	51.200	54.400	51.400	49.000	52.400	48.600	n.a.	51.400	45.800
1984	41.415	52.800	54.500	35.118	51.300	39.095	34.186	42.500	31.610
1985	51.800	58.199	59.569	35.118	60.000	51.300	46.800	52.300	25.193
1986	54.100	59.200	56.600	54.300	61.615	61.200	60.200	59.700	56.700
1987	37.758	57.000	57.900	52.600	51.700	55.600	n.a.	52.700	54.400
1988	21.580	50.900	45.200	38.329	50.500	37.948	28.543	41.610	32.525
1989	45.100	55.300	46.900	51.200	49.100	44.700	37.758	46.200	48.700
1990	47.600	61.900	59.100	56.000	50.500	58.800	55.400	59.200	52.100
1991	54.300	53.100	52.100	58.200	43.900	56.100	54.800	55.100	55.700
1992	50.800	59.200	55.600	61.817	54.100	59.117	55.800	60.000	52.600
1993	59.000	60.784	59.851	60.053	58.109	59.422	59.272	60.500	56.200
1994	54.500	36.621	61.000	57.300	49.300	61.800	55.800	58.700	51.800
1995	46.500	42.600	48.400	50.000	45.000	54.700	54.200	53.500	37.378

Year	SK 74126	SK 74127	SK 74128	SK 74129	SK 74131	SK 74132	SK 74133	SK 74134	SK 74135
1981	53.800	49.200	43.200	n.a.	n.a.	44.700	46.400	46.500	50.900
1982	58.600	50.600	48.800	n.a.	n.a.	51.500	58.000	61.500	53.000
1983	51.000	55.800	45.000	n.a.	48.600	48.600	49.900	51.100	45.500
1984	33.077	39.287	41.610	39.864	36.432	45.100	53.500	44.500	n.a.
1985	31.792	35.492	43.100	n.a.	42.000	52.600	60.947	56.900	n.a.
1986	54.900	50.900	46.300	52.100	50.700	58.500	51.500	58.100	54.600
1987	53.600	46.300	47.900	n.a.	43.500	51.100	46.300	n.a.	55.400
1988	43.000	19.553	25.367	n.a.	23.461	25.193	28.365	39.479	42.700
1989	48.200	39.095	32.525	n.a.	36.999	45.300	45.400	43.100	n.a.
1990	47.900	44.800	53.700	n.a.	45.700	57.400	50.900	47.900	n.a.
1991	59.900	50.700	57.600	n.a.	49.000	50.100	53.600	58.900	n.a.
1992	60.000	48.900	53.700	n.a.	51.100	51.800	53.000	58.400	n.a.
1993	60.500	55.500	61.394	n.a.	60.500	57.741	57.256	58.287	n.a.
1994	51.400	49.100	47.700	n.a.	54.300	55.800	57.300	60.728	n.a.
1995	n.a.	44.200	42.000	n.a.	47.200	44.500	46.100	55.700	55.100

Source: Canadian Wheat Board, Weather and Crop Surveillance Depatment

Table A.10. Cont...

Year	SK 74146	SK 74152	SK 74167	SK 74168	SK 74169	SK 74181	SK 74182	SK 74500	SK 74502
1981	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	43.900
1982	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	50.600
1983	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	49.200	45.700
1984	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	45.000	26.594
1985	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	39.287	35.867
1986	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	47.900	52.900
1987	n.a.	50.400	n.a.	n.a.	n.a.	n.a.	n.a.	31.064	50.900
1988	40.638	24.671	n.a.	n.a.	n.a.	n.a.	n.a.	24.325	32.892
1989	40.444	43.600	12.750	n.a.	n.a.	n.a.	n.a.	33.630	49.800
1990	55.200	53.900	37.567	54.000	n.a.	n.a.	n.a.	45.400	60.500
1991	46.600	55.700	51.400	54.300	55.900	n.a.	n.a.	51.100	56.800
1992	54.700	58.287	53.100	48.000	59.700	n.a.	n.a.	52.000	61.657
1993	56.530	58.797	58.199	58.700	58.375	61.301	61.900	59.496	59.272
1994	56.800	57.200	54.600	52.000	60.495	n.a.	47.800	49.800	54.100
1995	40.832	54.400	54.300	47.200	54.400	48.700	43.900	34.745	51.800

Year	SK 74504	SK 74512	SK 74513	SK 74514	SK 74516	SK 74517	SK 74518	SK 74521	SK 74524
1981	53.000	45.400	43.800	46.400	n.a.	57.600	n.a.	48.000	n.a.
1982	53.500	51.100	55.300	56.000	n.a.	61.529	n.a.	55.300	n.a.
1983	46.100	40.057	47.300	45.200	n.a.	52.100	53.700	54.600	53.000
1984	42.500	36.621	31.610	35.680	n.a.	51.900	45.200	41.805	n.a.
1985	59.500	51.500	43.100	39.287	42.300	61.253	49.000	n.a.	36.055
1986	61.800	61.500	60.500	46.800	51.300	61.300	n.a.	n.a.	48.000
1987	56.900	54.600	53.800	48.500	51.400	57.000	n.a.	n.a.	43.600
1988	49.800	38.903	29.438	24.671	31.975	47.800	11.751	n.a.	23.806
1989	49.900	42.100	32.341	44.800	47.200	48.700	n.a.	n.a.	35.118
1990	60.200	56.700	58.500	59.300	60.100	57.200	n.a.	n.a.	53.000
1991	58.500	55.700	n.a.	56.200	56.300	58.100	n.a.	n.a.	56.300
1992	57.834	51.500	n.a.	50.400	51.600	61.154	n.a.	n.a.	47.100
1993	60.947	58.100	n.a.	53.900	57.700	59.782	n.a.	n.a.	56.100
1994	60.554	51.200	n.a.	51.800	51.300	61.000	n.a.	n.a.	46.800
1995	58.700	48.600	n.a.	45.400	44.000	53.000	n.a.	n.a.	51.600

Source: Canadian Wheat Board, Weather and Crop Surveillance Depatment

Table A.10. Cont...

Year	SK 74526	SK 74527	SK 74532	SK 74535	SK 74538	SK 74540	SK 74541
1981	58.900	59.600	46.300	43.500	n.a.	48.600	n.a.
1982	61.200	n.a.	55.200	48.400	n.a.	54.100	n.a.
1983	53.000	52.900	47.200	55.000	55.300	n.a.	53.400
1984	49.700	52.300	31.064	n.a.	52.000	43.900	48.900
1985	60.200	61.600	34.558	n.a.	n.a.	36.999	54.400
1986	61.615	n.a.	50.300	53.100	60.053	52.500	61.500
1987	57.500	n.a.	49.300	n.a.	59.200	44.300	54.000
1988	42.600	33.077	25.367	16.719	48.100	23.461	39.287
1989	46.700	52.200	46.800	44.600	56.900	37.758	44.500
1990	53.700	n.a.	56.500	49.400	60.100	37.567	57.900
1991	58.000	n.a.	55.700	51.100	55.700	49.600	57.900
1992	59.300	n.a.	47.200	48.500	52.000	55.300	58.400
1993	58.879	n.a.	61.300	59.987	58.631	61.301	61.600
1994	59.195	n.a.	51.600	56.000	60.613	50.400	61.500
1995	59.600	n.a.	n.a.	46.600	54.900	45.900	52.200

Year	SK 74544	SK 74550	SK 74551	SK 74552	SK 74553	SK 74556	SK 74560
1981	47.900	41.026	44.600	57.300	48.800	60.400	50.800
1982	50.000	49.700	45.700	61.100	54.400	n.a.	56.600
1983	42.200	43.400	46.900	57.100	49.200	n.a.	51.500
1984	36.621	29.978	41.220	57.400	43.100	n.a.	48.400
1985	42.800	38.520	52.100	59.039	34.186	n.a.	54.900
1986	58.900	47.400	61.000	58.879	47.000	n.a.	60.500
1987	51.800	45.400	54.500	59.039	37.948	n.a.	59.200
1988	29.978	30.882	45.800	58.000	26.242	n.a.	47.900
1989	28.009	48.900	40.832	58.700	51.100	n.a.	48.800
1990	54.800	53.700	50.000	61.485	56.300	n.a.	57.900
1991	55.400	55.200	51.900	58.400	55.800	n.a.	49.300
1992	n.a.	52.500	58.200	56.300	51.000	n.a.	57.300
1993	n.a.	60.500	59.641	61.573	58.700	n.a.	60.784
1994	n.a.	50.400	52.100	59.272	52.200	n.a.	52.600
1995	n.a.	46.000	54.900	61.348	49.800	n.a.	45.200

Source: Canadian Wheat Board, Weather and Crop Surveillance Depatment

Table A.10. Cont...

Year	SK 74561	SK 74566	SK 74568	SK 74569	SK 74570	Western 71066	Western 71068
1981	n.a.	47.800	53.400	n.a.	n.a.	59.000	46.000
1982	n.a.	59.100	56.600	n.a.	n.a.	43.500	42.400
1983	n.a.	54.600	53.800	54.200	43.500	51.900	60.784
1984	n.a.	44.300	57.200	46.900	28.900	58.400	60.900
1985	n.a.	45.800	60.400	57.400	45.700	58.000	56.100
1986	n.a.	51.900	58.797	60.500	58.200	54.600	57.300
1987	n.a.	52.600	59.600	55.500	48.100	61.200	54.300
1988	38.712	27.123	57.000	32.708	22.946	59.300	59.347
1989	38.903	47.600	47.800	39.479	30.882	52.600	54.600
1990	59.400	55.100	57.300	47.400	58.100	57.800	55.000
1991	56.100	56.400	54.300	n.a.	54.600	59.422	51.300
1992	52.700	54.300	46.900	59.000	56.900	51.100	56.100
1993	61.394	57.900	59.100	57.927	61.000	52.800	61.615
1994	57.600	52.100	60.434	62.000	55.300	51.500	61.500
1995	53.300	41.610	53.200	53.200	48.600	47.000	38.903

Year	Western 71867	Western 71871	Western 71932	Western 71943	Western 74118	Western 74185	Western 74519
1981	52.500	46.800	56.500	51.500	54.500	n.a.	53.600
1982	52.700	61.104	57.500	56.900	59.800	n.a.	55.800
1983	53.500	47.800	48.100	59.851	51.900	n.a.	50.400
1984	52.000	n.a.	57.000	57.100	57.200	n.a.	52.900
1985	61.440	n.a.	61.154	51.100	61.440	n.a.	61.700
1986	61.348	n.a.	61.800	53.800	58.547	n.a.	55.400
1987	54.700	n.a.	49.900	56.090	60.800	n.a.	53.600
1988	41.610	n.a.	61.440	60.839	n.a.	n.a.	40.832
1989	51.200	n.a.	59.800	48.600	n.a.	n.a.	44.000
1990	48.400	n.a.	58.700	61.200	61.698	n.a.	n.a.
1991	43.000	55.800	61.500	53.200	56.000	n.a.	n.a.
1992	52.300	51.000	61.573	44.600	n.a.	n.a.	n.a.
1993	61.000	57.300	60.434	55.631	n.a.	n.a.	n.a.
1994	61.698	54.100	53.600	60.373	n.a.	47.900	n.a.
1995	47.100	46.000	61.900	56.637	n.a.	n.a.	n.a.

Source: Canadian Wheat Board, Weather and Crop Surveillance Department

TABLE B.1. Estimates of Acreage Demands under Yield Uncertainty CARA (First Difference Data)

a. Yield Predetermined, Ep market, Vp =0

Variables	Wheat--AR(1) Coeff	T-ratio	Barley--OLS Coeff	T-ratio	Canola--AR(1) Coeff	T-ratio
Er1	0.00031161	0.582	0.00072489	2.306	-0.00072706	-2.153
Er2	3.0225E-05	1.267	-1.9484E-05	-1.288	-6.8652E-06	-0.365
Er3	-0.00060847	-1.506	-0.00064322	-2.753	0.0012185	4.898
Er4	-0.12897	-2.861	-0.022464	-0.887	0.083215	3.258
Z	5.8951E-07	0.089	-1.6107E-06	-0.447	1.9667E-06	0.551
DZ	-1.3776E-06	-0.437	3.0586E-06	1.714	-4.4364E-07	-0.225
D	-0.15412	-2.854	0.066765	2.226	0.055073	1.757
T	-0.00063186	-0.509	-0.00042878	-1.021	0.00083912	2.333
Vr1	-1.292E-05	-0.051	-0.00041469	-2.699	0.00056843	3.220
Vr2	0.0018183	1.432	0.00065046	0.833	-0.0029233	-3.202
Vr3	0.001091	0.795	0.0011882	1.429	-0.0023926	-2.545
Vr4	-0.00030803	-2.995	4.7738E-05	0.753	0.00015779	2.101
Constant	0.014069	0.571	0.0087272	0.996	-0.014738	-1.906
Rho	0.462	2.855	-	-	-0.374	-2.211
R2 / DW	***0.809***	***1.698***	***0.7***	***1.899***	***0.823***	***1.987***

b. Yield Predetermined, Ep CWB, Vp =0

Variables	Wheat--AR(1) Coeff	T-ratio	Barley--AR(1) Coeff	T-ratio	Canola-OLS Coeff	T-ratio
Er1	0.00088539	2.024	0.00043834	1.420	-0.00086572	-1.966
Er2	4.8179E-06	0.378	-2.1118E-05	-1.564	3.0691E-05	1.861
Er3	-0.0012177	-3.619	-0.00084752	-3.208	0.0016286	4.334
Er4	-0.097503	-3.021	-0.02818	-1.266	0.06524	1.943
Z	9.1612E-06	1.763	-2.1148E-06	-0.705	-3.9419E-06	-0.802
DZ	-2.4266E-06	-1.059	3.3735E-06	1.824	-5.703E-07	-0.229
D	-0.10501	-2.531	0.065952	2.226	0.045325	1.055
T	-0.00041112	-0.257	-0.00040393	-1.185	0.00077473	1.270
Vr1	-9.3269E-06	-0.042	-0.00033016	-1.791	0.00025052	1.008
Vr2	0.00018883	0.453	0.00054197	1.360	0.00014432	0.277
Vr3	-1.0241E-05	-0.004	0.0011258	0.570	-0.0026	-0.912
Vr4	-0.00018311	-1.872	6.283E-05	0.915	-8.0968E-05	-0.772
Constant	-0.0027833	-0.090	0.0083733	1.169	-0.0086273	-0.699
Rho	0.716	5.618	-0.438	-2.671	-	-
R2 / DW	***0.878***	***1.297***	***0.69***	***1.798***	***0.848***	***2.228***

TABLE B.1. Cont... (First Difference Data)

c. Yield not Predetermined, Ep market, Vp market

	Wheat--AR(1)		Barley--OLS		Canola--OLS	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
Ep1	0.037957	1.559	-0.01307	-0.962	-0.00093357	-0.061
Ep2	0.039862	1.345	0.012025	0.735	-0.041256	-2.226
Ep3	-0.015431	-1.624	-0.010616	-2.007	0.030494	5.089
Ep4	-0.037373	-0.272	0.11693	1.677	-0.071941	-0.911
Pi1	-0.00013678	-0.104	0.0017809	2.464	-0.0015152	-1.851
Z	7.1759E-06	0.808	-6.6007E-06	-1.280	1.2021E-06	0.206
DZ	-3.4035E-06	-0.849	4.5351E-06	1.899	-7.9558E-07	-0.294
D	-0.12276	-1.629	0.051505	1.183	0.027933	0.567
T	-3.3945E-05	-0.019	-0.00040865	-0.793	7.7345E-05	0.132
Vp1	-0.095433	-2.133	0.026108	1.128	0.040429	1.542
Vp2	0.088533	1.006	-0.083244	-2.001	0.010219	0.217
Vp3	0.0016712	0.148	0.0016817	0.267	-0.0040111	-0.563
Vp4	0.016621	1.202	0.0058304	0.678	-0.022339	-2.293
Ew1	-2.1718E-05	-0.115	-0.0001321	-1.057	0.00018069	1.276
Vw1	6.1516E-06	1.484	-5.1173E-06	-2.040	6.6435E-07	0.234
Constant	-0.00055343	-0.016	0.0039963	0.363	0.0055218	0.443
Rho	0.54795	3.588	-	-	-	-
R2 / DW	*0.766*	*1.419*	*0.654*	*1.922*	*0.783*	*1.836*

d. Yield not Predetermined, Ep CWB, Vp market

	Wheat--AR(1)		Barley--OLS		Canola--OLS	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
Ep1	0.020838	2.468	-0.011142	-1.647	-0.0049614	-0.712
Ep2	0.021951	1.819	0.0095131	0.991	-0.018974	-1.917
Ep3	-0.03009	-2.937	-0.015215	-2.222	0.040781	5.777
Ep4	0.033212	0.346	0.049534	0.818	-0.073032	-1.169
Pi1	0.0012199	1.011	0.0014834	1.780	-0.0020179	-2.348
Z	1.317E-05	1.900	-5.0267E-06	-0.998	-3.8238E-06	-0.736
DZ	-4.8068E-06	-1.514	3.794E-06	1.562	1.2547E-06	0.501
D	-0.1001	-1.675	0.060497	1.352	-0.0060419	-0.131
T	-0.00034376	-0.254	-0.0002898	-0.534	5.3309E-05	0.095
Vp1	-0.042918	-1.221	0.035881	1.508	0.006582	0.268
Vp2	0.013831	0.172	-0.064368	-1.288	0.032144	0.624
Vp3	0.006034	0.514	0.00043719	0.058	-0.0046255	-0.593
Vp4	0.026788	2.072	0.00051465	0.051	-0.023795	-2.305
Ew1	2.496E-05	0.162	-0.00014341	-1.106	0.00014002	1.048
Vw1	2.2877E-06	0.702	-4.1834E-06	-1.613	-8.5151E-08	-0.032
Constant	-0.0063948	-0.243	0.0041833	0.362	0.010002	0.839
Rho	0.51748	3.312	-	-	-	-
R2 / DW	*0.847*	*1.717*	*0.622*	*1.816*	*0.803*	*1.903*

TABLE B.2. Estimates of Acreage Demands under Yield Uncertainty CRRA (First Difference Data)

a. Yield Predetermined, Ep market, Vp =0

Variables	Wheat--AR(1) Coeff	Wheat--AR(1) T-ratio	Barley--AR(1) Coeff	Barley--AR(1) T-ratio	Canola--OLS Coeff	Canola--OLS T-ratio
Er1	0.00055074	0.952	0.00057366	1.861	-0.00056234	-1.507
Er2	2.9346E-05	1.282	-1.3158E-05	-1.078	-1.0803E-05	-0.555
Er3	-0.00066981	-1.716	-0.00049378	-2.371	0.0012084	4.880
Er4	-0.22797	-2.350	0.094432	1.814	0.049409	1.203
Z	-3.3528E-07	-0.052	-3.33E-07	-0.096	2.2507E-06	0.642
DZ	-1.4246E-06	-0.465	2.9106E-06	1.781	-4.6607E-07	-0.233
D	-0.16009	-3.040	0.07371	2.624	0.050439	1.600
T	-0.0007284	-0.459	-0.00042618	-0.480	0.00067778	1.754
Vr 1	0.00012415	0.453	-0.00065972	-4.514	0.00063928	3.372
Vr2	0.0017456	1.430	0.0009259	1.423	-0.0032473	-3.420
Vr3	0.00084363	0.636	0.001982	2.803	-0.0023966	-2.539
Vr4	-0.00031571	-3.190	5.6069E-05	1.062	0.00017829	2.314
W01	-1.7733E-09	-1.068	2.0408E-09	2.292	-7.0335E-10	-1.005
Constant	0.021239	0.658	0.0039393	0.219	-0.010066	-1.131
Rho	0.598	4.086	0.62	4.325	-0.447	-2.734
R2 / DW	***0.820***	***1.506***	***0.733***	***1.907***	***0.833***	***2.056***

b. Yield Predetermined, Ep CWB, Vp =0

Variables	Wheat--AR(1) Coeff	Wheat--AR(1) T-ratio	Barley--AR(1) Coeff	Barley--AR(1) T-ratio	Canola--OLS Coeff	Canola--OLS T-ratio
Er1	0.00091875	1.977	0.00043327	1.277	-0.00069377	-1.482
Er2	4.228E-06	0.319	-2.0959E-05	-1.483	2.7173E-05	1.620
Er3	-0.0012072	-3.464	-0.00084868	-3.096	0.0016904	4.459
Er4	-0.11319	-1.617	-0.026613	-0.695	0.012026	0.199
Z	9.2742E-06	1.736	-2.1464E-06	-0.669	-2.8735E-06	-0.575
DZ	-2.4445E-06	-1.041	3.3779E-06	1.766	-8.3281E-07	-0.334
D	-0.10644	-2.475	0.066064	2.150	0.038637	0.892
T	-0.00046284	-0.271	-0.00039575	-1.003	0.00047332	0.705
Vr 1	-5.5733E-06	-0.024	-0.00033141	-1.740	0.00026567	1.070
Vr2	0.00014694	0.321	0.00054932	1.224	-8.8488E-05	-0.157
Vr3	0.00010708	0.039	0.0011082	0.526	-0.0018954	-0.649
Vr4	-0.0001744	-1.650	6.1508E-05	0.800	-3.6347E-05	-0.322
W01	-2.9853E-10	-0.251	3.3117E-11	0.050	-1.1238E-09	-1.056
Constant	-0.0013177	-0.039	0.0081569	0.940	-0.00082236	-0.057
Rho	0.725	5.773	-0.434	-2.636	-	-
R2 / DW	***0.879***	***1.278***	***0.690***	***1.795***	***0.729***	***1.982***

TABLE B.2. Cont... (First Difference Data)

c. Yield not Predetermined, Ep market, Vp market

	Wheat--AR(1)		Barley--AR(1)		Canola--OLS	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
Ep1	0.025797	0.938	0.0063501	0.402	-0.0093851	-0.507
Ep2	0.044158	1.455	0.020806	1.343	-0.040798	-2.181
Ep3	-0.019112	-1.772	-0.017162	-3.882	0.031204	4.949
Ep4	-0.15865	-1.019	0.065452	1.239	-0.03404	-0.449
Pi1	0.00049592	0.274	0.0023898	2.796	-0.0019722	-1.778
Z	6.651E-06	0.699	-1.2005E-05	-2.415	2.0215E-06	0.331
DZ	-3.0624E-06	-0.729	6.5631E-06	2.436	-5.3033E-07	-0.192
D	-0.13433	-1.683	0.010442	0.239	0.042271	0.822
T	-0.00015729	-0.087	-0.0008784	-2.134	0.00034707	0.552
Vp1	-0.084274	-2.163	-0.0048548	-0.298	0.043908	1.884
Vp2	0.10715	1.249	-0.06005	-2.067	0.0045221	0.104
Vp3	-0.0060275	-0.554	-0.0017039	-0.341	-0.0018734	-0.296
Vp4	0.017925	1.443	0.011574	1.631	-0.021762	-2.490
W01	-1.5708E-09	-0.686	-1.2695E-09	-1.474	1.1544E-09	0.990
Ew1	3.1852E-05	0.162	-0.00011916	-0.879	0.00015623	1.101
Vw1	5.51E-06	1.259	-6.5769E-06	-2.376	5.3503E-08	0.018
Constant	0.0073898	0.206	0.017618	1.835	-0.0021743	-0.159
Rho	0.53612	3.479	-0.59142	-4.017	-	-
R2 / DW	***0.769***	***1.432***	***0.729***	***2.058***	***0.797***	***1.780***

d. Yield not Predetermined, Ep CWB, Vp market

	Wheat--AR(1)		Barley--OLS		Canola--OLS	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
Ep1	0.022849	2.243	-0.0070174	-0.910	-0.0078856	-0.932
Ep2	0.020388	1.666	0.007123	0.749	-0.01503	-1.440
Ep3	-0.030397	-2.638	-0.016154	-2.321	0.039494	5.174
Ep4	0.017913	0.184	0.026741	0.478	-0.047926	-0.782
Pi1	0.0013881	0.791	0.0026654	2.140	-0.0025062	-1.835
Z	1.2377E-05	1.666	-4.4097E-06	-0.880	-4.8041E-06	-0.875
DZ	-4.631E-06	-1.361	3.3538E-06	1.389	1.9847E-06	0.750
D	-0.10674	-1.696	0.059813	1.330	-0.0053074	-0.108
T	-0.00050101	-0.334	-0.00056236	-0.959	0.00025205	0.392
Vp1	-0.031714	-0.896	0.03165	1.392	0.0097768	0.392
Vp2	0.0023489	0.029	-0.053789	-1.107	0.0096242	0.181
Vp3	0.0030997	0.231	-0.0053325	-0.662	0.0011579	0.131
Vp4	0.022217	2.046	0.0013984	0.166	-0.017868	-1.930
W01	-5.5469E-10	-0.310	-1.5924E-09	-1.403	1.0903E-09	0.876
Ew1	3.1918E-05	0.200	-0.00013601	-1.044	0.00011786	0.825
Vw1	1.9533E-06	0.560	-3.7842E-06	-1.415	-7.1812E-07	-0.245
Constant	-0.002668	-0.091	0.0095625	0.780	0.00538	0.400
Rho	0.5387	3.502	-	-	-	-
R2 / DW	***0.846***	***1.710***	***0.648***	***1.936***	***0.793***	***1.901***

Table B.3. Estimates of Production Functions

a. Restrictive Production Function (41)

	Wheat		Barley		Canola		Oats		Flaxseed		Rye	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
X1	-6.1434	-0.188	6.4745	0.175	9.6977	0.596	-20.436	-0.415	23.012	1.348	23.31	0.838
zi	-4.43E-18	-0.000	7.03E-17	0.000	-3.50E-17	-0.000	1.95E-15	0.000	-1.59E-17	-0.000	-4.66E-16	-0.000
T	0.35472	1.127	0.5433	1.272	0.17756	1.079	0.95513	1.905	0.11253	0.623	-0.035762	-0.122
G87	0.02552	1.398	0.024933	1.201	0.009243	0.949	0.009004	0.272	0.035377	3.181	0.044926	2.253
G87X	-4.08E-15	-0.000	-1.74E-13	-0.000	-6.34E-14	-0.000	-3.84E-13	-0.000	2.14E-14	0.000	4.77E-15	0.000
G87W	1.141E-07	0.344	1.39E-07	0.169	-5.94E-07	-1.309	2.98E-06	1.102	1.26E-06	0.772	9.46E-06	0.936
G87T	3.32E-17	0.000	1.61E-15	0.000	5.04E-16	0.000	3.13E-15	0.000	-1.94E-16	-0.000	-4.57E-17	-0.000
WC88	0.56656	2.313	-0.3471	-1.320	0.005012	0.052	-0.034604	-0.117	0.28714	2.731	0.35923	2.379
WC88X	-3.30E-14	-0.000	-1.50E-12	-0.000	-5.04E-13	-0.000	-3.18E-12	-0.000	1.97E-13	0.000	-1.65E-14	-0.000
WC88W	-9.87E-06	-1.369	5.95E-05	2.998	2.59E-06	0.673	4.38E-05	1.456	8.28E-06	0.286	0.000148	1.660
WC88T	2.47E-16	0.000	1.38E-14	0.000	3.92E-15	0.000	2.58E-14	0.000	-1.56E-15	-0.000	6.66E-16	0.000
Constant	10.511	1.491	18.689	2.109	10.661	2.495	32.208	2.463	-7.7457	-1.677	2.3361	0.295
R2 / DW	*0.700*	*1.911*	*0.805*	*2.443*	*0.648*	*1.407*	*0.598*	*2.490*	*0.809*	*1.539*	*0.532*	*2.017*

b. Unrestrictive Production Function (41)

	Wheat		Barley		Canola		Oats		Flaxseed		Rye	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
X1	271.86	0.656	-408.81	-0.545	-172.36	-0.539	1010.6	0.820	-357.63	-1.457	-222.79	-0.502
zi	-0.004482	-1.611	-0.013943	-1.164	0.0062803	1.219	0.023816	0.564	-0.005216	-0.581	0.04945	0.915
T	-0.35219	-0.095	7.6251	0.879	-0.007906	-0.004	-4.4227	-0.511	2.5365	1.110	2.1765	0.520
G87	-0.16817	-1.124	-0.1717	-0.817	0.0075261	0.250	0.44483	0.687	-0.052515	-1.145	0.087224	0.940
G87X	-0.58016	-0.622	0.87235	0.518	0.42679	0.594	-2.296	-0.821	0.85262	1.541	0.47607	0.476
G87W	9.97E-06	1.628	3.09E-05	1.137	-1.49E-05	-1.306	-5.03E-05	-0.510	1.36E-05	0.678	-9.68E-05	-0.795
G87T	0.0011088	0.133	-0.015253	-0.783	0.000259	0.052	0.011786	0.608	-0.005307	-1.028	-0.004306	-0.457
WC88	-0.054245	-0.043	-3.3366	-1.338	0.3561	0.818	3.4583	0.623	-0.53734	-0.954	0.010061	0.009
WC88X	-8.1317	-1.003	5.6996	0.452	2.91	0.503	-20.777	-0.900	6.6603	1.447	5.7322	0.708
WC88W	4.90E-05	1.005	0.000343	1.662	-0.000101	-1.108	-0.000307	-0.419	0.000102	0.608	-0.000671	-0.649
WC88T	0.033083	0.482	-0.077916	-0.628	-0.007641	-0.185	0.11038	0.715	-0.037076	-0.880	-0.031954	-0.414
Constant	99.503	1.465	108.63	1.170	11.699	0.875	-161.8	-0.586	30.16	1.488	-16.874	-0.414
R2 / DW	***0.760***	***1.823***	***0.839***	***2.471***	***0.706***	***1.731***	***0.644***	***2.436***	***0.869***	***1.860***	***0.678***	***2.441***

Table B.3. Cont...
c. Estimates of Production Function (42)

	Wheat		Barley		Canola		Oats		Flaxseed		Rye	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
X1	-8702	-1.024	-15759	-1.215	1497	0.287	-10560	-0.569	-1816.7	-0.356	839.1	0.103
zi	0.024539	0.596	-0.3078	-1.118	0.083843	0.725	0.061132	0.094	0.10844	0.606	-2.2274	-1.406
T	70.597	1.100	217.01	1.209	-42.339	-0.978	85.045	0.672	17.214	0.387	43.063	0.457
G87	2.2926	0.566	-8.7392	-1.063	0.47161	0.424	2.0844	0.103	0.58398	0.305	-5.1751	-1.158
G87X	40.635	1.063	72.516	1.234	-6.6762	-0.282	49.133	0.577	6.9318	0.301	-5.6226	-0.156
G87W	-0.000121	-0.641	0.0014241	1.126	-0.000371	-0.719	-0.000289	-0.095	-0.000528	-0.625	0.010348	1.467
G87T	-0.33189	-1.148	-1.0092	-1.233	0.18743	0.962	-0.40917	-0.718	-0.067185	-0.333	-0.17429	-0.418
WC88	-168.37	-1.467	-84.831	-0.863	7.9511	0.632	33.745	0.209	-4.0073	-0.317	-40.27	-0.728
WC88X	620.19	1.468	556.1	1.275	-28.947	-0.145	416.82	0.597	81.29	0.403	-310.32	-1.187
WC88W	0.002923	1.112	0.010206	1.062	-0.003532	-0.786	-0.010787	-0.458	-0.0052065	-0.729	0.071629	1.232
WC88T	-3.3282	-1.168	-6.9162	-1.423	1.331	0.697	-2.9963	-0.647	-0.47227	-0.279	1.3653	0.537
G287	-0.002821	-0.607	0.0099709	1.062	-0.000531	-0.415	-0.002637	-0.110	-0.000780	-0.353	0.0060371	1.221
G287X	-0.047079	-1.098	-0.083096	-1.251	0.0075083	0.280	-0.056824	-0.581	-0.0062618	-0.241	0.0082827	0.207
G287W	1.46E-07	0.682	-1.64E-06	-1.134	4.0791E-07	0.709	3.521E-07	0.097	6.3943E-07	0.646	-1.20E-05	-1.523
G287T	0.0003881	1.194	0.0011717	1.258	-0.000206	-0.943	0.00049167	0.768	6.4647E-05	0.283	0.00017568	0.382
WC288	3.2056	1.605	0.89122	0.728	-0.12478	-0.585	-0.49305	-0.315	0.12225	0.844	0.25575	0.367
WC288X	-8.2152	-1.640	-4.9121	-1.259	0.024558	0.012	-4.1536	-0.626	-0.8505	-0.428	5.1796	2.266
WC288W	-6.02E-05	-1.399	-8.19E-05	-0.953	3.63E-05	0.799	0.00017671	0.807	5.8443E-05	0.799	-0.000558	-1.043
WC288T	0.03472	1.126	0.054342	1.522	-0.0095649	-0.450	0.027652	0.592	0.0023337	0.138	-0.033807	-1.690
Constant	-434.46	-0.493	1942.9	1.081	-89.206	-0.369	-373.52	-0.088	-97.586	-0.237	1127.4	1.119
R2 / DW	***0.861***	***1.983***	***0.913***	***2.035***	***0.773***	***1.600***	***0.833***	***2.307***	***0.915***	***1.792***	***0.883***	***2.122***

Table B.4. Marginal Impact of Weather on Yield*

Year	Wheat	Barley	Canola	Oats	Flax	Rye
1961	0.02834	0.02568	0.00882	0.02455	0.03796	0.04960
1962	0.02852	0.02565	0.00902	0.03060	0.03714	0.05033
1963	0.02861	0.02577	0.00896	0.02791	0.03743	0.05092
1964	0.02885	0.02567	0.00877	0.02432	0.03779	0.05095
1965	0.02870	0.02575	0.00839	0.02602	0.03823	0.05197
1966	0.02886	0.02592	0.00834	0.02538	0.03775	0.05130
1967	0.02891	0.02601	0.00827	0.02439	0.03664	0.05090
1968	0.02883	0.02611	0.00862	0.02516	0.03727	0.05081
1969	0.02832	0.02618	0.00804	0.02543	0.03830	0.05236
1970	0.02690	0.02625	0.00682	0.02487	0.03953	0.05218
1971	0.02769	0.02680	0.00607	0.02512	0.03760	0.05351
1972	0.02791	0.02660	0.00727	0.02309	0.03704	0.05044
1973	0.02817	0.02653	0.00734	0.02502	0.03720	0.05044
1974	0.02798	0.02651	0.00737	0.02351	0.03720	0.05253
1975	0.02813	0.02640	0.00656	0.02305	0.03714	0.05199
1976	0.02862	0.02636	0.00819	0.02314	0.03638	0.05013
1977	0.02829	0.02650	0.00711	0.02159	0.03723	0.05028
1978	0.02845	0.02633	0.00510	0.01932	0.03701	0.05186
1979	0.02842	0.02614	0.00424	0.01721	0.03827	0.05197
1980	0.02861	0.02645	0.00619	0.01707	0.03710	0.05141
1981	0.02895	0.02670	0.00719	0.01815	0.03683	0.05438
1982	0.02900	0.02656	0.00665	0.01831	0.03734	0.05464
1983	0.02930	0.02629	0.00586	0.01682	0.03671	0.05397
1984	0.02916	0.02637	0.00476	0.01649	0.03762	0.05263
1985	0.02931	0.02643	0.00519	0.01613	0.03768	0.05252
1986	0.02943	0.02643	0.00544	0.01679	0.03772	0.05070
1987	0.02924	0.02649	0.00543	0.01656	0.03713	0.05051
1988	0.26026	0.20757	0.02863	0.37400	0.29625	0.44596
1989	0.24047	0.29084	0.02357	0.43534	0.29935	0.51878
1990	0.23222	0.26348	0.02106	0.41519	0.30134	0.47660
1991	0.22662	0.21500	0.02494	0.37948	0.29735	0.41681
1992	0.23751	0.15344	0.02440	0.33412	0.29236	0.40778
1993	0.27059	0.26675	0.03126	0.41760	0.29749	0.41429
1994	0.31234	0.23910	0.04168	0.39722	0.30196	0.42110
1995	0.30355	0.29025	0.03851	0.43491	0.30474	0.41074

*) under restricted production function (41)
1961-1987 using GRODEX weather data; 1988-1995 using CWB drought index

TABLE B.5. Nonlinear SUR Estimates of Acreage Demands under Price Uncertainty[*)] (Levels Data)

a. Yield Predetermined, Ep market, Vp market

	Wheat		Barley		Canola		(Wo + ER)/VRSQ	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
Er1	0.004943	0.433	-0.004387	-0.491	-0.000699	-0.135	-9.42E-06	-0.445
Er2	0.006055	0.989	-0.002172	-0.473	-0.002302	-0.842	1.25E-05	1.160
Er3	-0.002365	-0.354	-0.0098257	-1.639	0.011942	2.788	-2.14E-05	-1.654
Z	0.000196	2.219	-0.000161	-2.559	-3.79E-05	-1.170	-1.81E-07	-1.725
DZ	-0.000140	-2.361	0.000115	2.558	1.9366E-05	1.038	9.65E-08	1.354
Er4	0.35615	0.730	0.25903	0.727	-0.32165	-1.269	0.001044	1.223
D	-2.3092	-2.319	0.40778	0.673	0.56215	1.630	-0.003485	-2.533
T	-0.16234	-2.457	0.059456	1.949	0.11438	2.556	7.35E-05	1.160
W01	3.67E-09	0.344	1.96E-08	1.962	-1.107E-08	-1.851	-8.08E-12	-0.421
Vr1	0.000184	0.214	0.000171	0.257	-0.000237	-0.613	2.17E-06	1.353
Vr2	-0.000600	-1.036	0.000168	0.391	0.000288	1.093	-1.05E-06	-1.037
Vr3	0.000348	0.633	0.000396	0.917	-0.000412	-1.453	1.33E-06	1.333
Vr4	0.001244	1.592	-0.000426	-0.806	-0.000437	-1.318	8.35E-07	0.685
Constant	-0.73212	-0.302	9.4207	2.826	1.1518	0.903	0.0051771	1.170
C1	-23.818	-2.938	-23.818	-2.938	-23.818	-2.938	-	-
C2	0.001407	1.614	0.001407	1.614	0.001407	1.614	-	-
R2 / DW	***0.737***	***1.247***	***0.557***	***0.790***	***0.922***	***2.023***	***0.773***	***1.747***

b. Yield Predetermined, Ep CWB, Vp market

	Wheat		Barley		Canola		(Wo + ER)/VRSQ	
Variables	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio	Coeff	T-ratio
Er1	0.000665	0.048	0.008060	0.689	-0.006211	0.979	-5.86E-06	-0.581
Er2	0.01139	1.143	-0.003456	0.385	-0.000171	0.040	2.05E-06	0.287
Er3	-0.02329	-1.399	-0.016046	-1.077	0.037367	4.808	-2.95E-05	-2.334
Z	0.000435	2.944	-0.000363	-2.915	-7.04E-05	-1.063	-2.43E-07	-2.468
DZ	-0.000326	-3.264	0.000289	3.566	2.94E-05	0.634	1.31E-07	1.863
Er4	2.5488	2.305	-0.4147	-0.425	-1.1323	-2.162	0.001540	1.843
D	-6.1116	-3.407	1.6052	1.023	1.2683	1.554	-0.003389	-2.554
T	-0.41482	-4.882	0.16223	2.421	0.26603	6.081	0.000120	2.125
W01	1.67E-08	0.813	3.35E-08	2.056	-2.8E-08	-2.989	4.57E-12	0.306
Vr1	-0.001141	0.751	0.000978	0.734	0.000249	0.372	9.10E-07	0.834
Vr2	-0.001159	-1.147	0.000278	0.308	0.000113	0.260	-8.85E-08	-0.123
Vr3	0.000608	0.571	0.001353	1.480	-0.000785	-1.539	8.84E-07	1.121
Vr4	0.004109	3.048	-0.001272	-1.065	-0.001415	-2.245	8.38E-07	0.802
Constant	2.4245	0.416	20.237	3.877	1.9126	0.701	0.007645	1.845
C1	-63.698	-16.651	-63.698	-16.651	-63.698	-16.651	-	-
C2	0.002357	1.184	0.002357	1.184	0.002357	1.184	-	-
R2 / DW	***0.768***	***1.288***	***0.537***	***0.892***	***0.931***	***1.906***	***0.787***	***1.992***

[*)] Joint estimation using C1, C2, and betas from Manitoba results

Table C.1. Estimates for One Period Risk-Neutral Models (Linear Models)

	Canola			Flax			Rye		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Lagged market price									
Ep	-18.137	-1.067	-0.083	-28.07	-2.850	-0.195	5.1573	0.088	0.007
ω1	0.010982	1.261	0.149	0.039897	4.937	0.670	0.035488	2.184	0.308
ω2	0.090545	1.165	0.111	0.39362	5.371	0.598	0.27377	1.857	0.215
T	0.15457	2.471	0.151	0.05038	0.730	0.061	0.26644	1.903	0.166
Constant	12.362	3.268	0.672	-1.9989	-0.553	-0.134	8.7945	1.214	0.305
R2 / DW	***0.626***	***1.333***		***0.860***	***1.617***		***0.456***	***2.024***	
Lagged Average Price									
Ep	-17.584	-1.049	-0.080	-26.238	-2.819	-0.178	-2.7863	-0.045	-0.003
ω1	0.011054	1.265	0.150	0.039569	4.895	0.665	0.035855	2.216	0.311
ω2	0.091647	1.175	0.113	0.38547	5.276	0.586	0.27713	1.891	0.217
T	0.15442	2.458	0.151	0.080724	1.277	0.098	0.25494	1.875	0.159
Constant	12.259	3.259	0.666	-2.5289	-0.708	-0.170	9.1236	1.249	0.316
R2 / DW	***0.626***	***1.326***		***0.859***	***1.624***		***0.456***	***2.034***	

Table C.2. Estimates for One Period Linear Mean-Variance Models (Linear Models)

	Canola			Flax			Rye		
Variables	Coeff	T-ratio	Elasticity	Coeff	T-ratio	Elasticity	Coeff	T-ratio	Elasticity
Lagged market price									
Ep	-24.365	-1.169	-0.112	-12.014	-0.879	-0.084	-32.033	-0.456	-0.041
ω1	0.010892	1.235	0.148	0.041309	5.225	0.694	0.035904	2.206	0.311
ω2	0.092981	1.180	0.114	0.38725	5.425	0.589	0.2696	1.825	0.212
T	0.13429	1.815	0.131	0.16191	1.698	0.196	0.22175	1.502	0.138
Vp	10.349	0.530	0.008	-11.605	-1.647	-0.028	105.48	0.962	0.017
Constant	13.083	3.220	0.711	-5.4644	-1.333	-0.367	10.479	1.404	0.363
R2 / DW	*0.630*	*1.313*		*0.872*	*1.480*		*0.473*	*2.102*	

Table C.3. Estimates for One Period Linear Mean-Variance Models (Linear Models)

	Canola			Flax			Rye		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Lagged market price									
Ep	-22.116	-0.924	-0.102	-13.985	-0.990	-0.097	-35.695	-0.444	-0.046
ω1	0.011344	1.263	0.154	0.040914	5.036	0.687	0.035411	2.110	0.307
ω2	0.090906	1.140	0.112	0.38687	5.260	0.588	0.272	1.794	0.213
T	0.14129	1.822	0.138	0.14047	1.483	0.170	0.20686	1.249	0.129
Vp	88.95	0.080	0.001	-452.63	-1.390	-0.019	4726.2	0.663	0.012
Wo1	1.15E-06	0.703	0.046	-3.23E-07	-0.227	-0.016	9.75E-07	0.297	0.025
Constant	11.974	2.799	0.651	-4.668	-1.108	-0.314	10.372	1.300	0.360
R2 / DW	*0.633*	*1.343*		*0.869*	*1.519*		*0.467*	*2.080*	

Table C.4. Estimates of Risk-Neutral Polynomial Distributed Lag (Linear Models)

	Wheat - OLS			Barley - AR(1)			Oats - OLS		
Variables	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.	Coeff	T-ratio	Elas.
Lagged Average price									
P0	3.8237	0.089	0.007	-16.337	-0.179	-0.012	-209.82	-0.944	-0.080
P1	27.84	1.041	0.056	45.356	0.757	0.035	83.98	0.612	0.033
P2	22.924	0.986	0.047	45.976	0.869	0.037	78.067	0.632	0.032
P3	10.496	0.483	0.022	31.279	0.644	0.026	-10.616	-0.094	-0.004
P4	3.7293	0.145	0.008	28.096	0.503	0.024	-49.607	-0.380	-0.021
P5	7.5476	0.349	0.017	44.328	0.985	0.039	9.0809	0.082	0.004
P6	18.625	0.815	0.043	68.949	1.378	0.063	128.96	1.063	0.060
P7	25.387	0.896	0.060	72.007	1.086	0.068	189.05	1.257	0.091
P8	8.0085	0.155	0.020	4.6211	0.039	0.005	-16.078	-0.063	-0.008
Ep	0.025445	1.519	0.223	0.029972	1.453	0.181	0.042287	1.442	0.195
$\omega 1$	0.14693	0.976	0.116	0.17862	0.954	0.097	0.24866	0.932	0.104
$\omega 2$	0.72619	1.751	0.661	1.153	1.887	0.723	0.94708	1.279	0.454
T	-8.0375	-0.343	-0.281	-11.884	-0.373	-0.287	7.6199	0.196	0.141
Rho	-	-	-	-0.34501	-2.175	-	-	-	-
Σ lag coeff (PDL)	128.38	0.732		324.27	0.800		203.02	0.264	
Σ lag coeff (UDL)	135.15	0.722		323.17	0.770		137.18	0.184	
R2 / DW	*0.695*	*1.929*		*0.797*	*1.965*		*0.599*	*2.431*	