Dynamics of crop choice and rotations in view of high prices

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INTRODUCTION

In Western Canada, and especially in Saskatchewan, high prices for canola are leading to widespread changes in crop acreage and rotations.

Tighter rotations are now more frequent than before. It is likely that economic rotations depend on expected prices[1]. Price elasticities are central to understand how crop acreage and rotations respond to rising prices.

This study is part of a new growing body of literature that uses data from satellite imagery to estimate crop choice[2] and crop acreage[3], while also covering crop rotations in an economic sense.

OBJECTIVES

1) Create a dynamic model of crop choice.

The first objective is to examine the impact of major determinants on canola's choice. These include, for instance, crops grown in previous three years, prices, yields, and weather conditions.

2) Estimate price elasticities of canola's acreage and rotations.

The second objective is to examine: a) potential acreage gains (increases in canola plantings), b) short and long run response of acreage to a price increase, and c) if prices encourage tighter crop rotations.

EMPIRICS

The method uses a dynamic nested logit model for each major soil zone in Saskatchewan: brown, dark brown, black, and gray. Crop choice dynamics reflect what crop was grown in previous years.

The crop choice model considers barley, canola, lentils, oats, peas, and wheat. There are three crop nests: canola, cereals, and pulses. Much of the analysis focuses on canola.

An algorithm is then constructed to use the estimates of the determinants to calculate canola's acreage and rotation price elasticities in each soil zone. Further, the algorithm permits calculating these elasticities for any of the crops above.

DATA

The base data from 2009-2020 include the Annual Crop Inventory data from Agriculture and Agri-Food Canada, which rely on satellite imagery to identify crops grown on fields. These data are assembled with soil, soil zone, rural municipality, census agricultural region, weather, grain elevator, canola processing facility, yield, and price data. Reflective of some of the data tasks, Figure 1 visualizes canola fields and soil zones.

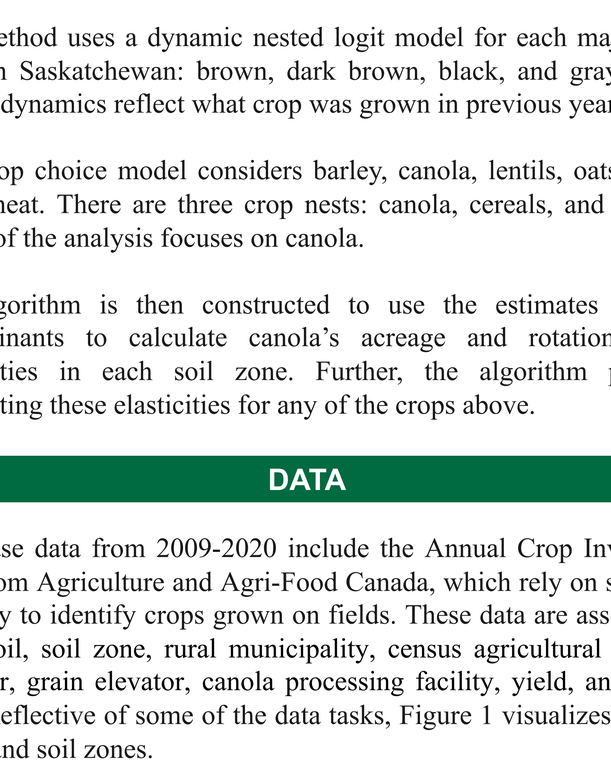

Figure 1. Soil zones, bordered rural municipalities, and canola fields

RESULTS

Canola's choice is influenced by major determinants such as previous crops grown, prices, yields, and weather conditions. Next, take, for instance, previous crops grown and prices.

The probability of growing canola decreases when canola was grown in the past year. This probability increases nearly in every soil zone when canola was grown two or three years ago. That is, most farmers grow canola with at least a one-year break. Across soil zones, higher prices increase the probability of growing canola.

Following a 1% increase in canola's price, Table 1 presents acreage gains in percentage point (pp). The largest acreage gain is found in the brown (0.28 pp) soil zone followed by the dark brown (0.18 pp), gray (0.15 pp), and black (0.13 pp) soil zones.

Table 1. Percent of canola's predicted (2012-2020) acreage by soil zone

Predicted acreage	Brown	Dark brown	Black	Gray
Before price increase	18.46	27.08	48.56	51.84
After price increase	18.74	27.26	48.69	51.99
Acreage gain	0.28	0.18	0.13	0.15

Figure 2 separates acreage price elasticities by year, suggesting that canola's acreage has a larger price response in the short run than in the long run.

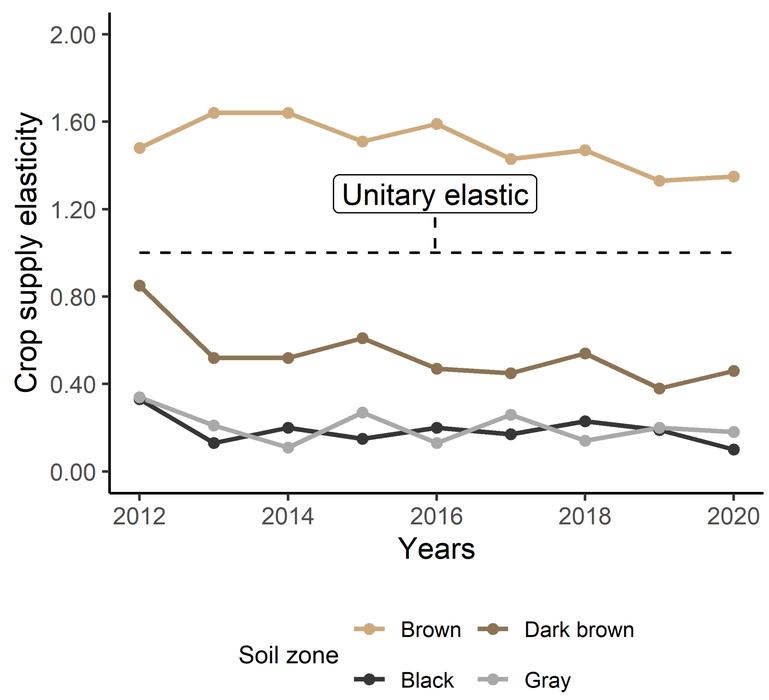

Figure 2. Canola's acreage price elasticities by year and soil zone

This study finds that most crop rotations respond to prices (Table 2). Namely, a continuous rotation, i.e., canola grown two years in a row, responds positively to a 1% price increase across soil zones. In the traditional black and gray soil zones, canola's rotations are less responsive to the price increase.

Table 2. Canola's rotation price elasticities by soil zone

Rotation	Brown	Dark brown	Black	Gray
Canola-no break-canola	1.50	1.15	0.59	0.82
Canola-one year break-canola	1.95	0.40	0.04	-0.06
Canola-two years break-canola	0.55	0.37	0.07	-0.14
Canola-three years break-canola	0.00	0.23	-0.12	0.03

Sometimes, crop disease and pests impede crop production. Provincially, there is consideration of clubroot development. Some fields may find that clubroot curtails canola's economic returns due to probable yield loss. In Saskatchewan, crop districts 6B, 9AW, 9AE, and 9B are affected by clubroot more than others.

Figure 3 adds an overlay of census agricultural regions (CARs) and emphasizes 6B, 9A (joins 9AW and 9AE), and 9B. In Figure 3 (A), farmland is reduced to canola to find the extent to which it is grown within a CAR. The discussed CARs implicate some major soil zones, as shown in Figure 3 (B).

RESULTS (continued)

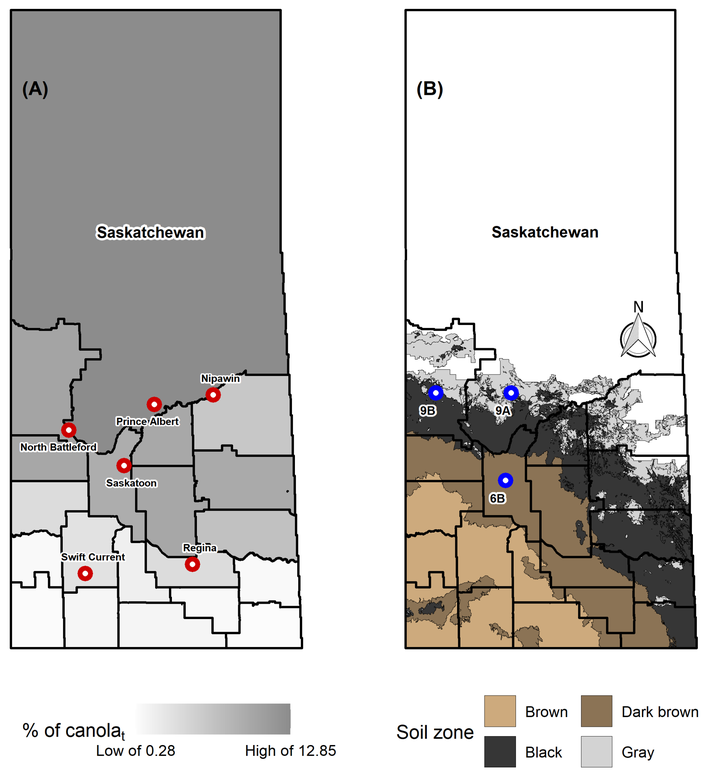

Figure 3. Bordered census agricultural regions (CARs): (A) contains the percent of canola grown in a CAR at time t and (B) places 6B, 9A, and 9B selected CARs over soil zones

Table 3 provides price elasticities of canola's rotations in some CARs dealing with clubroot. Most crop rotations bear a relation to prices. Propelled by the price increase, fields with continuous canola particularly reveal a positive response.

Table 3. Canola's rotation price elasticities in regions facing clubroot

	Dark brown (CAR)	Black (CAR)		Gray (CAR)	
Rotation	(6B)	(9A	9B	6B)	(9A	9B)
Canola-no break-canola	1.10	0.55	0.65	0.71	0.81	0.75
Canola-one year break-canola	0.45	0.13	-0.02	0.13	-0.02	0.13
Canola-two years break-canola	1.06	0.06	0.24	0.00	-0.33	0.24
Canola-three years break-canola	0.16	-0.54	-0.41	0.97	0.27	0.00

CAR, census agricultural region.

POLICY IMPLICATIONS

If canola's prices continue to increase, they mirror strong demand and they tend to have two main impacts on crop rotations:

1) Higher prices reduce efforts to adhere to one canola crop every four years, a cropping practice endorsed as a standard rotation.

2) Higher prices contribute to tighter rotations including continuous canola, which boost supply in view of growing demand.

Canola's acreage adjusts after a price increase, responding more in the short run than in the long run.

REFERENCES

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ADDITIONAL

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