An Agent Based Simulation of Farm Succession and Farmland Valuation

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Notes from the author:

1. Agent Based Model: It is a new type of model in academia. The model allows heterogeneity and stochastic momentum. The model is similar with a video game, but instead of being a player, I play a role of the God to watch and manipulate the model input and agents' behavior. In the model there are 717 farmers and 3 institutional investors farming and bidding farmland in CAR 1A in Saskatchewan. There are more than 100,000 lines of Java code that simulating the whole process of farmers' planning, seeding, harvesting, financing, succession, farmland purchasing and renting as well as institutional investors' bidding and renting farmland.

2. In the model, the simulated detrended crop yield, real price and real yields for stock indices that are used to determine the institutional investors' bidding price for farmland by CAPM model are generated by a bootstrapping process that ensure similar correlation, s.d. and mean (difference <10%) with the historical data.

3. Due to the restriction of the space, the poster and abstract can only present limited information of the study. If you have more questions about this study, please feel free to email me and I would be more than glad to discuss with you.

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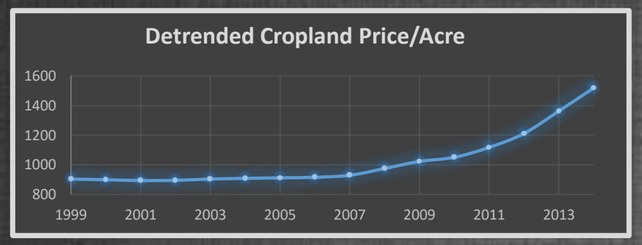
Chi Su,
Master Candidate

INTRODUCTION

Facts:

- A rapid price increase of Saskatchewan farmland;
- Average age of a farm operator is 54.2 in 2011, 3% higher than 2006 and 7.8% higher than 2001;
- Outside financial investors are buying Saskatchewan farmland.



Questions:

- Create hypothetical scenarios that institutional investors actively participate into Saskatchewan farmland investment.
- Impact on 1) farmland purchase prices and rent, 2) farm succession and 3) long-run farm structure.

THEORY BACKGROUND

Farm Succession

- Willingness for the heirs to success the farm is determined by farm type, farm size, educational level and off-farm income. (modeled by a linear regression model from a survey).

Financial Investors

- Financial investors are institutional investors bidding farmland for the optimization of their portfolios as Saskatchewan farmland with stable return is a good tool for risk diversification (such as Kaplan, 1985, Lins, Sherrick and Venigalla, 1992 and Painter, 2005).
- Financial investors base on variance of returns (E-V) (Markowitz, 1952) and CAPM (Sharpe, 1960) to determine their bidding prices (Painter, 2008 and Painter, 2010)

METHODOLOGY

Surveying:

- Surveying students with farm background about their willingness to success the farms, and build up the succession probability model.

Bootstrapping:

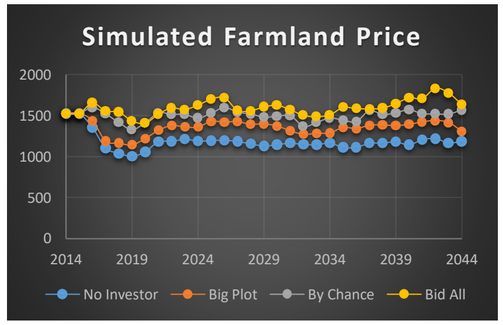
- Bootstrapping the 30-year future financial stock yields for ten major nations by GARCH model;
- Bootstrapping the 30-year future price and yields for major products in CAR 1 by GARCH model.

Agent Based Modeling:

- Adding succession and financial investor parcels into Anderson (2012)'s model.
- 3 investors with different asset bundles and 717 farmers bid for 1988 plots of land.
- Four scenarios, no investor, investor bidding big plots (>4), investor bidding by chance and investor bidding farmland on the market.

Research Results

- Results are based on 100 runs for each of the four scenarios (100*4), and the simulated period is 30 years (2014-2044).



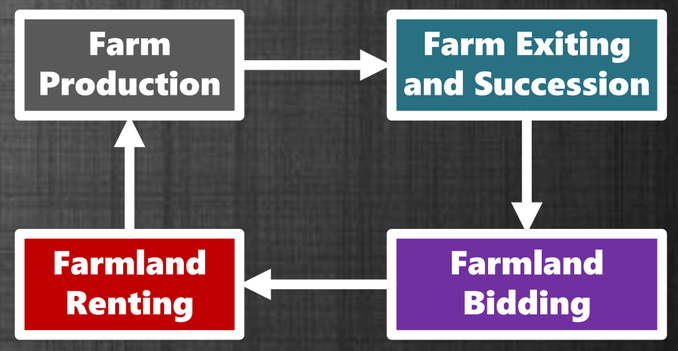
- On average, the participation of institutional investors would increase farmland price for 10% to 37%, but farmland rents are very similar among scenarios.

Answers for Research Questions:

- If institutional investors are encouraged to invest on Saskatchewan, then:

Institutional Investors	Better Portfolio Efficiency
Retired Farmers	More Retire Pension from Farmland Selling
Existing Farmers	Cheaper Access for Expansion
Farm Successors	No Significant Difference

MODEL STRUCTURE



- The model is based on Canadian Agricultural Region 1 of Saskatchewan.
- The farms can produce seven grains, hay and beef cow based on linear optimization decisions.
- Three reasons for exiting: retirement, bankruptcy and insolvency.
- Farmland from exited farms would be on the bidding market for investors and farmers to purchase.
- Unsold farmland would enter the leasing markets for farmers to rent.