Effects of Genetically Modified Crops on the Actuarial Risk Classification of Canola

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Objectives

- To examine the possibility of using genetically modified crops as a rating variable in determining crop insurance premiums
- Specifically examine the yields of canola producers in the Province of Manitoba, Canada
- As non-GM canola becomes more popular as a crop for export and niche markets, this becomes an important distinction to make

Parallels in other Insurance Industries

- The health and life insurance industries are also currently considering the possibility of using customer's genetic profiles
- In life/health insurance this practice would greatly reduce adverse selection, however this is not as much of a concern in crop insurance due to subsidized premiums.
- Although the fundamental question is the same, the concerns raised by critics are quite different

Background

- Four primary biotech crops in North America: corn, soybeans, canola, and cotton
- Can be herbicide tolerant (HT), insect tolerant (BT), or a stacked-gene variety
- First introduced by Monsanto in 1990's

The Biotech Yield Endorsement

- In 2008 the FCIC began a pilot program to provide reduced premiums to producers using Monsanto's Roundup Ready® and YieldGard® corn seeds
- For 2009 participating corn farmers paid $4.24/acre less on average, resulting in a savings of $50 million to the producers
- Discontinued in 2011 due to concerns over the role of government in promoting the use of GM seeds

Performance of GM Canola

- From 1996 to 2004, HT Canola was responsible for an 11% increase in average canola yields in Canada and by 2013 average canola yields had increased from 26.2 bu/acre in 1996 to 40 bu/acre (Brooks and Barfoot, 2005) (Stats Canada, 2014)

- A 2006 analysis of canola yields indicated that Canola in Manitoba with HT traits had no effect on yield variability (Carew and Smith, 2006)

Crop Insurance Premiums in Manitoba

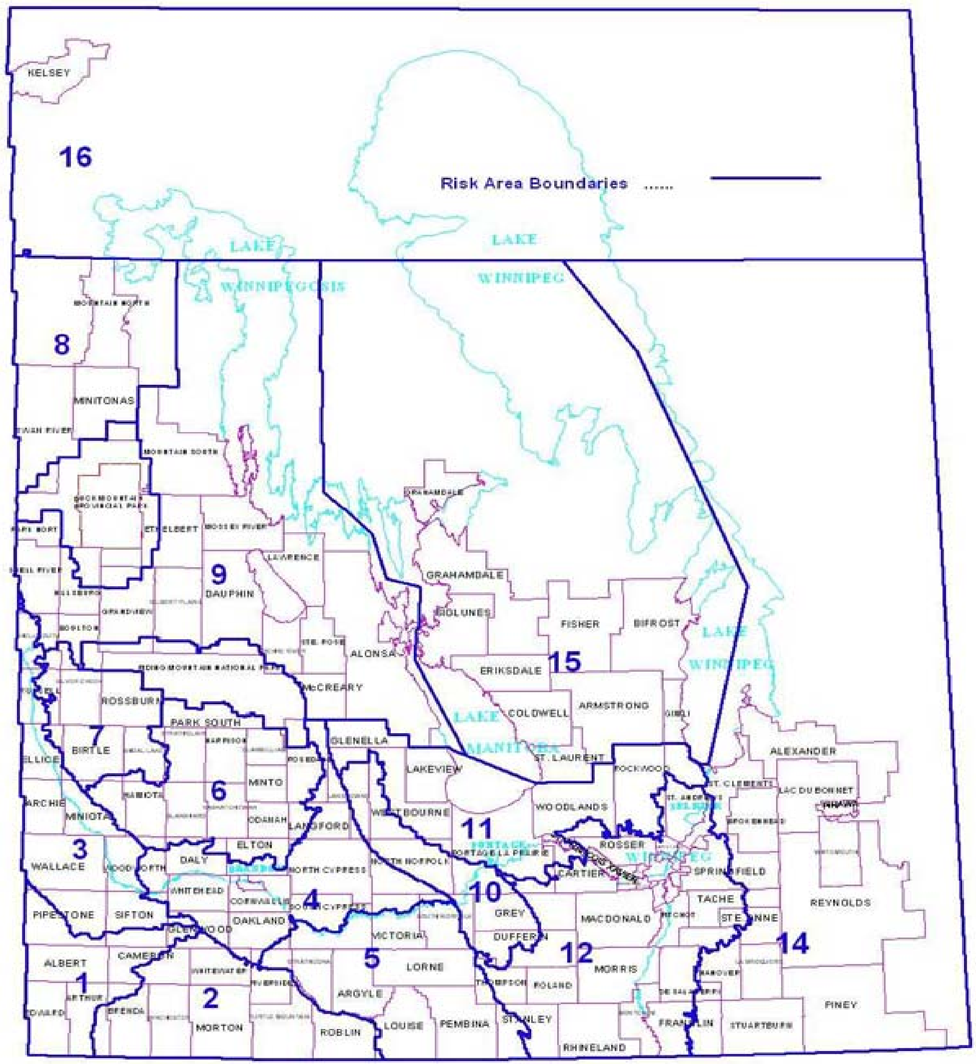
- Most crop insurance is sold by Manitoba Agricultural Service Corporation (MASC) as “AgriInsurance” multiple peril crop insurance to protect against production losses and certain crop quality losses

- Premiums are charged based on crop type, level of coverage selected and geographical risk area

- Sample Premiums for producer with 50% coverage planting Arg Canola:

Risk Area 1	Risk Area 2	Risk Area 3	Risk Area 4	Risk Area 5	Risk Area 6
$3.84/acre	**$2.69/acre**	**$3.37/acre**	**$2.66/acre**	**$2.53/acre**	**$2.31/acre**

Risk Zones



Risk Area Boundaries ......
16
8
9
7
6
3
1
2
4
5
10
11
12
14
15
LAKE WINNIPEGOSIS
LAKE WINNIPEG
LAKE MANITOBA
KELSEY
MINITONAS
SWAN RIVER
ETHELBERT
DAUPHIN
LAWRENCE
GRAHAMDALE
FISHER
BIFROST
ALONSA
ERIKSDALE
COLDWELL
ARMSTRONG
McCREARY
ROSSBURN
PARK SOUTH
BIRTLE
GLENELLA
LAKEVIEW
ST. LAURENT
ROCKWOOD
ALEXANDER
MINTO
ODANAH
LANGFORD
WESTBOURNE
WOODLANDS
ROSSER
MINIOTA
ARCHIE
WALLACE
DALY
ELTON
NORTH CYPRESS
PORTAGE LA PRAIRIE
CARTIER
SPRINGFIELD
TACHE
REYNOLDS
PIPESTONE
SIFTON
WHITEHEAD
CORNWALLIS
OAKLAND
GLENWOOD
GREY
MACDONALD
STE ANNE
VICTORIA
DUFFERIN
ALBERT
CAMERON
LORNE
MORRIS
MORTON
ARGYLE
ROBLIN
LOUISE
PEMBINA
STANLEY
RHINELAND
FRANKLIN
PINEY

IPI

- IPI (Individual Productivity Index) ratings are given to each producer annually and are used to calculate expected yields

- Every year MASC records the ratio of each producer's yield to the average yield of producers in the same soil type and risk area, and IPI is the 10 year average of those ratios.

Year	1	2	3	4	5	6	7	8	9	10
Rating	1.32	0.95	1.23	1.14	0.93	1.10	1.35	0.67	1.24	0.97

- The 10 year average of these ratings is 1.09. Therefore, if the average yield for canola producers in the same risk area and soil type is 38 bu/acre, then this producer's expected yield for the next year will be 1.09*38 = 41.42 bu/acre

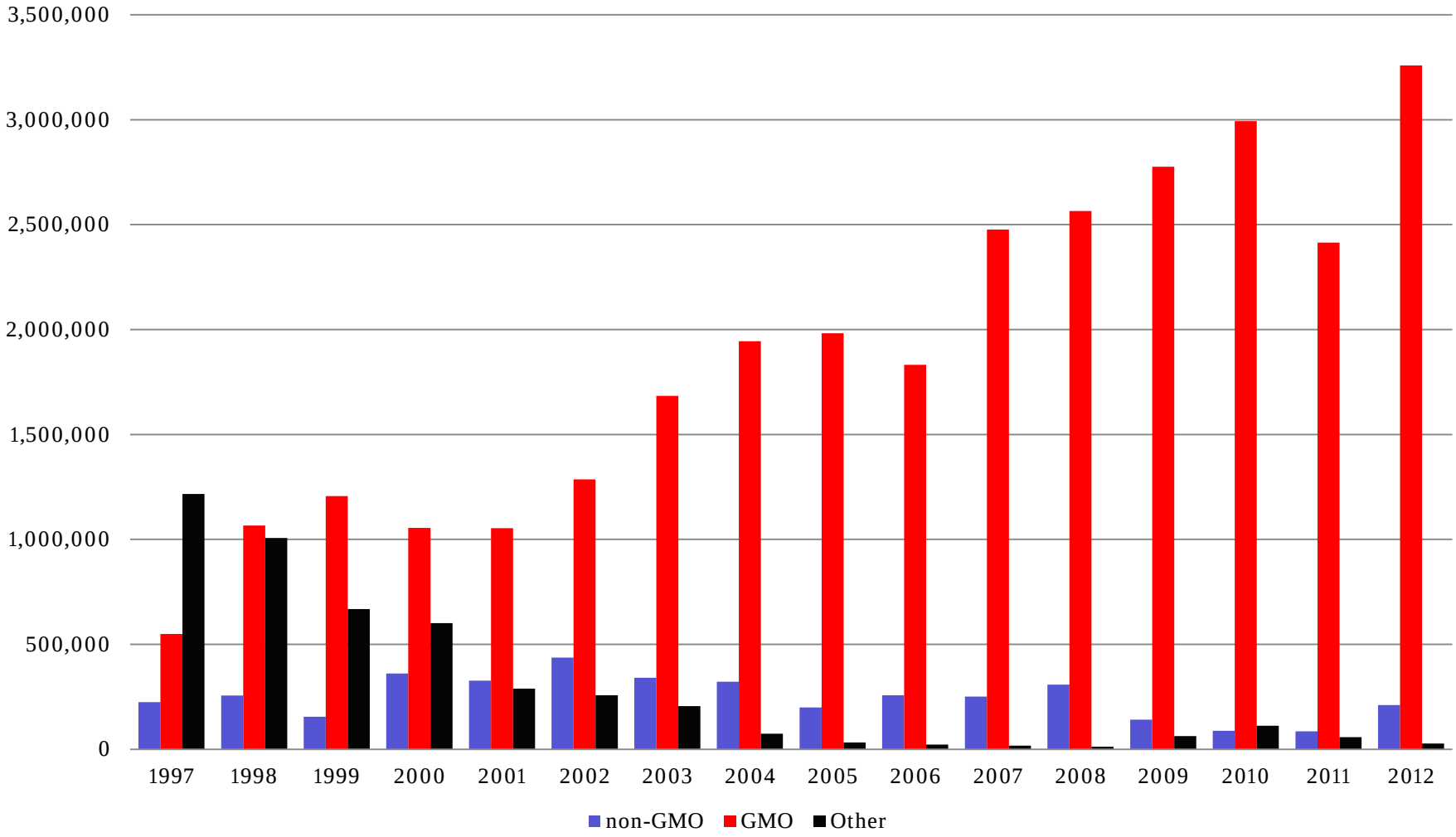
Data

- The data used for analysis was provided by the MASC
- Consists of farm level data for every canola producer in Manitoba from 1997 to 2012 including yield, indemnities, level of insurance coverage and IPI rating
- Aggregated by variety of seed (GM vs conventional varieties) as well as geographical risk area
- All crop yields were detrended using linear regression and fitted to a Weibull distribution based on Bayesian Information Criterion

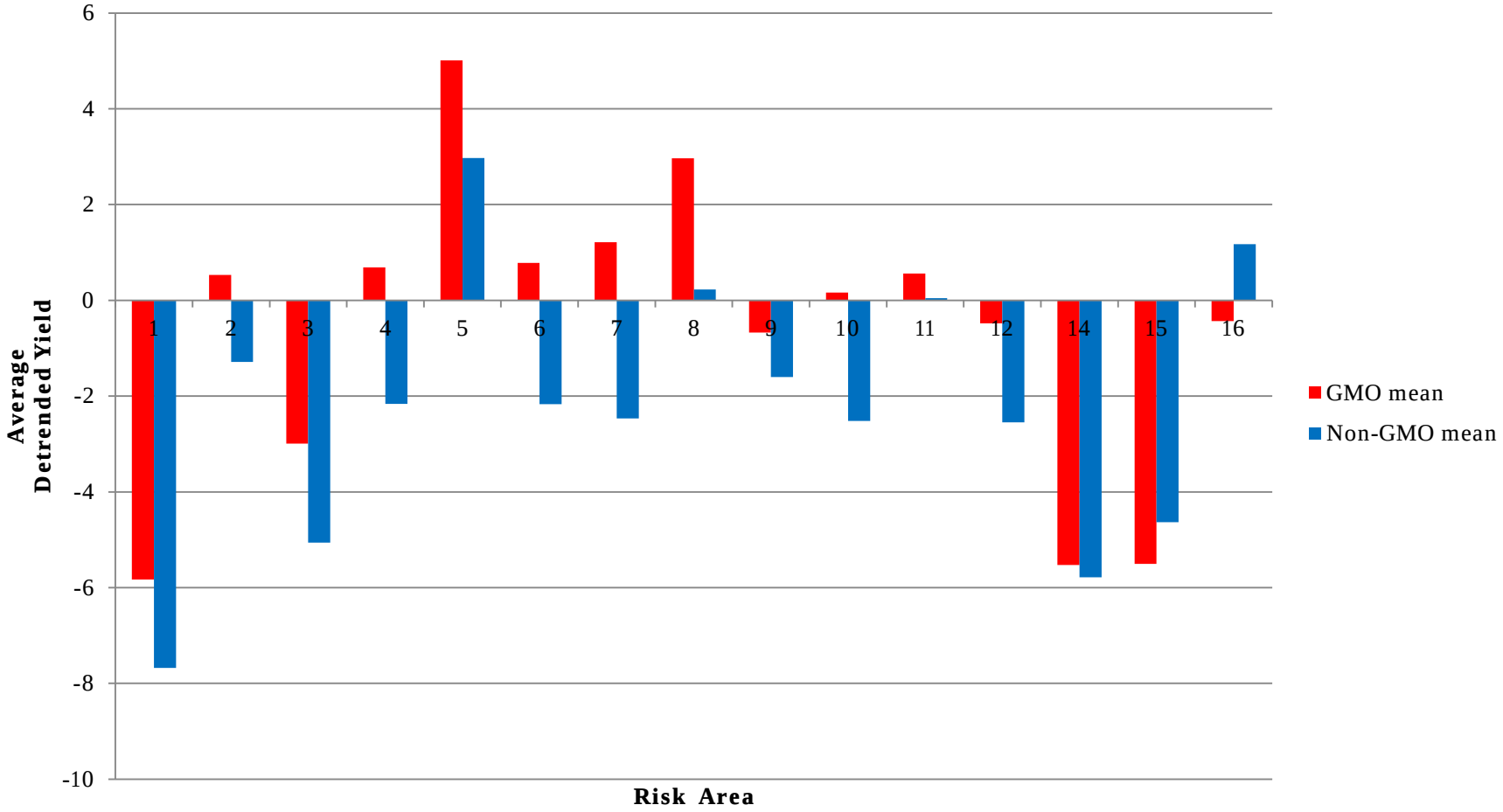
Assumptions

- The presence of a linear technological trend over time in yield data (Ker & Tolhurst, 2013)
- Due to lack of information, certain seed varieties were unable to be classified as either GM or conventional, and were therefore excluded from analysis
- Seeds were classified based on the criteria of MASC and MAFRI

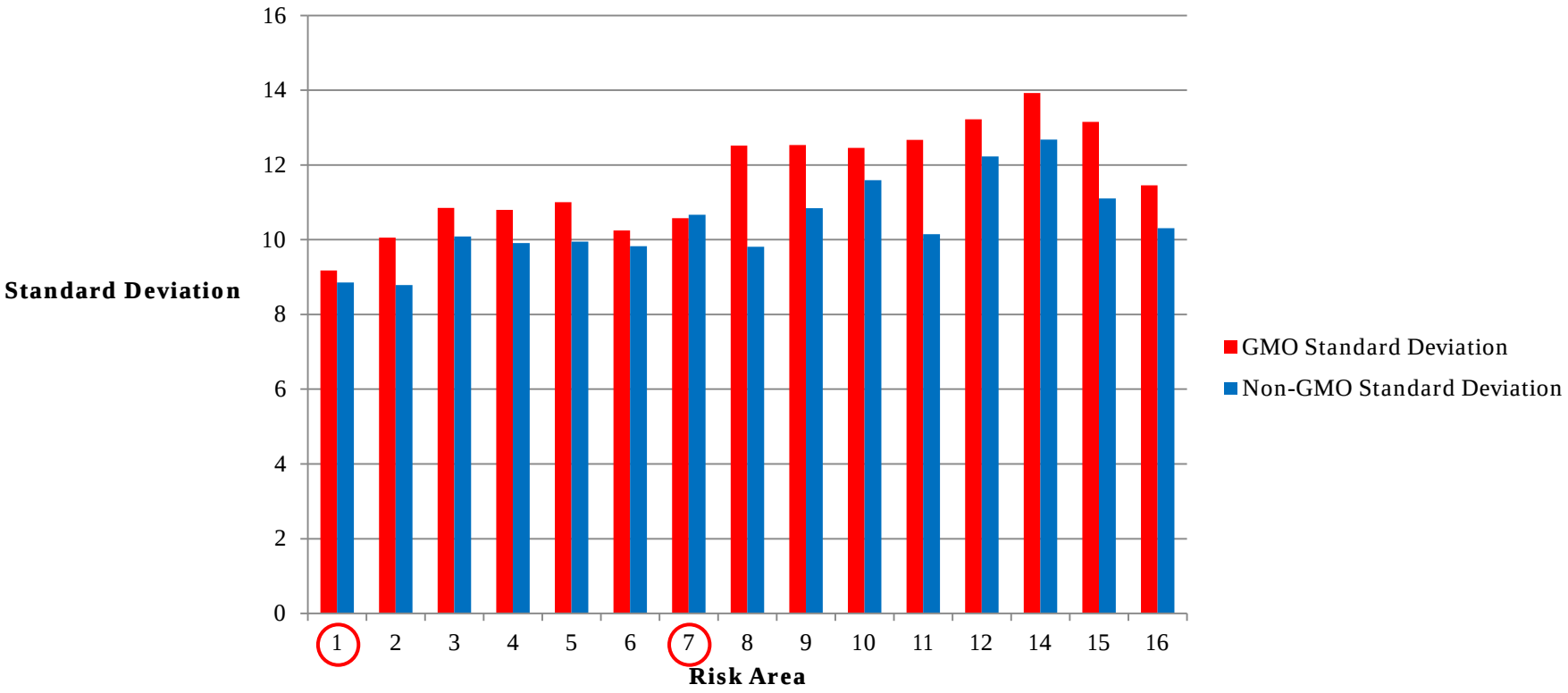
Total Canola Acreage for Manitoba 1997-2012



Comparison of Means



Comparison of Standard Deviations



Next Steps

- An analysis of lost cost ratios for GM vs. non-GM canola
- Utilize the IPI metric to better account for other variables such as management practices
- Using more sophisticated detrending methods to compensate for technology trends