

Introduction

To date, there has been almost no research on the impact of droughts on financial stability globally. Here in New Zealand, this issue is of utmost importance for a number of reasons:

- there has been a rapid growth of farm debts, specifically in the dairy sector (270% in twenty years - RBNZ).
- NZ has experienced two very costly droughts in recent years (2008 and 2013).

Therefore, the relationship between droughts, farms' balance sheets, and banks is important to understand. This research project addresses this gap, by contributing a farm-level analysis of the impact of droughts, using the NZ Pasture Growth Index (NZPGI) which accounts for sunlight, temperature and rainfall.

Literature

Studies have found negative impacts of drought on agricultural production and business indicators (Edwards, Gray, and Hunter, 2009; Lawes and Kingwell, 2011).

Others have concluded a positive impact of drought on farms' profitability (Kingwell and Xayavong, 2016; Pourzand, Noy, & Saglam, 2020).

It is shown that debts can help to smooth income between financially good and difficult years (Greig, Nuthall, & Old, 2019; Ma, Renwick, & Zhou, 2020).

Data & Methodology

Financial (StatsNZ) data:

Annual Longitudinal Business Data (LBD) farm-level Agricultural Production Survey (APS) and Census (APC) from 2002–2018

Annual IRD farm-level tax data (debt measures from the IR10 form)

Geographic location of farms by meshblock ID

Environmental (NIWA) data:

Daily NZPGI dataset at 11,491 virtual climate station network (VCSN) grids (~5km apart) covering the whole of New Zealand from 1972-2020

Geographical location of each VCSN raster grid identified by coordinate point

Linking data:

I link the VCSN locations of the NZPGI to the nearest meshblock using minimum distance

1,746 dairy farms

1,863 s&b farms

Over 17 years (2002-2018)

Econometric Modelling

Model 1

$$Debt_{it} = \alpha + \delta_0 D_{it} + \delta_1 D_{it-1} + \delta_2 D_{it-2} + c_i + u_{it}$$

Model 2

$$Debt_{it} = \alpha + \delta CD_{it} + c_i + u_{it}$$

where:

Debt denotes the debt measures (real short term, long term and total debts)

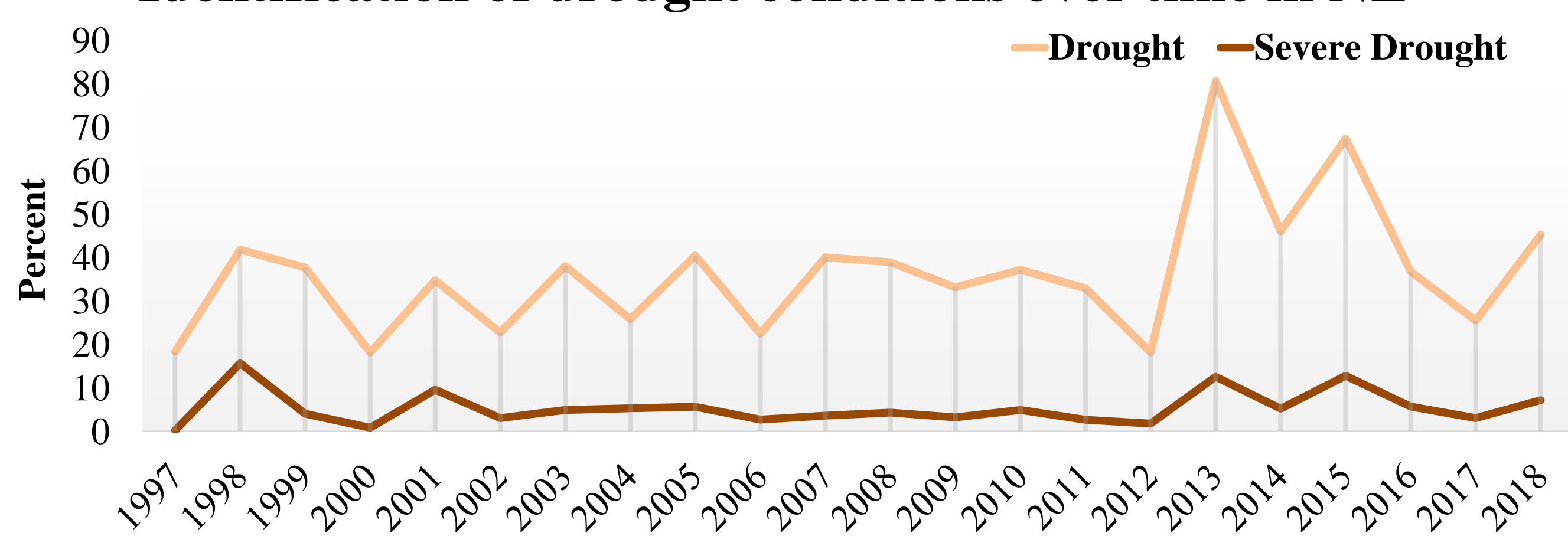
D denotes a binary variable indicating drought

CD denotes a consecutive drought condition

and subscripts denote farm *i* at time *t* (annual)

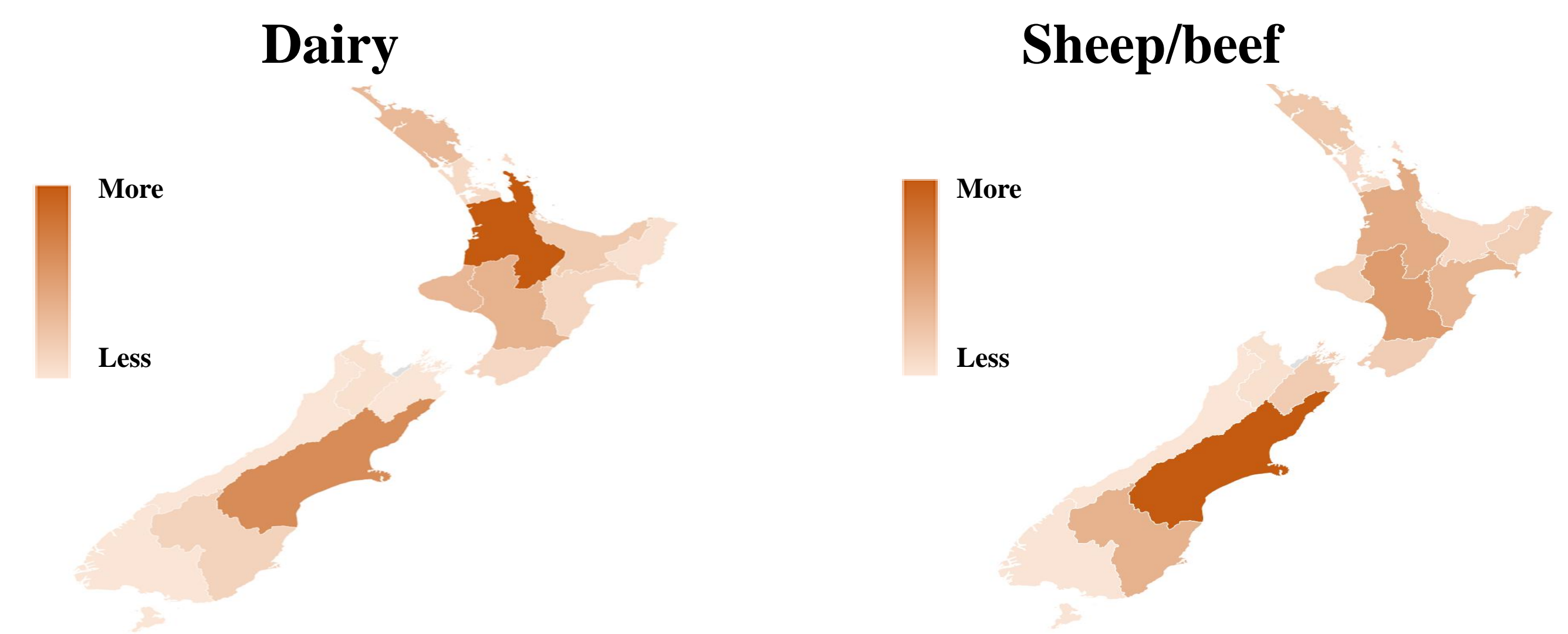
Analysis

Identification of drought conditions over time in NZ



This graph shows the percentage of all VCSN grids presenting: Drought - measured by NZPGI ≤ 30 over ≥ 10 consecutive days, or Severe Drought - measured by NZPGI ≤ 20 over ≥ 20 consecutive days

Drought conditions by region for agricultural land in 2020



These graphs present the number of drought affected VCSN grids within each agricultural land type, per region. These range from 0-365 grids for dairy and 0-844 for sheep and beef.

Results

Dairy Farming

Sheep and Beef Farming

Model	Short-term Debt		Long-term Debt		Total Debt		Model	Short-term Debt		
	1	2	1	2	1	2		1	2	
Droughts							Droughts			
Drought (t)	33.00** (16.67)		59.31** (27.73)		76.66** (34.59)		Drought (t)	13.57*** (3.99)		
Drought (t-1)	50.28** (20.14)		67.02** (31.49)		106.5*** (39.06)		Drought (t-1)	14.41*** (5.52)		
Drought (t-2)	86.31*** (15.61)		133.91*** (42.11)		213.3*** (43.10)		Drought (t-2)	15.40*** (5.71)		
CD		15.63** (6.85)		13.29* (7.01)		26.98*** (8.39)	CD		5.61*** (1.88)	
Adj R-Sq	0.4341	0.4352	0.7811	0.7809	0.7911	0.7907	Adj R-Sq	0.05650	0.5649	
Severe Droughts							Severe Droughts			
Drought (t)	59.03** (26.22)		101.95* (51.92)		145.59** (62.73)		Drought (t)	34.10** (16.89)		
Drought (t-1)	48.10* (24.97)		68.90 (62.16)		102.02 (69.82)		Drought (t-1)	25.34*** (8.03)		
Drought (t-2)	69.01** (29.10)		98.63 (61.03)		157.16** (66.90)		Drought (t-2)	26.52*** (8.13)		
CD		38.12** (15.17)		39.66 (25.78)		68.80** (30.72)	CD		15.06* (8.60)	
Adj R-Sq	0.4333	0.4332	0.7809	0.7809	0.7907	0.7906	Adj R-Sq	0.5651	0.5647	
n	26,142						n	27,690		

Note: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$, and *n* is constant in all specifications

Drought = NZPGI ≤ 30 over ≥ 10 consecutive days.

Severe Drought = NZPGI ≤ 20 over ≥ 20 consecutive days

CD stands for consecutive drought season

Robust standard errors clustered at farm level in parentheses

Conclusion

Our results show a statistically significant positive impact of droughts on short-term and long-term debts for dairy farming and short-term debts for sheep and beef farming.

Our results appear robust to an alternative set of farm debt data reported by RBNZ of each bank for dairy and sheep/beef farming and so provides rigorous evidence on the significant impact of drought conditions on farm debts for dairy and sheep/beef farming in New Zealand.

We hope this will be a useful study for the agriculture and financial sector when formulating policies for farmers' wellbeing and setting the cost of funds during or after drought conditions. This study can be further extended to test the impact of drought on financial stability.

Additional Information

Disclaimer – The researcher (Shabana Kamal) takes full responsibility for the paper, that Statistics NZ will not be held accountable for any error or inaccurate findings within the paper or presentation, and acknowledgement that access to data is in accordance with the Statistics Act-1975.

Access to the data used in this study was provided by Statistics New Zealand under conditions designed to give effect to the security and confidentiality provisions of the Statistics Act 1975. The results presented in this study are the work of the author, not Statistics NZ.

Careful consideration has been given to the privacy, security, and confidentiality issues associated with using administrative and survey data in the IDI. Further detail can be found in the Privacy impact assessment for the Integrated Data Infrastructure available from www.stats.govt.nz.

The results are based in part on tax data supplied by Inland Revenue to Statistics NZ under the Tax Administration Act 1994. This tax data must be used only for statistical purposes, and no individual information may be published or disclosed in any other form, or provided to Inland Revenue for administrative or regulatory purposes. Any person who has had access to the unit record data has certified that they have been shown, have read, and have understood section 81 of the Tax Administration Act 1994, which relates to secrecy. Any discussion of data limitations or weaknesses is in the context of using the IDI for statistical purposes, and is not related to the data's ability to support Inland Revenue's core operational requirements.

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