Impacts of improving cow-calf systems in a pasture-based cattle production country.

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Selected Poster prepared for presentation at the 2024 Agricultural & Applied Economics Association Annual Meeting, New Orleans, LA: July 28-30, 2024

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Introduction

Beef production has been in the spotlight of the climate change debate since 2006, when FAO overestimated its impact on green house gas (GHG) emissions. Uruguay's beef sector develops over the Pampas biome taking advantage of the natural grasslands. The sector is structured in a value chain that comprises different processes at the rancher level: cow-calf, stocker, fattening, or complete cycle are different arrangements that differs in time and technical processes. Uruguay is a significant exporter of beef (ranks 9th worldwide), and is recognized for the quality of pasture based meat. In the last 30 years the country has improved the beef fattening production process reducing the age of animal slaughter. However, the cow-calf system faces efficiency issues, leading to situations where it is sometimes more convenient to slaughter unproductive or even pregnant cows rather than improve the weaning percentage. Over the last 20 years, the sector has undergone significant changes, with 80% of its production now geared towards export and approximately 25% of the domestic market being supplied by neighboring countries. International markets, especially those with higher prices, are increasingly focused on the environmental impacts of production processes. This paper aims to estimate the trade-offs among selling decisions, technical efficiency, and potential climate change impacts of policy recommendations for cow-calf ranches.

Methods

The model allow to estimate the marginal rate of transformation between calves and cows and therefore analyze the allocation of resources efficiency by comparing to price ratio. The relative prices of calves and cows might be a signal used to induce ranchers to adjust the system's weaning percentage. If the sector understands the importance of increasing the overall efficiency of production it might adjust the cow-calf system to reduce inefficiency. Additionally, a bad output is incorporated estimating the amount of GHG emissions from different systems to compare potential climatic change effects. A stochastic frontier is estimated to determine the inefficiency of each census area and to estimate the response at this level on stock, rain fed, forage availability, and GHG emissions. The data comprises all census areas of the country conforming a panel from 2016/17 to 2022/23.

Empirical model

We estimated a translog model,

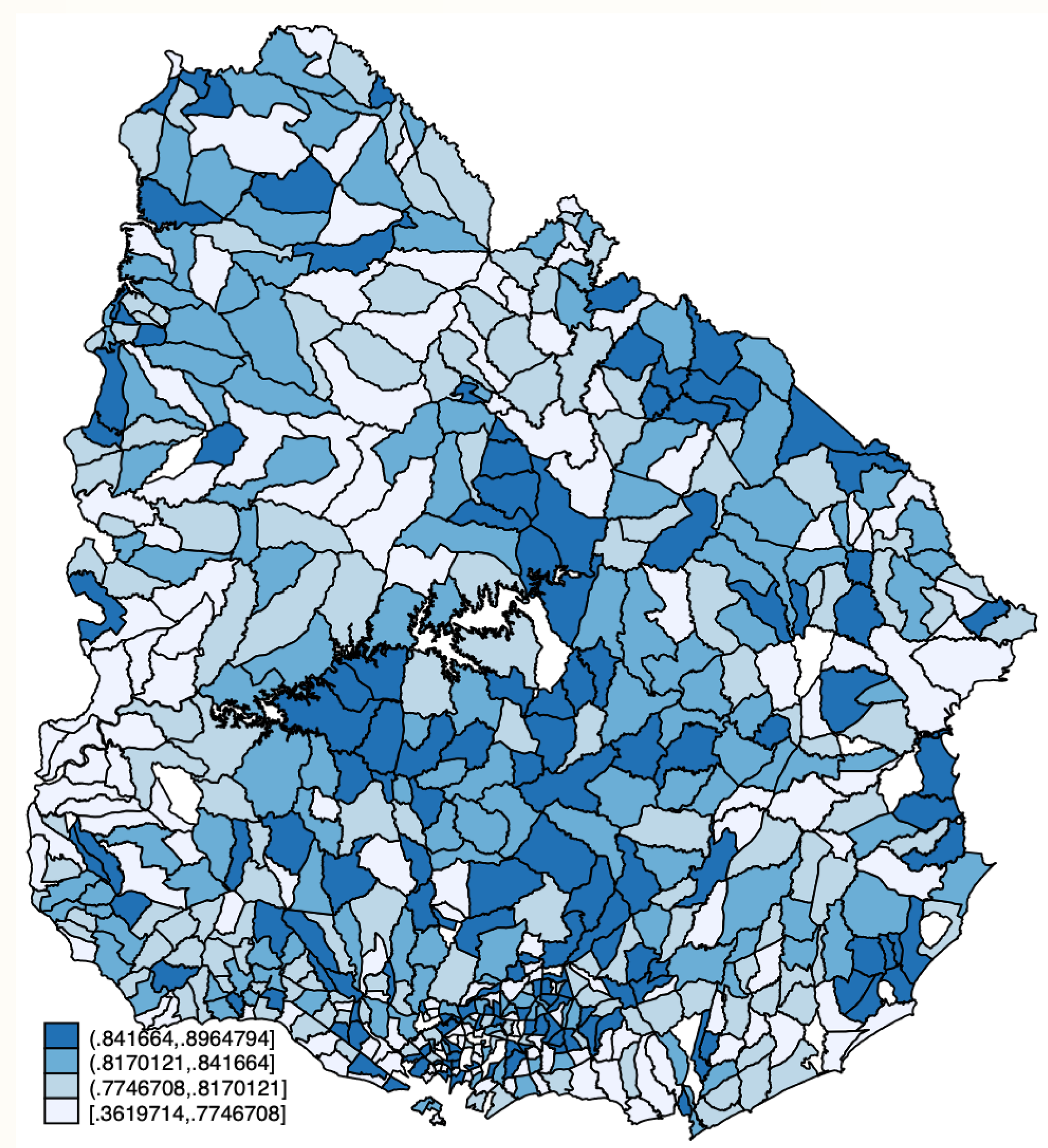
$$y_{it} = \alpha_0 + \sum_{j=1}^{4} \beta j x_{jit} + \frac{1}{2} \sum_{j=1}^{4} \sum_{l=1}^{4} \beta_{jl} x_{jit} x_{lit} + t + \nu_{it} - u_{it} \quad (1)$$

Where y_{it} is production, and x_{it} is a vector of factor including grazing area (Land), proportion of improved pasture (PIP), normalized difference vegetation index (NDVI), and precipitation (prec).

Data

A multi-output model at the smallest administrative level available is constructed to analyze how decisions on whether to increase weaning rates or sell cows, adjusting for soil quality, rain fed, and forage availability, is performed. The data comes from the national agricultural ministry, and it is provided at the smallest administrative census region.
We use the NDVI index as a proxy for pasture availability and CHIRPS which is a 30+ years global rainfall database for yearly precipitation.

Technical Efficiency Results



BC-88 model Technical Efficiency results by available Census Area in 2021.

Response elasticity

	Mean	SD	Min	Max
BC-92				
Land	0.927	0.089	0.658	1.144
PIP	0.657	0.290	-0.195	1.840
L.NDVI	-0.941	1.720	-6.844	4.479
L.CHIRPS	-0.482	0.784	-3.316	1.435
BC-88				
Land	0.926	0.074	0.703	1.116
PIP	0.816	0415	-0.446	2.504
L.NDVI	-1.218	1.814	-7.507	4.376
L.CHIRPS	-0.069	0.746	-2.543	1.882

TE distribution

	Obs.	Mean	SD	Min	Max
BC-92					
2018	-	-	-	-	-
2019	460	0.901	0.078	0.046	0.956
2020	488	0.862	0.071	0.119	0.935
2021	539	0.807	0.084	0.248	0.912
2022	516	0.735	0.110	0.0473	0.871
BC-88					
2018	531	0.795	0.081	0.362	0.896
2019	533	0.793	0.082	0.362	0.896
2020	567	0.796	0.0763	0.428	0.895
2021	591	0.794	0.080	0.362	0.896
2022	543	0.794	0.080	0.401	0.896

Final remarks

- The TE results show that areas with a higher existence of cattle have higher efficiency scores..
- When TE estimation is performed under time-decaying model we find that $\eta < 0$ indicating that the efficiency is declining over time. This is consisting of the performance over the last five years.
- Estimating technical efficiency in grazing based cattle production is challenging since input use is low and production decisions are deferred over time.
- To gain deeper insights into production decisions, it's crucial to disaggregate the animal categories, particularly at the cow-calf level. By breaking down these categories, we can better understand the nuances and factors influencing production choices.

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