Measuring Efficiency on Milk Production Farms on the Cities of the Agreste Region of Pernambuco

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1. Introduction

1.1. Objective

This study intends to conduct a efficiency analysis on the cow milk production in the cities of the Agreste region of the state of Pernambuco, in Brazil.

- Efficiency frontier
- Efficiency scores
- Improvement points
- Geographical clustering of the industry

2. Data

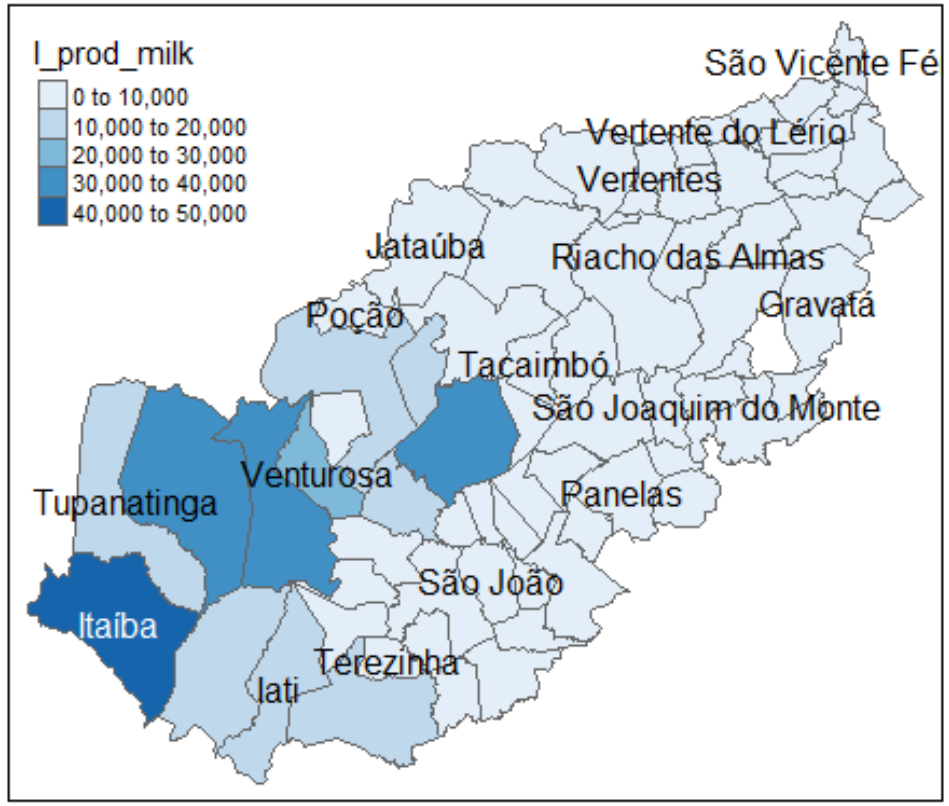
2.1. Discriptive statistics

Variables	Mean	SD	1st Quartile	Median	3rd Quartile
l_prod_milk	5643.84	9654.70	657.50	1379.00	4540.25
n_settlements	831.41	597.42	419.25	736.00	1040.50
a_pasture	9306.26	8348.71	3828.13	7171.40	10452.69
n_milk_cows_percent	15.39	11.10	7.99	12.28	22.12

Source: IBGE, own elaboration

2.2. Biggest and smallest producers

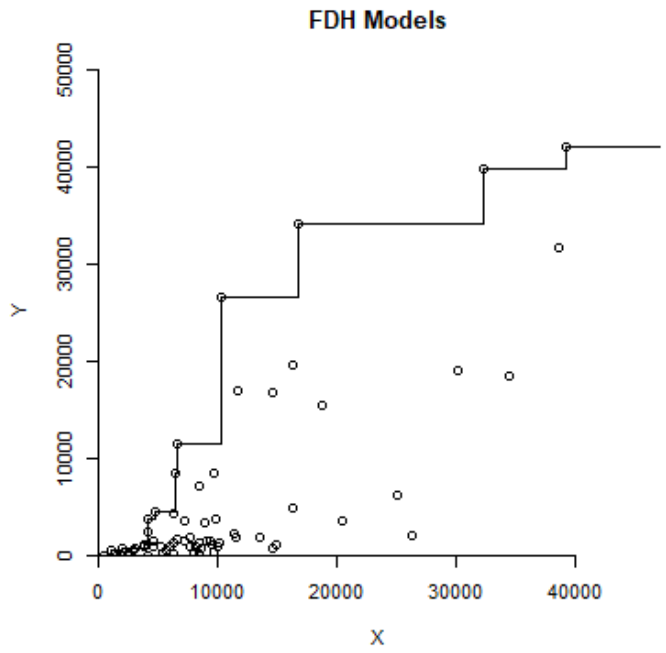
City	Milk Produced (liters)	Total milk production
Itaíba	42042	10.64%
Pedra	39711	10.05%
São Bento do Una	34195	8.66%
Buíque	31689	8.02%
Venturosa	26598	6.73%
Tupanatinga	19520	4.94%
…	…	…
João Alfredo	126	0.03%
Cupira	114	0.03%
Machados	73	0.02%
Barra de Guabiraba	58	0.01%
Toritama	50	0.01%
Salgadinho	36	0.01%
São Vicente Férrer	14	0%

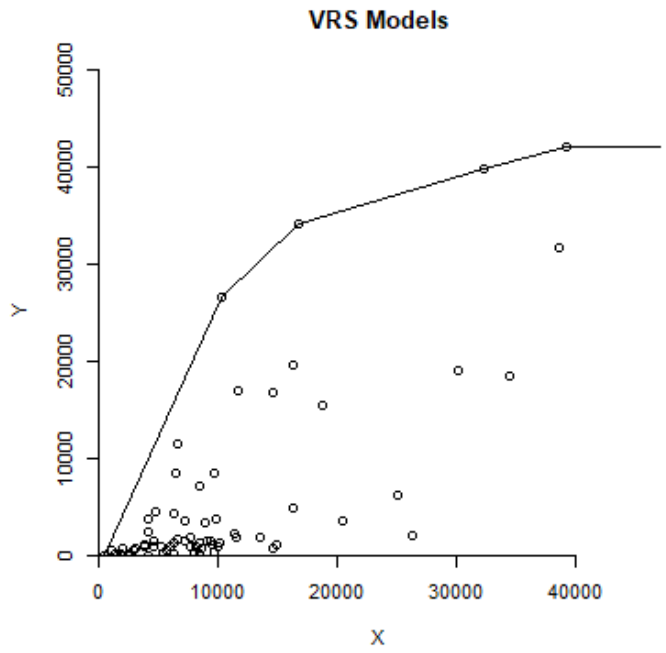


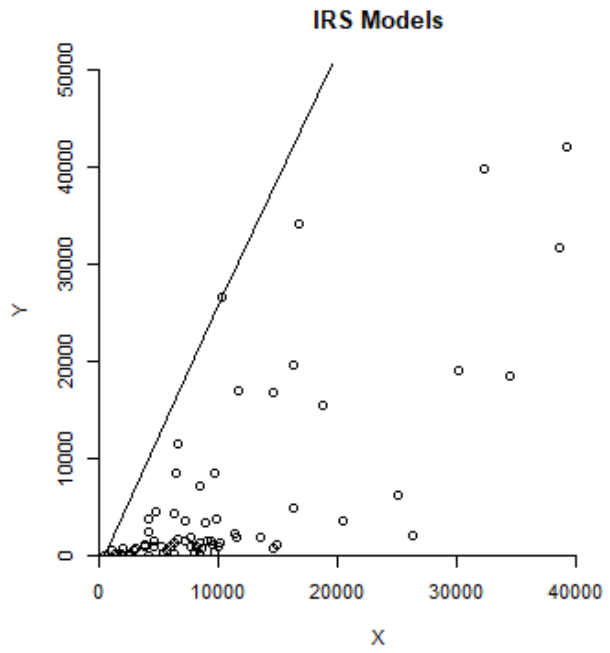
Source: IBGE, own elaboration.

3. Model

3.1. Estimating possible models







3.2. Choosing a model

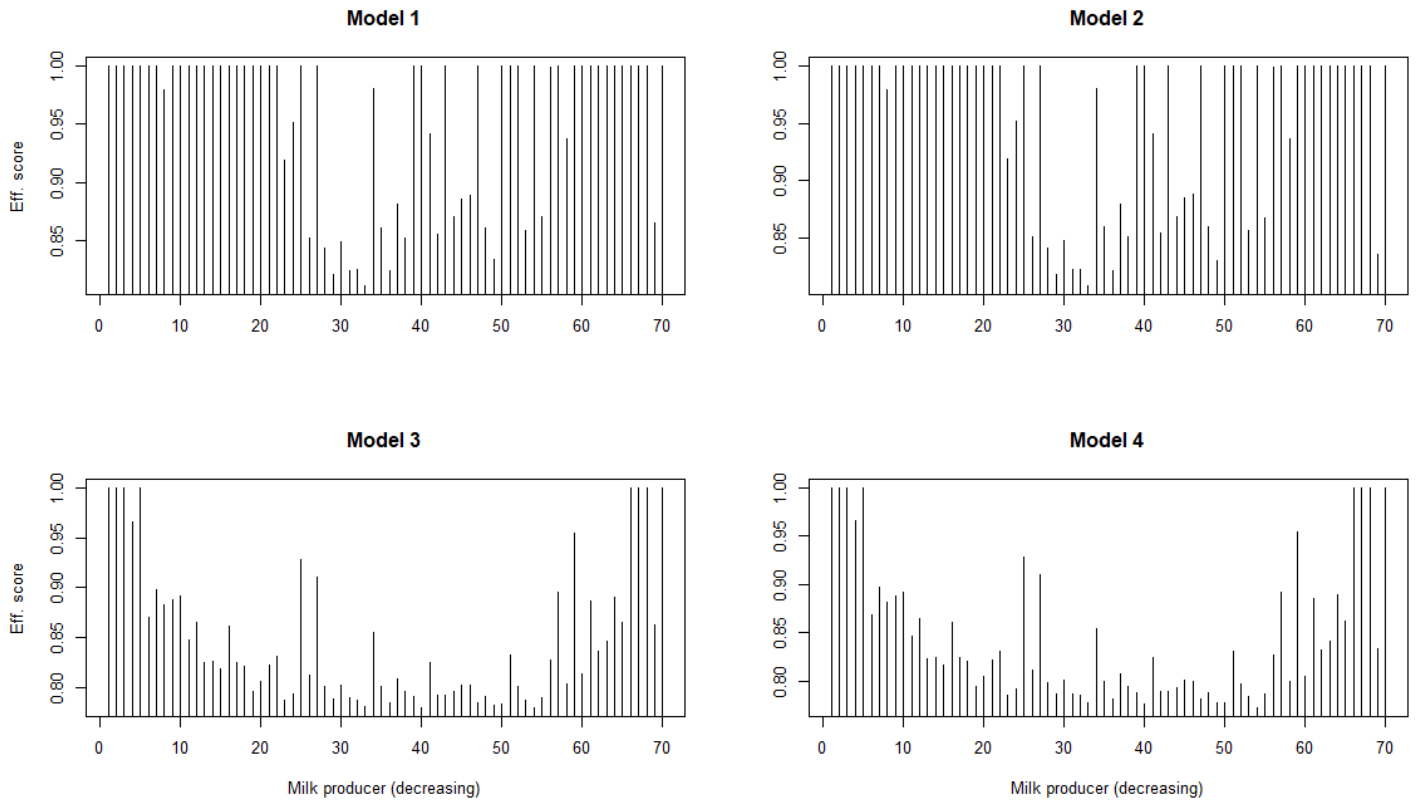
Credits and methodology:

- Before choosing a model, statistical tests performed with Wilson, Paul W. (2008)'s FEAR pakcage developed for R.
- And models were estimated with Peter Bogetoft and Lars Otto's Benchmarking package developed for R.
- The possible models contemplated (FDH and VRS) were chosen from the tests obtained for Convexity of the production and return to scale, respectively.
- The tests rejected both the **Convexity** hypothesis and **Constant Return to Scale**, so the models tested will follow at least one of the opposing assumptions.

Models:

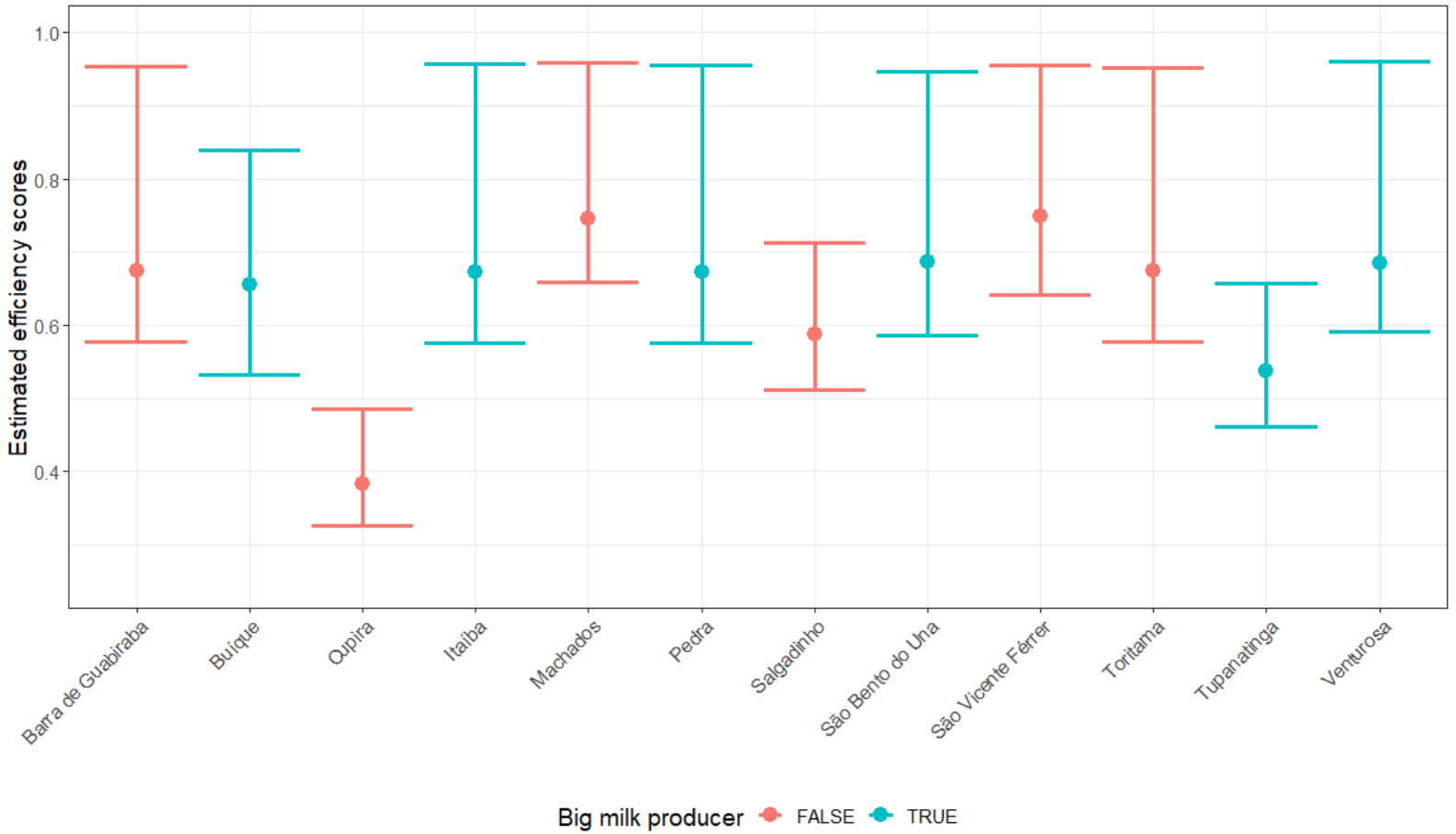
1. Free Disposability Hull (FDH) with fixed number of settlements and oriented for input and output;
2. Same as model 1, but only oriented for input;
3. Variable Return to Scale (VRS) with fixed number of settlements and oriented for input and output;
4. Same as model 3, but only oriented for input.

3.3. Efficiency scores



4. Bootstrapping and Separability

4.1. Bootstrapping results for the biggest and smallest productions



4.2. Separabily results

- The separability tests included geographical placement of the cities, and the results generally reject the hypothesis of **Geographic impact** over the efficiency of the cities;
- The results are shown at the right side:
  - P-values with Latitude and Longitude:
    - **0.252, 0.509**;
  - P-values with Longitude only:
    - **0.029, 0.076**;
  - P-values with Latitude only:
    - **0.139, 0.123**.