AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
<http://ageconsearch.umn.edu>
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

The economic growth impacts of sugarcane expansion in Brazil:

An inter-regional analysis

Annelies Deuss

Department of Economics, Carnegie Mellon University, Pittsburgh, PA

Poster prepared for presentation at the Agricultural & Applied Economics Association's 2011 AAEA & NAREA Joint Annual Meeting, Pittsburgh, Pennsylvania, July 24-26, 2011.

Motivation

Since 2001, Brazil experienced a sharp expansion in sugarcane production. Over 60% of this expansion occurred in São Paulo state (SP). By 2020, the country is planning to double the amount of sugarcane plantations. Most of these expansions will take place in the region of the Center-South excluding São Paulo (CSexclSP).

Map: Concentration of sugarcane plantations in Brazil (2007)

The drivers behind this expansion were the increased demand for sugar and ethanol. In Brazil, both sugar and ethanol are entirely derived from sugarcane.

This expansion can have both positive and negative impacts on local economies:

Positive: creation of income and employment in sugar and ethanol sector [2]

Negative: sugarcane monopolizes land use and economic activities [3]

Moreover, economic impacts of sugarcane expansion might *depend on the region* where sugarcane is grown.

Research questions

Question 1: What was the impact of sugarcane expansion on economic growth in the sugarcane-expanding municipalities in Brazil and in the main sugarcane-growing regions?

Question 2: What are the potential economic growth impacts of the planned sugarcane expansions in the municipalities in the Center-South excluding São Paulo (CSexclSP)?

Methodology

Classify municipalities into Treatment (T=1) and Control (T=0) groups. A municipality is treated if its average annual growth rate in sugarcane production between 2001 and 2007 was equal to or above the regional average.

Classification of municipalities according to average annual growth in sugarcane production (SUGR) between 2001-2007

Region	Region's average (RA)	# muni in treated SUGR ≥ RA	# muni in control SUGR ≤ 0	# muni excluded 0 < SUGR < RA
BR	6.5%	1428	3158	975
NE	1.5%	539	1336	56
CS	7.7%	910	1634	775
SP	7.4%	255	213	177
CSexclSP	8.1%	635	1421	618

Source: IBGE [1]

Question 1: Estimate the Average Treatment Effect on the Treated (ATT) for the various regions using the propensity score $p(X)$ [4]:

$$ATT = E(Y_1 | T=1, p(X)) - E(Y_0 | T=1, p(X))$$

Question 2: Estimate the Average Treatment Effect on the Untreated (ATU) for CSexclSP using the propensity score $p(X)$ [4]:

$$ATU = E(Y_1 | T=0, p(X)) - E(Y_0 | T=0, p(X))$$

Y_i = average annual GDP per capita growth, 2001-07 ($i=0,1$)

$p(X)$ = $\text{prob}(T=1 | X)$, i.e. the “propensity score” or the conditional probability that a municipality increased sugarcane production given a set of observable characteristics X . One of these observable characteristics is a municipality's suitability to grow sugarcane, data recently published by EMBRAPA [5].

Applied four types of estimators based on the estimated $p(X)$ to estimate ATT and ATU.

Results

Kernel densities of estimated propensity scores before and after reweighting – illustration for SP

Question 1: ATT and standard errors¹

region		blocking	reweighting	mixed blocking	mixed reweighting
BR	ATT	0.500	0.537	0.452	0.491
	std.err.	(0.231)**	(0.263)**	(0.239)*	(0.217)**
NE	ATT	0.818	0.959	0.933	0.923
	std.err.	(0.335)**	(0.440)**	(0.330)***	(0.370)**
CS	ATT	0.020	0.099	0.136	0.143
	std.err.	(0.323)	(0.312)	(0.314)	(0.292)
SP	ATT	0.250	0.666	0.407	0.617
	std.err.	(1.270)	(1.325)	(1.010)	(1.062)
CSex	ATT	0.498	0.494	0.550	0.508
	std.err.	(0.258)*	(0.255)*	(0.320)*	(0.262)*

Question 2: ATU and standard errors¹

	blocking	reweighting	mixed blocking	mixed reweighting
<i>Scenario 1: sugarcane expansion ≥ 1%</i>				
ATU	0.712	0.610	0.733	0.609
std.err.	(0.324)**	(0.334)*	(0.334)**	(0.328)*
<i>Scenario 2: sugarcane expansion ≥ 5%</i>				
ATU	0.597	0.588	0.611	0.606
std.err.	(0.334)*	(0.348)*	(0.320)*	(0.332)*
<i>Scenario 3: sugarcane expansion ≥ 10%</i>				
ATU	0.676	0.651	0.639	0.632
std.err.	(0.404)*	(0.415)	(0.415)	(0.403)

¹ Note: values for bias, standard errors, t-values, and MSE are obtained using bootstrap procedures with 10,000 replications. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

Conclusions

Question 1:

- Sugarcane-expanding municipalities in BR, NE and CSexclSP experienced a higher economic growth due to sugarcane expansion.

- In BR and CSexclSP: 0.5 percent higher average annual economic growth.
- In NE: 0.9 percent higher average annual economic growth

- Sugarcane-expanding municipalities in CS and SP did not experience a higher economic growth due to sugarcane expansion.

Question 2: Sugarcane non-expanding municipalities in CSexclSP would have experienced a 0.6 percent higher average annual economic growth if they had expanded sugarcane production.

Literature and data cited

- [1] IBGE (Instituto Brasileiro de Geografia e Estatística). 2010. Online database.
- [2] Macedo, I. (ed.) 2005. A energia da cana-de-açúcar: doze estudos sobre a agroindústria da cana-de-açúcar no Brasil e sua sustentabilidade. São Paulo, Brazil: União da Agroindústria Canavieira do Estado de São Paulo (UNICA).
- [3] Ramos, P. 2008. “Os impactos da expansão do lavoura canavieira na estrutura fundiária e as manifestações de sua concentração no Brasil.” Paper presented at the “Workshop sobre os impactos da evolução do setor sucroalcooleiro”, UNICAMP, Campinas, Brazil, 16 May.
- [4] Rosenbaum, P.R. and D.B. Rubin. 1983a. The central role of the propensity score in observational studies for causal effects. *Biometrika* 70:41-55
- [5] EMBRAPA. 2009. Zoneamento agroecológico da cana-de-açúcar.

Acknowledgements

I would like to acknowledge valuable comments and suggestions from Steven Kyle, David Just, Antonio Bento, Heloisa Burnquist, Alceu Veiga Filho, Antonio Florido, Carlos Edoardo Fredo, Antonio de Padua Rodrigues, Eduardo Leão de Sousa, Gerd Sparovek and Arnaldo César Walter. This research was supported by grants from the following institutions at Cornell University: the Department of Applied Economics and Management, the Mario Einaudi Center, the Graduate School, and the Latin American Studies Program.

Copyright

Copyright 2011 by Annelies Deuss. All rights reserved. Readers may make verbatim copies of this document for non-commercial purposes by any means, provided that this copyright notice appears on all such copies.

About the author

Annelies Deuss is a Visiting Assistant Professor of Economics in the Department of Economics at Carnegie Mellon University. She obtained her PhD in Applied Economics from Cornell University in 2010. For further information, please contact deuss@andrew.cmu.edu