



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 effect of technical change and public expenditure on the tradeoff between
the Brazilian Amazon forest and agricultural commodities**

Felipe de F. Silva

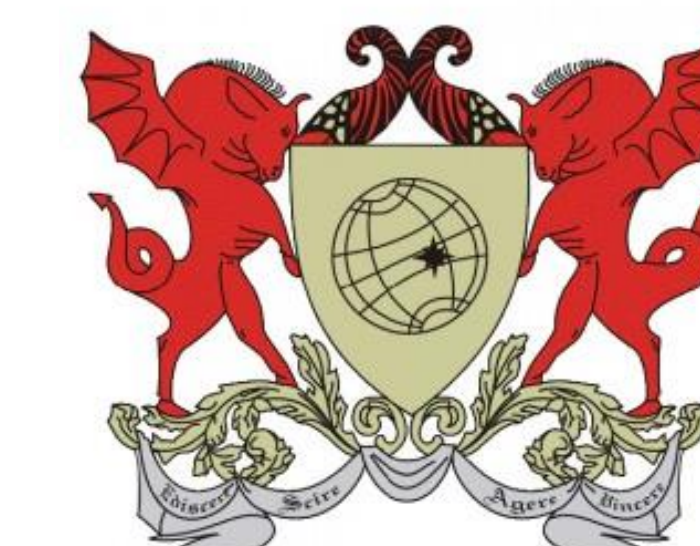
University of Nebraska-Lincoln
felipe.silva@huskers.unl.edu

*Selected paper prepared for presentation at the 2017 Agricultural & Applied Economics Association
Annual Meeting, Chicago, Illinois, July 30-August 1*

*Copyright 2017 by Silva. 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.
Please do not cite.*



The effect of technical change and public expenditure on the tradeoff between the Brazilian Amazon forest and agricultural commodities



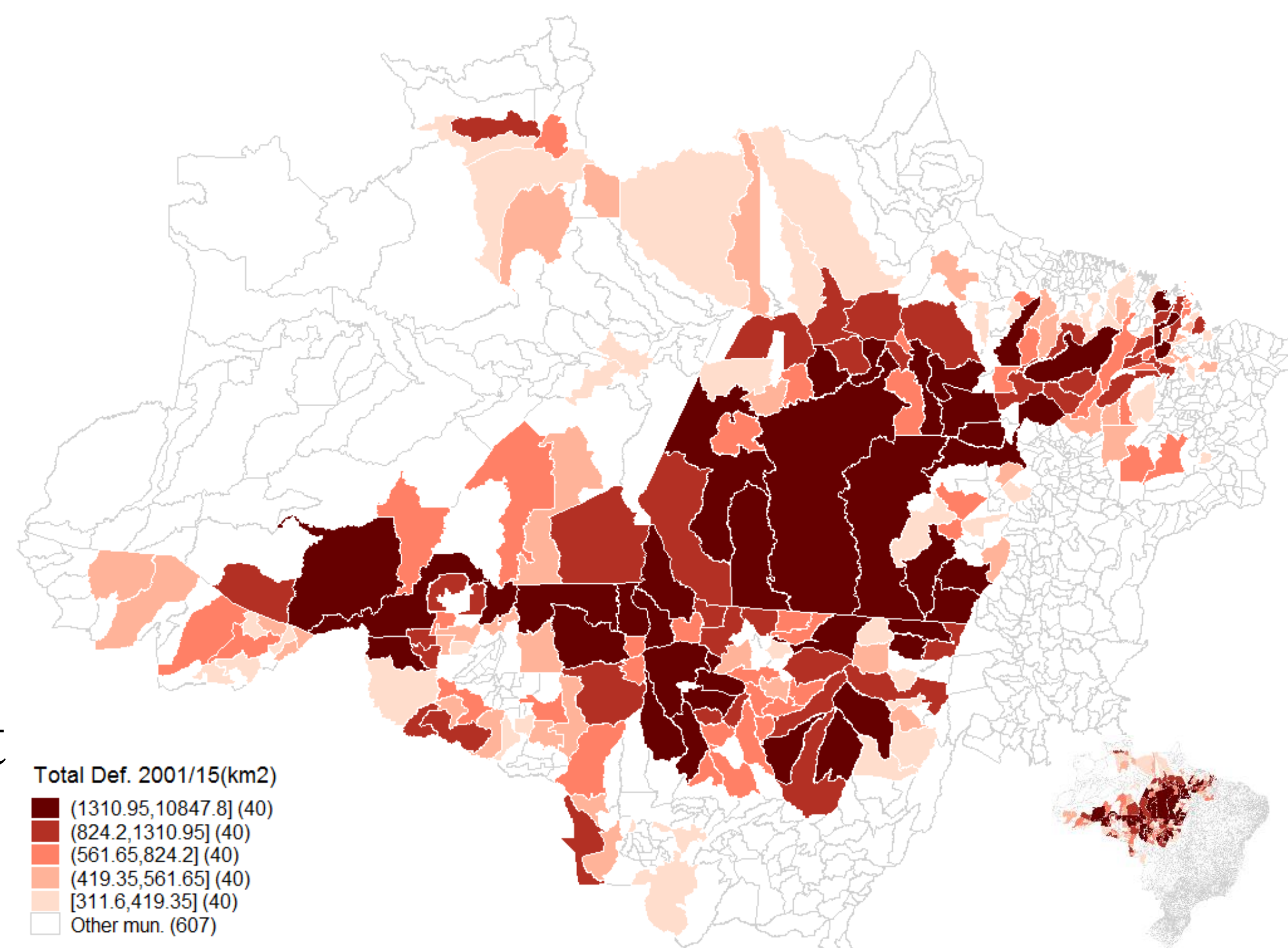
Felipe Silva

Department of Agricultural Economics, University of Nebraska-Lincoln

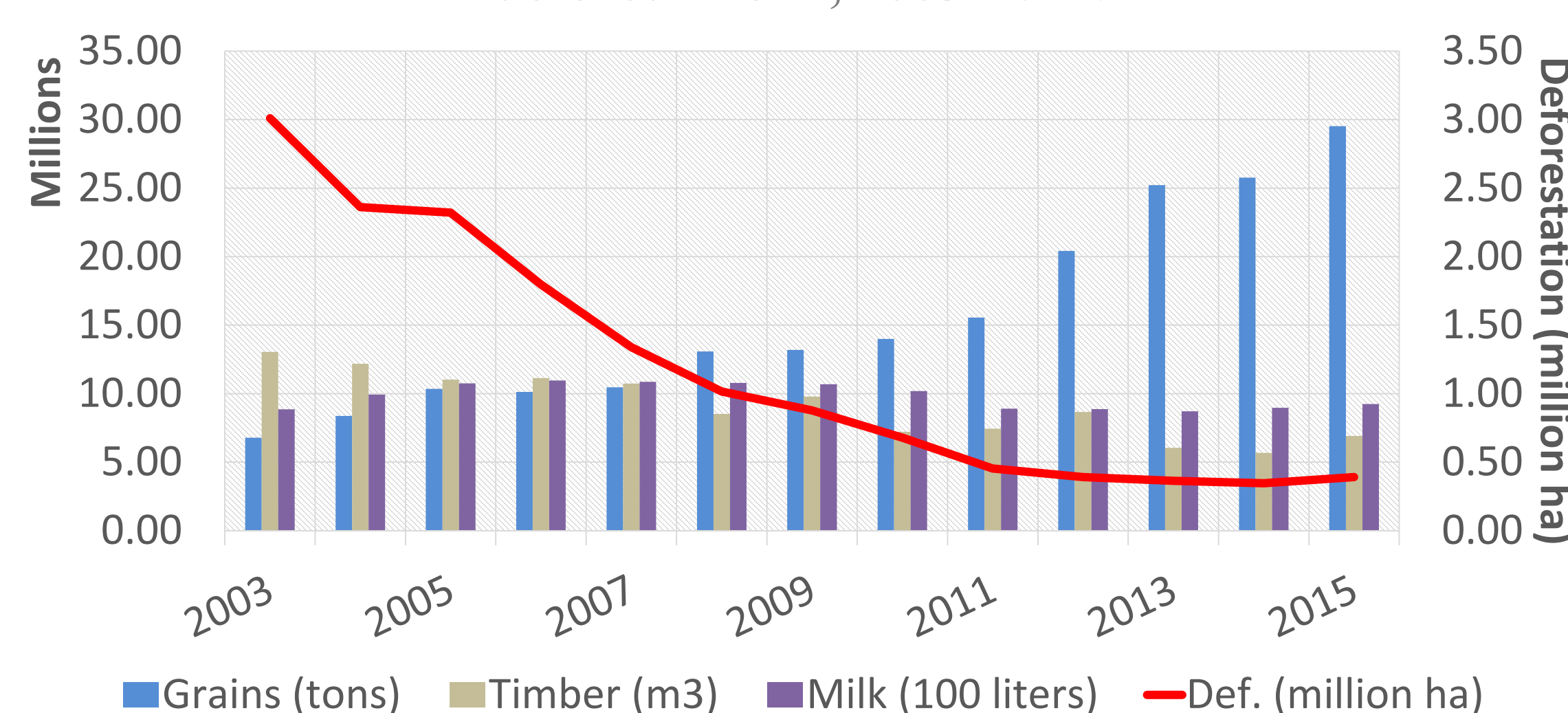
Introduction

▪ Brazilian agriculture has experienced high rates of **productivity** growth since early 70's. Several studies found this result but without accounting for harmful environmental impacts of agriculture.

▪ Brazilian agricultural production **emitted 8.4% of the world's CO₂e emissions** generated by agriculture, most from land use change.



Agricultural outputs and deforestation in the “arc of deforestation”, 2003-2015.



We estimate a production possibility frontier including deforestation as a bad output and grains, livestock and timber as good output for the “arc of deforestation” in the Brazilian Amazon to evaluate the:

- **Rate of technical change (RTC);**
- **Bias of technical change (BTC);**
- **Bias of public expenditure (BPE).**

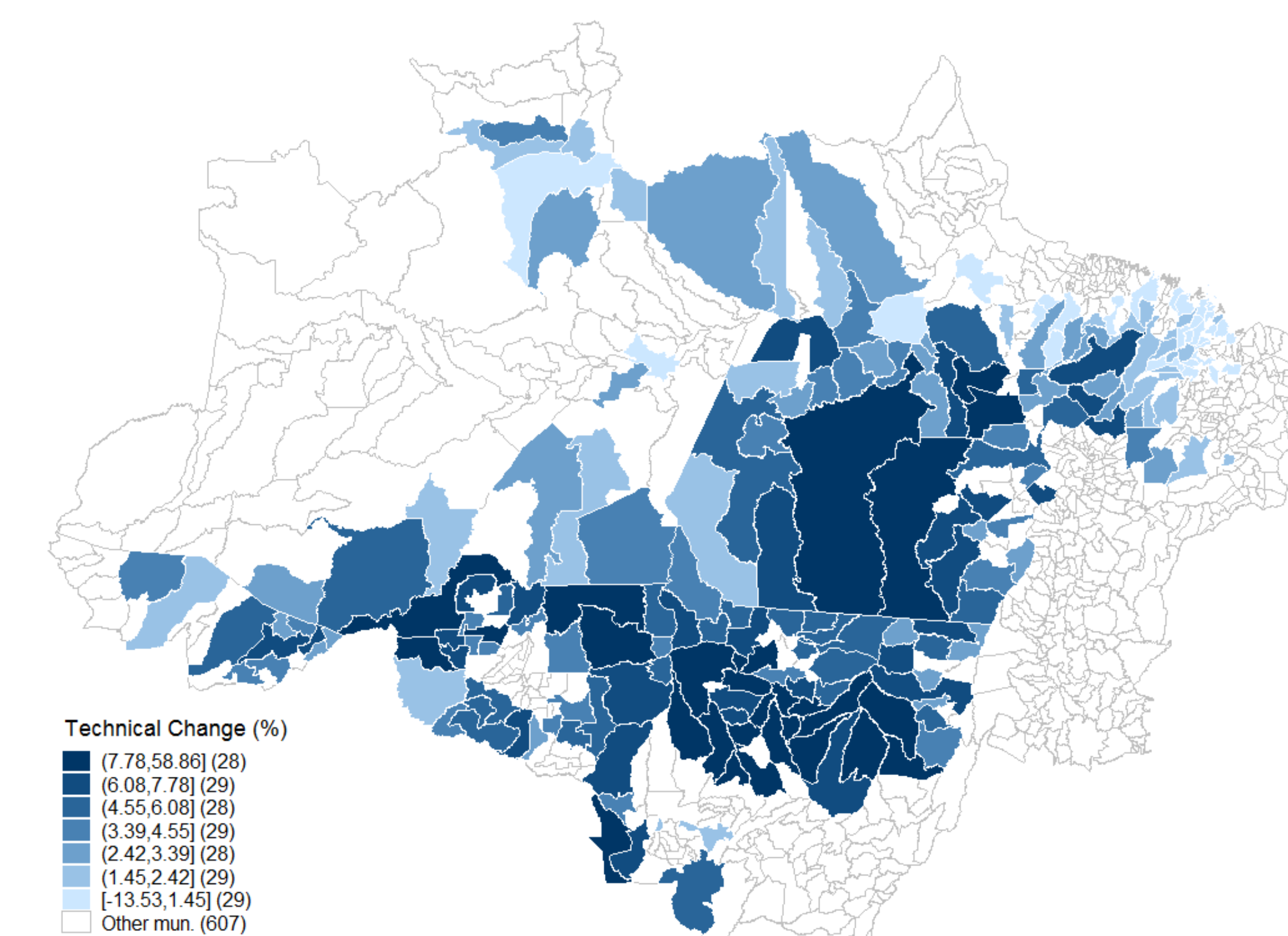
Data

- The sample contains 200 municipalities that have deforested more than 31 thousand hectares during the period 2001-2015 (adding up to 2600 obs.).
- Grains, livestock and timber, and inputs (labor, capital, area and public exp.) from the Brazilian Institute of Geography and Statistics (IBGE, 2017);
- Deforestation from the National Institute for Space Research (INPE, 2017);
- Public expenditure from the Brazilian National Treasure Secretary (2017).

Results

▪ Overall average **RTC** was 4.6%.

This implies that technical change has led to an increase agricultural production and a decrease in deforestation during the period from 2003 to 2015.



$$\text{▪BTC} = \frac{\partial \ln(MRT_{mj})}{\partial t} > 0,$$

This implies that on the PPF, technical change has allowed tradeoff of more agricultural production (grains, livestock and timber) for a smaller decrease in deforestation than was previously feasible.

$$\text{▪BPE} = \frac{\partial \ln(MRT_{mj})}{\partial x} > 0,$$

This implies that on the PPF, increased public expenditure has also allowed tradeoff of more ag production per unit decrease in deforestation.

Methods

▪ We estimate the PPF using a directional distance function:

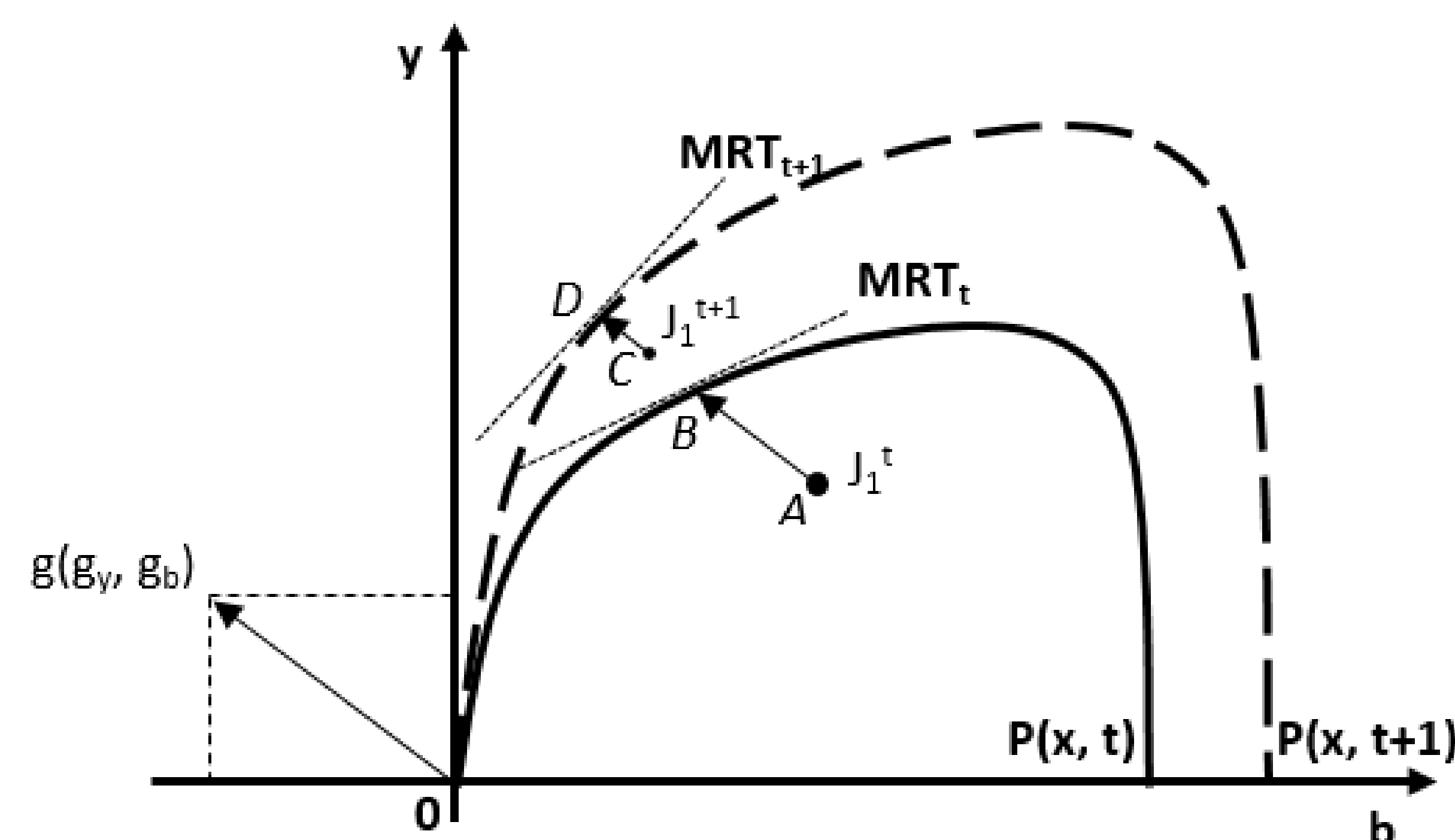
$$\vec{D}_o(\mathbf{x}, \mathbf{y}, \mathbf{b}, t; \mathbf{g}_y, \mathbf{g}_b) = \max\{\alpha: (\mathbf{y} + \alpha \mathbf{g}_y, \mathbf{b} - \alpha \mathbf{g}_b) \in P(\mathbf{x})\}$$

where \mathbf{y} is a vector of desirable outputs, \mathbf{b} is a vector of undesirable outputs, \mathbf{x} is a vector of inputs, t represents time, and $\mathbf{g} = (\mathbf{g}_y, \mathbf{g}_b) = (1, -1)$ represents the directional vector used.

▪ We estimate this equation using Maximum Likelihood Estimation (MLE) and Generalized Method of Moments (GMM).

▪ We use this information to obtain the:

- **Rate of technical change** = $\frac{\partial \vec{D}_o}{\partial t}$,
- **Bias of technical change** = $\frac{\partial \ln(MRT_{mj})}{\partial t}$
- **Bias of public expenditure** = $\frac{\partial \ln(MRT_{mj})}{\partial x}$



Conclusions

- We have found a lower **RTC**, of 4.6%, compared with studies that do not consider deforestation as a bad output, which have measured a 7% RTC;
- The **BTC** and **BPE** have changed the tradeoff on the PPF that allows increased agricultural production with smaller increments in deforestation.