Extended Abstract
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Paper/Poster Title	**The economic and ecological impact of soy in Brazil: A Synthetic Control Method approach**

Abstract prepared for presentation at the 98th Annual Conference of The Agricultural Economics Society will be held at The University of Edinburgh, UK, 18th - 20th March 2024.

Abstract	***200 words max***

The impact of soy production in Brazil, one of the largest food producers in the world, has been widely explored. Scholars have looked at its link with deforestation, employment, economic growth, and income distribution, among others. However, there is no clear consensus about soy's socioeconomic benefits and drawbacks. This research builds on the existing stream of literature, and applies a Synthetic Control Method for investigating the impact of soy on GDP, agricultural CO_2 emissions, and deforestation at state level – focusing on Goiás, Paraná, Piauí, Rio Grande do Sul, and Tocantins as treated states given the incidence of soy on their GDP since specific years. Three of the treated states experienced a positive impact on their GDP (while one saw a decrease) and a negative impact in terms of deforestation. However, the impact in terms of agricultural CO_2 emissions is less straightforward: in Tocantins we detect a reduction in CO_2 emissions along the whole treated period, and only in Goiás in 2019 we see a significant increase. Elsewhere, emissions increased but not significantly. The heterogeneity of our results across states and over time suggest that the relationship between soy production and socio-ecological outcomes is rather complex.

Keywords	e.g. Bioenergy, Energy Efficiency
JEL Code	e.g. Energy: Demand and Supply Q41 see: www.aeaweb.org/jel/guide/jel.php?class=Q)

Introduction	***100 – 250 words***

Brazil is one of the largest food producers and exporters globally. Starting from the 1960s, the Brazilian Government has invested strongly in federal and state-level programmes for supporting export-oriented agri-food producers and developing financial and physical infrastructures for boosting the country's agricultural productivity and modern supply chains (Stabile et al., 2020). Likewise other Latin American countries, Brazil has seen an exponential increase in the cultivation of soy, which has become one of the most produced Brazilian commodities – mainly exported to Asian and European markets (Weinhold et al., 2013; Wesz Junior et al., 2021).

Methodology

100 – 250 words

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This paper uses SCM to estimate the impact that soy production has had on three indicators – GDP, agricultural CO_2 emissions[1] and deforestation[2] – in five Brazilian states. Originally developed by Abadie and Gardeazabal (2003) in their study on the effects that the *Euskadi Ta Askatasuna* (ETA) activities have had on income in the Basque region, SCM represents one of the most influential recent contributions in quantitative studies on the effects of a given treatment (Athey and Imbens, 2017).

SCM is a data-driven econometric technique which builds a counterfactual unit – a "synthetic unit" as it is called in the SCM jargon – to show how the treated unit would have performed if the treatment had not occurred. The synthetic unit is built using "donor" units appropriately weighted, with donors not having been exposed to the treatment. The difference between the synthetic and the observed values gives a measure of the effect of the treatment. The possibility of combining multiple donors represents a methodological innovation if compared to employing a single comparison unit; the weighted combination which creates the synthetic unit provides a (statistical) superior fit for the unit of observation.

Results

100 – 250 words

Our results show a heterogeneous picture across Brazilian states, which cannot be reduced to a hegemonic, dominant trend. In the last decades, the Brazilian economy has experienced increasing deindustrialisation and re-primarisation based on (neo)extractivist practices (Andrade, 2022; Cooney, 2021; Lamoso, 2020; Vieira and Santos, 2022). Soy played an important role in supporting the country's economic growth; however, we suggest that this commodity cannot be considered as the main contributor to this phenomenon – measured in terms of GDP increase – or the only one with a negative impact on the environment. We found that those Brazilian states where soy played an important role experienced different impacts on their GDP, which can be explained by their different industrialization level and the economic structure characterizing rural areas. Therefore, economic benefits cannot be univocally linked to soy production. Equally, while we found evidence of negative environmental impacts, especially in terms of deforestation, we also observed a non-significant impact on CO_2 emissions in most instances, which indicated that soy cultivation might be potentially less impactful than other agricultural activities whose environmental impact has been discussed in previous studies – primarily livestock farming (IPCC, 2019; Vogel et al., 2021). Consequently,

[1] The estimate of CO_2 emissions from agriculture and livestock covers perennial and non-perennial agricultural production activities, as well as animal husbandry and production including cattle, chicken, goats, buffaloes, mules, among others. It also includes all activities related to soil nitrogen fertilization and organic soils (SEEG, 2022). This indicator is measured in terms of tons of CO_2 per square kilometre.

[2] Mapbiomas (2022) defines deforestation as the complete or almost complete suppression of existing native vegetation in a given area. For more information, see https://storage.googleapis.com/alerta-public/dashboard/rad/2022/RAD_2022.pdf. This indicator is measured in terms of square kilometres of forest lost over 1,000 square kilometres.

any policy measures aimed at protecting the environment or achieving balanced growth in rural areas should consider these complex interrelationships, rather than adopting a strictly sectoral approach.

Discussion and Conclusion

100 – 250 words

Soy production has had (and still has) a relevant impact on the economy of Brazil, since it has modified its socio-economic structure as well as the agricultural and natural landscape. Several studies investigated this phenomenon and identified costs and benefits, but a consensus on its impact on different socio-economic and environmental aspects is still lacking. This research contributes to advancing our understanding of this phenomenon by considering the overall country system comparatively – and accounting for the diverging trajectories of Brazilian states to build counterfactual outcomes for those states which have been affected most by the expansion of soy production. The SCM is here used for analysing a longitudinal dataset covering almost 30 years, to test the impact of soy on the logarithm of the GDP per capita, CO_2 emissions, and deforestation.