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# **Harvesting Trade Opportunities: Staggered DID of Impact and Structural Gravity of Future of EU-UK Agrifood Trade**

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# Harvesting trade opportunities

Staggered DID of impact and structural gravity of future of EU-UK agrifood trade

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## Motivation

On 1st Jan 2021 UK left EU Customs Union and Single Market and started trading with the EU under the Trade and Cooperation Agreement (TCA)



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- Export and import with EU are down by 20% and 25% (Du, Shepotylo and Shi, 2023) - Agriculture and food products being most affected

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## Goals of the project

- We study the impact of deep free trade agreements (FTAs) on agrifood trade
- All trade agreements are not created equal, so we focus on heterogeneity of impact
  - as function of depth of the agreement
  - as function of legal enforceability of the agreement
- We use structural gravity model to develop counterfactual scenarios for UK agrifood trade under different policy scenarios

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## Structural estimation or causal inference approach?

- Existing literature uses **structural gravity model**: an average PTA effect of 23% increase in trade (Larch and Yotov, 2023), but there is heterogeneity across specific PTAs, sectors, and periods
- We use **causal inference**:
  - Apply difference in difference (Calloway and Sant'anna, 2021): staggered implementation of PTAs that stretches along a quarter of a century
  - Decompose the impact of PTAs on agrifood trade at extensive and intensive margins:
    - duration
    - timing
    - cohorts

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## Key findings

- **Staggered difference in difference** is well suited for studying the impact of PTAs on trade
- **Deeper and legally enforceable agreements** have a stronger and more robust impact on agrifood trade, especially at **extensive** margins
- Deep agreements with the **EU** generate most agrifood trade
- Deepening UK-EU TCA would help to **mitigate** the negative impact of Brexit on UK agrifood exports

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## Literature

- Proliferation of deep free trade agreements (FTAs) in the last 25 years (Limao, 2016)
- New World Bank data on PTAs (Hofmann et al., 2019, Matoo et al., 2020)
- Heterogeneity of impact of PTAs (Baier et al, 2019; Larch and Yotov, 2023)
- Explosion of literature on causal inference, with focus on staggered implementation (Callaway and Sant'Anna, 2021)
- Structural gravity models (Anderson and van Wincoop, 2003; Head and Mayer, 2014; Anderson et al., 2018)

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# Data and methodology

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## Data

- Data from World Bank on 279 PTAs and COMTRADE exports data from 1995-2019 are used for analysis (Hofmann et al., 2019)
  - Use information on extent of agriculture and SPS provisions in PTAs
  - PTAs are classified into 4 categories: Agriculture, Agriculture Plus, Agriculture Extra, and SPS
  - Each type can be legally enforceable (LE) or not legally enforceable (NLE)
- Trade data 1995-2019 COMTRADE in HS Chapters 1-24
  - Animal (HS1-5)
  - Vegetable (HS6-14)
  - Fat (HS15)
  - Food (HS16-24)

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## Depth of PTAs

- PTAs are classified into 4 categories:
  - Agriculture
  - Agriculture Plus
  - Agriculture Extra
  - SPS

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## Legal enforceability of PTAs

- PTAs can be legally enforceable (LE) or not legally enforceable (NLE)
- Legal enforceability is measured by the presence of a dispute settlement mechanism (DSM) in the agreement

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## Methodology

- Derive estimated equations from a model with heterogeneous firms and aggregate it up to extensive (number of varieties) and intensive (average export value) margins for agrifood trade (or its components) between country-pairs
  - Gravity model, Poisson Pseudo Maximum Likelihood (PPML) estimator (Silva and Tenreyro, 2006)
- Use staggered implementation of PTAs to estimate the impact of PTAs on agrifood trade (Callaway and Sant'Anna, 2021)
  - Event study approach
  - Cohorts of agreements
  - Duration of agreements
- Use structural gravity model to simulate impact of counterfactual scenarios for UK agrifood trade under different policy scenarios (Anderson et al., 2018)

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## Model

- Firms are heterogeneous in productivity and markets are monopolistically competitive
- There are fixed costs of exporting
- Trade in good  $g$  from  $i$  to  $j$  at time  $t$  is described by a gravity equation

$$x_{ij,t}^g = N_{i,t}^g \left( \tilde{\phi}_{ij,t}^g \right)^{-\theta} A_{j,t}^g \left( \tau_{ij,t}^g \right)^{-\theta}$$

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## Aggregation

- Aggregation to a product group G:

$$\text{Export}_{ij,t}^G = N_{i,t}^G \left( \tilde{\phi}_{ij,t}^G \right)^{-\theta} A_{j,t}^G \left( \tau_{ij}^G \right)^{-\theta}$$

- Extensive margins of trade

$$\text{EM}_{ij,t}^G = \sum_{g \in G} 1(x_{ij,t}^g > 0) = N_{i,t}^G \left( \phi_{ij,t}^G \right)^{-\theta}$$

- Intensive margins of trade

$$\text{IM}_{ij,t}^G = \frac{\text{Export}_{ij,t}^G}{\text{EG}_{ij,t}^G} = A_{j,t}^G \left( \tau_{ij}^G \right)^{-\theta}$$

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## Trade policy

- PTAs impact variable and fixed costs of exporting
- Variable costs

$$\tau_{ij,t}^G = \gamma PT A_{ij,t} + \tau_{ij}^G + \tau_{j,t}^G + e_{ij,t}^G$$

- Fixed costs

$$\tilde{\phi}_{ij,t}^G = \kappa PT A_{ij,t} + f_{ij}^G + f_{j,t}^G + \varepsilon_{ij,t}^G$$

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# Structural estimation: gravity model of trade

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## Structural estimation results

Notes: Standard errors clustered at country pair is in parentheses Panels B and C also control for PTA, Agri and SPS, but the estimated coefficients are not included due to space limits. + p<0.1, \* p<0.05, \*\* p<0.01

	Total	Animal	Food	Total EXT	Animal EXT	Food EXT	Total INT	Animal INT	Food INT
<b>A: SPS</b>									
PTA	.382**	.007	.536**	.041	.106	.010	.253	.337	.343*
	(.124)	(.115)	(.187)	(.061)	(.103)	(.079)	(.205)	(.259)	(.162)
SPS	.229**	.460**	.149*	.167**	.223**	.122**	.057	.297**	.004
	(.053)	(.101)	(.067)	(.020)	(.027)	(.020)	(.059)	(.091)	(.065)
<b>B: Agri Extra</b>									
Agriculture Extra	.169**	.107	.221**	.121**	.187**	.099**	.139**	.125*	.069
	(.049)	(.075)	(.061)	(.018)	(.025)	(.018)	(.053)	(.062)	(.067)
<b>C: LE</b>									
Agri Extra LE	.107+	.152	.251**	.205**	.394**	.119**	.180*	.286**	.228**
	(.061)	(.099)	(.069)	(.025)	(.036)	(.025)	(.072)	(.094)	(.081)
SPS LE	.086	.163	.021	.043	.086*	.031	-.019	.017	

Total	Animal	Food	Total EXT	Animal EXT	Food EXT	Total INT	Animal INT	Food INT
(.069)	(.133)	(.083)	(.029)	(.042)	(.030)	(.090)	(.116)	(.121)

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## Heterogeneity of impact

- Impact of PTA is highly heterogeneous
- Only few agreements generate positive impact
- Long tail of agreements with no impact

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## Individual agreements

Standard errors clustered at country pair in parentheses. + p<0.1, \* p<0.05, \*\* p<0.01

Variable	Coef.	SE	Variable	Coef.	SE
China - Macao, China	-1.552	(.305)**	Turkey - Malaysia	1.203	(.325)**
EC- Palestinian Authority	-1.274	(.688)+	EFTA	1.21	(.266)**
Georgia - Turkmenistan	-1.271	(.181)**	EFTA - Accession of Iceland	1.212	(.266)**
EFTA - Mexico	-1.187	(.399)**	Turkey - Syria	1.214	(.354)**
EFTA - Macedonia	-1.012	(.343)**	Japan- Switzerland	1.219	(.250)**
EFTA - Tunisia	-1.002	(.261)**	Chile-Korea	1.278	(.288)**
EFTA - Albania	-0.973	(.290)**	Dominican Republic - Central America	1.317	(.354)**

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Variable	Coef.	SE	Variable	Coef.	SE
Hong Kong, China - Chile	-0.847	(.250)**	EFTA - Montenegro	1.418	(.310)**
China-Peru	-0.828	(.283)**	Panama - Singapore	2.072	(.571)**
EFTA - Egypt	-0.778	(.719)	Ukraine - Montenegro	4.759	(.888)**

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# Causal inference approach: staggered difference-in-difference

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## Event study approach

- Look at intensive and extensive margins
- Agri Extra and SPS LE have strongest impact
- Cumulative effect increases over time at extensive margin

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## Calendar approach

- Impact is pro-cyclical
- Strongest impacts 2004-2009 and 2014-2019
- Poor estimations for 1995-2003

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## Cohort approach

- Strongest cohorts are 2004 and 2007
- EU enlargement in 2004 and 2007
- Strong extensive margin effect



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# Simulations: UK trade policy scenarios post Brexit

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## Counterfactual scenarios

Scenario	Withdrawal from EU	New PTA agreement with EU	PTA coef
1	Yes	None	0
2	Yes	PTA EU	0.221
3	Yes	Veterinary agreement	0.248
4	Yes	Agriculture Extra EU	0.382
5	Yes	Agriculture Extra LE EU	0.623
0	No	EU membership	0.89

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## UK agrifood trade under different policy scenarios: Structural gravity simulation results

Outcome	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
	Hard Brexit	TCA	VA	Agri Extra	Agri Extra LE
Producer price change, %	2.67	2.00	1.92	1.51	2.02
Value added in agriculture change, %	-0.58	-0.38	-0.36	-0.26	-0.14
Agrifood export change, %	-52.59	-43.38	-42.10	-35.24	-20.88
Agrifood import change, %	-2.55	-1.46	-1.36	-0.90	4.13
Intranational trade change, %	8.10	5.77	5.50	4.21	4.68

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## Conclusions

- **Staggered difference in difference** is well suited for studying the impact of PTAs on trade
- **Deeper and legally enforceable agreements** have a stronger and more robust impact on agrifood trade, especially at extensive margins
- UK should **deepen** its trade agreement with the EU to **Agri Extra LE** to mitigate the negative impact of Brexit on UK agrifood exports

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## Questions and comments?

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