The Imperialism of Standards
An Empirical Strategy for Measuring the Effects of GMO Regulations on International Trade Flows

Vigani M., Raimondi V. and Olper A.

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Research objective

- **Build a GMO regulatory index**
  - Based on the *relevant* regulatory dimensions

- **Quantify the trade effect of across-country distance in GMO regulation**
  - Using a gravity model

- **To control for the endogeneity of GMO regulations to trade flows**

Main finding

- Country differences in GMO regulation significantly affect trade flows

- The regulatory dimension that matter the most are
  - Labeling
  - Approval process
  - Traceability system

- Endogenizing the GMO index increases its trade effect of about two times

Outline

- **Motivation and value added**
- The GMO regulatory index
- Data and econometric specification
- Basic results
- Endogeneity of GMO standards
- Concluding comments

Motivation and value added

- World wide polarization around GMO standards

- Multidimensionality in GMO regulations

- Developing countries dilemma about their welfare-maximizing GMO regulation

- Few (ex-post) empirical studies on GMO standards and trade, with some weakness
  - GMO standards captured by a simple dummy variable
  - Focus especially on producer (US…) vs. consumer (EU…) trade effects
  - Failure to control for key trade costs like tariffs
    - e.g. Tothova-Oehmke (2004), Disdier-Fontagné (2008)

Motivation and value added

This paper:

- Build an index of GMO regulations across 60 countries, to study
  - The overall trade effect of GMO regulations
  - As well as the effect of six regulatory sub-components
- We try to answer a slight different question with respect to previous analysis, namely
  - How much the similarity/dissimilarity in GMO regulation affects bilateral trade flows ?
- We use a gravity-like model controlling for
  - Relevant bilateral trade costs, including **tariffs**
  - Sample selection (zero trade flows)
  - **Endogenous** nature of the GMO index

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The GMO regulatory index

- ## Sample
  - 60 countries from all continents

- ## Data source
  - GAIN reports on Biotech (FAS, USDA), plus national official sources

- ## Regulatory categories
  - Approval process; Risk assessment; Labeling policies; Traceability systems; Coexistence; Membership of intern. Agreements

- ## Strategy
  - Assign an objective scores to each dimension
    - higher score means increase in restrictiveness in production and commercialization

The GMO regulatory index

- Example of score definition

Approval process	Score
Lack of rules or ambiguity that do not put constraints on the cultivation and marketing	0
Mandatory approval process, established at legislative level but still far from implementation	1
Mandatory approval process in accordance with the principle of substantial equivalence	2
Mandatory approval process under the precautionary principle	3
Countries declared GM free (prohibition of cultivation and marketing)	4

Labelling policies	Score
It is not required a label or is just at proposal stage	0
Voluntary GMO labelling	1
Mandatory GMO label without threshold or with threshold $\geq 5\%$	2
Mandatory GMO label with threshold $\leq 1\%$	3
Countries declared GM free	4

Traceability requirements	Score
It is not required a GMO traceability process	0
GMO traceability process is at proposal stage	1
Mandatory GMO traceability	2
Countries declared GM free	3

The GMO regulatory index

- The overall index is obtained by the score summation and normalization (range from 0 to 1)
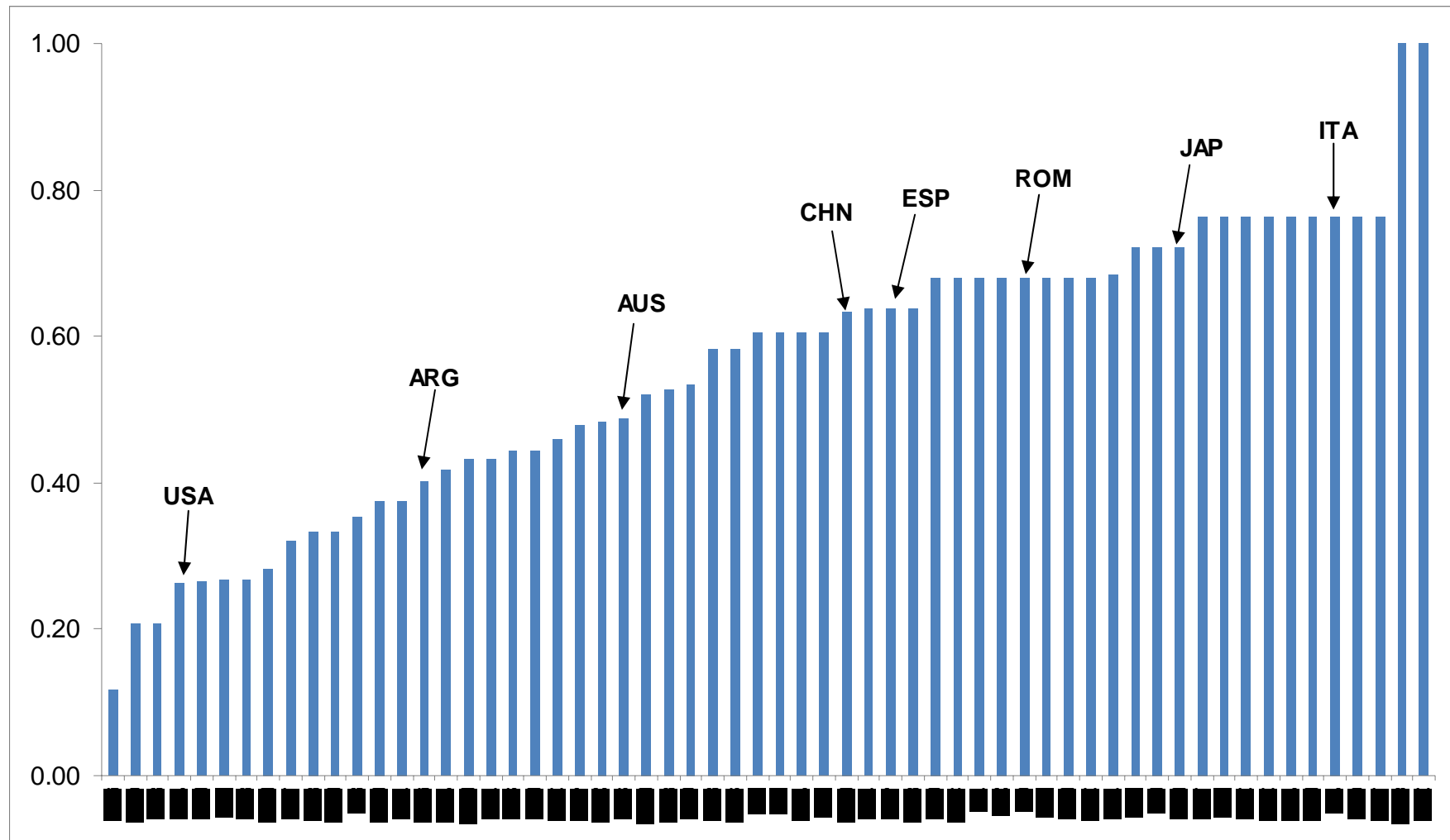
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Data and econometric specification

- ## Trade data (average 2005-2007)

  - Three product aggregates at HS (2002) 6 digit plus cotton (import data from COMTRADE)

    - Maize, soybean, rapeseed (headings for human destination and animal feed)
    - Cotton (headings related to seeds, oils and cake)

  - Total aggregates of *potentially* GMO trade (maize+soybean+rapeseed+cotton)

  - Each of the four groups considered individually

- ## Country sample

  - **Importers**: all the countries with GMO index

  - **Exporters**: selected excluding countries that, simultaneously, have no export and production of the products considered (based on FAO)

Data and econometric specification

- ## The gravity equation

$$\log M_{ij} = \beta_0 + \lambda_j + \chi_i + (1-\sigma)\gamma \log D_{ij} + (1-\sigma)\log \tau_{ij} + \beta_1 GMO_{ij} + u_{ij}$$

  - D_{ij} and τ_{ij} are distance and bilateral ad-valorem **tariffs** (source CEPII and MAcMap)
  - $GMO_{ij} = \left| GMO_i - GMO_j \right|$ **bilateral GMO index**
  - We add also contiguity, language, and colony (from CEPII)
  - Importers, exporters and product (HS 2-digit) fixed effects

- ## Econometric strategy

  - Two stage Heckman procedure (81% zero trade flows!) following Helpman et al (2008) extension
  - In a second step, we instrument the GMO index with the values of the closed neighboring, following Djankov *et al* (2008)

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Basic results
II stage of the Heckman procedure

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
GMO Index	-0.927*** (0.245)						
Labeling		-0.795*** (0.164)					
Approval			-0.759*** (0.197)				
Traceability				-0.534** (0.207)			
Risk					-0.439 (0.533)		
Coexistence						-0.019 (0.120)	
Agreements							-0.211 (0.160)
$Ln\ Distance_{ij}$	-1.733*** (0.094)	-1.705*** (0.092)	-1.747*** (0.094)	-1.692*** (0.113)	-1.577*** (0.090)	-1.882*** (0.134)	-1.763*** (0.096)
Contiguity	1.272*** (0.130)	1.299*** (0.128)	1.266*** (0.128)	1.261*** (0.131)	1.202*** (0.127)	1.248*** (0.151)	1.256*** (0.130)
Colony	0.285** (0.130)	0.319*** (0.131)	0.299** (0.131)	0.118 (0.152)	0.176 (0.142)	0.266* (0.142)	0.266** (0.131)
$Ln\ (1 + tariff_{ij})$	-1.965*** (0.221)	-1.971*** (0.221)	-2.010*** (0.221)	-2.403*** (0.284)	-1.588*** (0.325)	-2.402*** (0.283)	-2.019*** (0.221)
Mills ratio	2.183*** (0.211)	2.188*** (0.208)	2.196*** (0.210)	2.234*** (0.237)	1.506*** (0.195)	2.166*** (0.265)	2.180*** (0.212)
FE Importer, exporter and HS2	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	17112	17113	17112	9669	13057	10800	17112

Results at the products level
II stage of the Heckman procedure

Variables	Total	Corn	Soybean	Canola	Cotton
GMO Index	-0.927***	-1.061***	-1.299***	-1.408**	2.137*
	(0.245)	(0.295)	(0.412)	(0.694)	(1.100)
Ln Distance $_{ij}$	-1.733***	-1.833***	-1.480***	-2.154***	-4.245***
	(0.0940)	(0.115)	(0.146)	(0.264)	(1.097)
Contiguity	1.272***	1.089***	1.369***	1.583***	1.577*
	(0.130)	(0.151)	(0.232)	(0.233)	(0.858)
Colony	0.285**	0.173	-0.031	0.279	-0.519
	(0.130)	(0.162)	(0.229)	(0.282)	(0.702)
Ln (1 + tariff $_{ij}$)	-1.965***	-1.300***	-2.060***	-3.688**	2.207
	(0.221)	(0.252)	(0.588)	(1.651)	(2.601)
Mills ratio	2.183***	1.998***	1.668***	2.323***	5.763***
	(0.211)	(0.238)	(0.313)	(0.483)	(1.819)
Constant	7.775***	8.480***	4.630**	8.850***	8.167**
	(0.647)	(0.985)	(2.264)	(1.749)	(3.900)
FE Importer, exporter and HS2	Yes	Yes	Yes	Yes	Yes
Observations	17112	8236	3983	2119	316

Results: IV regressions

Variables	Heckman procedure			OLS	IV
	I stage	II stage OLS	II stage IV		
GMO Index	-0.211***	-0.927***	-2.011***	-0.650***	-2.024***
	(0.078)	(0.245)	(0.421)	(0.249)	(0.426)
Ln Distance $_{ij}$	-0.665***	-1.733***	-1.716***	-0.863***	-0.807***
	(0.018)	(0.094)	(0.064)	(0.045)	(0.038)
Contiguity	0.461***	1.272***	1.298***	0.952***	0.981***
	(0.067)	(0.130)	(0.086)	(0.135)	(0.087)
Language	0.226***			0.129	0.612***
	(0.041)			(0.116)	(0.082)
Colony	0.213***	0.285**	0.337***	-0.173	-0.111
	(0.062)	(0.130)	(0.101)	(0.128)	(0.100)
Ln (1 + tariff $_{ij}$)	-0.345***	-1.965***	-1.906***	-1.640***	-1.548***
	(0.059)	(0.221)	(0.202)	(0.221)	(0.203)
Mills ratio		2.183***	2.256***		
		(0.211)	(0.143)		
FE Importer, exporter and HS2	Yes	Yes	Yes	Yes	Yes
Observations	91253	17112	17112	17112	17112

Conclusion

- Countries with great differences in GMO regulation trade significantly less
  - For trade flows standards harmonization matter as well as stringency of the standards

- Labeling, approval process and traceability system are the regulatory dimensions that matter the most

- Finally the results confirm the importance of taking into account the endogeneity of GMO index