The trade effects of environmentally related technical measures

Fabio Santeramo[1,2], Emilia Lamonaca[1], Charlotte Emlinger[3]
[1]University of Foggia (Italy), [2]European University Institute (Italy), [3]Virginia Tech (USA)

This version: April 2022

1. Introduction

Over the last decades, trade regulations have been characterised by a reduction of tariff levels on goods to an average below 5% and a consistent increase of technical measures at the border, such as Sanitary and Phytosanitary (SPS) measures and Technical Barriers to Trade (TBT). These measures are adopted by governments establishing requirements that both domestically produced and imported goods must meet to fulfil public policy objectives. The pursued policy objectives differ depending on the measure implemented. The main scopes of SPS measures are ensuring food safety for consumers (i.e., protection of human life and health) and preventing the spread of pests or diseases among animals and plants (i.e., protection of animal and plant life and health): they have prevalently a territorial coverage. TBT may consist in technical regulations, standards, testing and certification procedures, whose aim is to achieve certain standards of human health and safety, environmental protection, consumer information, or quality. TBT regulate also public goods, such as the environment, thus their coverage is territorial and extra-territorial. The Agreements on the application of SPS measures (i.e., WTO SPS Agreement) and of TBT (i.e., WTO TBT Agreement) aims to ensure these measures are notified according to the public policy objectives they pursue while avoiding unnecessary obstacles to trade.

The environmental protection is a raising issue. Emissions come from many sectors: the greatest contributor is the energy sector (electricity, heat, and transport account for 73.2% of total emissions), followed by agriculture, forestry, and land use (18.4%), direct industrial processes (5.2%) and waste (3.2%) (Ritchie, 2020). The length and complexity of supply chains joint with the globalisation and fragmentation of production processes across countries have contributed to the growth in international trade: global freight transport heavily contributes to carbon dioxide ($CO2_)$ emissions (Shapiro, 2016). According to the Organisation for Economic Co-operation and Development (OECD) and International Transport Forum (ITF) projections, CO_2 emissions from global freight transport are expected to increase fourfold within 2050 (OECD/ITF, 2016).Challenges posed by climate change have fed notifications related to environment purposes: according to data from the WTO TBT Information Management System (IMS), they were 26 TBT notifications in 1995-2008 and have increased up to 3,927 in 2009-2021; moreover, after the Paris Agreement, environmentally related TBT notifications have increased by 73%.The environmental protection is an issue for some countries, such as China and United States, and for some sectors and particularly relevant for the agri-food sector.

Trade policies may help enforcing commitments on the environmental protection. But trade policies are distortive: they limit the achievement of welfare maximisation (Anderson & van Wincoop, 2001) and are biased against the environment (Shapiro, 2021).

Technical regulations, such as TBT are numerous and growing, especially in sensitive sectors (e.g., agriculture and labour-intensive sectors), since they have replaced tariff cuts. However, they are less

transparent than price measures and characterised by welfare effects heterogeneous across measures and products and difficult to quantify (Cadot et al., 2018; Gourdon et al., 2020). Technical regulations are frequently used in support of non-trade policy objectives, such as the environmental protection (Borchert et al., 2021), but the difference between environmental protection and protectionism is borderline (Fontagné et al., 2005). The extent to which technical regulations are set to achieve environmental protection or protectionism shapes the environmental-welfare trade-off.
Given that trade policies are against the environment (Shapiro, 2021), this study aims to analyse if environmentally related technical measures are pro-environment.

2. Empirical strategy

We rely on a gravity-type approach (e.g., Costinot and Rodriguez-Clare, 2014; Head and Mayer, 2014) and regress trade and environmental outcomes on technical regulations, according to the following specification:

$$\boldsymbol{Y}_{ijkt} = \alpha + \beta_{ikt} + \beta_{jt} + \beta_{ijk} + \gamma \boldsymbol{X}_{jkt} + \delta t_{ijk} + \varepsilon_{ijkt} \quad (1)$$

where i is the exporter, j is the importer, k is the product, t is the year, α is a constant, γ and δ are parameters to be estimated, ε_{ijkt} is the error term. The dependent variable ($\boldsymbol{Y}_{ijkt}$) is, alternatively, the welfare (i.e., bilateral exports) and environmental (i.e., bilateral exports times exporter's emissions) outcomes. Exporter-product-time fixed effects (β_{ikt}) are supply-side controls, importer-time fixed effects (β_{jt}) are demand-side controls that allow for cross-year variation, exporter-importer-product fixed effects (β_{ijk}) are overtime trade costs. Technical regulations ($\boldsymbol{X}_{jkt}$) implemented by i on j's exports include measures notified under different policy objectives, that are environmental protection, civil and political rights, economic and social rights, security issues, other objectives (Borchert et al., 2021). The focus is on environmentally related technical measures, regulations notified under other policy objectives serve as controls. The model controls for ad valorem tariffs (t_{ijk}).
We calculate the welfare effects of technical measures in terms of ad valorem equivalent, using bilateral exports as dependent variable in equation (1), and the environmental effects of technical measures with a similar approach, but using as dependent variable the interaction between bilateral exports and exporter's emissions (Shapiro, 2016, 2021). The environment-welfare trade-off is obtained as a ratio (environmental effects / welfare effects) for each technical measure. The trade-off for other technical measures serves as a benchmark to assess the contribution of environmentally related technical measures.

3. Hypotheses and preliminary evidence

We formalise four tests on the role of economic development in the trade and environmental policy regime testing the following research hypotheses.

3.1. Cross-country effects

The welfare and environmental outcomes of technical measures may differ across countries. On the environment side, environmentally related technical measures increase the demand for imports of

high environmental quality (i.e., with lower trade embedded emissions, see Shapiro, 2021). On the welfare side, complying with environmentally related technical measures informs consumers in the importing country on the environmental quality of the exported products (i.e., trade catalyst effect), but this does not come without additional costs (i.e., trade barrier effect) (Fontagné et al., 2005).

HP1.1: Environmentally related technical measures affect the environment-welfare trade-off

Regulations are heterogeneous across countries due to differences in preferences, risk assessment, production capacity, risk-reducing technologies, among others (Maertens & Swinnen, 2009; Grossman et al., 2021). The welfare effects of technical measures are heterogeneous across countries with different economic development (e.g., Jaffee & Henson, 2005; Beghin et al., 2006). The same applies to environmentally related technical measures: the level of economic development is correlated with emissions level and environmental standards, with consequences on the environmental effects of technical measures. Because environmental quality is a normal good, less developed countries will adopt relatively low environmental standards (Copeland & Taylor, 1994).

HP1.2: The environment-welfare trade-off differs according to the economic development of traders

To explore the cross-country effect of technical regulations, we estimate the model in equation (1) on different samples. The results are reported in tables 1 (effects on the value of bilateral exports) and 2 (effects on the volume of bilateral exports). The results on whole sample (i.e., all country-pairs across years, specifications 1) serves as benchmark. To test the role of economic development in facing technical regulations, we interact the variables proxying environmentally related technical regulations with the level of economic development of exporters (specifications 2). To test the sensitiveness of these results, we cut the sample considering the level of economic development of exporters (specifications 3-6). Exporters are classified in developed economies, economies in transition, developing economies, least developing countries (UN, 2020).

Table 1. Trade effects of technical measures on the value of bilateral exports by economic development of exporters.

Variables	(1) All	(2) All	(3) Developed	(4) Transition	(5) Developing	(6) LDC
Environmental protection	-0.0044*		-0.0070**	0.0251	-0.0019	-0.1964***
	(0.0025)		(0.0031)	(0.0167)	(0.0047)	(0.0469)
Environmental protection * developed		-0.0121***				
		(0.0030)				
Environmental protection * transition		-0.0005				

		(0.0134)				
Environmental protection * developing		0.0124***				
		(0.0041)				
Environmental protection * LDC		-0.0498				
		(0.0376)				
Civil and political rights	0.0108***	0.0104***	0.0161***	0.1495***	-0.0121**	0.1634***
	(0.0034)	(0.0034)	(0.0043)	(0.0206)	(0.0057)	(0.0384)
Security issues	-0.2810***	-0.2809***	-0.3392***	0.3091	-0.2295***	-0.4696
	(0.0312)	(0.0312)	(0.0384)	(0.1889)	(0.0563)	(0.4196)
Economic and social rights	0.0005	0.0006	-0.0069***	-0.0310**	0.0103***	0.0673**
	(0.0021)	(0.0021)	(0.0025)	(0.0141)	(0.0038)	(0.0295)
Other objectives	0.0124**	0.0123**	0.0185***	0.0315	0.0315***	0.3234***
	(0.0053)	(0.0053)	(0.0062)	(0.0317)	(0.0103)	(0.1073)
Ad valorem tariff	-0.4372***	-0.4369***	-0.2632***	-0.2842***	-0.7609***	-0.8175***
	(0.0110)	(0.0110)	(0.0147)	(0.0529)	(0.0193)	(0.1074)
Observations	26,894,882	26,894,882	17,015,318	1,030,998	8,589,250	259,285
R^2	0.86	0.86	0.87	0.85	0.86	0.87

Notes: Estimates of the model in equation (1). The dependent variable is the value of bilateral exports (log). Technical measures are modelled as dummy variables. All specifications include exporter-product-time, importer-time and country-pair-product fixed effects, ad valorem tariff (log). In the specification (2), the dummy for environmentally related technical measures is interacted with the level of economic development of exporters. The specifications (3)-(6) are estimated on subsamples of differently developed exporters. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Table 2. Trade effects of technical measures on the volume of bilateral export by economic development of exporters.

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	All	All	Developed	Transition	Developing	LDC
Environmental protection	-0.0255***		-0.0340***	-0.0188	-0.0044	-0.2203***
	(0.0034)		(0.0041)	(0.0227)	(0.0060)	(0.0563)
Environmental protection * developed		-0.0444***				
		(0.0039)				
Environmental protection * transition		-0.0443**				
		(0.0179)				

Environmental protection * developing		0.0172***				
		(0.0055)				
Environmental protection * LDC		-0.0409				
		(0.0503)				
Civil and political rights	0.0270***	0.0258***	0.0368***	0.2015***	-0.0078	0.1842***
	(0.0044)	(0.0044)	(0.0057)	(0.0278)	(0.0073)	(0.0458)
Security issues	-0.3435***	-0.3433***	-0.2926***	-0.0934	-0.4752***	-0.2248
	(0.0421)	(0.0421)	(0.0524)	(0.2776)	(0.0735)	(0.6066)
Economic and social rights	0.0032	0.0033	-0.0048	-0.0093	0.0093*	0.1086***
	(0.0027)	(0.0027)	(0.0034)	(0.0191)	(0.0048)	(0.0352)
Other objectives	-0.0112	-0.0114	-0.0077	0.0162	-0.0027	0.0610
	(0.0071)	(0.0071)	(0.0085)	(0.0433)	(0.0136)	(0.1293)
Ad valorem tariff	-0.4475***	-0.4468***	-0.2586***	-0.3450***	-0.7612***	-1.1357***
	(0.0146)	(0.0146)	(0.0198)	(0.0712)	(0.0248)	(0.1271)
Observations	26,658,881	26,658,881	16,888,423	1,024,232	8,491,517	254,678
R^2	0.89	0.89	0.89	0.90	0.88	0.91

Notes: Estimates of the model in equation (1). The dependent variable is the volume of bilateral exports (log). Technical measures are modelled as dummy variables. All specifications include exporter-product-time, importer-time and country-pair-product fixed effects, ad valorem tariff (log). In the specification (2), the dummy for environmentally related technical measures is interacted with the level of economic development of exporters. The specifications (3)-(6) are estimated on subsamples of differently developed exporters. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Overall, environmentally related technical measures are anti-trade: they tend to hinder both the value and volume of bilateral exports. Differences are observed across countries. While environmentally related technical measures exert a negative pressure on exports from developed and least developing countries, they seem to be beneficial for exports of developing countries.

3.2. Cross-sector effects

The welfare and environmental outcomes of technical measures may differ across sectors. On the environment side, protection tend to be relatively higher for products obtained with cleaner techniques of production (Shapiro, 2021). On the welfare side, protection tends to differ according to products' value added and development.

HP2.1: The environment-welfare trade-off differs by sectors

On the welfare side, protection tends to differ according to products' development. For instance, in agriculture, developed sub-sectors (e.g., processed production in high-income economies and primary production in low-income economies) are more exposed to technical measures (and tariffs) and less developed sub-sectors (e.g., primary production in high-income economies and processed production in low-income economies) receive domestic support (Anderson et al., 2006; Kee et al., 2009). Moreover, environmentally related technical measures enforced by a single country are concentrated in labour-intensive industries (Fontagné et al., 2005). On the environment side, products'

development is related to environmental standards and environmental regulations (De Melo & Solleder, 2020).

HP2.2: The environment-welfare trade-off differs according to the economic development of sectors

To disentangle the cross-sector effect of technical regulations, we estimate the model in equation (1) interacting variables for technical regulations with dummies for groups of products (i.e., agri-food *versus* non-agri-food, specification 1, table 3) and technological level of products (i.e., high, medium, low, no tech, specification 2, table 3).

Table 3. Trade effects of technical measures on the value of bilateral exports by economic development of products.

	(1)	(2)
Variables	Ag. vs. non-ag.	Tech
Environmental protection * agri-food product	0.2392***	
	(0.0101)	
Environmental protection * non-agri-food products	-0.0144***	
	(0.0026)	
Environmental protection * high tech products		-0.0155***
		(0.0053)
Environmental protection * medium tech products		-0.0197***
		(0.0033)
Environmental protection * low tech products		0.0102
		(0.0087)
Environmental protection * no tech products		0.0306***
		(0.0045)
Civil and political rights	-0.0083**	0.0080**
	(0.0034)	(0.0034)
Security issues	-0.2744***	-0.2791***
	(0.0312)	(0.0312)
Economic and social rights	0.0006	-0.0001
	(0.0021)	(0.0021)
Other objectives	0.0133**	0.0123**
	(0.0053)	(0.0053)
Ad valorem tariff	-0.4376***	-0.4376***
	(0.0110)	(0.0110)
Observations	26,894,882	26,894,882
R^2	0.86	0.86

Notes: Estimates of the model in equation (1). The dependent variable is the value of bilateral exports (log). Technical measures are modelled as dummy variables. All specifications include exporter-product-time, importer-time and country-pair-product fixed effects, ad valorem tariff (log). In the specification (1), the dummy for environmentally related technical measures is interacted with the type of products (agri-food versus non-agri-food). In the specification (2), the dummy for environmentally related technical measures is interacted with the technological level of products. *** Significant at the 1 percent level. ** Significant at the 5 percent level. * Significant at the 10 percent level.

Preliminary results confirm that the welfare outcomes of environmentally related technical measures are heterogeneous across sectors and products. Environmentally related technical measures tend to be pro-trade for agri-food products and for not technologically advanced products. Differently,

environmentally related technical measures are detrimental for trade of more developed products (i.e., products with a high or medium technological level).

Further analyses based on the assessment of the environmental outcomes of technical measures will allow us to understand what the impact on the environment is as compared to the effects on welfare.

Essential references

Anderson, J.E., & Van Wincoop, E. (2001). Borders, trade and welfare. NBER Working Paper 8515.

Anderson, K., Martin, W., & Valenzuela, E. (2006). The relative importance of global agricultural subsidies and market access. World Trade Review, 5(3), 357-376.

Beghin, J., Diop, N., & Matthey, H. (2006). Groundnut trade liberalization: Could the South help the South? World Development, 34(6), 1016-1036.

Borchert, I., Conconi, P., Di Ubaldo, M., & Herghelegiu, C. (2021). The pursuit of non-trade policy objectives in EU Trade Policy. World Trade Review, 20(5), 623-647.

Cadot, O., Gourdon, J., & van Tongeren, F. (2018). Estimating ad valorem equivalents of non-tariff measures: Combining price-based and quantity-based approaches. OECD Trade Policy Papers, No. 215, OECD Publishing, Paris.

Copeland, B.R., & Taylor, M.S. (1994). North-South trade and the environment. The Quarterly Journal of Economics, 109(3), 755-787.

Costinot, A., & Rodríguez-Clare, A. (2014). Trade theory with numbers: Quantifying the consequences of globalization. In Handbook of International Economics (Vol. 4, pp. 197-261). Elsevier.

De Melo, J., & Solleder, J. M. (2020). Barriers to Trade in Environmental Goods: How Important they are and what should developing countries expect from their removal. World Development, 130, 104910.

Fontagné, L., Von Kirchbach, F., & Mimouni, M. (2005). An Assessment of Environmentally-related Non-tariff Measures. World Economy, 28(10), 1417-1439.

Gourdon, J., Stone, S., & van Tongeren, F. (2020). Non-tariff measures in agriculture, OECD Food, Agriculture and Fisheries Papers, No. 147, OECD Publishing, Paris.

Grossman, G.M., McCalman, P., & Staiger, R.W. (2021). The "New" Economics of Trade Agreements: From Trade Liberalization to Regulatory Convergence? Econometrica, 89(1), 215-249.

Head, K., & Mayer, T. (2014). Gravity equations: Workhorse, toolkit, and cookbook. In Handbook of International Economics (Vol. 4, pp. 131-195). Elsevier.

Jaffee, S., & Henson, S. (2005). Agro-food Exports from Developing Countries: The Challenges Posed by Standards. World Bank, Washington.

Kee, H.L., Nicita, A., & Olarreaga, M. (2009). Estimating trade restrictiveness indices. The Economic Journal, 119(534), 172-199.

Maertens, M., & Swinnen, J.F. (2009). Trade, standards, and poverty: Evidence from Senegal. World Development, 37(1), 161-178.

OECD/ITF. (2016). The Carbon Footprint of Global Trade: Tackling Emissions from International Freight Transport. Paris, France: Organisation for Economic Co-operation and Development and International Transport Forum.

Ritchie, H. (2020). Sector by sector: where do global greenhouse gas emissions come from? Our World in Data, September 18, 2020. Available at: ourworldindata.org (accessed on November 12, 2021).

Shapiro, J.S. (2016). Trade costs, CO 2, and the environment. American Economic Journal: Economic Policy, 8(4), 220-54.

Shapiro, J.S. (2021). The environmental bias of trade policy. The Quarterly Journal of Economics, 136(2), 831-886.

United Nations (2020). World Economic Situation and Prospects 2020. United Nations: New York.