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Do Trade Agreements Contribute to Technology Internationalization?

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This research, based on Arregui and Martínez-Zarzoso (2022), investigates the effect of free trade agreements (FTAs) on technology internationalization. We estimate the effect of FTAs on domestic ownership of foreign inventions with a gravity model, using a panel of 6,480 country pairs of high- and middle-income countries for the period 1980-2015. The main results indicate that FTAs lead to a significant increase in technology internationalization, especially when the FTAs cover trade in goods and services. This effect increases over time considering the period of implementation and enforcement, subsequent to the ratification of an agreement and depends on the policy scope of the FTA and the economic distance between trading partners. Moreover, countries that are geographically and institutionally closer exchange more knowledge and provisions on intellectual property rights add to this positive effect.

The present research contributes to the literature by estimating the effect of free trade agreements (FTAs) on technology internationalization, which can result on international technology transfers (ITTs), for a global sample of countries. Rather than considering trade or FDI flows, the focus is on membership in an FTA –that may contain various technology provisions– as target

variable. In this regard, our paper, Arregui and Martínez-Zarzoso (2022), is closely related to Santacreu (2022), who investigates the effect of FTAs on international licensing, another important aspect of technology internationalization, and to Jinji (2019) that focus on the determinants of patent citations across countries and also considers ratification of FTAs as one of the

determinants. Differently, we use cross-country patenting applications and co-patenting as the main outcome variables and focus on the contribution of technology provisions of various types.

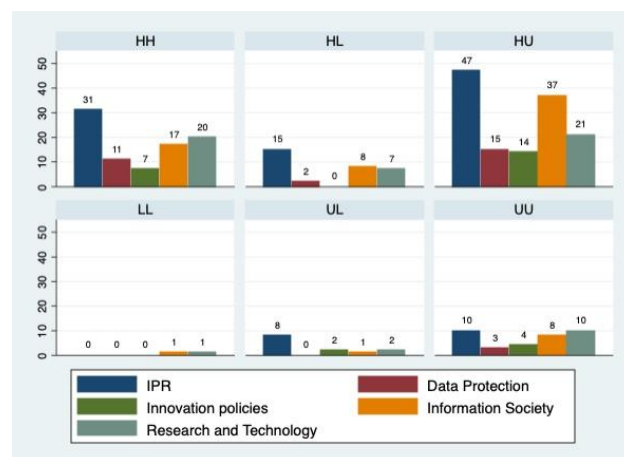
This research also builds on a recent strand of literature that studies the effect of technology-related content of FTAs on the international exchange of goods (Maskus and Ridley, 2016; Campi and Dueñas, 2019; Martínez-Zarzoso and Chelala, 2021; LaBelle and Santacreu, 2021; Erixon et al., 2022). We borrow from this literature the classification of technology provisions into distinct categories (see Figure 1) and the consideration of heterogeneous effects of FTAs ratification by level of development of the countries involved in the process of technology internationalization (Figure 1).

Over the years, the scope of FTAs has grown, going from mere trade liberalization to a vast range of policy areas that include the environment, the labor market, as well as investment and technology transfers (Dür et al., 2014; Hofmann et al., 2017). The empirical literature to date has shown that the content of trade agreements fosters ITTs through bilateral trade of goods with different technological intensities (Maskus and Ridley, 2016; Campi and Dueñas, 2019; Martínez-Zarzoso and Chelala, 2021). These results have been heterogeneous depending on the economic level of the trading partners, the specific provisions included in an agreement, and the technological intensity of the traded goods. However, the impact of the content of trade agreements on technology internationalization remains, to the best of

our knowledge, understudied and deserves further attention.

We bridge this gap in the literature by estimating a gravity model of technology internationalization using a panel of 6,480 country pairs of high- and middle-income countries for the period 1980-2015. Patent statistics of foreign inventions owned by domestic firms are taken as a proxy for technology internationalization. By means of the Poisson Pseudo Maximum Likelihood (PPML) estimator, we estimate the effect of FTAs, their technology-related content (see Figure 1), as well as geographical and institutional distance on the likelihood of a country owning new technologies created in another country, using a gravity model.

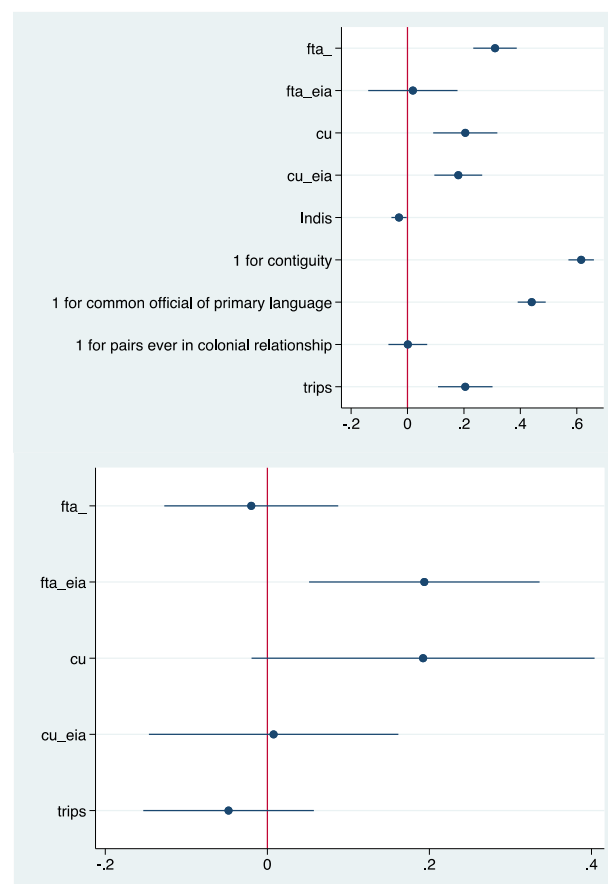
Figure 1. Technology provisions in FTAs



Note: Bilateral and regional trade agreements in force since or after 1980, classified according the income level of the member states and technology content. HH: FTA among high income countries; HL: FTA among high income and low middle-income countries. HU: FTA among high income and upper middle-income countries; UU: FTA among upper middle-income countries; LL: FTA among low middle- countries; and UL: FTA among upper and low middle- countries. **Source:** Hofmann et al. (2017) and authors' elaboration.

The main results are twofold. First, the findings indicate that FTAs have an economic and informational effect on firms' technology internationalization decisions. The first effect relates to the increase in economic interaction between trading partners after trade liberalization, which raises the likelihood of technology internationalization between countries. The second effect, in contrast, refers to a policy commitment that creates incentives for firms to internationalize their technological activities with the other member states of the agreement. Specifically, the main estimation results show that trade agreements lead to a significant increase in technology internationalization (cross-country patenting). This effect increases over time considering the period of implementation, subsequent to the ratification on an agreement. However, the effect depends strongly on the policy scope of the agreement and the economic distance between trading partners. Second, the results also show that countries that are geographically and institutionally closer exchange more technology and knowledge. This can be explained by the decreasing costs of communication and coordination associated with geographical and institutional proximity. Figure 2 shows the estimates of two theoretically-based gravity models that explain cross-country patenting with countries participation in regional integration agreements at different levels, the distance between them, if they share border or language and have a colonial relationship or have ratified the TRIPS.

Figure 2. Explaining technology internationalization



Note: the upper graph shows the point estimates and the 5% confident bands for the variable coefficients of a model specification with gravity variables and two sets of country-and-time fixed effects (FE) to proxy for multilateral resistance. The lower graph is based on a model that adds to the country-and-time FE a set of bilateral FE (that replace time-invariant gravity variables) to account for endogeneity issues; fta denotes free trade agreements in goods, fta_eia in goods and services, cu denotes customs unions and cu_eia customs unions & economic integration agreements. The models are estimated using the Stata command *ppml_panel_sg* (Larch et al., 2019).

Figure 2 (top) estimated coefficients indicate that whereas geographical distance slightly deters cross-country patenting, contiguous countries (those with common official language) exchange technology 85 (74) percent more than others. Similarly, countries in an FTA/CU exchange technology 24 percent more than others (bottom graph).

Implications

FTAs have an economic and informational effect on firms' technology internationalization decisions. The first effect relates to the increase in economic interaction between trading partners after trade liberalization, which raises technology internationalization between countries. The second effect, in contrast, refers to a policy commitment that creates incentives for firms to internationalize their technological activities with the other member states of the agreement. The findings in this research indicate that cross-country patenting is incentivised not only by proximity but also by countries' participation in free trade agreements that cover goods and services and in customs unions, more even when the agreements include IPR provisions that protect the innovators.

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