

Gnangnon, Sèna Kimm

Working Paper

The Least developed countries' TRIPS Waiver and the Strength of Intellectual Property Protection

Suggested Citation: Gnangnon, Sèna Kimm (2023) : The Least developed countries' TRIPS Waiver and the Strength of Intellectual Property Protection, ZBW - Leibniz Information Centre for Economics, Kiel, Hamburg

This Version is available at:

<https://hdl.handle.net/10419/271537>

Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

Terms of use:

Documents in EconStor may be saved and copied for your personal and scholarly purposes.

You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.

If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.

The Least developed countries' TRIPS Waiver and the Strength of Intellectual Property Protection

Author: Sèna Kimm GNANGNON¹

Manuscript date: June 2023

Abstract

Members of the World Trade Organization (WTO) have accorded many flexibilities to the least developed countries (LDCs) in the WTO's Trade-Related Intellectual Property (TRIPS) Agreement. A major LDC-specific flexibility in this Agreement that other developing country Members of the WTO do not enjoy has been the general transition period for the implementation of the Agreement, in view, *inter alia*, of their need for flexibility to create a viable technological base. The present article investigated whether this LDC-specific Waiver in the TRIPS Agreement genuinely helped LDCs reduce the strength of their Intellectual Property Protection (IPR), as expected. The analysis was carried out using the Difference-in-Difference framework, along with the within fixed effects and the 'Quantile via Moments' estimators. The panel dataset contains 24 LDCs (treatment group) and two control groups, over the period from 1970 to 2015. The first control group (the main one in the analysis) included 15 countries that had not been in the LDC category, but would not have met the criteria for graduating from the category of LDCs if they were included in the category. The second control group, used for robustness check, included 9 low-income countries that yet, were not LDCs, but were eligible to the Poverty Reduction and Growth Facility of the International Monetary Fund. The empirical analysis has established that the TRIPS Waiver was instrumental in reducing the IPR levels in LDCs, and LDCs that had lower IPR levels (i.e., those located in the lower quantiles) enjoy larger reductions in IPR levels, thanks to this Waiver. Moreover, the effect of the TRIPS Waiver on LDCs' IPR levels depended on LDCs' duration of the membership in the WTO, as well as on their level of innovation-driven export variety, measured by their level of export product concentration or alternatively their degree of economic complexity.

Keywords: Least developed countries; TRIPS Waiver; World Trade Organization.

JEL Classification: F13; O34.

DISCLAIMER

This is a working paper, which represents the personal opinions of individual staff members and is not meant to represent the position or opinions of the WTO or its Members, nor the official position of any staff members. Any errors or omissions are the fault of the author.

¹ Economist at the World Trade Organization (WTO). E-mail for correspondence: kgnangnon@yahoo.fr

1. Introduction

Do Least developed countries (LDCs) really make use of the policy space available to them in the Trade-Related Intellectual Property Agreement² (TRIPS) of the World Trade Organization (WTO) by reducing the level of their intellectual property rights (IPR) protection? The present article aims to address this question, which is relevant for policymakers in least developed economies, the international organizations and non-governmental organizations, and the donor-community that pay special attention to LDCs through international support measures.

The category of the least developed countries (LDCs) was created in 1971 by the United Nations as the poorest and weakest segment of the international community. This group is built on the basis of three criteria³, and contains essentially the world⁴'s poorest and most vulnerable countries to environmental shocks, and external economic and financial shocks.

In light of their specific features, LDCs receive a special attention from the international community, notably through strong international support (e.g., United Nations, 2021; UNCTAD, 2021). The World Trade Organization (WTO) is not an exception, as WTO Agreements and Decisions contain several flexibilities⁵ in favour of the LDCs for the implementation of WTO rules and their achievement of their development objectives, including through a greater participation in international trade (e.g., WTO, 2022a, 2023). Some of these flexibilities are contained in the Trade-Related Intellectual Property (TRIPS) Agreement⁶, and are at the heart of the present analysis.

The TRIPS Agreement, which is one the founding Agreements of the WTO, aims to protect and enforce intellectual property rights, with a view to promoting technological innovation and, transfer and dissemination of technology⁷. To that effect, it has established minimum standards of protection that each government has to provide to the intellectual property⁸ of fellow WTO member states. Nevertheless, WTO Members have some policy space on how to achieve these minimum standards. In particular, they are free to provide greater protection of intellectual property, and to determine the appropriate method of implementing the provisions of the Agreement within their own legal system and practice (see *Article 1 of the TRIPS Agreement*).

LDCs enjoy several flexibilities in the TRIPS Agreement, in view of their significant resource and capacity constraints that impede the implementation of the Agreement. In general, the recognition by WTO Members of the difficulties that LDCs could face in implementing WTO rules is reflected in Article XI:2 of the Marrakesh Agreement⁹ establishing the WTO, which states that "*The least-developed countries recognized as such by the United Nations will only be required to undertake*

² This Agreement is available online at: https://www.wto.org/english/docs_e/legal_e/27-trips_01_e.htm

³ These criteria are the income level, the human assets level, and the magnitude of economic and environmental vulnerability. Detailed information on the category of LDCs could be obtained in the website of the United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries and Small Island Developing States (<https://www.un.org/ohrrls/content/least-developed-countries>).

⁴ As of May 2023 (that is, at the time of writing the present paper), the group of LDCs contains 46 countries (see information online at: <https://www.un.org/ohrrls/content/list-ldcs>).

⁵ "Flexibilities" reflect here the policy space available for the implementation of WTO Agreements and Decisions.

⁶ This Agreement is available online at: https://www.wto.org/english/docs_e/legal_e/27-trips_01_e.htm

⁷ Article 7 of the TRIPS Agreement states the objective of the TRIPS Agreement as follows: "The protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge and in a manner conducive to social and economic welfare, and to a balance of rights and obligations."

⁸ The concept of 'intellectual property rights' refers to those legal rules, norms and regulations that prevent the unauthorized use of intellectual products (UNCTAD, 2007: page 91).

⁹ https://www.wto.org/english/docs_e/legal_e/04-wto_e.htm

commitments and concessions to the extent consistent with their individual development, financial and trade needs or their administrative and institutional capabilities." Consistent with this, Article 66:1 of the TRIPS Agreement allows WTO LDC Members to delay the application of the provisions of the Agreement, other than Articles¹⁰ 3, 4 and 5, for a period of 11 years from the year 1995 (see Article 66:1 of the Agreement). This is in view of their special needs and requirements, economic, financial and administrative constraints, as well as their need for flexibility to create a viable technological base. This general transition period was further extended three times, including in 2005, in 2013 and in 2021, with the current extension lasting until 1 July 2034, or until a member graduates from LDC status, whichever occurs earlier.

In addition to this general transition period for the implementation of the TRIPS Agreement, LDCs were granted in 2001, a specific transition period during which they are exempted from providing patent protection and undisclosed information for pharmaceutical products. This period was further extended to 1 January 2033, or until a member graduates from the LDC status, whichever is earlier (WTO, 2022a).

These two major transitional periods represent major flexibilities for LDCs in the TRIPS Agreement that other developing countries do not enjoy. In fact, non-LDC developing Members of the WTO were allowed to delay the implementation of the TRIPS Agreement (other than Articles 3, 4 and 5) for a period of 5 years (from 1995) (see Article 65:2 of the Agreement). This 5-year transition period was not renewed for these Members¹¹. Nonetheless, all WTO Members, including developed countries, LDCs and Non-LDC member states benefit from a number of inbuilt flexibilities in the TRIPS Agreement that help them meet their TRIPS obligations without undermining the achievement of their development goals.

One question that arises here is whether LDCs have really taken advantage of the existing flexibilities (i.e., policy space) in the TRIPS Agreement by reducing the strength of their IPR protection. This question, which to the best of our knowledge, has not been investigated in the literature, is all the more relevant that LDCs participate in various bilateral and regional investment treaties and trade agreements, and enjoy bilateral (non-reciprocal) preferential arrangements that compel them to strengthen their intellectual property protection above the requirements of the TRIPS Agreement (through the so-called 'TRIPS-plus' provisions). As a result, this could potentially limit LDCs' policy space in terms of intellectual property rights protection (e.g., Thrasher, 2021; UNCTAD, 2007; UNECA, 2016).

The present article aims to address this question by investigating whether the LDC related TRIPS flexibilities (henceforth referred to as TRIPS Waiver) have led to a reduction or strengthening of IPR protection in LDCs. The analysis involves examining empirically how the IPR protection levels unfolded in LDCs versus other developing countries that have similar characteristics to LDCs, but that did not enjoy the same flexibilities in the TRIPS Agreement, since 1995 (first year of the start of the implementation of the TRIPS Agreement for all WTO Members) compared to the preceding period. To that effect, we use two different groups of countries that are similar to LDCs, but did not enjoy the policy space in the TRIPS Agreement that LDCs

¹⁰ Articles 3, 4 and 5 of the TRIPS Agreement concern respectively "National Treatment", "Most-Favoured-Nation Treatment", and "Multilateral Agreements on Acquisition or Maintenance of Protection".

¹¹ It is worth noting that pursuant to Article 65:1 of the Agreement, "no Member shall be obliged to apply the provisions of this Agreement before the expiry of a general period of one year following the date of entry into force of the WTO Agreement." This means that developed country Members of the WTO had only a one-year period of transition to implement the TRIPS Agreement.

enjoyed. The first and main group is comprised of countries that had not been in the LDC category, but would not have met the criteria for graduation from the LDC category if they were included in the category (see Klasen et al., 2021: p164). The second group, which is used for robustness check in the empirical analysis, contains low-income countries that are not in the LDC category (and hence did not enjoy LDC-specific TRIPS flexibilities), but are eligible to the Poverty Reduction and Growth Facility (PRGF) of the International Monetary Fund (IMF) (see IMF, 2022: p57).

The analysis covers 24 LDCs, 15 countries in the first control group, and 9 countries in the second group, over the annual period from 1970 to 2015. It has used the within fixed effects estimator and the Method of Moments Quantile Regression proposed by Machado and Santos Silva (2019). Results indicate that the LDC TRIPS Waiver was associated with lower IPR levels in LDCs, and LDCs located in the lower quantiles of the distribution of IPR had the largest fall in IPR levels, thanks to the Waiver. Furthermore, the IPR level effect of the TRIPS Waiver in LDCs appeared to be dependent on the duration of their membership in the GATT/WTO, and on the level of minor innovation (or imitation) measured by the level of innovation-driven export variety.

The remainder of the paper is organized as follows. Section 2 discusses how the LDC TRIPS Waiver could affect the strength of IPR protection in these countries. Section 3 presents the empirical model, and the empirical approach to estimate it. Section 4 describes the empirical approach. Section 5 interprets empirical outcomes, and Section 6 concludes.

2. Discussion on the effect of the LDC TRIPS Waiver on IPR level

The TRIPS Agreement has three main features. First, it sets out minimum standards of protection to be provided by each WTO Member. Second, it lays down certain general principles applicable to domestic procedures and remedies for the enforcement of all intellectual property rights. As such, it addresses national intellectual property rights, regardless of whether these are trade-related or not. Third, it provides for dispute settlement procedures to settle disputes between WTO Members concerning the compliance with the TRIPS obligations. The Agreement covers¹² a wide range of intellectual property areas, including copyrights and related rights; trademarks, including service marks; geographical indications, including appellations of origin; industrial designs; patents, including the protection of new varieties of plants; the layout-designs of integrated circuits; and undisclosed information including trade secrets and test data.

In this section, we first present the rationale for the Waiver granted to LDCs in the TRIPS Agreement (see sub-section 2.1). Second, we highlight the LDC-specific flexibilities in the TRIPS Agreement (see sub-section 2.2) and consider whether the extent to which these flexibilities are used by LDC Members. Sub-section 2.3 and sub-section 2.4 discuss respectively the extent to which the duration of membership in the WTO, and the level of innovation (or imitation) have a bearing the effect of the LDC-specific TRIPS flexibilities affect LDCs' levels of IPR strengthen. The discussion in sub-sections 2.2 to 2.4 allows laying out the theoretical hypotheses that will be tested empirically in the analysis.

¹² See information online at: https://www.wto.org/english/tratop_e/trips_e/intel2_e.htm

2.1. The rationale for the TRIPS Waiver for LDCs

Archibugi and Filippetti (2010) have argued that to benefit from a greater IPR protection, countries should have a certain degree of absorptive capacity and strong technological infrastructures. This is not the case for LDCs in which the strengthening of the IPR regime will increase costs and reduce technology transfer. In the same vein, the World Bank (World Bank, 2002) has estimated that a comprehensive upgrade of the IPR regimes in the poorest countries (excluding training costs) could require a significant up-front expenditure of \$1.5 to \$2 million, plus recurrent costs. Finger and Schuler (1999) have noted that these costs could be even far higher than estimated. Providing greater IPR protection means increasing the levels of IPR protection, as required by the TRIPS Agreement, i.e., protecting IPRs as exclusive rights, without necessarily balancing such protection with other interests, including countervailing public interests (e.g., Gathii, 2016; Park and Lippoldt, 2008).

Consistent with Article 66.1 of the TRIPS Agreement, a compelling historical and empirical evidence lends support to the argument that due *among others*, to their low level of technological development and their strong resources and capacity constraints, countries at the early stages of industrial growth seek to improve their capacity to imitate imported technologies freely, and hence called for limited protection of IPRs (e.g., Maskus, 2005).

From the historical perspective, Lall (2003) has argued that weak patents permit imitation and reverse engineering, and hence, help local firms in the early stages of their growth to build their technological capabilities (e.g., Republic of Korea and Taiwan). This argument builds on the findings by the author that the intensity of patenting initially falls with increasing income, as countries build local capabilities by copying, and then rises as they engage in more domestic innovative efforts. The turning point was US dollar 7,750 per capita (in 1985 prices), which was far higher than LDCs' income levels. Building on the Korean experience, Kim (2003) has surmised that IPR protection should become an important element in technology transfer of industrial activities only after countries have accumulated sufficient indigenous capabilities with extensive science and technology infrastructure to undertake creative imitation in the later stage. Along the same lines, Kim (1997) has contended that the absence of IPR protection may be necessary in order to allow learning through imitation at the initial levels of technological development. This is because strengthening IPR protection may pre-empt duplicative imitation of foreign technologies, which were essential for the technological catch-up of countries such as the Republic of Korea and Japan. More generally, historical experiences from many countries such as those in East Asia (Japan, Republic of Korea and Taiwan), Brazil, the Philippines, Switzerland, late industrializers in Europe (e.g., Amsden, 1989; Chang, 2002) and even the United States (e.g., Yu, 2007) have shown that incremental innovation, absorption and diffusion of technology, particularly in small and medium enterprises are promoted in countries with weak IP protection.

On the empirical front, many studies have reported that strengthening IPR protection is conducive to innovation (e.g., Allred and Park, 2007; Chen and Puttitanun, 2005; Gmeiner and Gmeiner, 2021; Lerner, 2009), but these findings tend to apply mainly to developed economies and high-income developing countries. This is because many creative activities in low-income developing countries, and in particular LDCs fall outside the ambit of IPR regimes of developed

economies (e.g., Chander and Sunder, 2004; Dreyfuss, 2010; Gathii, 2016). In their three requests¹³ for the extension of the transition period for the implementation of provisions contained in the TRIPS Agreement, LDCs put forth the argument that being required to protect IPRs would prevent them from developing a technological base in their economies. This argument is consistent with the findings by many studies that protecting patents promotes economic growth only after a country has reached a high threshold of economic development (e.g., Briggs, 2013; Chen and Puttitanun, 2005; Chu et al., 2014; Kim et al., 2012; Maskus and Reichman, 2005; Schneider, 2005; World Bank, 2002).

For example, Kim et al. (2012) have found that while patent protection is a major ingredient for innovation in developed countries, and that patentable innovations foster economic growth in these countries, this is not the case in developing countries. For the later, it is rather minor forms of IPRs, namely utility models, that promotes innovation and growth. Chen and Puttitanun (2005) have found that a developing country's innovations increase in its IPR protection level, with the IPR protection being possibly related non-monotonically with the country's development level. Especially, the authors have yet found that greater IPR protection promotes innovations in developing countries, but there is a U-shaped relationship between IPR protection and economic development. Schneider (2005) has obtained evidence that the strengthening of IPR protection affects much more innovation in developed countries than in developing countries. This finding has been confirmed by Kanwar and Evenson (2009) who have found that countries' technological development level weakly affects the level of IPR protection that they provide. In particular, the lack of financial resources and human capital, and the inward-looking trade orientation are among chief factors that explain why technology-have-not (i.e., developing countries) offer weak IPR protection. For Goldberg and Pavcnik (2007) and Madsen et al. (2010), innovations occur in poor countries essentially through imitation. As a consequence, strengthening IPR protection in LDC economies impede innovation by reducing the opportunities for technological learning through imitation. The study by Hudson and Alexandru (2013) has also challenged the view that strengthening IPR protection consistently enhances innovation. The authors have used a dataset of both developing and developed countries¹⁴, and observed that strengthening the protection of IPR exerts a complex effect on innovation, depending on countries' initial level of IPR protection and real per capita income (the latter being a proxy for countries' development level). In particular, no country should set its IPR protection level between values of 1.8 and 3.3, and IPR protection enhancement in poorer countries whose levels of initial IPR range between 1.8 and 3.3 is likely to result in less innovation. Chu et al. (2014) have shown that the optimal protection of IPR is stage dependent. Countries implement a weak IPR protection to facilitate imitation at an early stage of development, and a strong IPR protection to encourage domestic innovation at a later stage of development. As a result, the growth-maximizing and welfare-maximizing levels of patent strength increase as the country evolves towards the world technology frontier. More recently, Auriol et al. (2023) have obtained empirically that the enhancement of IPR protection in poorer countries decreases the learning (inside-the-frontier) activities as well as innovation (on-the-frontier) activities.

¹³ The three LDCs' requests for an extension of the transition period under TRIPS Article 66.1 for LDC Members, were submitted respectively on 13 October 2005 (see WTO document IP/C/W/457); on 5 November 2012 (see WTO document IP/C/W/583); and on 1 October 2020 (see WTO document IP/C/W/668).

¹⁴ These countries' IPR levels range from 0.588 to 4.667.

2.2. LDC-specific flexibilities in the TRIPS Agreement and their utilization

This sub-section first presents the flexibilities accorded by WTO Members to LDCs in the TRIPS Agreement, and then considers whether these flexibilities have been utilized by countries in practice. The discussion under this section allows laying out the theoretical hypotheses that will be tested empirically in the analysis.

2.2.1 LDC-specific flexibilities in the TRIPS

In the TRIPS Agreement, LDCs were initially (i.e., from the date of application of the Agreement) allowed to delay the application of the provisions of the Agreement, other than Articles¹⁵ 3, 4 and 5, for a period of 11 years from the year 1995 (see Article 66:1 of the Agreement). Article 66:1 of the Agreement additionally provides that the Council¹⁶ for TRIPS shall, upon duly motivated request by a least developed country Member, accord extensions of this period. WTO LDC Members were accorded several extensions¹⁷ of this general transition period, including in 2005, in 2013 and in 2021. Currently, LDC Members of the WTO enjoy the extension of the transition period for the implementation of the TRIPS Agreement (other than Articles 3, 4 and 5) until 1 July 2034, or until a member graduates from LDC status, whichever occurs earlier. As per Article 66:1 of the Agreement, this general transition period would provide LDCs with the needed flexibility to "*create a viable technological base*" in view of their special needs and requirements, and their economic, financial and administrative constraints. Moreover, at the fourth WTO Ministerial Conference in Doha in 2001, LDCs were granted additional time to develop pharmaceutical patenting rules and capabilities. This flexibility took the form of a specific transition period (until 1 January 2016) during which they would not provide patent protection and undisclosed information for pharmaceutical products. This transition period¹⁸ was further extended to 1 January 2033, or until a member graduates from LDC status, whichever is earlier (WTO, 2022a).

To help in LDC governments' efforts to create "a sound technological base" - as envisaged in the TRIPS Agreement - LDC Members were also granted a specific flexibility in the TRIPS Agreement, whereby "*developed country Members shall provide incentives to enterprises and institutions in their territories for the purpose of promoting and encouraging technology transfer to least developed country Members.*" (see Article 66:2 of the TRIPS Agreement). In the context of the implementation of Article 66.2 of the TRIPS Agreement, a mechanism was set up by the Council for TRIPS in February 2003 to ensure the monitoring and full implementation of the obligations in the TRIPS Agreement by Members. This mechanism provides that detailed information needs to be supplied by developed countries (by the end of every year) on how their incentives, referred to in Article 66.2, are functioning in practice. Watal and Caminero (2018) have provided a factual review of the

¹⁵ Articles 3, 4 and 5 of the TRIPS Agreement concern respectively "National Treatment", "Most-Favoured-Nation Treatment", and "Multilateral Agreements on Acquisition or Maintenance of Protection".

¹⁶ The Council for TRIPS is the WTO Body legally responsible for monitoring the operation of the TRIPS Agreement, and, in particular, Members' compliance with their obligations in this Agreement (see Article 8 of the TRIPS Agreement). At the Doha Ministerial Conference in 2001, Trade ministers agreed that the Council for TRIPS would "put in place a mechanism for ensuring the monitoring and full implementation of the obligations", and the Council for TRIPS adopted a decision to set up this mechanism in February 2003.

¹⁷ The first renewal of the general transition period (i.e., under Article 66.1 of the TRIPS Agreement) was on 29 November 2005, and the transition period was extended until 1 July 2013 (see the TRIPS Council Decision in document IP/C/40). The second renewal of the general transition period took place on 11 June 2013, with the transition period being extended until 1 July 2021 (see the TRIPS Council Decision in document IP/C/64). The third and most recent renewal of the general transition period occurred on 11 June 2021, and the transition period was extended until 1 July 2034 (see the TRIPS Council Decision in document IP/C/88).

¹⁸ See also WTO official documents numbers WT/MIN(01)/DEC/2, IP/C/25, WT/L/478 and IP/C/73.

information submitted by developed Members, and encouraged developed country WTO Members and LDC Members to take steps to improve the implementation of Article 66.2. Moon (2008) has not reached a clear-cut conclusion in her analysis on whether Article 66.2 had led to any increase in incentives for technology transfer to LDCs.

In contrast with LDC member states, non-LDC developing Members of the WTO were allowed for a period of 5 years (from 1995) to delay the implementation of the Agreement (other than Articles 3, 4 and 5) (see Article 65:2 of the Agreement). This 5-year transition period was not renewed for non-LDC developing Members of the WTO¹⁹. In addition to the above-mentioned LDC-specific flexibilities in the TRIPS Agreement, the one-year initial transition period accorded to all WTO Members, and the 5-year transition period granted initially (and specifically) to non-LDC developing countries, the rules in the TRIPS Agreement also incorporate a number of flexibilities that could be invoked by all WTO Members. These flexibilities aim to help all WTO Members comply with their TRIPS obligations while pursuing their public policies, and establishing economic conditions favourable to the achievement of their development goals. For example, Article 8:1 of the TRIPS Agreement allows all Members "*in formulating or amending their laws and regulations, to adopt measures necessary to protect public health and nutrition, and to promote the public interest in sectors of vital importance to their socio-economic and technological development, provided that such measures are consistent with the provisions of the Agreement.*" Built-in flexibilities in the TRIPS Agreement could include for example, compulsory licensing²⁰, government use exceptions²¹, parallel importation²², exceptions to patents rights²³ of which the Bolar exception²⁴ and the research and experimental use exception), standards of patentability²⁵, and other procedural flexibilities²⁶.

Furthermore, at the Twelfth WTO Ministerial Conference held in Geneva in June 2022, Trade Ministers adopted a Decision on the TRIPS Agreement to enhance developing countries' COVID-19 vaccine production capacity²⁷. Paragraph 1 of this Decision reads as follows: "*Notwithstanding the provision of patent rights under its domestic legislation, an eligible Member²⁸ may limit the*

¹⁹ It is worth noting that Article 65: 1 of the Agreement has provided that "no Member shall be obliged to apply the provisions of this Agreement before the expiry of a general period of one year following the date of entry into force of the WTO Agreement." This means that developed country Members of the WTO had only a one-year period of transition to implement the TRIPS Agreement.

²⁰ Compulsory licensing is a tool that allow a government to authorize a third party to exploit patented inventions without the consent of the patent owner, provided that conditions set under the TRIPS Agreement (Article 31) are complied with.

²¹ This tool allows a government to use the patent without obtaining the consent of the patent holder for the purpose of public interest, including public health necessities.

²² Parallel importation is an option built in the TRIPS Agreement that permits member states to obtain patented products when they are lawfully available in a foreign market at a lower price, provided that hat the country has adopted an exhaustion regime suitable to its needs and priorities. This tool, therefore, enables countries to have access to cheaper patented products (see Article 6 of the TRIPS Agreement).

²³ For this flexibility tool in the WTO Agreement, members "may provide limited exceptions to the exclusive rights conferred by a patent, provided that such exceptions do not unreasonably conflict with a normal exploitation of the patent and do not unreasonably prejudice the legitimate interests of the patent owner, taking account of the legitimate of third parties ." (see Article 30 of the TRIPS Agreement).

²⁴ This is a major exception built in the TRIPS Agreement. It aims to facilitate the production and introduction of generic medicines into the market on the date of patent expiry. As a result, a government can make use of an invention for the purpose of obtaining approval of a generic product before the patent actually expires and without having to obtain the patentee's approval.

²⁵ As per the standards of patentability flexibility in the TRIPS Agreement, patent protection must be granted for new products and processes that involve an inventive step and are industrially applicable.

²⁶ This policy tool also aims to help improve the quality of granted patents and limits "evergreening" is pre-grant and post-grant patent oppositions, in addition to patent revocation proceedings (e.g., El Said, 2022).

²⁷ See WTO document WT/MIN(22)/30 - WT/L/1141.

²⁸ For the purpose of this Decision, all developing country Members are eligible Members. Developing country Members with existing capacity to manufacture COVID-19 vaccines are encouraged to make a binding commitment not to avail themselves of this Decision. Such binding commitments include statements made by eligible Members to the General Council, such as those

rights provided for under Article 28.1 of the TRIPS Agreement (hereinafter "the Agreement") by authorizing the use of the subject matter of a patent²⁹ required for the production and supply of COVID-19 vaccines without the consent of the right holder to the extent necessary to address the COVID-19 pandemic, in accordance with the provisions of Article 31 of the Agreement, as clarified and waived in paragraphs 2 to 6 below." Paragraph 2 of the same Decision clarifies the statement in paragraph 1 by providing, *inter alia*, that "an eligible Member may authorize the use of the subject matter of a patent under Article 31 without the right holder's consent through any instrument available in the law³⁰ of the Member such as executive orders, emergency decrees, government use authorizations, and judicial or administrative orders, whether or not a Member has a compulsory license regime in place."

Thus, the "Decision provides a platform for eligible Members, i.e. all developing country Members of the WTO, except those that made a binding commitment not to avail themselves of the Decision, to work together to overcome potential intellectual property obstacles to expanding and geographically diversifying COVID-19 vaccine production capacity, with a view to promoting access and resilience (see WTO document³¹ WT/COMTD/W/271). The provisions of the Decision are applicable by eligible Members until 17 June 2027 (see Paragraph 8 of the Decision), and WTO Members are currently considering whether the Decision, which covers essentially COVID-19 vaccines, could be extended to cover the production and supply of COVID-19 diagnostics and therapeutics.

The TRIPS Agreement also contains, in Article 67, a provision relating to technical cooperation, which aims to facilitate the implementation of the Agreement by both LDCs and non-LDC developing Members. It states, *inter alia*, that "developed country Members shall provide, on request and on mutually agreed terms and conditions, technical and financial cooperation in favour of developing and least-developed country Members."

Overall, a major difference in terms of flexibilities in the TRIPS Agreement between LDCs and non-LDC developing Members resides in the transition period. On the one hand, LDCs have been granted a general transition period (renewed three times) that currently lasts until 2034, and a transition period that lasts until 1 January 2033 for providing patent protection and undisclosed information for pharmaceutical products. On the other hand, non-LDC developing Members were allowed to delay the implementation of all provisions in the TRIPS Agreement only for 5 years from the date of application of the Agreement (i.e., 1995). However, not all non-LDC Members have the same development levels. Among this set of countries are low-income countries, which for many reasons, have not been included in the LDC category. Klasen et al. (2021) have established that there are some developing countries that have not been included in the category of the LDC Group, but would not have fulfilled the criteria for graduation from the LDC category if they had been in this category. The authors have analysed the last four tri-annual reviews (2006, 2009, 2012, 2015) performed by the United Nations' Committee of Development Policy, and identified that 18 developing countries fall in this group (see Klasen et al., 2021: p164). Many of

made at the General Council meeting on 10 May 2022, and will be recorded by the Council for TRIPS and will be compiled and published publicly on the WTO website [see footnote 1 of the Ministerial Decision].

²⁹ For the purpose of this Decision, it is understood that 'subject matter of a patent' includes ingredients and processes necessary for the manufacture of the COVID-19 vaccine [see footnote 2 of the Ministerial Decision].

³⁰ Paragraph 2 of the Decision specifically provides clarity on the meaning of the "law of a Member", by stating that "the "law of a Member" refers to in Article 31 is not limited to legislative acts such as those laying down rules on compulsory licensing, but it also includes other acts, such as executive orders, emergency decrees, and judicial or administrative orders."

³¹ This is a WTO Secretariat Note prepared for the Committee on Trade and Development, and titled Special and Differential Treatment Provisions in WTO Agreements and Decisions". This Note was circulated on 16 March 2023.

these countries were not part of the group of LDCs probably because they might not have performed poorly enough to meet the criteria of inclusion in the LDC category, despite their poor economic and social (including in terms of education and health) performance. In addition, other countries like India and Pakistan were not included in the LDC category - despite their poor performance on income and human assets criteria for a long time (notably from the 1970s to the early 2000s) - because they never met the structural economic vulnerability criterion, which is one of the three criteria used to include in or graduate a country from the LDC category. Likewise, while Ghana, Papua New Guinea, and Zimbabwe had met the inclusion criteria in the past, their governments did not accept the recommendation by the Committee of Development Policy that they would be considered as LDCs. This was because the governments of these countries did not want to be associated with the worst off countries, and were reluctant to acknowledge the economic decline of their country (see Klasen et al., 2021. P164). Thus, the 18 countries identified by Klasen et al. (2021) did not enjoy the LDC-specific flexibilities embedded in the TRIPS Agreement, and could, therefore, serve as a benchmark group (or control group) to investigate empirically whether the LDC TRIPS Waiver has been instrumental in helping LDCs reduce (or at least not strengthen their IPR levels). Against this backdrop, we postulate the following **first hypothesis**.

Hypothesis 1: The LDC TRIPS Waiver had led to reduced levels of IPR protection in LDCs.

The same hypothesis should apply to countries that are not LDCs, but are identified by the International Monetary Fund (IMF) as low-income countries (LICs) because they are eligible for the Poverty Reduction and Growth Trust (PRGT³²) facilities (see IMF, 2022: p57), and hence share many characteristics with LDCs. Note that we would have argued that the same argument applied to the set of LICs identified as such by the World Bank, but this group contains essentially LDCs.

That being noted, a number of constraints could weigh on the utilization of the TRIPS flexibilities by both LDCs and non-LDC developing Members, and eventually lead to higher IPR protection levels in LDCs compared to other countries that could have been included in the LDC category, but were not in fact. In fact, bilateral and regional investment treaties and trade agreements tend to include complex chapters on IPR protection that provide for higher standards of IPR protection (i.e., TRIPS-Plus provisions) than the ones demanded in the multilateral TRIPS Agreement (e.g., Biadgleng and Maur, 2011; Campi and Dueñas, 2019; Maskus, 2015; Mercurio, 2006). According to Thrasher (2021: p54), the newer regime of free trade agreements and bilateral investment treaties has further expanded IPRs - through TRIPS-plus provisions - to effectively undermine the flexibilities inherent within the TRIPS Agreement. By introducing new standards in patentability, revocation and exceptions, inserting new rules to protect innovators, and adding new enforcement requirements for intellectual property infringements, the TRIPS-plus provisions have affected access to medicines (Thrasher (2021: p54). Maskus (2015) has noted that the increase in the number of trade agreements, and the strengthening of IPR systems could not be thought as independent processes.

³² The PRGT is the main vehicle used by the IMF to provide concessional loans (currently at zero interest rates) to LICs (as defined by the IMF). See further information online at: <https://www.imf.org/en/About/Factsheets/IMF-Support-for-Low-Income-Countries>

UNECA (2007) has claimed that African countries (including African LDCs) that have negotiated bilateral free trade agreements with the United States, Japan or the European Union have, in general, less bargaining power than they do in multilateral negotiations. According to UNECA (2007), negotiations of the IPR section in a free trade agreement to which the United States is party, have resulted in the introduction of new legislation by other parties, to strengthen IPR protection in line with the intellectual property legislation in force in the United States (USTR, 2004). Thus, developing countries that enter into a free trade agreement with the United States would typically accept obligations that go far beyond the ones required under the TRIPS Agreement. Standard features of such an agreement include greater patent protection via 'pipeline' protection³³ and extended period of data exclusivity³⁴ (e.g., Correa, 2000; Maskus, 1997; Shadlen, 2005). Shadlen et al. (2005) have uncovered that the membership in the WTO and pressures from the United States in bilateral reciprocal agreements have led to higher IPR protection levels in both rich and poor countries. Likewise, the United States has put a strong emphasis on the protection and enforcement of IPRs as key prerequisites for eligibility to the African Growth and Opportunity Act³⁵ (AGOA) scheme, whose beneficiaries are African countries, including both LDCs and Non-LDCs African countries. Moreover, UNCTAD (2007) has argued that the membership of many African LDCs in intellectual property regional organizations such as the Organization Africaine de la Propriété Intellectuelle and the African Regional Intellectual Property Office, may limit the use of the LDC-specific TRIPS Waiver. According to Correa (2007), the majority of non-African LDCs have applied the legislation of the countries whose colonies they once were, and hence seemed to confer patent protection for pharmaceutical products.

One another note, some free trade agreements to which LDCs are parties require that countries not make use of parallel imports and extend the duration of the copyright. Other free trade agreements that involve LDCs restrict the grounds for compulsory licences (UNCTAD, 2007). In many cases, TRIPS-plus regulations impose even higher standards and obligations on LDCs (either at the time or immediately following accession to the WTO) than on other WTO members (UNCTAD, 2007). Wu (2020) has reported that intellectual property provisions are included in slightly more than 70 percent of the 245 regional trade agreements notified to the WTO and that are in force (as of February 2014). Of the regional trade agreements that have intellectual property provisions, at least one-third contain provisions have increased IPR protection for pharmaceuticals. Interestingly, 90 per cent of regional trade agreements concluded after 2009 contain a chapter on intellectual property. The author has also found that while the majority of these treaties were initially concluded with the United States or countries in the European Free Trade Association, an increasing number of newer treaties resulting in higher intellectual property commitments were being concluded among low-and-middle income countries. For example, IPR-related provisions in preferential trade agreements between developing countries increased

³³ Pipeline protection entail the granting of patents to products that are not new. For example, developing countries did not earlier patent drugs due to the lack of patent laws, but are required, under pipeline protection, to patent drugs for the duration of the patent in the first country (UNECA, 2016: page 134).

³⁴ The "extended exclusivity" involves blocking access to the test data of a pharmaceutical company. This prevents producers of generic medicines from getting regulatory approval without replicating the clinical trials which are extremely expensive and time consuming (UNECA, 2016: page 134).

³⁵ See the Written Comments of the International Intellectual Property Alliance (IIPA) 2023 AGOA Eligibility Review. June 23, 2022. See document online at: <https://www.iipa.org/files/uploads/2022/06/International-Intellectual-Property-Alliance-Comments-on-2023-AGOA-Eligibility-Review.pdf> - See also information on the United States' International Trade Administration website: <https://legacy.trade.gov/agoa/eligibility/>

substantially between 2011 and 2015. Wu (2020: p212) has concluded that "at least a number of developing countries have internalized the need for IPRs to allow for deeper integration via PTAs."

In light of the foregoing, we formulate the following **second hypothesis** (an alternative to the first hypothesis set out above).

Hypothesis 2: Stringent TRIPS-plus clauses negotiated in bilateral and regional trade and investment agreements, as well as in preferential (non-reciprocal) arrangements that involve LDCs, may limit the effective utilization of the policy space granted to LDCs at the multilateral level in the TRIPS Agreement (e.g., Roffe and Vivas, 2007; UNCTAD, 2007; UNECA, 2016).

2.2.2 Utilization of LDC-specific flexibilities in the TRIPS Agreement: current status of intellectual property laws in LDCs

This section presents some data that show the reality concerning the use of intellectual property flexibilities on the ground. The reality is that LDCs like Bangladesh have gained substantially from the inbuilt flexibilities in the TRIPS Agreement. For example, Bangladesh increased substantially its export earnings of pharmaceutical products, and became self-sufficient in the pharmaceutical sector, as it supplied almost 97% of medicines for the local market (e.g., Azam, 2016). Gathii (2016) has examined the current status of intellectual property laws in various LDCs by relying on information from the World Intellectual Property Organization (WIPO), the WTO Trade Policy Review Reports, and information from individual countries. He has found that many of these laws existed before the entry into force of the TRIPS Agreement, even though they were rarely enforced. In particular, 87.5% of all LDCs have legal protection for patents, 93.75% for copyrights, 91% for trademarks, and 37.5% for plant varieties. Since the entry into force of the TRIPS Agreement (in 1995) notably for other developing countries than LDCs, 56.25% of LDCs have passed new patent laws, 58.33% have passed copyright laws, 52.08% trademark laws, and 64.58% plant varieties laws. Vawda (2022) has used the TRIPS Flexibilities Database³⁶ to examine the extent to which countries (among the 82 countries in the database) have made use of the TRIPS flexibilities available to them. The TRIPS flexibilities database is the most comprehensive database developed by "Medicines Law and Policy"³⁷ on the use of TRIPS flexibilities. The author has found that compulsory licensing and government use were the most invoked flexibilities (105 measures were invoked) in the TRIPS Agreement - with a view to enhancing access to medicines. This was followed by the LDC pharmaceutical transition period provision, as 40 of the 46 instances of the utilization of flexibilities by LDCs concerned the LDC transition provision. Nevertheless, apart from Bangladesh, no other LDC had invoked this flexibility prior to the Doha Declaration, which suggests that the invocation of this flexibility by LDCs has increased substantially after the Doha Declaration.

In view of the whole discussion provided above, we can be tempted to postulate that the LDC TRIPS Waiver may exert a negative effect on levels of IPR protection in LDCs. Nonetheless, as indicated above, we may not rule out the possibility of a positive effect of this Waiver on IPR protection in LDCs, notably if TRIPS-plus provisions contained in the bilateral and regional trade and investment agreements, as well as in non-reciprocal trade agreements, result in higher IPR

³⁶ The database records some 155 instances of the use of various TRIPS flexibilities since 2001 in 82 countries, including LDCs, developing countries and high-income countries (see Vawda, 2022).

³⁷ Medicines Law and Policy, "The TRIPS Flexibilities Database" <http://tripsflexibilities.medicineslawandpolicy.org/>.

protection levels in LDCs, including compared to other countries that have similar characteristics to LDCs, but have not enjoyed the LDC TRIPS Waiver.

Besides, one could question whether all LDC Members of the WTO benefit equally from the LDC-specific flexibilities in the TRIPS Agreement. In fact, two main factors may contribute to explaining how differently LDC-specific TRIPS flexibilities have affected IPR protection levels in LDC Members of the WTO. These factors are the membership in the WTO, notably the duration of this membership, and the level of 'minor' innovation (or imitation) in LDCs.

2.3. Does the WTO membership duration matter?

Yet, LDC-specific flexibilities embedded in the TRIPS Agreement apply to all LDC Members of the WTO, but it is unlikely that all WTO LDC Members benefit equally from the TRIPS flexibilities in terms the changes in their IPR protection level. The question raised in this sub-section is whether the effect of the LDC TRIPS Waiver on IPR protection level is the same for longstanding WTO LDC Members and for relatively new WTO Members. Thus, we first discuss the effect of the duration of membership in the GATT³⁸/WTO on the IPR levels, and question whether the effect of the LDC TRIPS Waiver on LDCs' IPR protection levels depends on the LDCs' duration of membership in the WTO.

Works on the effect of the membership in the WTO on IPR protection are not abundant. These studies are less relevant here since the present analysis focuses only on LDC Members of WTO, as they are only those entitled to LDC-specific flexibilities in the TRIPS Agreement. However, these works provide guidance for the analysis of the effect of the membership duration in the WTO on LDCs' IPR protection levels, insofar as such a membership duration (which is in fact the duration of membership since the creation of the GATT) encapsulates both the membership in the organization, and the time spent since a country has joined it.

Jandhyala (2015) has argued and provided empirical support for the argument that member states' commitments to the WTO (considered as external pressures on their IPR protection) lead to a higher intellectual property protection, although countries' domestic characteristics influence differently the effect of these commitments on countries' IPR protection levels. In the same vein, Cardwell and Ghazalian (2012) have shown that the TRIPS Agreement has been successful in coercing WTO member states to strengthen their IPR protection. Both studies, therefore, convey the message that the membership in the WTO has resulted in greater IPR protection levels. However, it is not clear whether WTO Members tend to increase their IPR protection levels over years. In other words, these findings do not allow us to infer that the duration of the membership in the WTO (and more generally in the GATT/WTO) is positively associated with the IPR protection. In fact, this could be the case. We put forth two main arguments to justify it. First, in a recent study, Dutt (2020) has provided empirical evidence that the GATT/WTO membership exerts a strong positive effect on bilateral trade, and the magnitude of this positive increases almost monotonically with years of membership. Moreover, and interestingly, these positive effects of the membership in the WTO exceed the positive trade effects of preferential trade agreements over the long term. In particular, the positive long-term effects of WTO membership exceed those of bilateral and multilateral preferential trade agreements, but fall short of deep integration arrangements (customs union, common markets, and economic union). One implication of this

³⁸ The GATT (General Agreement on Tariffs and Trade) is the predecessor of the WTO.

analysis is clearly that the duration of the membership in the GATT/WTO exerts a positive effect on trade flows.

On the other hand, countries that enhance their participation in international trade face a greater competition that induces them to develop growth-promoting institutions, and to protect their interests better. As a result, these countries would adopt stronger IPR protection levels (e.g., Kanwar and Evenson, 2009). Furthermore, in addition to the positive effect of the membership in the WTO (through the TRIPS Agreement) on IPR protection (e.g., Cardwell and Ghazalian, 2012; Jandhyala, 2015), the participation³⁹ of developing countries (including LDCs) in bilateral and regional trade and investment agreements contribute to heightening IPR levels through the TRIPS-plus provisions (e.g., Campi and Dueñas, 2019; Maskus, 1997; Shadlen, 2005). In this context, it is likely that as the duration of membership in the WTO increases, countries would experience a higher level of IPR protection. Overall, one can expect that the duration of membership in the WTO (for any developing country member) would be positively associated with greater levels of IPR protection.

However, this assumption might not hold for LDCs. This is because these countries are mainly exporters of primary commodities (some of them like Bangladesh export 'light' manufactured products). The natural resource sector in developing countries, and particularly in LDCs is prone to rent-seeking behaviours of political elites, which could be detrimental to competition, weaken the domestic institutional framework, and ultimately hamper economic development (e.g., Ades and Di Tella 1999; Acemoglu et al., 2002; Jensen and Wantchekon 2004; Wick and Bulte, 2006). Thus, LDCs might not necessarily strengthen their IPR levels as their membership duration increases, insofar as they enjoy flexibilities in the TRIPS Agreement that allow them not to strengthen their IPR protection levels.

In light of the foregoing, we hypothesize that LDCs would not strengthen their IPR protection levels (or reduce their IPR protection levels) as the duration of their membership in the WTO increases (*hypothesis 3*). However, it is possible that as the membership duration increases, LDCs that are parties to bilateral and regional trade and investment agreements⁴⁰ that demand stronger IPR protection would experience higher IPR protection levels than those subject to lesser stringent IPR provisions in bilateral and regional trade and investment agreements, despite the existence of the TRIPS Waiver for those LDCs. Put differently, even though the membership duration exerts a negative effect on IPR protection levels in LDCs, it is possible that longstanding LDC WTO Members would experience a lower negative effect of their membership duration on their IPR protection levels than countries that have a relatively lower membership duration (i.e., relatively new WTO Members) (*hypothesis 4*). We will test both hypotheses later.

³⁹ The proliferation of regional trade agreements (involving both developed and developing countries) is, among other things, due to the slow progress of multilateral trade negotiations, under the ambit of the WTO.

⁴⁰ Mansfield and Reinhardt (2003) have shown that the GATT/WTO has played a major role in encouraging the formation of preferential trade agreements. In fact, entering into PTAs allows WTO member states to increase their bargaining power. PTAs provide WTO member states with insurance against conditions that would emerge within the GATT/WTO and threaten their economic interests. PTAs also allow them to have a greater voice in multilateral trade negotiations, and increase their market power. The incentive of a WTO member state to join a PTA also lies on the fact that if this member state finds itself in a GATT/WTO dispute, third parties of the PTA can help it improve its leverage in the conflict, or seek to obtain from third parties countervailing market access, insurance against future failures to enforce GATT/WTO rules, or additional bargaining power.

2.4. Does the export variety-based innovation matter?

In its narrower sense, innovation refers to instances when firms introduce for the very first time products or production processes that are new to the world. However, this definition of innovation may not be appropriate for LDCs where technological capabilities are developed mainly through learning⁴¹ and not by pushing further the global knowledge frontier. For developing countries, and particularly LDCs, creative technological innovation may arise from the introduction of products, services and processes that are yet new to a country or to an individual firm, but not necessarily totally new to the world (e.g., Nelson and Rosenberg, 1993; OECD, 2005; OECD/Eurostat, 2018; UNCTAD, 2007). Thus, an innovation may arise in LDCs because some firms imitate a pioneering firm by introducing 'minor' improvements in or adaptations to improve a product or a production process. From that perspective, one could consider that in least developed economies, innovation arises from 'creative imitation' and 'commercialization of inventions' (UNCTAD, 2007). Many studies support the view that innovation in poor countries is mainly driven by imitation (e.g., Correa, 2003; Chu et al. 2014; Goldberg and Pavcnik, 2007; Madsen et al., 2010). For example, Correa (2003) has observed that patenting is rarely prevalent among small and medium enterprises in LDCs, as these firms tend to protect their innovations through informal means such as trade secrets, trust and contracts. Gehl Sampath (2007) has using data from a survey over the period from October 2006 to May 2007 to explore the effect of IPR protection on innovation's⁴² incentives in firms operating in three domestic processing sectors in Bangladesh. The sectors include agro-processing, textiles and garments sectors (i.e., low-technology sectors), and the pharmaceutical sector (i.e., a patent-intensive high-technology sector). He has observed a very weak innovative capacity within local firms across the three sectors. Innovation arises essentially from firms' own indigenous innovation efforts, and imitation and copying from others. Moreover, IPR protection strengthening does not provide incentives for local firms' innovation, but instead of innovation by multinational firms that operate in the country. He has concluded that in Bangladesh, the strengthening of IPR protection is unlikely to be appropriate for the types of incremental innovations in which most firms are involved. This is particularly owe to the fact that many creative activities in LDCs fall outside the ambit of IPR regimes of developed economies (e.g., Chander and Sunder, 2004; Dreyfuss, 2010; Gathii, 2016). Against this backdrop, standard indicators of technological development, i.e., innovation such as the number of scientific and engineering journal articles, R&D expenditure, would not be appropriate measures for innovation in LDC economies, as such indicators are much more relevant for developed nations than for developing countries, let alone LDCs (e.g., James, 2006).

In light of this, the present analysis uses indicators of innovation-driven export variety to measure innovation in LDCs. These are the indicator of export product diversification, and alternatively the indicator of economic complexity (see Sweet and Maggio⁴³, 2015). The rationale for the use of these indicators is as follows. It is now well established in the literature that innovation is critical for the expansion of export product varieties, including the diversification of

⁴¹ This requires the acquisition, diffusion and upgrading of existing technologies in technologically developed nations.

⁴² The study has considered innovation in a large sense, that is, involving *incremental innovations that range from small changes in process technologies that lead to significant improvements in production methods, to new organizational techniques that lead to improved delivery efficiency for existing products or to the production of new technologically improved products. Innovation was measured by the number of new product and process developments applied by the firms in the past five years. Hence, innovation has been measured by the number of new product and process developments applied by the firms in the past five years* (Gehl Sampath, 2007).

⁴³ According to Sweet and Maggio (2015), a country's degree of economic complexity reflects strongly its innovation level.

export products, and the export of sophisticated products (e.g., Chen, 2013; Cirera et al., 2015; Greenhalgh, 1990; Hidalgo, 2022; Maurya and Sahu, 2022; Parteka, 2020; Sweet and Maggio, 2015). LDCs are characterized by a very high degree of export product concentration on primary commodities (WTO, 2022b), and have very low levels of economic complexity⁴⁴. This is one of the reasons underlying the WTO LDC Members' requests for a general transition period concerning the implementation of the TRIPS rules. However, not all LDCs have the same level of export product concentration (WTO, 2022b) or the same level of economic complexity. Some LDCs have a relatively more diversified export product basket (toward light manufacturing products such as garments and textile) than others that still rely heavily on primary commodities for their product exports (WTO, 2022b). This difference in export product diversification levels among LDCs can reflect different imitation capabilities.

We formulate the hypothesis that a higher degree of export product concentration in LDCs would be associated with a lower level of IPR protection, given that imitation in these countries would lead governments to adopt a weak protection of IPRs, with a view to diversifying export products. Thus, among LDCs, those with a relatively low level of export product concentration could experience a higher level of IPR protection (*hypothesis 5*), notably in the post-TRIPS period compared to the pre-TRIPS period (*hypothesis 6*). Likewise, even though LDCs' levels of economic complexity are very low, it is possible that relatively more complex LDC economies likely experience a lower degree of IPR protection than relatively less complex ones (*hypothesis 7*), notably in the post-TRIPS period compared to the pre-TRIPS period (*hypothesis 8*).

3. Model specification

To test the hypotheses set out above, we consider a baseline model specification that contains a set of control variables, in addition to our main variable of interest that captures the effect of the LDC TRIPS Waiver on the level of IP protection in LDCs, and the indicators capturing respectively the duration of membership in the WTO, and the level of minor innovation. These control variables are derived from existing works on the determinants of IP protection levels (e.g., Cardwell and Ghazalian, 2012; Campi and Nuvolari, 2021; Cook and Liu, 2016; Ginarte and Park, 1997; Jandhyala, 2014; Kanwar and Evenson, 2009; Lerner, 2002; Marron and Steel, 2000; Shadlen et al., 2005). Controls include the real per capita income (as a proxy for the development level), the level of export product concentration (and alternatively the economic complexity level), the duration of membership in the WTO, and the level of economic freedom.

Also, many studies (see those cited above) have pointed to the significant role of human capital resources in the strengthening of IPR protection. However, given that LDCs are highly dependent on development aid (i.e., the official development assistance) for financing their development goals, including the accumulation of human capital (education and health), we refrain from including an indicator of human capital in the baseline model, and mainly use the variable capturing total development aid in the analysis. Another justification of the use of development aid in the analysis is that part of this aid is allocated for technical cooperation (through financial and technical assistance) provided by developed countries to LDCs, as envisaged in Article 67 of the TRIPS

⁴⁴ The economic complexity reflects the diversity and sophistication of a country's export structure, and hence indicates the diversity and ubiquity of that country's export structure (e.g., Hausmann and Hidalgo, 2009). An economy is deemed 'complex' if it exports a wide variety of goods that cannot be easily reproduced by other countries (i.e., it have a low ubiquity).

Agreement. Nevertheless, as we will see later, we replace the indicator of development aid with that of human capital⁴⁵, for robustness check analysis.

In general, a higher real per capita income is associated with a higher protection of IP level (e.g., Ginarte and Park, 1997; Jandhyala, 2014; Kanwar and Evenson, 2009; Lerner, 2002; Marron and Steel, 2000). For example, countries that enjoy an increase in their income have greater resources to build better administrative bureaucracies, enhance the skills of personnel, have better access to information, and improve civil service. All these contribute to ensuring the monitoring, implementation and IPR protection (Marron and Steel, 2000). However, given the prevalent financial and human resources constraints in LDCs, an increase in the real per capita income may not result in a higher level of IP protection, insofar as LDCs benefit from specific flexibilities in the TRIPS Agreement. Likewise, an improvement in economic freedom reflects the existence of political consensus and/or decision making apparatus to implement the requisite institutions such as intellectual property laws (e.g., Kanwar and Evenson, 2009). We expect that an improvement in economic freedom will lead to a greater protection of IPR.

We consider the following model specification:

$$IPR_{it} = \alpha_0 + \alpha_1[(LDC_i) * (TRIPS)_t] + \alpha_2LDC_i + \alpha_3TRIPS_t + \alpha_4EPC_{it} + \alpha_5DUR_{it} + \alpha_6Log(GDPC)_{it} + \alpha_7Log(ODA)_{it} + \alpha_8EFI_{it} + \alpha_9TREND_t + \mu_i + \epsilon_{it} \quad (1)$$

The subscripts i and t stand respectively for a country, and a time-period. The panel dataset is unbalanced and covers 24 LDCs (the treatment group), along with two control groups. The first control group (denoted "CG1") is our main control group in the analysis, and includes countries that had not been in the LDC category, but would not have met the criteria for graduating from the LDC category if they were included in that category (see Klasen et al., 2021: p164). There are 15 countries in the control group CG1. The second control group (denoted "CG2") is used for robustness check, and contains 9 LICs, which are not LDCs but are eligible to the PRGF of the IMF (see IMF, 2022: p57). The panel dataset covers sub-periods over the entire period from 1970 to 2015.

The parameters α_0 to α_9 will be estimated. The source of the variables contained in the baseline model (1) are described in Appendix 1. The standard descriptive related to these variables are displayed in Appendices 2a, 2b, and 2c respectively for the treatment group (i.e., LDCs), the control group CG1, and the control group CG2. The lists of countries contained in each of these groups are provided in Appendix 3.

The dependent "IPR" is the measure of the degree of strength of intellectual property rights. While there is a wide range of intellectual property instruments (e.g., patents, copyrights, trademarks), there is a consensus that in practice, the major differences in intellectual property protection among nations reside in the sphere of patents (e.g., Kanswar and Evenson, 2009). We, therefore, follow the extant literature, and use an index of patent rights as the indicator of IPR protection level in the present study. In particular, we measure the indicator "IPR" by means of the widely used index of patent rights drawn from Park (2008) (see also Park and Wagh, 2002)

⁴⁵ As we will see later, data on human capital cover a lower number of countries in the sample of LDCs (already relatively limited) used in the present analysis.

who updated the index constructed by Ginarte and Park (1997). The Index is based on patentee rights, and comprises five components, each component's score varying between 0 and 1. These include the duration of patent protection relative to the international standard; the subject matter that is patentable (or not unpatentable); the participation in international Intellectual Property Rights agreements; the enforcement mechanisms available; and how limited (or less restricted) the patenting exceptions are (such as any requirement to practice the invention or license the patents to third parties). The score of the overall index of patent protection varies from 0 to 5, with higher numbers reflecting strong levels of patent rights. Data on the indicator "IPR" is available every five years, and covers in the present analysis the years 1975; 1980; 1985; 1990; 1995; 2000; 2005; 2010; and 2015.

The variable "LDC" in model (1) is a dummy indicator that captures LDCs, i.e., the treatment group. It takes the value of "1" for LDCs, and the value of "0" for countries in the control groups, either CG1 or CG2.

The variable "TRIPS" captures the years of the implementation of the TRIPS Agreement, i.e., the years during which LDCs have enjoyed the LDC-specific TRIPS flexibilities, especially the general transition period for the implementation of TRIPS rules. This is a dummy indicator that takes the value of 1 from 1995 onwards, and the value of "0" for the preceding period. In other words, the dummy variable "TRIPS" takes the value 1 (from 1995), i.e., from the sub-period 1995-1999 to the sub-period 2010-2014, and the value of 0 for the preceding sub-periods, which are 1970-1974; 1975-1979; 1980-1984; 1985-1989 and 1990-1994. As the TRIPS Agreement is a multilateral Agreement (i.e., adopted by all WTO Members and not by only developing or developed Members, let alone LDC Members), it is unlikely that the reverse causality from the level of IPR protection to LDC TRIPS Waiver prevails. Therefore, the variable "TRIPS" is considered as exogenous in model (1).

The interaction variable "LDC*TRIPS" in model (1) is the interaction between the dummy "TRIPS" and the dummy "LDC", the latter taking the value of 1 for LDCs, and 0, for countries in the control group (control group 1 or control group 2). We label this interaction variable "DiD" in the regression Tables: $DiD = (LDC_i) * (TRIPS)_t$. The coefficient of this variable (i.e., α_1) is our main coefficient of interest in the analysis, and represents the causal effect of the LDC-specific TRIPS flexibilities on the IPR protection level in LDCs. It measures the difference-in-difference effect between control countries (countries in CG1 or CG2) pre-and-post-TRIPS Agreement, and treated countries (LDCs) pre-and-post-TRIPS Agreement. The above-mentioned exogeneity of the variable "TRIPS" implies that the interaction variable "DiD" is also exogenous.

The variable "DUR" is the indicator of the duration of membership in the GATT/WTO. It represents, for a given country and in a given year, the time that has elapsed since that country has joined the GATT or the WTO. The indicator has been computed taking into account the month (in a given year) in which a given country has joined the GATT or WTO. For example, if country A and B have joined the GATT respectively in June 1990 and September 1990, the variable "DUR" takes the value of 0.5 for country A in the year 1990, and the value of 0.333 (= 4/12) for country B in the year 1990. The value of the indicator "DUR" is then incremented by 1 for every additional year of the GATT/WTO membership until the last year of the period under analysis. Taking into account the month during which a country has joined the GATT or the WTO allows ensuring a difference in the membership duration among countries that have joined the organization in the same year. It is important to note that there are no substantial qualitative differences in terms of

empirical results when we attributed the value of 1 to the indicator "DUR" for the first year of membership in the GATT/WTO for two or many countries that have joined the GATT or the WTO the same year.

The variable "EPC" represents the overall export product concentration. It is calculated using the Theil index and following the definitions and methods used in Cadot et al. (2011). The overall Theil index of export product concentration is the sum of the intensive and extensive components of the "EPC" variable. Indeed, export product diversification can occur either over product narrowly defined or trading partners. It can be broken down into the extensive and intensive margins of concentration. Extensive export product diversification reflects an increase in the number of export products or trading partners, while intensive export product diversification considers the shares of export volumes across active products or trading partners. This index has been computed using a classification of products into "Traditional", "New", or "Non-Traded" products categories. Higher values of "EPC" signifies an increase in the level of overall export product concentration, while lower values of this index indicate a rise in the degree of overall export product diversification (that is, greater export product diversification).

In the empirical analysis carried out later, we replace the indicator of overall export product concentration with its two main components, namely export product concentration at the intensive margins (denoted "EPCINT"), and export product concentration at the extensive margins (denoted "EPCEXT"). "EPCINT" is the Theil index of export product concentration at the intensive margins. Higher values of this index indicate a rise in the level of export product concentration at the intensive margins, while declining values of this index reflect lower levels of concentration at the intensive margins, i.e., greater diversification of export product at the intensive margins. "EPCEXT" is the Theil index of export product concentration at the extensive margins. Higher values of this index indicate greater export product concentration at the extensive margins, while declining values of this index reflect a lower concentration at the extensive margins, i.e., greater diversification of export product at the extensive margins.

As indicated in section 2.4, an alternative indicator to the overall export product concentration as a measure of export variety-based innovation is the indicator of economic complexity, denoted "ECI". As noted above, it reflects the diversity and sophistication of a country's export structure, and hence indicates the diversity and ubiquity of that country's export structure. It has been estimated using data connecting countries to the products they export, and applying the methodology in described in Hausmann and Hidalgo (2009). Higher values of this index reflect a higher degree of economic complexity.

The variable capturing the real per capita income is denoted "GDPC", expressed in constant 2015 US dollar. The variable "ODA" is the real net disbursements of total Official Development Assistance (ODA), expressed in constant prices 2020, US dollar. To limit the skewed distributions of these two variables, we have logged them, using the natural logarithm.

The variable "EFI" is the index of economic freedom. It summarizes five major areas of economic freedom, including the size of government, the legal system and security of property rights; the sound money (access to finance); the freedom to trade internationally; and the regulation of credit, labour and business markets. The values of this indicator range between 0 and 10, with higher values indicating greater economic freedom.

Finally, as indicated above, we have replaced the variable measuring the overall development assistance with the indicator of human capital, notably the one of Barro and Lee (2013), denoted

"HUM". It represents the average years of total schooling for the population aging between 15 and 64.

Data on the indicator of the economic freedom index and human capital are available only every five years, which are 1970; 1975; 1980; 1985; 1990; 1995; 2000; 2005; 2010; and 2015.

Data on all other control variables, including "DUR", "EPC", "GDPC" and "ODA" are available over the sub-periods 1970-1974; 1975-1979; 1980-1984; 1985-1989; 1990-1994; 1995-1999; 2000-2004; 2005-2009, and 2010-2014. Using these sub-periods allows making these five variables exogenous with regard to the dependent variable "IPR", that is, we significantly limit the reverse causality problem between these regressors and the dependent variable. Hence, in our empirical analysis, we will, for example, be examining the effect of the membership duration (or export product concentration) in let us say, 1970-1974 on the level of IPR protection in 1975.

4. Empirical approach

In this section, we first assess the validity of the Difference-in-Difference framework for the empirical analysis (sub-section 4.1). We, then, present the econometric approach used to estimate the baseline model (1) or the different variants of this model utilized to test the various hypotheses set out in section 2.

4.1. Testing the validity of the Difference-in-Difference approach

The reliability of the analysis carried out in the Difference-in-Differences framework to uncover the causal effect of the LDC TRIPS Waiver on LDCs' level of IPR, hinges on the strong assumption of parallel trends between the average level of IPR of the treatment group (i.e., LDCs) and the average level of IPR in countries of each control group (CG1, and CG2) in the pre-treatment period, i.e., before the entry into force of the TRIPS Agreement. Thus, this assumption requires that the average outcomes of treated units and control units follow parallel trends over time in the absence of the intervention, i.e., prior to the implementation of the TRIPS Agreement (Abadie, 2005). Fredriksson and Oliveira (2019) have argued that this assumption is fundamentally untestable since the treatment group is only observed as treated. Wing et al. (2018, p. 459) has argued that while a visual plot may precede a statistical test of the parallel trends assumption, it is less compelling, especially when the data are noisy or when the time series is short. This is simply because in these instances, it becomes hard to separate statistical noise from genuine deviations from the common trends.

Mora and Reggio (2012, 2015, 2017) have developed a 'common pre-dynamics test' to test the parallel trends assumption. This statistical test consists of examining the existence of common pre-treatment dynamics in the treatment group (i.e., LDCs) and the control group (Mora and Reggio, 2015). The null hypothesis of the test is the presence of common dynamics and equal dynamic effects in the treatment group and control group before the treatment, that is, here, before the entry into force of the TRIPS Agreement. In the present analysis, we implement the test proposed by Mora and Reggio (2012, 2015, 2017). But before implementing this test, we provide a first insight into the development of the average index of the strength of intellectual property protection in the group of LDCs and each of the two control groups CG1 and CG2 (see Figure 1). Figure 1 shows that there exist strong parallel movements of the average IPR level of LDCs with the average IPR level of countries in CG1 and CG2 before 1995 (year of entry into force of

the TRIPS Agreement). While the average IPR levels in CG1 and CG2 were quite similar between 1975 and 1995, LDCs' average IPR level over the same sub-period was slightly higher than those of countries in CG1 and CG2. However, after 1995, there was a divergence between the average LDCs' average IPR level and those of countries in the control groups CG1 and CG2 (the average IPR levels of countries in these two control groups remained very similar from 1995 to 2015). More specifically, LDCs experienced a lower IPR level compared to countries in CG1 and CG2. This divergence of the average IPR levels between LDCs and countries in the control groups may be explained by the LDC-specific flexibilities in the TRIPS Agreement that allowed them to reduce their IPR protection level compared to other developing countries, including those in CG1 and CG2.

We now move on to carry out the statistical test proposed by Mora and Reggio (2012, 2015, 2017) to ascertain the validity of the Difference-in-Difference approach in the present study. The outcomes of this statistical test⁴⁶ carried out over the full sample that contains the treated group (i.e., LDCs) and countries in the control group CG1 indicate that the relevant statistic is equal to 0.3536, and the related p-value is equal to 0.986. The same test implemented over the full sample that comprises the LDCs and countries in the control group CG2, reveals a statistic equal to 0.128, and a p-value amounting to 0.998. On the basis of these outcomes, we conclude that we cannot reject the null hypothesis of common pre-treatment dynamics in the treatment group and each of the two control groups before the treatment. Therefore, the empirical analysis can be undertaken in the Difference-in-Difference framework.

4.2. Econometric approach

To begin with, we estimate model (1) using three standard estimators. The first estimator (which is our first main estimator in the empirical analysis) is the within fixed effects estimator (denoted "FE"). Standard errors of estimates are corrected for the problems of heteroscedasticity, autocorrelation and the correlation among countries in the error term, by means of the technique proposed by Driscoll and Kraay (1998). The second estimator is the random-effects Mundlak estimator (Mundlak, 1978), also termed the 'correlated random effects model'. In contrast with the within fixed effects estimator that accounts only for within country variations, the random-effects Mundlak estimator takes into account both the within-country effects and the between-country effects across countries under analysis. In the random-effects Mundlak model, the unobserved heterogeneity depends on the country-level time averages of regressors. It involves introducing the vector of time-averaged regressors in model (1), in order to control for time-invariant unobserved heterogeneity (between-country effects) in the regressions. Hence, the within effects estimates in the random-effects Mundlak (henceforth "REM") model will be measured by the parameters α_0 to α_9 in model (1), given that the between effects were already controlled for by the averages of regressors across years and per country in the REM-based model. The third estimator is the feasible generalized least squares (FGLS) estimator proposed by Zellner (1962) that allows to uncover more efficient estimates than the ones arising from the ordinary least squares, especially in the presence of heteroskedasticity, as well as serial and cross-sectional correlations (see also Bai et al., 2021).

⁴⁶ We have used the routine "didq" developed in the Stata software by Mora and Reggio (2015) to implement the test of parallel trends assumption proposed by Mora and Reggio (2012, 2017).

The FE, FGLS and REM estimators help uncover the average effect of a regressor on the dependent variable over the full sample, that is, the effect of a given regressor on the dependent variable at the mean of the conditional distribution of the dependent variable. Thus, this estimator does not provide a full picture concerning the effect of a given regressor (notably here, the TRIPS Waiver) on the dependent variable across the distribution of the dependent variable (i.e., here, the level of IPR strength) over the full sample. To capture this effect, we use the panel quantile regression approach, especially the Method of Moments Quantile Regression (MMQR) with fixed effects approach (also known as "Quantile via Moments") developed by Machado and Santos Silva (2019). Like other panel quantile approaches (e.g., Canay, 2011; Koenker, 2004), the MMQR approach (which is our second main estimator in the analysis) helps handle the problems of heteroscedasticity and outliers, and does not rely on conditional means, that is, it allows obtaining the effect of the LDC TRIPS Waiver on the level of IPR strength at different quantiles of the distribution function of the indicator of IPR protection. But, the MMQR approach has many advantages over the other panel quantile regression approaches (e.g., Canay, 2011; Koenker, 2004). First, it allows the effects of countries' time-invariant characteristics to vary across different quantiles of the conditional distribution of the dependent variable (here, the level of IPR strength), and hence departs from standard panel quantile approaches based on the ordinary least squares fixed effects estimator where countries' fixed effects represent location (intercept) shifters (e.g., Heckman et al., 1997). Second, it relies on the method of moments, which allows it to handle endogeneity concerns, i.e., to deal appropriately with the endogenous regressors in the model estimated. Thus, in the present analysis, the use of the MMQR is instrumental in dispelling any doubts about the endogeneity of some regressors, including for example, export product concentration, economic complexity, development aid, and the real per capita income.

We obtain the conditional quantiles for IPR level using the following panel quantile function:

$Q_{IPR_{it}}(\tau/X_{it}) = [(\mu_i + \delta_i q(\tau)) + X_{it}\beta + Z_{it}\gamma q(\tau)]$ (2), where the scalar parameter $\mu_i(\tau) = \mu_i + \delta_i q(\tau)$ indicates the quantile- τ fixed effects for individual country i , or the distributional effect at τ . It captures the time-invariant effect of individual country characteristics that potentially vary depending on where a country lies in the conditional distribution of IPR level. The individual time-invariant (i.e., fixed) effects in the MMQR approach do not represent location (intercept) shifts (as in the ordinary least squares fixed effects approach), but are time-invariant unobserved individual characteristics that have varying effects on the conditional distribution of IPR_{it} (i.e., they have heterogenous impacts across different quantiles of the conditional distribution of IPR_{it}).

From equation (2), the conditional quantile function of the level of IPR $q(\tau)$ (i.e., the τ -th quantile) based on the MMQR approach, is obtained from the optimization of the following function:

$$\min_q \sum_i \sum_t \theta_\tau(\hat{R}_{it} - (\hat{R}_{it} + Z'_{it} \hat{\gamma})q) \quad (3),$$

where the check function $\theta_\tau(A) = (\tau - 1)AI\{A \leq 0\} + \tau AI\{A > 0\}$ is the standard quantile loss function.

In the present work, we use the MMQR approach of Machado and Santos Silva (2019) to estimate empirically⁴⁷ the effect of the LDC TRIPS Waiver on the level of IPR protection across the conditional distribution of the IPR level, for 10 quantiles, including Q10th (i.e., the 10th quantile), Q20th, Q30th, Q40th, Q50th, Q60th, Q70th, Q80th and Q90th (i.e., the 90th quantile).

To test hypotheses 1 to 8, we estimate various specifications of model (1), using the FE, FGLS and REM estimators, and various specifications of model (2) by means of the MMQR approach. We describe here these different specifications of models (1) and (2). Note that all regressions are performed over two types of the full sample. The first full sample contains countries in the treatment group (LDCs) and countries in the control group CG1. The second full sample includes countries in the treatment group and countries in the control group CG2.

We, first, use the FEDK, REM and FGLS estimators to estimate model (1) as it stands. The outcomes of these estimations help test hypothesis 1 (or alternatively hypothesis 2) (which relates to the effect of the TRIPS Waiver on LDCs' IPR levels), as well as hypothesis 3 (concerning the effect of the duration of membership in the WTO on IPR levels), hypothesis 5 (which relates to the effect of export product concentration on IPR levels) and hypothesis 7 (which concerns the effect of economic complexity on IPR levels). These outcomes are presented in Table 1. As we will see below, the estimates obtained when using the FEDK and REM estimators are very similar. This is why the other specifications of model (1) are estimated using the FE estimator.

Second, we use the FE estimator to test hypothesis 4, which concerns the extent to which the membership duration in the WTO influences the effect of the TRIPS Waiver on IPR levels in LDCs. To that effect, we estimate a specification of model (1) that contains the interaction between the variables "DUR" and "DiD". The outcomes arising from this estimation are reported in Table 2.

Third, we use the FE estimator to test hypotheses 6 and 8, that is, whether (and if so the extent to which) the effect of the TRIPS Waiver on IPR levels in LDCs depends on the LDCs levels of export product concentration, and alternatively their levels of economic complexity. Here, we estimate several variants of model (1). To test hypothesis 6, the specifications of model (1) estimated include the interaction variable between the index of the overall export product concentration (or each of the two components of this indicator) and the variable "DiD". The specification of model (1) used to test hypothesis 8 is model (1) in which we introduce the interaction between the index of economic complexity⁴⁸ and the variable "DiD". The estimates obtained are provided in Table 3.

Fourth, results reported in Table 4 are obtained by estimating model (2) by means of the MMQR approach. These outcomes allow testing hypothesis 1 (or alternatively hypothesis 2) (as for results in Table 1), hypothesis 3, hypothesis 5 and hypothesis 7.

Fifth, outcomes displayed in Table 5 are obtained by using the MMQR approach to estimate variants of model (2) in order to test hypotheses 6 and 8 (as it was the case for outcomes presented in Table 3 using specifications of model (1)).

It is important to note that estimates reported in Tables 4 and 5 are essentially those relating to the interaction variables and the regressors used to construct the interaction variables. Results

⁴⁷ A routine (`mmqreg`) in the Stata software has been developed by Rios-Avila (2020) to estimate quantile regressions via the Quantile via Moments approach of Machado and Santos Silva (2019).

⁴⁸ Note here that data limitation on the index of economic complexity has resulted in the lost of many observations when we performed the regressions over each of the above-mentioned full samples.

concerning other control variables have not been reported in order to save space, and could be obtained upon request.

5. Empirical results

Starting with outcomes reported in Table 1, we note on the one hand that estimates in columns [1] and [2] are quite similar, and on the other hand, that coefficients in columns [7] and [8] are also quite similar. These outcomes suggest strong similarities between results obtained using the FE and the REM estimators. This is why in the other columns of the Table, we have reported essentially results based on the FE estimator. Interestingly, we observe that across all columns of the Table, the coefficients of the variable "DiD" are negative and significant at the 1% level, although not necessarily of the same magnitudes. In particular, results based on the FGLS estimator are lower in absolute value than those based on the FE and REM estimators (see columns 3 and 9). These outcomes lend support for hypothesis 1 (at the detriment to hypothesis 2). We conclude that the LDC TRIPS Waiver was instrumental in reducing the IPR protection levels in LDCs. Results in columns [1] and [2] of Table 1 (those that are obtained when using the full sample that contain LDCs and countries in CG1) suggest that in the post-TRIPS period compared to the pre-TRIPS period, LDCs experienced a fall in their IPR levels by 0.645 point, including relatively to countries in the control group CG1. Likewise, estimates in columns [7] and [8] of Table 1 (those obtained when using the full sample that contain LDCs and countries in CG2) indicate that in the post-TRIPS period compared to the pre-TRIPS period, IPR protection levels in LDCs declined by 0.721 point relatively to the IPR levels of countries in the control group CG2. For the interpretation of estimates related to control variables in Table 1, we focus essentially on those obtained using the FE estimator, which to recall, is our first main estimator.

Regarding the estimates of control variables in Table 1, we find that an increase in the level of the overall export product concentration is associated with a reduced level of IPR protection, at the 1% level (see columns [1], [6], [7] and [12]). This finding is confirmed when we consider the components of the overall export product concentration (see columns [4] and [10]). A higher degree of export product concentration at the intensive margins or at the extensive margins affects negatively and significantly (at the 1% level) the level of IPR. These findings support hypothesis 5. Interestingly, export product concentration at the extensive margins exerts a larger negative effect on the IPR protection level than export product concentration at the intensive margins does. At the same time, economic complexity does not affect significantly (at the 10% level) the IPR protection level (see columns [4] and [8]). The difference between the economic complexity related outcomes and the ones obtained with the indicators of export product concentration lies on the fact that the concept of 'economic complexity' is more encompassing than that of 'export product diversification' in the sense that for an economy to become complex, it should not only enjoy a greater level of export product diversification, but that the knowledge embedded (innovation) in the exported products should be such that those products could not be easily reproduceable by other countries. These outcomes do not really support hypothesis 7. It is important to emphasize that fewer observations are available when using the economic complexity indicator in the regressions than when using the indicators of export product concentration.

The duration of membership in the WTO is negatively and significantly associated (mostly at the 1% level) with lower IPR levels (see all columns of results based on the FE estimator). This finding confirms hypothesis 3, and indicates that longstanding WTO Members tend to reduce to

a greater extent their IPR protection levels than relatively new WTO Members. However, as we will see later, this does not imply that this finding holds in the post-TRIPS period versus the pre-TRIPS period. Development aid affects significantly (at the 10% level) the IPR level. We also notice from columns [6] and [12] of the Table that when we replace the indicator of human capital with the indicator of development aid in model (1), we lose many countries⁴⁹ (for example we lose six countries from the full sample of LDCs + CG1). At the same time, we observe a negative and significant effect (at least at the 5% level) of human capital on the level of IPR. This signifies that as countries accumulate the human capital, they tend to relax their IPR protection level, possibly to encourage imitation and minor innovations, with a view to ultimately developing a viable technological base, as envisaged in the TRIPS Agreement.

Results obtained over the full sample of LDCs plus countries in CG1 suggest no significant effect of the economic freedom on the level of IPR protection (except for the outcome in column [5] where the coefficient of the economic freedom index is positive and significant at the 1% level). However, outcomes obtained when relying on the full sample of LDCs plus countries in CG2, tend to suggest, in line with our theoretical expectation, a positive and significant effect (at least at the 5% level) of economic freedom on the level of IPR (see columns [7] as well as [10] to [12]). Finally, countries tend to exhibit rising levels of IPR over time, as the coefficients of the trend indicator tend to be positive and significant at the 1% level.

We now take up estimates displayed in Table 2. To recall, these estimates were reported with a view to testing hypothesis 4. We find that the coefficients of the interaction variable ["DiD*DUR"] are positive and significant at the 1% level in the two columns of the Table, while the coefficients of the variable "DiD" are negative and significant at the 1% level in the two columns of the Table. These results clearly show that LDCs' duration of membership in the WTO influences the effect of the TRIPS Waiver on LDCs' IPR levels. Based on these outcomes, we can deduce that LDCs tend to increase their IPR protection levels as their WTO membership duration increases, especially when it exceeds 134.48 years ($= 0.901/0.00670$) (based on results in column [1]) and 139.2 years ($= 0.980/0.00704$) (based on results in column [2]). As the numbers '134.48 years' and '139.2 years' largely exceed LDCs' maximum duration of membership in the WTO (this maximum duration amounts to 64.5 - see Appendix 2a), **we conclude that while longstanding LDC Members of the WTO experienced lower IPR protection levels than relatively new LDC Members of the WTO, the TRIPS Waiver exerted a larger negative effect on IPR protection levels of relatively new LDC WTO Members than on the IPR protection levels of longstanding LDC Members of the WTO. These findings, therefore, lend support for hypothesis 4.**

Incidentally, in the two columns of Table 2, and in line with outcomes in Table 1, the overall export product concentration exerts a negative and significant effect (at the 1% level) on the IPR levels.

Outcomes in Table 3 allow testing hypotheses 6 and 8. Results in columns [1] and [2] (based on the full sample of LDCs + countries in CG1), and in columns [4] and [5] (based on the full sample of LDCs + countries in CG2) permit to test hypothesis 6. Estimates that allow testing

⁴⁹ For this reason, and given the critical role played by development aid in the accumulation of human capital in LDCs and LICs, we opted for pursuing the analysis by relying on the specifications of model (1) with development aid and not human capital.

hypothesis 8 are those displayed in column [3] (based on the full sample of LDCs + countries in CG1), and in column [6] (based on the full sample of LDCs + countries in CG2).

We observe that the coefficients of the variable "DiD" in columns [1] and [2] and in columns [4] and [5] are all negative and significant at the 1% level. In the same columns, the coefficients of the interaction variables between "DiD" and the indicators of export product concentration ("EPC", "EPCINT" and "EPCEXT") are all positive and significant at the 1% level. These results clearly show that LDCs' levels of export product concentration contribute to explaining the differences in their levels of IPR protection in the post-TRIPS period compared to the pre-TRIPS period. We can infer from these outcomes that the TRIPS Waiver was associated with higher levels of IPR protection in LDCs, as the latter experience higher levels of export product concentration, especially when the value of the latter exceeds a certain level. This turning point of the indicator of export product concentration above which the TRIPS Waiver resulted in higher IPR protection levels in LDCs amounts respectively to 8.5 ($= 1.268/0.149$) for results concerning the overall export product concentration in column [1]; 9.2 ($= 1.234/0.134$) for results concerning export product concentration at the intensive margins in column [2]; 6.9 ($= 1.234/0.179$) for results concerning export product concentration at the extensive margins in column [2]; 9.5 ($= 1.288/0.136$) for results concerning the overall export product concentration in column [4]; 10.2 ($= 1.251/0.123$) for results concerning export product concentration at the intensive margins in column [5] and 8.1 ($= 1.251/0.154$) for results concerning export product concentration at the extensive margins in column [5]. It appears from Appendix 2a that the maximum values of indicators of export product concentration are: 6.269 for the index of overall export product concentration, 5.854 for the index of export product concentration at the intensive margins, and 2.707 for the indicator of export product concentration at the extensive margins. All the turning points found above are higher than these maximum values of the indicators of export product concentration. We conclude that the TRIPS Waiver was always associated with lower IPR levels in LDCs, but this negative effect was lower (in magnitude) for LDCs with higher degrees of export product concentration than with those with relatively lower levels of export product concentration. In other words, **the LDC TRIPS Waiver had been associated with a larger reduction of IPR levels in LDCs that had higher degrees of export product diversification than in those with relatively lower levels of export product diversification.** These outcomes do not fully support hypothesis 6.

Results in columns [3] and [6] indicate that the coefficients of the variable "DiD" are at best significant at the 10% level, while the coefficients of the interaction variable ["DiD*ECI"] are positive and significant at the 1% level. We conclude that at the 5% level, the TRIPS Waiver was associated with an increase in IPR protection levels in LDCs, as these countries' levels of economic complexity improve: LDCs that enjoy lower degrees of economic complexity tended to strengthen lesser their IPR protection levels than LDCs that had higher levels of economic complexity, in the post-TRIP period compared to the pre-TRIPS period.

The outcomes concerning the control variables in Tables 2 and 3 align with those in Table 1.

Let us now consider estimates presented in Table 4. Note that here, outcomes are reported not only for the two types of full samples described above, but also when the specification of model (2) contains either the variables "EPC" or its two components or the variable "ECI". We find that in the entire Table, the location parameters related to the variable "DiD" (see column [1])

are negative and significant at the 1% level, while the scale parameters associated with the same variable are yet positive, but not statistically significant at the conventional significance levels. The combination of these two outcomes suggest that while the effect of the LDC TRIPS Waiver on the IPR protection levels was negative and significant, its scale diminished across all quantiles of the conditional distribution of IPR, from lower quantiles to upper quantiles. Specifically, we find that for the specification of model (2) with "EPC", the estimates associated with the variable "DiD" across all quantiles (i.e., in columns [3] to [11]) (for the full sample = LDCs + CG1) are not far higher than the mean average reported in column [1] of Table 1. Similarly, for the specification of model (2) with "EPC", over the full sample that includes LDCs and countries in CG2, the coefficients of "DiD" in columns [3] to [11] of Table 4 are not far higher than the mean average provided in column [7] of Table 1. The same conclusions apply when the specifications of model (2) include the components of "EPC" (in comparison with results in column [4] for the full sample = LDCs + CG1, and with outcomes in column [10] for the full sample = LDCs + CG2) or when they include the indicator of economic complexity (in comparison with results in column [5] for the full sample = LDCs + CG1, and with outcomes in column [11] for the full sample = LDCs + CG2).

All these outcomes confirm hypothesis 1 (at the expense of hypothesis 2) and suggest that regardless of whether we use the overall export product concentration (or its two components) or alternatively the indicator of economic complexity in specifications of model (2), the TRIPS Waiver had always affected negatively and significantly IPR protection levels in LDCs.

At the 5% level, export product concentration exerted a higher negative and significant effect on IPR protection levels in upper quantiles than in lower quantiles. This was the case for countries located in quantiles ranging from the 20th quantile to the 90th quantile of the conditional distribution of IPR, for results based on the full sample containing LDCs and countries in CG1. Similar outcomes are observed for countries located in quantiles ranging from the 50th quantile to the 90th quantile of the conditional distribution of the conditional distribution of IPR, when the full sample contains LDCs and countries in CG2. The same conclusions can be derived when we consider outcomes in Table 4 arising from estimating specifications of model (2) using the two types of the full sample mentioned above. It appears that at the 5% level, for results based on the full sample containing LDCs and countries in CG1, export product concentration at the intensive margins induced a negative effect on the IPR level for countries in the 50th to 90th quantiles, with the scale of this negative effect becoming larger as we move from the lower to the upper quantiles. At the same time, at the 5% level (and when the full sample contains LDCs + countries in CG1), export product concentration at the extensive margins exerted a significant (and negative effect) on IPR protection levels only for countries located in 30th to 50th quantiles, given that the effect is statistically nil at the 5% level for countries located in the other quantiles. At the 5% level, similar outcomes are found (when the full sample contains LDCs + countries in CG2) concerning the effect of export product concentration at the extensive margins on IPR protection levels for countries located in the 50th to 90th quantiles.

In general, no significant effect at the 5% level is found (when the full sample contains LDCs + countries in CG2) for the effect of export product concentration at the intensive margins on IPR levels, across quantiles of the distribution of IPR. Likewise, over the full sample that includes LDCs and countries in CG1, there is no significant effect of economic complexity on the IPR level across all quantiles, at the 5% level. But over the full sample comprising LDCs and countries in

CG2, this effect appears to be significant for countries situated in the 70th to 90th quantiles. Thus, for these countries, greater economic complexity was negatively associated with IPR protection levels, but the magnitude of this negative effect becomes larger as we move from the 70th to the 90th quantiles.

Summing-up, key messages conveyed by Table 4 are that the TRIPS Waiver had genuinely been instrumental in reducing IPR protection levels in LDCs, including across all quantiles of the distribution of IPR. LDCs with lower IPR protection levels (e.g., countries situated in lower quantiles) tend to experience the largest negative effect of the TRIPS Waiver on IPR levels. Also, the overall export product concentration (as a measure for innovation based on export variety) did not really affect IPR levels in LDCs that had the lowest levels of IPR protection (i.e., those located in the 10th quantile). In contrast, for other LDCs, especially those located in the 50th to the 90th quantiles of the distribution of IPR the overall export product concentration was associated with reduced IPR protection levels, regardless of whether we used CG1 or CG2 as control groups in the analysis: the higher the quantile, the larger was the negative effect of the overall export product concentration on IPR protection levels. Meanwhile, the effect of economic complexity (as an alternative measure for innovation based on export variety) on IPR levels across quantiles of the distribution of IPR is not clear-cut, and appears to be dependent on the type of control group used in the analysis. This effect was almost not significant when we relied on results based on the full sample that contains LDCs and countries in the control group CG1 (which to recall, was our main control group in the analysis). However, the effect was found to be negative and significant (for countries situated in the upper quantiles, that is, in the 70th to 90th quantiles) when we relied on the second full sample where the control group (CG2) contained rather a lower number of countries compared to CG1.

Results in Table 5 that allow testing hypotheses 6 and 8, show that across the entire Table, and regardless of whether CG1 or CG2 was used as control group, the location parameters associated with the interaction between the variable "DiD" and each of the three indicators of export product concentration are all positive and significant at the 1% level. At the same time, the scale parameters associated with these interaction variables are all negative but not significant at the conventional significance levels. These outcomes imply that the effect of the TRIPS Waiver on LDCs' IPR protection levels depended on LDCs' levels of export product concentration or economic complexity. In particular, this effect is positive and significant across almost all quantiles of the distribution of IPR, and its scale decreased as we moved from the lowest quantile (i.e., 10th quantile) to the highest quantile (i.e., 90th quantile). Regardless of the level of export product concentration or economic complexity in LDCs, the TRIPS Waiver was associated with a rise in the IPR levels of LDCs located in all quantiles, but the scale of this positive effect decreased from the lowest quantile to the highest quantile of the distribution of IPR. As the coefficient associated with the indicators of export product concentration in Table 5 are all negative and significant either at the 1% level (for most of them) or at the 5% level, we calculated for each quantile, the turning point of the relevant indicator of export product concentration (either "EPC", "EPCINT" or "EPCEXT") above which the effect of the TRIPS Waiver on LDCs' IPR levels became positive (as otherwise it would be negative). We obtained that these turning points were always higher than the maximum value of the relevant indicator of export product concentration. We, therefore, reach conclusions similar to the ones derived from the analysis of results in columns [1] and [2], and columns [4] and [5] of Table 3: **the TRIPS Waiver was associated with a larger reduction of**

IPR levels in LDCs that had higher degrees of export product diversification than in those with relatively lower levels of export product diversification. These negative effects on IPR protection levels were more pronounced in LDCs located in the lower quantiles than in LDCs located in relatively higher quantiles of the distribution of IPR.

As for the interaction variable ["DiD*ECI"] which is the interaction between the variable "DiD" and the indicator of economic complexity, we observe from Table 5 (see the bottom of this Table) that the location parameter and the scale parameter are positive and significant at the 1% level when the full sample containing LDCs and countries in CG2 was used. Results based on the full sample containing LDCs and countries in CG1 suggest that only the location parameter is significant (at the 1% level), as the scale parameter is not significant at the 10% level. While these outcomes suggest that the coefficients of the interaction variable ["DiD*ECI"] increase as we move from the lowest quantile to the highest quantile across the distribution of IPR, it appears that all these coefficients are significant, including at the 1% level when the full sample containing LDCs and countries in CG1 was used. For the second full sample, the coefficients that are significant at the 5% level are only those for countries located in the 60th to the 90th quantiles. Note at the same time that the coefficients of the variable "DiD" are not significant at the conventional significance levels across all quantiles when using the full sample containing LDCs and countries in CG1. For results based on the second full sample, the coefficients of the variable "DiD" are not significant for countries located in the 60th to the 90th quantiles. The main message conveyed by these outcomes (in support of hypothesis 8) is that **the TRIPS Waiver resulted in higher LDCs' IPR protection levels regardless of their level of economic complexity, but led to higher IPR protection levels in LDCs that endeavoured to improve their economic complexity levels than in those with relatively lower levels of economic complexity.**

6. Conclusion

Members of the World Trade Organization (WTO) have accorded many flexibilities to the LDCs in the WTO's Trade-Related Intellectual Property (TRIPS) Agreement. A major LDC-specific flexibility in this Agreement that other developing country Members of the WTO have not enjoyed, is the general transition period for the implementation of the TRIPS Agreement. This general transition period aims to help LDCs create a viable technological base. Another important LDC-specific flexibility in the TRIPS Agreement is the specific transition period that exempts LDCs from providing patent protection and undisclosed information for pharmaceutical products.

The present study investigated whether this LDC-specific Waiver in the TRIPS Agreement genuinely helped LDCs reduce their level of intellectual property rights (IPR), as expected. The analysis was carried out in the Difference-in-Difference framework, using with the within fixed effects and the 'Quantile via Moments' estimators. The panel dataset contains 24 LDCs (treatment group) and two control groups, over the period from 1970 to 2015. The first control group (the main one in the analysis) included 15 countries that had not been in the LDC category, but would not have met the criteria for graduating from the category of LDCs if they were included in the category. The second control group was used for robustness check, and contained 9 low-income countries that were not LDCs, but eligible to the Poverty Reduction and Growth Facility of the International Monetary Fund.

The empirical analysis has revealed that the TRIPS Waiver was instrumental in reducing LDCs' IPR levels. LDCs situated in the lower quantiles (i.e., those with lower IPR levels) enjoyed larger declines in IPR levels thanks to this Waiver than LDCs in the upper quantiles. Moreover, the effect of the TRIPS Waiver on LDCs' IPR levels appeared to depend on LDCs' duration of the membership in the WTO, as well as on their level of export variety driven innovation, measured by their level of export product concentration, or alternatively by their degree of economic complexity. In particular, the TRIPS Waiver exerted a larger negative effect on IPR levels of relatively new LDC WTO Members than on the IPR levels of longstanding LDC Members of the WTO. We also observe that when innovation is driven by a greater diversification of export products, the TRIPS Waiver also resulted in a greater reduction in IPR protection levels in LDCs. The IPR reduction effect of the Waiver was larger for LDCs with a greater level export product diversification than for those that experienced relatively lower levels of export product diversification. Concurrently, we found that the TRIPS Waiver led to an increase in IPR protection levels in LDCs situated in the upper quantiles of the distribution of IPR, and that endeavoured to improve their economic complexity: the higher the quantiles, the larger was the positive effect of the TRIPS Waiver on IPR protection levels.

These findings clearly show that the TRIPS Waiver has been fulfilling its objective (at least partially) of reducing IPR levels in LDCs, even though it did not affect equally all LDC Members of the WTO, given the heterogeneity of this group of countries. These outcomes can, therefore, justify additional requests by WTO LDC Members for the extension of the TRIPS Waiver for LDCs. Meanwhile, as LDCs have, sooner or later, to leave the LDC category, they should take the necessary steps to maximize the benefits of TRIPS Waiver in order to develop the requisite technological base for a diversification of their production structure. In view of their special needs and requirements as well as their economic, financial and administrative constraints, LDCs need to be assisted in this endeavour by the international community, including the donor-community.

References

- Abadie, A. (2005). Semiparametric difference-in-differences estimators. *Review of Economic Studies*, 72(1), 1-19.
- Acemoglu, D., Johnson, S., and Robinson, J.A. (2002). Reversal of fortune: Geography and institutions in the making of the modern world income distribution. *The Quarterly Journal of Economics* 117(4), 1231-1294.
- Ades, A., and Di Tella, R. (1999). Rents, competition, and corruption. *American Economic Review*, 89(4), 982-993.
- Allred, B.B., and Park, W.G. (2007). The influence of patent protection on firm innovation investment in manufacturing industries. *Journal of International Management*, 13 (2), 91-109.
- Amsden, A.H. (1989). *Asia's Next Giant: South Korea and Late Industrialization*. Oxford University Press, New York.
- Archibugi, D., and Filippetti, A. (2010). The Globalisation of Intellectual Property Rights: Four Learned Lessons and Four Theses. *Global Policy*, 1(2), 139-145.
- Auriol, E., Biancini, S., and Paillacar, R. (2023). Intellectual property rights protection and trade: An empirical analysis. *World Development*, 162, 106072.
- Azam, M. (2016). Has the TRIPS Waiver Helped the Least Developed Countries Progress Towards Innovation and Compliance? In *Intellectual Property and Public Health in the Developing World* (1st ed., pp. 239-280). Open Book Publishers.
- Bai, J., Choi, S.H., and Liao, Y. (2021). Feasible generalized least squares for panel data with cross-sectional and serial correlations. *Empirical Economics*, 60, 309-326.
- Barro, R., and Lee, J-W. (2013). A New Data Set of Educational Attainment in the World, 1950-2010. *Journal of Development Economics*, 104, 184-198.
- Biadgleng, E. T. and J.-C. Maur (2011). The Influence of Preferential Trade Agreements on the Implementation of Intellectual Property Rights in Developing Countries: A First Look. UNCTAD-ICTSD Project on IPRs and Sustainable Development Paper No. 33. Available at SSRN: <https://ssrn.com/abstract=1962832>.
- Briggs, K. (2013). Does patent harmonization impact the decision and volume of high technology trade? *International Review of Economics & Finance*, 25, 35-51.
- Cadot, O., Carrere, C., and Strauss-Kahn, V. (2011). Export Diversification: What's Behind the Hump? *Review of Economics and Statistics*, 93, 590-605.
- Campi, M., and Dueñas, M. (2019). Intellectual property rights, trade agreements, and international trade. *Research Policy*, 48(3), 531-545.

- Campi, M., and Nuvolari, A. (2021). Intellectual Property Rights and Agricultural Development: Evidence from a Worldwide Index of IPRs in Agriculture (1961-2018). *Journal of Development Studies*, 57(4), 650-668.
- Canay, I. A. (2011). A Simple Approach to Quantile Regression for Panel Data. *The Econometrics Journal*, 14(3), 368-386.
- Cardwell, R., and Ghazalian, P.L. (2012). The Effects of the TRIPS Agreement on International Protection of Intellectual Property Rights. *The International Trade Journal*, 26(1), 19-36.
- Chander, A., and Sunder, M. (2004). The Romance of the Public Domain, *California Law Review*, 92(5), 1331-1373.
- Chang, H.J. (2002). *Kicking Away the Ladder: Development Strategy in Historical Perspective*. Anthem Press, London.
- Chen, W.-C. (2013). The Extensive and Intensive Margins of Exports: The Role of Innovation. *The World Economy*, 36(5), 607-635.
- Chen, Y., and Puttitanun, T. (2005). Intellectual property rights and innovation in developing countries. *Journal of Development Economics*, 78(2), 474-493.
- Chu, A.C., Cozzi, G., and Galli, S. (2014). Stage-dependent intellectual property rights. *Journal of Development Economics*, 106, 239-249.
- Cirera, X., Marin, A., and Markwald, R. (2015). Explaining export diversification through firm innovation decisions: The case of Brazil. *Research Policy*, 44(10), 1962-1973.
- Cook, T.R., and Liu, A. H. (2016). Using Linguistic Networks to Explain Strength of Intellectual Property Rights. *World Development*, 87, 128-138.
- Correa, C. (2003). Do small and medium enterprises benefit from patent protection? In Pietrobelli, C. and Sverrisson, A. (eds.), *Linking Local and Global Economies: Organisation, Technology and Export Opportunities for SMEs*. Routledge, London and New York.
- Correa, C. (2000). *Intellectual Property Rights, the WTO and Developing Countries: The TRIPS Agreement and Policy Options*. London and New York: Zed Books.
- Correa, C. (2007). *Technology transfer and IPRs*. Study prepared as a background paper for The Least Developed Countries Report 2007, UNCTAD, Geneva.
- Dreyfuss, R.C. (2010). Does IP Need IP? Accommodating Intellectual Production Outside the Intellectual Property Paradigm, 31 *Cardozo Law Review*, 1437-1473.
- Driscoll, J. C., and Kraay, A.C. (1998). Consistent Covariance Matrix Estimation with Spatially Dependent Panel Data. *Review of Economics and Statistics*, 80(4), 549-560.
- Dutt, P. (2020). The WTO is not passé. *European Economic Review*, 128, 103507.

El Said, M. (2022). The Impact of ‘TRIPS-Plus’ Rules on the Use of TRIPS Flexibilities: Dealing with the Implementation Challenges. In: Access to Medicines and Vaccines - Implementing Flexibilities Under Intellectual Property Law. Edited by Correa, C.M., and Hilty, R.M. Published by the registered company Springer Nature Switzerland AG.

Finger, J. Michael, and P. Schuler. 1999. “Implementation of Uruguay Round Commitments: The Development Challenge.” Manuscript. World Bank, Washington, D.C.

Fredriksson, A. and Oliveira, G.M.D. (2019). Impact evaluation using Difference-in-Differences. RAUSP Management Journal, 54(4), 519-532.

Gathii, J.T. (2016). Strength in Intellectual Property Protection and Foreign Direct Investment Flows in Least Developed Countries, 44 GA. Journal of International & Comparative Law, 499-553.

Gehl Sampath, P. (2007). Intellectual property in least developed countries: pharmaceutical, agro-processing and textiles and RMG in Bangladesh. Study prepared for UNCTAD as a background paper for The Least Developed Countries Report 2007, UNCTAD, Geneva.

Ginarte, J.C., and Park, W.G. (1997). Determinants of Patent Rights: A Cross-national Study. Research Policy, 26, 283-301.

Gmeiner, R., and Gmeiner, M. (2021). Encouraging domestic innovation by protecting foreign intellectual property. International Review of Law and Economics, 67, 106000.

Goldberg, P. K. and Pavcnik, N. (2007). Distributional effects of globalization in developing countries. Journal of Economic Literature 45 (1), 39-82.

Greenhalgh, C. (1990). Innovation and trade performance in the United Kingdom. Economic Journal, 100(400), 105-118.

Gwartney, J., Lawson, R., Hall, J., Murphy, R., Djankov, S., and McMahon, F. (2022). Economic Freedom of the World 2022 Annual Report. The Fraser Institute, Vancouver, Canada.

Hausmann, R., and Hidalgo, C.A. (2009). The building blocks of economic complexity. Proceedings of the National Academy of Sciences, 106 (26), 10570-10575.

Heckman, J.J., Smith, j., and Clements, N. (1997). Making The Most Out of Programme Evaluations and Social Experiments: Accounting For Heterogeneity in Programme Impacts. Review of Economic Studies, 64(4), 487-535.

Henn, C., Papageorgiou, C., and Spatafora, N. (2013). Export quality in developing countries (IMF Working Paper 13/108). Washington, DC: International Monetary Fund (IMF).

Henn, C., Papageorgiou, C., and Spatafora, N. (2015). Export quality in advanced and developing economies: Evidence from a new dataset (WTO Working Paper, ERSD-2015-02). Geneva, Switzerland: World Trade Organization (WTO).

Hidalgo, C.A. (2022). The Policy Implications of Economic Complexity. arXiv:2205.02164, <https://doi.org/10.48550/arXiv.2205.02164>

Hudson, J., and Alexandru, M. (2013). Innovation, Intellectual Property Rights, and Economic Development: A Unified Empirical Investigation. *World Development*, 46, 66-78.

IMF (2022). *Macroeconomic Developments and Prospects In Low-Income Countries -2021*. IMF Policy Paper, International Monetary Fund, Washington, D.C.

James, J. (2006). An institutional critique of recent attempts to measure technological capabilities across countries. *Journal of Economic Issues*, 40 (3), 743-766.

Jandhyala, S. (2015). International and domestic dynamics of intellectual property protection. *Journal of World Business*, 50(2), 284-293.

Jensen, N., and Wantchekon, L. (2004). Resource wealth and political regimes in Africa. *Comparative Political Studies*, 37(7), 816-841.

Kanwar, S., and Evenson, R. (2009). On the strength of intellectual property protection that nations provide. *Journal of Development Economics*, 90(1), 50-56.

Kim, L. (1997). *Imitation to Innovation: The Dynamics of Korea's Technological Learning*. Harvard Business School Press, Boston.

Kim, L. (2003). Technology transfer and intellectual property rights: Lessons from Korea's experience. Issue Paper No. 2, UNCTAD-ICTSD project on IPRs and Sustainable Development, Geneva.

Kim, Y.K., Lee, K., Park, W.G., and Choo, K. (2012). Appropriate intellectual property protection and economic growth in countries at different levels of development. *Research Policy*, 41(2), 358-375.

Klasen, S., Martínez-Zarzoso, I., Nowak-Lehmann, F., and Bruckner, M. (2021). Does the designation of least developed country status promote exports? *Journal of International Trade & Economic Development*, 30(2), 157-177.

Klasen, S., Martínez-Zarzoso, I., Nowak-Lehmann, F., and Bruckner, M. (2021). Does the designation of least developed country status promote exports? *Journal of International Trade & Economic Development*, 30(2), 157-177.

Koenker, R. (2004). Quantile regression for longitudinal data. *Journal of Multivariate Analysis*, 91(1), 74-89.

Lall, S. (2003). Indicators of the relative importance of IPRs in developing countries. Issue Paper No. 3, UNCTAD-ICTSD Project on IPRs and Sustainable Development, Geneva.

Lerner, J. (2002). 150 Years of Patent Protection. *American Economic Review*, 92, 221-225.

Lerner, J., 2009. The empirical impact of intellectual property rights on innovation: puzzles and clues. *American Economic Review*, 99 (2), 343-348.

Liu, Y., Park, W.G., and Fu, D. (2021). Export quality and patent protection: Stage-dependent effects in development. *Review of Development Economics*, 25(2), 601-629.

Loungani, P., Mishra, S., Papageorgiou, C., and Wang, K. (2017). World Trade in Services: Evidence from A New Dataset. IMF Working Paper WP/17/77. International Monetary Fund, Washington, D.C.

Machado, J.A.F., and Santos Silva, J.M.C. (2019). Quantiles via moments. *Journal of Econometrics*, 213(1), 145-173.

Madsen, J. B., Islam, M. R. and Ang, J. B. (2010). Catching up to the technology frontier: the dichotomy between innovation and imitation. *Canadian Journal of Economics/Revue Canadienne d'Economie*, 43 (4), 1389-1411.

Mansfield, E., and Reinhardt, E. (2003). Multilateral Determinants of Regionalism: The Effects of GATT/WTO on the Formation of Preferential Trading Arrangements. *International Organization*, 57(4), 829-862.

Marron, D.B., and Steel, D.G. (2000). Which Countries Protect Intellectual Property? The Case of Software Piracy. *Economic Inquiry*, 38, 159-174.

Maskus, K. (1997). Implications of Regional and Multilateral Agreements for Intellectual Property Rights. *World Economy*, 20, 681-94.

Maskus, K. (2005). The role of intellectual property rights in encouraging foreign direct investment and technology transfer. In Fink, C. and Maskus, K. (eds.), *Intellectual Property and Development: Lessons from Recent Economic Research*. World Bank and Oxford University Press, Washington, DC.

Maskus, K. E. (2015). Intellectual property in a globalizing world: issues for economic research. *Asia-Pacific Journal of Accounting & Economics* 22 (3), 231-250.

Maskus, K., and Reichman, J. (2005). The Globalization of Private Knowledge Goods and the Privatization of Global Public Goods. In K. Maskus & J. Reichman (Eds.), *International Public Goods and Transfer of Technology Under a Globalized Intellectual Property Regime* (pp. 3-45). Cambridge: Cambridge University Press.

Maurya, G., and Sahu, S. (2022). Cross-country variations in economic complexity: The role of individualism. *Economic Modelling*, 115, 105961.

Mercurio, B. C. (2006). TRIPS-plus provisions in FTAs: recent trends. Available at SSRN: <https://ssrn.com/abstract=947767>

Moon, S. (2008). Does Article 66.2 Encourage Technology Transfer to LDCs? An Analysis of Country Submissions to the TRIPS Council (1999–2007). UNCTAD/ICTSD Project on IPRs, and Policy Brief Number 2, Geneva, Switzerland.

Mora, R., and I. Reggio. (2015). didq: A command for treatment-effect estimation under alternative assumptions. *The Stata Journal*, 15(3), 796-808.

Mora, R., and Reggio, I. (2012). Treatment effect identification using alternative parallel assumptions. Working Paper 1233, Universidad Carlos III de Madrid. Accessible online at: <https://core.ac.uk/download/pdf/29404052.pdf>

Mora, R., and Reggio, I. (2017). Alternative diff-in-diffs estimators with several pre-treatment periods, *Econometric Reviews*, 38(5), 465-486.

Mundlak, Y. (1978). On the pooling of time series and cross section data. *Econometrica*, 46(1), 69-85.

Nelson, R.R. and Rosenberg, N. (1993). Technical innovation and national systems. In Nelson, R. (ed.), *National Innovation Systems: A Comparative Analysis*. Oxford University Press, Oxford.

OECD/Eurostat (2005). *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*, 3rd Edition. Organization for Economic Co-operation and Development, OECD Publishing, Paris.

OECD/Eurostat (2018). *Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation*, 4th Edition. The Measurement of Scientific, Technological and Innovation Activities. OECD Publishing, Paris/Eurostat, Luxembourg.

Park, W. G. (2008). International patent protection: 1960-2005. *Research Policy*, 37(4), 761-766.

Park, W.G., and Lippoldt, D.C. (2008). *Technology Transfer and the Economic Implications of the Strengthening of Intellectual Property Rights in Developing Countries* (OECD Trade Policy, Working Paper No. 62 (2008)), OECD, Paris.

Park, W., and Wagh, S. (2002). Index of Patent Rights 2000 Update. In: Gwartney, J., Lawson, R. (Eds.), *Economic Freedom of the World Annual Report 2002*. Fraser Institute, Vancouver.

Parteka, A. (2020). What drives cross-country differences in export variety? A bilateral panel approach. *Economic Modelling*, 92, 48-56.

Rios-Avila, F. (2020). MMQREG: Stata module to estimate quantile regressions via Method of Moments. Statistical Software Components S458750. Boston College Department of Economics, revised on 21 June 2022.

Roffe, D. and Vivas, D. (2007). *Maintaining Policy Space for Development: A Case Study on IP Technical Assistance in FTAs*, International Centre for Trade and Sustainable Development (ICTSD), Issue Paper No. 19. Intellectual Property and Sustainable Development Series, Geneva.

Schneider, P.H. (2005). International trade, economic growth and intellectual property rights: A panel data study of developed and developing countries. *Journal of Development Economics*, 78(2), 529-547.

Shadlen, K. (2005). Exchanging development for market access?: Deep integration and industrial policy under multilateral and regional-bilateral trade agreements. *Review of International Political Economy* 12, 750-775.

Shadlen, K.C., Schrank, A., and Kurtz, M.J. (2005). The Political Economy of Intellectual Property Protection: The Case of Software. *International Studies Quarterly*, 49(1), 45-71.

Sweet, C.M., and Maggio, D.S.E. (2015). Do Stronger Intellectual Property Rights Increase Innovation? *World Development*, 66, 665-677.

Thrasher, R. D. (2021). Trade-Related Aspects of Intellectual Property, Investment Rules and Access to Medicines. In *Constraining Development: The Shrinking of Policy Space in the International Trade Regime* (pp. 41-60). Anthem Press. <https://doi.org/10.2307/j.ctv1qmpd18.7>

United Nations (2021). *Handbook on the Least Developed Country Category: Inclusion, Graduation and Special Support Measures - Fourth Edition*. Committee for Development Policy and United Nations Department of Economic and Social Affairs, United Nations publication Sales No.: E.22.II.A.1. New York.

United Nations Conference on Trade and Development (UNCTAD) (2007). *The Least Developed Countries Report 2007: Knowledge, Technology Learning and Innovation for Development*. United Nations Conference on Trade and Development, UNCTAD/LDC/2007, Geneva.

United Nations Conference on Trade and Development (UNCTAD) (2021). *The Least Developed Countries in the post-COVID world: Learning from 50 years of experience*. The Least Developed Countries Report 2021. United Nations, UNCTAD/LDC/2021, New York.

United Nations Economic Commission for Africa (UNECA) (2016). *Industrial Policy for Africa in the New Global Environment* (Chapter 5). In "Transformative Industrial Policy for Africa" (pp. 114-159), UNECA, Addis Ababa, Ethiopia.

USTR (United States Trade Representative). (2004). *Intellectual Property Chapters in Free Trade Agreements*. Retrieved from https://ustr.gov/archive/Trade_Sectors/Intellectual_Property/IP_Chapters_in_FTAs/Section_Index.html.

Vawda, Y.A. (2022). *Compulsory Licenses and Government Use: Challenges and Opportunities*. In: Correa, C.M., Hilty, R.M. (eds) *Access to Medicines and Vaccines*. Springer, Cham. https://doi.org/10.1007/978-3-030-83114-1_3

Watal, J., and Caminero, L. (2018). *Least-developed countries, transfer of technology and the TRIPS Agreement*. Staff Working Paper ERS-2018-01. World Trade Organization, Geneva, Switzerland.

Wick, K., and Bulte, E.H. (2006). *Contesting resources - Rent seeking, conflict and the natural resource curse*. *Public Choice* 128(3-4), 457-76.

Wing, C., Simon, K., & Bello-Gomez, R. A. (2018). *Designing difference in difference studies: Best practices for public health policy research*. *Annual Review of Public Health*, 39, 453-469.

World Bank (2002). *Global Economic Prospects and the Developing Countries: Making Trade Work for the World's Poor*. World Bank, Washington, D.C.

World Trade Organization (WTO) (2022a). *Boosting trade opportunities for least-developed countries - Progress over the past ten years and current priorities*. Geneva, Switzerland. Accessible online at: https://www.wto.org/english/res_e/publications_e/boottradeopp22_e.htm

World Trade Organization (WTO) (2022b). *Market access for products and services of export interest to least developed countries*. Note by the Secretariat prepared for the Sub-Committee on

Least Developed Countries, WT/COMTD/LDC/W/70, 18 October 2022. World Trade Organization, Geneva, Switzerland.

World Trade Organization (WTO) (2023). Special And Differential Treatment Provisions in WTO Agreements and Decisions. Note by the Secretariat prepared for the Committee on Trade and Development, WT/COMTD/W/271, 13 March 2023. World Trade Organization, Geneva, Switzerland.

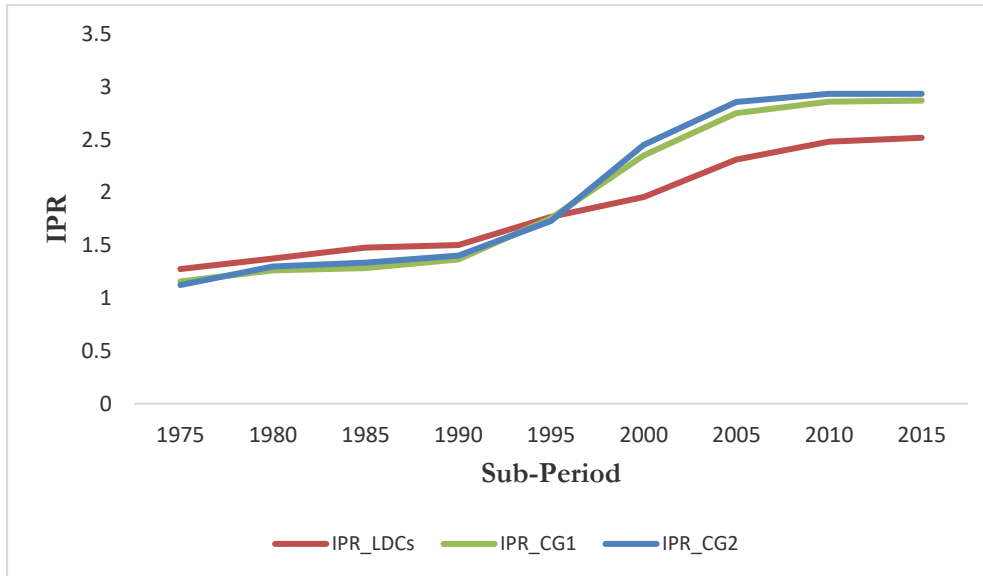
Wu, M. (2020). Intellectual Property Rights, Chapter 7. In "Handbook of Deep Trade Agreements" (pp. 203-222). Edited by Aaditya, M., Rcha, N., and Ruta, M. Washington, DC: World Bank.

Yu, P.K. (2007). The international enclosure movement. *Indiana Law Journal*, 82 (Winter).

Zellner, A. (1962). An efficient method of estimating seemingly unrelated regressions and tests for aggregation bias. *Journal of the American statistical Association*, 57(298), 348-368.

FIGURES

Figure 1: Development of the index of the strength of intellectual property protection in the group of LDCs and each of the two control groups (CG1 and CG2)



Source: Author

Note: The group "CG1" refers to the first control group, which comprises countries that had not been in the LDC category, but would not have met the criteria for graduating from the category of LDCs if they were included in the category (see Klasen et al., 2021: p164). The group "CG2" refers to the second control group, i.e., that is the control group containing low-income countries (LICs) that are not LDCs, but are eligible to the PRGF of the International Monetary Fund (IMF) (see IMF, 2022: p57).

Table 1: Effect of the TRIPS Waiver for LDCs on the strength of their intellectual property protection
Estimators: FE, FGLS and Random-effects Mundlak (REM)

Variables	Full sample = LDCs + CG1						Full sample = LDCs + CG2					
	FE	REM	FGLS	FE	FE	FE	FE	REM	FGLS	FE	FE	FE
	IPR	IPR	IPR	IPR	IPR	IPR	IPR	IPR	IPR	IPR	IPR	IPR
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
DiD	-0.645*** (0.0315)	-0.645*** (0.0767)	-0.363*** (0.0619)	-0.643*** (0.0316)	-0.683*** (0.0645)	-0.767*** (0.0350)	-0.721*** (0.0169)	-0.721*** (0.0819)	-0.500*** (0.0741)	-0.715*** (0.0171)	-0.663*** (0.0346)	-0.784*** (0.0411)
TRIPS	0.674*** (0.0931)	0.674*** (0.0944)	1.318*** (0.164)	0.672*** (0.0926)	0.555*** (0.110)	0.781*** (0.0982)	0.757*** (0.0817)	0.757*** (0.100)	1.512*** (0.182)	0.753*** (0.0815)	0.543*** (0.0935)	0.762*** (0.0743)
LDC		0.644 (0.612)	0.310*** (0.0896)					2.470 (2.682)	0.450*** (0.0859)			
EPC	-0.127*** (0.0216)	-0.127*** (0.0464)	0.0258 (0.0240)			-0.113*** (0.0300)	-0.106*** (0.0289)	-0.106*** (0.0442)	0.0152 (0.0229)			-0.106*** (0.0337)
EPCINT				-0.114*** (0.0179)						-0.0890*** (0.0244)		
EPCEXT				-0.150*** (0.0324)						-0.137*** (0.0401)		
ECI					-0.0292 (0.0705)						-0.0671 (0.0491)	
DUR	-0.0188*** (0.00304)	-0.0188*** (0.00653)	0.00475* (0.00260)	-0.0188*** (0.00302)	-0.0143* (0.00816)	-0.0177*** (0.00262)	-0.0178*** (0.00292)	-0.0178*** (0.00631)	0.00483** (0.00234)	-0.0180*** (0.00286)	-0.00827 (0.00577)	-0.0183*** (0.00273)
Log(GDPC)	0.0283 (0.0355)	0.0283 (0.0823)	0.188*** (0.0509)	0.0205 (0.0385)	-0.0150 (0.0734)	0.0832** (0.0359)	-0.0415 (0.0507)	-0.0415 (0.0847)	0.243*** (0.0476)	-0.0557 (0.0566)	-0.194* (0.0943)	0.00653 (0.0615)
Log(ODA)	-0.0928 (0.0551)	-0.0928** (0.0395)	-0.00344 (0.0203)	-0.0926 (0.0552)	-0.0742 (0.0728)		-0.0519 (0.0394)	-0.0519 (0.0428)	-0.0257 (0.0226)	-0.0511 (0.0396)	-0.0157 (0.0389)	
HUM						-0.0915** (0.0437)						-0.173*** (0.0334)
EFI	0.0333 (0.0349)	0.0333 (0.0336)	0.0312 (0.0193)	0.0339 (0.0338)	0.124*** (0.0291)	0.0651* (0.0331)	0.0656** (0.0290)	0.0656** (0.0325)	0.0614*** (0.0205)	0.0662** (0.0273)	0.159*** (0.0173)	0.0990*** (0.0274)
TREND	0.228*** (0.0242)	0.228*** (0.0338)	-0.00863 (0.0251)	0.227*** (0.0243)	0.198*** (0.0607)	0.240*** (0.0293)	0.211*** (0.0222)	0.211*** (0.0330)	-0.0170 (0.0259)	0.210*** (0.0222)	0.156*** (0.0406)	0.277*** (0.0230)
Constant	3.202** (1.308)	-3.814 (4.409)	-0.259 (0.554)	3.224** (1.333)	2.165 (1.719)	0.976** (0.380)	2.664** (1.133)	-6.357 (6.151)	-0.419 (0.546)	2.712** (1.173)	2.008 (1.186)	1.496** (0.547)
Observations/Countries	308/39	308/39	308/39	308/39	179/23	275/34	267/33	267/33	267/33	267/33	148/19	243/29
Within R ²	0.7582	0.7582		0.7586	0.7891	0.7706	0.7752	0.7752		0.7758	0.8421	0.7856

Between R ²	0.4625		0.5082
Overall R ²	0.5867		0.6265
Pseudo R ²		0.6885	0.7085

*Note: *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust standard errors are in parenthesis. The Pseudo R² has been computed for the regressions based on the FGLS estimator as the correlation coefficient between the dependent variable and its predicted values. The full sample contains LDCs and countries in one of the two control groups (i.e., CG1 or CG2). Control group 1 contains countries that had not been in the LDC category, but would not have met the criteria for graduating from the category of LDCs if they were included in the category (see Klasen et al., 2021: p164). Control group 2 includes low-income countries (LICs) that are not LDCs but are eligible to the PRGF of the International Monetary Fund (IMF) (see IMF, 2022: p57). The dummy variable "TRIPS" takes the value 1 (from 1995), i.e., here from the sub-periods 1995-1999 to 2010-2014, and the value of 0 for the preceding sub-periods. The variable "DiD" is the interaction between the dummy "TRIPS" and the dummy "LDC", the latter taking 1 for LDCs, and 0, for countries in the control group (CG1 or CG2). Results reported in columns [1] to [6] are obtained using the full sample that contains LDCs and countries in CG1. Results reported in columns [7] to [12] are obtained using the full sample that contains LDCs and countries in CG2.*

Table 2: Effect of the TRIPS Waiver for LDCs on the strength of their intellectual property protection in longstanding GATT/WTO LDC Members versus relatively new LDC Members of the GATT/WTO

Estimator: Within Fixed Effects (FE)

Variables	Full sample = LDCs + CG1	Full sample = LDCs + CG2
	IPR (1)	IPR (2)
DiD*DUR	0.00670*** (0.00216)	0.00704*** (0.00214)
DiD	-0.901*** (0.0794)	-0.980*** (0.0697)
TRIPS	0.706*** (0.0917)	0.789*** (0.0803)
EPC	-0.131*** (0.0264)	-0.111*** (0.0343)
DUR	-0.0258*** (0.00443)	-0.0257*** (0.00473)
Log(GDPC)	0.00427 (0.0295)	-0.0759 (0.0453)
Log(ODA)	-0.0953* (0.0558)	-0.0520 (0.0409)
EFI	0.0369 (0.0355)	0.0683** (0.0293)
TREND	0.253*** (0.0288)	0.238*** (0.0281)
Constant	3.465** (1.324)	2.961** (1.157)
Observations/Countries	308/39	267/33
Within R ²	0.7608	0.7784

Note: *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust standard errors are in parenthesis. The full sample contains LDCs and countries in one of the two control groups (i.e., CG1 or CG2). CG1 contains countries that had not been in the LDC category, but would not have met the criteria for graduating from the category of LDCs if they were included in the category (see Klasen et al., 2021: p164). CG2 includes low-income countries (LICs) that are not LDCs but are eligible to the PRGF of the International Monetary Fund (IMF) (see IMF, 2022: p57). The dummy variable "TRIPS" takes the value 1 (from 1995), i.e., here from the sub-periods 1995-1999 to 2010-2014, and the value of 0 for the preceding sub-periods. The variable "DiD" is the interaction between the dummy "TRIPS" and the dummy "LDC", the latter taking 1 for LDCs, and 0, for countries in the control group (CG1 or CG2). Results reported in column [1] are obtained over the full sample that contains LDCs and countries in CG1, while results reported in column [2] are obtained over the full sample that contains LDCs and countries in CG2.

Table 3: Effect of the TRIPS Waiver for LDCs on the strength of intellectual property protection for varying degrees of export
Estimator. Within Fixed Effects (FE)

Variables	Full sample = LDCs + CG1			Full sample = LDCs + CG2		
	IPR (1)	IPR (2)	IPR (3)	IPR (4)	IPR (5)	IPR (6)
DiD	-1.268*** (0.158)	-1.234*** (0.162)	-0.159 (0.113)	-1.288*** (0.137)	-1.251*** (0.131)	-0.170* (0.0881)
DiD*EPC	0.149*** (0.0316)			0.136*** (0.0321)		
DiD*EPCINT		0.134*** (0.0331)			0.123*** (0.0329)	
DiD*EPCEXT		0.179*** (0.0361)			0.154*** (0.0269)	
DiD*ECI			0.507*** (0.137)			0.486*** (0.0910)
TRIPS	0.652*** (0.0913)	0.644*** (0.0899)	0.560*** (0.112)	0.735*** (0.0800)	0.728*** (0.0795)	0.551*** (0.0948)
EPC	-0.195*** (0.0390)			-0.169*** (0.0461)		
EPCINT		-0.184*** (0.0383)			-0.154*** (0.0420)	
EPCEXT		-0.214*** (0.0459)			-0.192*** (0.0513)	
ECI			-0.101 (0.0800)			-0.153** (0.0549)
DUR	-0.0216*** (0.00323)	-0.0215*** (0.00321)	-0.0153* (0.00815)	-0.0204*** (0.00319)	-0.0204*** (0.00316)	-0.00929* (0.00524)
Log(GDPC)	0.0422 (0.0385)	0.0464 (0.0393)	-0.00540 (0.0626)	-0.0243 (0.0535)	-0.0263 (0.0597)	-0.186** (0.0829)
Log(ODA)	-0.0936* (0.0549)	-0.0930 (0.0553)	-0.0862 (0.0736)	-0.0521 (0.0387)	-0.0515 (0.0392)	-0.0367 (0.0406)
EFI	0.0345 (0.0347)	0.0354 (0.0334)	0.127*** (0.0271)	0.0663** (0.0285)	0.0672** (0.0270)	0.162*** (0.0151)
TREND	0.242*** (0.0279)	0.242*** (0.0280)	0.200*** (0.0608)	0.225*** (0.0254)	0.224*** (0.0252)	0.158*** (0.0378)
Constant	3.407** (1.427)	3.338** (1.437)	2.292 (1.644)	2.823** (1.241)	2.785** (1.278)	2.303* (1.133)
Observations/Countries	308/39	308/39	179/23	267/33	267/33	148/19
Within R ²	0.7628	0.7633	0.7943	0.7797	0.7802	0.8483

Note: *p-value<0.1; **p-value<0.05; ***p-value<0.01. Robust standard errors are in parenthesis. The full sample contains LDCs and countries in one of the two control groups (i.e., CG1 or CG2). CG1 contains countries that had not been in the LDC category, but would not have met the criteria for graduating from the category of LDCs if they were included in the category (see Klasen et al., 2021: p164). CG2 includes low-income countries (LICs) that are not LDCs but are eligible to the PRGF of the International Monetary Fund (IMF) (see IMF, 2022: p57). The dummy variable "TRIPS" takes the value 1 (from 1995), i.e., here from the sub-periods 1995-1999 to 2010-2014, and the value of 0 for the preceding sub-periods. The variable "DiD" is the interaction between the dummy "TRIPS" and the dummy "LDC", the latter taking 1 for LDCs, and 0, for countries in the control group (CG1 or CG2). Results reported in columns [1] to [3] are obtained using the full sample that contains LDCs and countries in CG1. Results reported in columns [4] to [6] are obtained using the full sample that contains LDCs and countries in CG2.

Table 4: Effect of the LDC TRIPS Waiver on the strength of intellectual property protection
Estimator. Method of Moments Quantile Regression (MMQR)

<i>Dependent variable: IPR</i>											
Variables	Location ^a	Scale ^b	Q10 th	Q20 th	Q30 th	Q40 th	Q50 th	Q60 th	Q70 th	Q80 th	Q90 th
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
<i>Results with "EPC" over the full sample of LDCs and CG1</i>											
DiD	-0.646*** (0.0779)	0.0282 (0.0346)	-0.687*** (0.0881)	-0.678*** (0.0835)	-0.669*** (0.0803)	-0.662*** (0.0786)	-0.647*** (0.0778)	-0.634*** (0.0806)	-0.622*** (0.0855)	-0.615*** (0.0900)	-0.607*** (0.0955)
EPC	-0.101*** (0.0372)	-0.00517 (0.0210)	-0.0937* (0.0532)	-0.0954** (0.0482)	-0.0970** (0.0443)	-0.0982** (0.0416)	-0.101*** (0.0373)	-0.103*** (0.0361)	-0.106*** (0.0372)	-0.107*** (0.0390)	-0.108*** (0.0416)
Observations	308	308	308	308	308	308	308	308	308	308	308
<i>Results with "EPC" over the full sample of LDCs and CG2</i>											
DiD	-0.715*** (0.0855)	0.0471 (0.0413)	-0.783*** (0.101)	-0.768*** (0.0950)	-0.754*** (0.0906)	-0.738*** (0.0872)	-0.719*** (0.0857)	-0.695*** (0.0885)	-0.672*** (0.0953)	-0.661*** (0.100)	-0.650*** (0.106)
EPC	-0.0831** (0.0370)	-0.00876 (0.0199)	-0.0704 (0.0520)	-0.0733 (0.0475)	-0.0759* (0.0438)	-0.0788* (0.0404)	-0.0823** (0.0375)	-0.0869** (0.0360)	-0.0911** (0.0371)	-0.0931** (0.0386)	-0.0953** (0.0406)
Observations	267	267	267	267	267	267	267	267	267	267	267
<i>Results with "EPCINT" and "EPCEXT" over the full sample of LDCs and CG1</i>											
DiD	-0.645*** (0.0779)	0.0280 (0.0345)	-0.685*** (0.0887)	-0.676*** (0.0837)	-0.668*** (0.0808)	-0.662*** (0.0790)	-0.646*** (0.0779)	-0.633*** (0.0804)	-0.622*** (0.0852)	-0.614*** (0.0898)	-0.606*** (0.0952)
EPCINT	-0.0915** (0.0423)	-0.00915 (0.0212)	-0.0784 (0.0533)	-0.0816* (0.0490)	-0.0841* (0.0464)	-0.0861* (0.0446)	-0.0913** (0.0424)	-0.0954** (0.0429)	-0.0992** (0.0452)	-0.102** (0.0476)	-0.104** (0.0506)
EPCEXT	-0.116** (0.0540)	0.00299 (0.0283)	-0.121* (0.0687)	-0.120* (0.0631)	-0.119** (0.0595)	-0.118** (0.0571)	-0.116** (0.0540)	-0.115** (0.0549)	-0.114* (0.0584)	-0.113* (0.0618)	-0.112* (0.0660)
Observations	308	308	308	308	308	308	308	308	308	308	308
<i>Results with "EPCINT" and "EPCEXT" over the full sample of LDCs and CG2</i>											
DiD	-0.711*** (0.0864)	0.0483 (0.0418)	-0.781*** (0.102)	-0.766*** (0.0962)	-0.751*** (0.0917)	-0.736*** (0.0883)	-0.715*** (0.0866)	-0.690*** (0.0896)	-0.668*** (0.0959)	-0.655*** (0.101)	-0.646*** (0.106)
EPCINT	-0.0698* (0.0424)	-0.00525 (0.0203)	-0.0621 (0.0521)	-0.0638 (0.0486)	-0.0654 (0.0458)	-0.0671 (0.0438)	-0.0693 (0.0424)	-0.0721* (0.0432)	-0.0744 (0.0457)	-0.0758 (0.0480)	-0.0769 (0.0501)

EPCEXT	-0.105**	-0.0158	-0.0820	-0.0871	-0.0919	-0.0969*	-0.104**	-0.112**	-0.119**	-0.123**	-0.126**
	(0.0521)	(0.0277)	(0.0656)	(0.0607)	(0.0569)	(0.0540)	(0.0522)	(0.0536)	(0.0576)	(0.0611)	(0.0643)
Observations	267	267	267	267	267	267	267	267	267	267	267

Results with "ECI" over the full sample of LDCs and CG1

DiD	-0.686***	0.0493	-0.757***	-0.741***	-0.730***	-0.707***	-0.685***	-0.665***	-0.649***	-0.624***	-0.609***
	(0.0907)	(0.0380)	(0.0913)	(0.0882)	(0.0876)	(0.0881)	(0.0912)	(0.0964)	(0.102)	(0.113)	(0.124)
ECI	-0.112	-0.0493	-0.0411	-0.0571	-0.0676	-0.0908	-0.113	-0.132	-0.149	-0.174*	-0.189*
	(0.0949)	(0.0401)	(0.123)	(0.114)	(0.109)	(0.100)	(0.0952)	(0.0929)	(0.0931)	(0.0964)	(0.101)
Observations	179	179	179	179	179	179	179	179	179	179	179

Results with "ECI" over the full sample of LDCs and CG2

DiD	-0.662***	0.0650	-0.764***	-0.735***	-0.713***	-0.690***	-0.660***	-0.640***	-0.618***	-0.588***	-0.559***
	(0.0826)	(0.0428)	(0.108)	(0.0969)	(0.0900)	(0.0856)	(0.0832)	(0.0841)	(0.0874)	(0.0946)	(0.108)
ECI	-0.133	-0.127***	0.0662	0.00983	-0.0331	-0.0780	-0.136	-0.175*	-0.218**	-0.277***	-0.333***
	(0.0964)	(0.0454)	(0.134)	(0.120)	(0.111)	(0.105)	(0.0986)	(0.0974)	(0.0977)	(0.101)	(0.102)
Observations	148	148	148	148	148	148	148	148	148	148	148

Note: * p -value <0.1 ; ** p -value <0.05 ; *** p -value <0.01 . Robust standard errors are in parenthesis. (a) indicates the location parameters, and (b) refers to the scale parameters. The full sample contains LDCs and countries in one of the two control groups (i.e., CG1 or CG2). CG1 contains countries that had not been in the LDC category, but would not have met the criteria for graduating from the category of LDCs if they were included in the category (see Klasen et al., 2021: p164). CG2 includes low-income countries (LICs) that are not LDCs but are eligible to the PRGF of the International Monetary Fund (IMF) (see IMF, 2022: p57). The dummy variable "TRIPS" takes the value 1 (from 1995), i.e., here from the sub-periods 1995-1999 to 2010-2014, and the value of 0 for the preceding sub-periods. The variable "DiD" is the interaction between the dummy "TRIPS" and the dummy "LDC", the latter taking 1 for LDCs, and 0, for countries in the control group (CG1 or CG2).

Table 5: Effect of the LDC TRIPS Waiver on the strength of intellectual property protection for varying levels of export product upgrading
Estimator. Method of Moments Quantile Regression (MMQR)

<i>Dependent variable: IPR</i>											
Variables	Location ^a	Scale ^b	Q10 th	Q20 th	Q30 th	Q40 th	Q50 th	Q60 th	Q70 th	Q80 th	Q90 th
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
<i>Results with "EPC" over the full sample of LDCs and CG1</i>											
DiD*EPC	0.167*** (0.0502)	-0.0208 (0.0274)	0.198*** (0.0615)	0.190*** (0.0559)	0.185*** (0.0532)	0.179*** (0.0510)	0.169*** (0.0500)	0.158*** (0.0528)	0.151*** (0.0567)	0.144** (0.0614)	0.138** (0.0659)
DiD	-1.346*** (0.228)	0.110 (0.124)	-1.510*** (0.267)	-1.469*** (0.244)	-1.441*** (0.233)	-1.409*** (0.226)	-1.357*** (0.226)	-1.299*** (0.243)	-1.259*** (0.263)	-1.224*** (0.286)	-1.194*** (0.307)
EPC	-0.177*** (0.0403)	0.00253 (0.0213)	-0.180*** (0.0538)	-0.180*** (0.0489)	-0.179*** (0.0461)	-0.178*** (0.0433)	-0.177*** (0.0406)	-0.176*** (0.0404)	-0.175*** (0.0420)	-0.174*** (0.0446)	-0.173*** (0.0473)
Observations	308	308	308	308	308	308	308	308	308	308	308
<i>Results with "EPC" over the full sample of LDCs and CG2</i>											
DiD*EPC	0.156*** (0.0497)	-0.0270 (0.0272)	0.196*** (0.0595)	0.186*** (0.0545)	0.179*** (0.0517)	0.171*** (0.0498)	0.159*** (0.0494)	0.144*** (0.0527)	0.133** (0.0576)	0.126** (0.0619)	0.118* (0.0669)
DiD	-1.368*** (0.223)	0.157 (0.122)	-1.597*** (0.254)	-1.543*** (0.234)	-1.501*** (0.224)	-1.452*** (0.218)	-1.387*** (0.221)	-1.300*** (0.240)	-1.233*** (0.265)	-1.190*** (0.286)	-1.145*** (0.310)
EPC	-0.155*** (0.0397)	0.00331 (0.0207)	-0.160*** (0.0513)	-0.159*** (0.0471)	-0.158*** (0.0443)	-0.157*** (0.0418)	-0.155*** (0.0399)	-0.153*** (0.0402)	-0.152*** (0.0426)	-0.151*** (0.0450)	-0.150*** (0.0482)
Observations	267	267	267	267	267	267	267	267	267	267	267
<i>Results with "EPCINT" and "EPCEXT" over the full sample of LDCs and CG1</i>											
DiD*EPCINT	0.149*** (0.0489)	-0.0157 (0.0262)	0.172*** (0.0581)	0.167*** (0.0538)	0.162*** (0.0511)	0.158*** (0.0493)	0.150*** (0.0488)	0.142*** (0.0516)	0.136** (0.0557)	0.132** (0.0598)	0.128** (0.0641)
DiD*EPCEXT	0.211*** (0.0699)	-0.0217 (0.0363)	0.242*** (0.0910)	0.235*** (0.0835)	0.229*** (0.0784)	0.222*** (0.0742)	0.211*** (0.0700)	0.201*** (0.0704)	0.193*** (0.0737)	0.187** (0.0776)	0.181** (0.0823)
DiD	-1.313*** (0.227)	0.0909 (0.122)	-1.443*** (0.266)	-1.413*** (0.246)	-1.388*** (0.235)	-1.361*** (0.227)	-1.315*** (0.227)	-1.272*** (0.241)	-1.237*** (0.261)	-1.211*** (0.281)	-1.186*** (0.301)
EPCINT	-0.172*** (0.0455)	-0.00400 (0.0227)	-0.166*** (0.0547)	-0.167*** (0.0510)	-0.168*** (0.0484)	-0.169*** (0.0465)	-0.171*** (0.0454)	-0.173*** (0.0470)	-0.175*** (0.0500)	-0.176*** (0.0531)	-0.177*** (0.0564)
EPCEXT	-0.187*** (0.0570)	0.0217 (0.0263)	-0.218*** (0.0694)	-0.211*** (0.0647)	-0.205*** (0.0616)	-0.199*** (0.0592)	-0.187*** (0.0571)	-0.177*** (0.0580)	-0.169*** (0.0605)	-0.163** (0.0634)	-0.157** (0.0666)
Observations	308	308	308	308	308	308	308	308	308	308	308

Results with "EPCINT" and "EPCEXT" over the full sample of LDCs and CG2											
DiD*EPCINT	0.141*** (0.0491)	-0.0270 (0.0262)	0.181*** (0.0576)	0.171*** (0.0530)	0.163*** (0.0502)	0.157*** (0.0490)	0.144*** (0.0488)	0.130** (0.0522)	0.118** (0.0572)	0.111* (0.0608)	0.104 (0.0653)
DiD*EPCEXT	0.189*** (0.0678)	-0.0328 (0.0354)	0.237*** (0.0898)	0.226*** (0.0815)	0.215*** (0.0757)	0.208*** (0.0726)	0.192*** (0.0683)	0.175** (0.0682)	0.160** (0.0717)	0.153** (0.0751)	0.144* (0.0797)
DiD	-1.337*** (0.224)	0.159 (0.120)	-1.571*** (0.259)	-1.515*** (0.239)	-1.464*** (0.227)	-1.429*** (0.223)	-1.353*** (0.223)	-1.269*** (0.240)	-1.200*** (0.264)	-1.162*** (0.281)	-1.118*** (0.302)
EPCINT	-0.147*** (0.0451)	0.00693 (0.0217)	-0.157*** (0.0527)	-0.155*** (0.0492)	-0.153*** (0.0468)	-0.151*** (0.0456)	-0.148*** (0.0449)	-0.144*** (0.0469)	-0.141*** (0.0505)	-0.139*** (0.0531)	-0.138*** (0.0565)
EPCEXT	-0.167*** (0.0546)	0.00585 (0.0263)	-0.176*** (0.0659)	-0.174*** (0.0612)	-0.172*** (0.0578)	-0.171*** (0.0562)	-0.168*** (0.0546)	-0.165*** (0.0562)	-0.162*** (0.0599)	-0.161** (0.0628)	-0.159** (0.0666)
Observations	267	267	267	267	267	267	267	267	267	267	267
Results with "ECI" over the full sample of LDCs and CG1											
DiD*ECI	0.490*** (0.148)	0.0736 (0.0627)	0.384** (0.165)	0.414*** (0.153)	0.429*** (0.150)	0.458*** (0.146)	0.488*** (0.148)	0.524*** (0.154)	0.551*** (0.163)	0.578*** (0.174)	0.599*** (0.182)
DiD	-0.180 (0.161)	0.121* (0.0710)	-0.355** (0.177)	-0.306* (0.164)	-0.281* (0.161)	-0.233 (0.159)	-0.184 (0.162)	-0.125 (0.171)	-0.0800 (0.182)	-0.0353 (0.196)	-0.00114 (0.206)
ECI	-0.187* (0.105)	-0.0643 (0.0462)	-0.0942 (0.138)	-0.120 (0.124)	-0.134 (0.119)	-0.159 (0.111)	-0.185* (0.106)	-0.217** (0.103)	-0.240** (0.104)	-0.264** (0.108)	-0.282** (0.111)
Observations	179	179	179	179	179	179	179	179	179	179	179
Results with "ECI" over the full sample of LDCs and CG2											
DiD*ECI	0.464*** (0.154)	0.203*** (0.0774)	0.136 (0.213)	0.231 (0.189)	0.310* (0.175)	0.393** (0.164)	0.479*** (0.158)	0.560*** (0.157)	0.621*** (0.160)	0.699*** (0.169)	0.770*** (0.176)
DiD	-0.190 (0.157)	0.262*** (0.0770)	-0.612*** (0.199)	-0.491*** (0.177)	-0.388** (0.169)	-0.282* (0.164)	-0.170 (0.165)	-0.0657 (0.169)	0.0126 (0.174)	0.114 (0.186)	0.206 (0.201)
ECI	-0.219** (0.111)	-0.175*** (0.0557)	0.0637 (0.170)	-0.0175 (0.150)	-0.0864 (0.137)	-0.157 (0.124)	-0.232** (0.115)	-0.302*** (0.109)	-0.354*** (0.106)	-0.422*** (0.108)	-0.483*** (0.105)
Observations	148	148	148	148	148	148	148	148	148	148	148

Note: * p -value <0.1 ; ** p -value <0.05 ; *** p -value <0.01 . Robust standard errors are in parenthesis. (a) indicates the location parameters, and (b) refers to the scale parameters. The full sample contains LDCs and countries in one of the two control groups (i.e., control group 1 or control group 2). Control group 1 contains countries that had not been in the LDC category, but would not have met the criteria for graduating from the category of LDCs if they were included in the category (see Klasen et al., 2021: p164). Control group 2 includes low-income countries (LICs) that are not LDCs but are eligible to the PRGF of the International Monetary Fund (IMF) (see IMF, 2022: p57). The dummy variable "TRIPS" takes the value 1 (from 1995), i.e., here from the sub-periods 1995-1999 to 2010-2014, and the value of 0 for the preceding sub-periods. The variable "DiD" is the interaction between the dummy "TRIPS" and the dummy "LDC", the latter taking 1 for LDCs, and 0, for countries in the control group (control group 1 or control group 2).

Appendix 1: Definition and source of variables

Variables	Definition	Source
IPR	This is the overall index of patent protection. Its values vary from 0 to 5, with higher numbers reflecting strong levels of patent rights.	The indicator "PRI" is developed by Park (2008) see data online at: http://fs2.american.edu/wgp/www/
DUR	This is the indicator of the duration of membership in the GATT/WTO.	Author's computation based on data collected from the website of the WTO. The list of countries (128) that had signed GATT by 1994 is accessible online at: https://www.wto.org/english/thewto_e/gattmem_e.htm The list of states that were GATT Members, and that joined the WTO, as well as those that joined the WTO under the WTO's Article XII is accessible online at: https://www.wto.org/english/thewto_e/whatis_e/tif_e/org6_e.htm
EPC	This is the variable capturing the overall export product concentration. Higher values of this indicator reflect an increase in the level of overall export product concentration, while a decrease in the values of this index indicate a rise in the degree of overall export product diversification (that is, greater export product diversification).	Details on the methodology used to calculate this index can be found in Henn et al. (2013, 2015). Data are available from the International Monetary Fund's Diversification Toolkit (see: https://www.imf.org/external/np/res/dfidimf/diversification.htm)
EPCINT	This the Theil index of export product concentration at the intensive margins. Higher values of this index indicate a rise in the level of export product concentration at the intensive margins, while declining values of this index reflect lower levels of concentration at the intensive margins, i.e., greater diversification of export product at the intensive margins.	Details on the methodology used to calculate this index can be found in Henn et al. (2013, 2015). Data are available from the International Monetary Fund's Diversification Toolkit (see: https://www.imf.org/external/np/res/dfidimf/diversification.htm)

EPCEXT	This is the Theil index of export product concentration at the extensive margins. Higher values of this index indicate greater export product concentration at the extensive margins, while declining values of this index reflect a lower concentration at the extensive margins, i.e., greater diversification of export product at the extensive margins.	Details on the methodology used to calculate this index can be found in Henn et al. (2013, 2015). Data are available from the International Monetary Fund's Diversification Toolkit (see: https://www.imf.org/external/np/res/dfidimf/diversification.htm)
ECI	This is the economic complexity index (see Hausmann and Hidalgo, 2009). Higher values of this index reflect greater economic complexity.	MIT's Observatory of Economic Complexity (https://oec.world/en/rankings/eci/hs6/hs96)
ODA	This is the real net disbursements of total Official Development Assistance (ODA), expressed in constant prices 2020, US dollar.	OECD (Organization for Economic Cooperation and Development) database on development indicators.
EFI	This is the index of economic freedom. Its values range between 0 and 10, with higher values indicating greater economic freedom.	Data collected from the Fraser Institute (https://www.fraserinstitute.org/economic-freedom/dataset) (see Gwartney et al., 2022)
GDPC	Per capita Gross Domestic Product (constant prices, 2015 US\$).	World Development Indicators (WDI) of the World Bank
HUM	This is the indicator of human capital. It is measured by the average years of total schooling for the population aging between 15 and 64.	Barro and Lee Database, updated in 2021 (see Barro and Lee, 2013). Accessible online at: http://www.barrolee.com/

Appendix 2a: Descriptive statistics on variables used in the analysis over the group of LDCs

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
IPR	186	1.967	0.728	0.000	3.300
ECI	76	-1.039	0.330	-2.298	-0.335
EPC	186	4.321	0.833	2.356	6.269
EPCINT	186	3.529	0.942	2.129	5.854
EPCEXT	186	0.785	0.747	0.005	2.707
DUR	186	27.158	15.962	0.000	64.500
HUM	162	3.355	1.635	0.462	7.988
EFI	186	5.203	1.027	2.500	7.380
GDPC	186	665.767	426.544	158.777	3086.525
ODA	186	677000000	597000000	52400000	3280000000

Appendix 2b: Descriptive statistics on variables used in the analysis over the Control Group 1 (CG1)

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
IPR	122	2.017	0.898	0.000	3.758
ECI	103	-0.865	0.670	-2.373	0.993
EPC	122	3.795	0.966	1.879	6.139
EPCINT	122	3.169	0.867	1.726	5.346
EPCEXT	122	0.622	0.502	0.003	1.821
DUR	122	29.642	17.950	0.000	64.500
HUM	113	5.204	1.787	1.760	9.000
EFI	122	5.470	1.033	2.500	7.370
GDPC	122	1680.352	795.930	357.197	5337.677
ODA	122	932000000	1020000000	8998333	4900000000

Note: Control Group 1 comprises countries that had not been in the LDC category, but would not have met the criteria for graduating from the category of LDCs if they were included in the category (see Klasen et al., 2021: p164).

Appendix 2c: Descriptive statistics on variables used in the analysis over the Control Group 2 (CG2)

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
IPR	81	2.008	0.900	0.000	3.350
ECI	72	-0.909	0.528	-1.826	0.993
EPC	81	3.865	0.689	2.545	5.785
EPCINT	81	3.279	0.624	2.235	4.604
EPCEXT	81	0.581	0.468	0.003	1.561
DUR	81	27.777	17.929	0.000	64.500
HUM	81	5.079	1.606	1.760	8.126
EFI	81	5.512	1.082	2.500	7.370
GDPC	81	1640.587	474.750	788.387	2814.551
ODA	81	616000000.000	408000000.000	8998333.000	2540000000.000

Note: Control Group 2 contains LICs that are not LDCs, but that are eligible to the PRGF of the International Monetary Fund (IMF) (see IMF, 2022: p57).

Appendix 3: List of countries contained in the group of LDCs (24 countries), and of countries in control groups 1 and 2

LDCs	Control Group 1 (CG1)	Control Group 2 (CG2)
Angola	Cameroon	Cameroon
Bangladesh	Congo, Rep.	Congo, Rep.
Benin	Cote d'Ivoire	Cote d'Ivoire
Burkina Faso	Eswatini	Ghana
Burundi	Ghana	Honduras
Central African Republic	Guyana	Kenya
Chad	Honduras	Nicaragua
Congo, Dem. Rep.	India	Papua New Guinea
Haiti	Kenya	Zimbabwe
Madagascar	Nicaragua	
Malawi	Nigeria	
Mali	Pakistan	
Mauritania	Papua New Guinea	
Mozambique	Vietnam	
Myanmar	Zimbabwe	
Nepal		
Niger		
Rwanda		
Senegal		
Sierra Leone		
Tanzania		
Togo		
Uganda		
Zambia		

Note: The Group "CG1" refers to the first Control Group, which comprises countries that had not been in the LDC category, but would not have met the criteria for graduating from the category of LDCs if they were included in the category (see Klasen et al., 2021: p164). The Group "CG2" refers to the second Control Group, i.e., that is the control group containing LICs that are not LDCs, but that are eligible to the PRGF of the International Monetary Fund (IMF) (see IMF, 2022: p57).