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Institute of Economics
Scuola Superiore Sant'Anna

Piazza Martiri della Libertà, 33 - 56127 Pisa, Italy
ph. +39 050 88.33.43
institute.economics@sssup.it

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Intellectual property rights and agricultural development: Evidence from a worldwide index of IPRs in agriculture (1961-2018)

Mercedes Campi [a]
Alessandro Nuvolari [b]

[a] CONICET & University of Buenos Aires, Faculty of Economics, IIEP-Baires, Argentina.
[b] Institute of Economics and Department EmbeDS, Scuola Superiore Sant'Anna, Pisa, Italy.

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Intellectual property rights and agricultural development: Evidence from a worldwide index of IPRs in agriculture (1961-2018)

Mercedes Campi[1,*] and Alessandro Nuvolari[2]

[1]CONICET - University of Buenos Aires, Faculty of Economics, IIEP-Baires

[2]Istituto di Economia, Scuola Superiore Sant'Anna

[*]Corresponding author: mercedes.campi@fce.uba.ar

Abstract

This paper revises and updates the Campi-Nuvolari index of intellectual property protection for plant varieties (Campi and Nuvolari, 2015). The new index has been updated and provides yearly scores for the period 1961-2018 for a total number of 104 countries, which have legislation on plant variety protection in force. The new evidence highlights the tendency towards more similar and stronger systems of intellectual property rights (IPRs) worldwide, regardless of individual characteristics of countries. The signing of the TRIPS and of trade agreements with TRIPS-Plus provisions are major drivers of this process. In addition, certain features of countries such as the regulatory environment, the level of human capital, the importance of agricultural production, and openness to trade, are also significant determinants of the evolution of IPRs systems. We conclude discussing other possible applications of the data.

Keywords: Intellectual property rights; Plant breeders' rights; Patents; Agricultural development; International comparison

JEL Codes: Q01; O31; O34; O50

1 Introduction

Recent decades have witnessed a global process of strengthening and harmonization of intellectual property rights (IPRs) systems. While this was a gradual process during most of the twentieth century, it was strongly boosted by the signing of the agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS) by the end of 1994, which has had notable effects on the design of the main IPRs systems worldwide.

In the case of agriculture, this is particularly true because, before the signing of the TRIPS, a significant number of countries provided labile IPRs and many other countries did not provide any type of formal intellectual property (IP) protection for plant varieties at all. The TRIPS agreement made compulsory to provide IP protection for plant varieties –either by patents or by a *sui generis* system–, and to allow patentability of microorganisms, non-biological and microbiological processes for the production of plant varieties, as well as for pharmaceutical products. Thus, most countries had to implement dramatic changes in their IP protection systems, in particular developing countries, which were mainly those with weaker IPRs systems in agricultural and biological domains.

Simultaneously, another driver of IP reforms has been the signing of an increasing number of trade and investment agreements that include legally enforceable provisions related to IPRs (Biadgleng and Maur, 2011; Campi and Dueñas, 2019; Morin and Surbeck, 2020). The signing of these type of agreements imply clearly defined obligations that effectively bind the parties to implement measures that strengthen their IPRs systems (Horn et al., 2010). They include legally enforceable provisions that go beyond the minimum requirements of the TRIPS and, for this reason, they are known as TRIPS-Plus or TRIPS+ (Mercurio, 2006).

Both the signing of the TRIPS and of trade and investment agreements with IP provisions have generated changes in IPRs systems, which are expected to have significant effects, and their implementation implies a real and complex challenge, mainly for developing countries. Not surprisingly, this process of strengthening of IPRs regimes has been surrounded by lively controversies on its impact on economic performance and on its broader effects on social welfare (Campi, 2018).

Therefore, quantitative indicators measuring these jurisdictional and regulatory shifts are important tools to assess empirically the effects of tighter IPRs systems and for policy design. In the manufacturing sector, a large number of empirical works have analysed the implications of shifts in IPRs systems on a wide variety of dimensions such as innovation, productivity, economic growth, and development, using indicators of patent protection for the manufacturing sector or for the whole economy. Instead, in the agricultural sector, where formal IP protection is much more recent, the empirical literature is more limited but it is increasing. In this context, the construction of a comprehensive indicator capable to capture on a comparative basis the variation of IPRs regimes in agriculture would represent an important research tool for tackling a number of questions.

In Campi and Nuvolari (2015), we have constructed the index of IP protection for plant varieties by means of a detailed study of the historical evolution of the legislation in each country, identifying the key features characterizing the differences of IPRs systems for plant varieties, and developing a simple approach for transforming these legislative provisions into quantitative indicators. We selected countries that are characterized by a rather similar basic legal framework regulating plant variety protection, which follows the general guidelines established by the UPOV and seeks to comply with the TRIPS agreements.

We have used the index to investigate the impact of IPRs systems on agricultural productivity (Campi, 2017), international trade of agricultural products (Campi and Dueñas, 2016), and mergers and acquisitions in the agri-food sector (Campi et al., 2019). In addition, several authors have used the index to illustrate the strengthening and harmonization of IPRs systems in agriculture, to analyse their impact on agricultural productivity, or have cited the index as a reliable synthetic indicator of the evolution of agricultural IP protection (see, for example Spielman and Ma, 2016; Clancy and Moschini, 2017; Baker et al., 2017; Zhou et al., 2018; Nhemachena et al., 2019; Papageorgiadis and McDonald, 2019; Gold et al., 2019).

Although there is evidence of a process of strengthening and harmonization of IPRs systems in agriculture, there is still an open debate in the literature on the effect of IP protection and on the role of IPRs encouraging innovation and agricultural development. IPRs can foster investment in research and development (R&D), and innovation, which, in turn, might underpin agricultural production –for example, by allowing production in areas previously not suitable for agricultural production–, the value of agricultural production –for example, by allowing the production of new products of higher value–, and agricultural productivity –by allowing increases in yields or the production of higher-yields products (see, for example Naseem et al., 2005; Lipton, 2007; Kolady and Lesser, 2009).

However, IPRs also restrict access to knowledge, which might hinder future innovation, production, and productivity, especially affecting poor countries. There is low evidence on the impact of agricultural IPRs systems on innovation, agricultural production, and productivity. For different countries and regions the evidence is mixed and it mainly depends on specific features of countries, such as their development level and characteristics of their agricultural systems (see, for example: Louwaars et al., 2005; Campi, 2017; Moser et al., 2017). In addition, plant breeding has been recently driven by important technological changes that could need different types of IPRs, that had resulted in a process of industrial concentration, and that affect differently countries with different technological capabilities (Zilberman et al., 2007; Pray and Naseem, 2007). Thus, empirical analysis addressing the effect of changes in IPRs systems in different contexts are critically important to understand the net effect of formal IP protection on agricultural development.

Using the approach adopted in Campi and Nuvolari (2015), in this paper we present a substantially revised and updated index that covers 104 countries and the period 1961-2018. We document trends and patterns in the evolution of the index and we clearly observe that all countries have been notably increasing their levels of IP protection for plant varieties, particularly after TRIPS, while there seems to be no relation between the level of IPRs and the level of GDP per capita of countries. We conclude that the evidence might reflect that the recent strengthening and harmonization of IPRs systems was not endogenously decided according to the needs of individual countries but instead it was guided by an exogenous policy derived from the obligations of the TRIPS and of the adoption of TRIPS-Plus provisions.

We study which factors determine the adoption of IPRs systems. We conclude that certain features of countries such as the regulatory environment, the level of human capital, the importance of agricultural production, and openness to trade, are significant determinants of IPRs systems. Instead, GDP per capita is not significant, which implies that IPRs systems are not determined by the development levels of countries. Finally, the signing of the TRIPS and of trade agreements with TRIPS-Plus provisions are significant drivers of this process, especially for developing countries.

The rest of the paper is organized as follows. In Section 2, we first explain in detail the index and the main changes and updates. In Section 3, we analyse the evidence of this new version of the index, which highlights the tendency towards more similar and stronger systems of IPRs worldwide, regardless of individual characteristics of countries. In Section 4, we present the econometric estimations. Finally, in Section 5 we conclude discussing the findings of the empirical analysis and other possible applications of the data.

2 The construction of the index

In this section, we describe the index and the main revisions and updates that we included in this new version. The index considers the elements that, within the common framework provided by the UPOV and by the TRIPS, tend to vary more from country to country and over time. The index has five components:

1. *Ratification of UPOV conventions*: this component considers whether a country has adhered to the subsequent revisions of the UPOV convention (1961, 1978 and 1991).
2. *Farmers' exception*: this component considers whether the farmers' right to save seeds –that is, their entitlement to freely use the product of harvests obtained from seeds of any protected plant variety for the purpose of reproduction in their farms– is permitted, limited, or forbidden in the plant variety protection legislation.
3. *Breeders' exception*: this component considers the so-called breeders' exception –which states that the exclusion right does not extend to the use of a plant variety for experimental or research purposes by other breeders. Although the breeders'

exception is compulsory in all UPOV conventions, the version of 1991 introduced the concept of "essentially derived variety" –one that is clearly distinguishable from the initial one but retains its essential characteristics–, which are excluded from the breeders' exception, resulting in a limitation of its scope because when this limitation is introduced a breeder working on the development of a variety considered "essentially derived" needs the authorization of the owner of the initial variety even for its experimental use.

4. *Protection length*: this component considers the duration of the right.
5. *Patent scope*: this component considers whether patents are allowed in five domains which are related to plant breeding and agriculture: (i) food, which processes products from agriculture; (ii) microorganisms, which are closely related to the development of biotechnology and its application to plant breeding; (iii) pharmaceutical products because this industry also relies on biodiversity and genetic resources; (iv) plant and animals - when the invention is not limited to a specific variety; and (v) plant varieties (either sexually or asexually reproduced specific plant varieties).

We have developed a simple approach for transforming these features into quantitative indicators and, subsequently, we have aggregated these indicators in a composite index. We have normalized the values of each component so that, for any country in a given year, the index can take a score from 0 to 5, with higher scores indicating stronger intensity of IP protection.[1] The index components and the scores of the updated version of the index are presented in Table 1.

The new features of this revised version of the index are the following.

Time update: We present an yearly index for the whole period 1961-2018 (58 years).

Country coverage: In the previous version of the index, we considered 69 countries which were members of the UPOV in 2011. In this updated version, we have included 73 countries that are members of the UPOV convention in 2018 and 31 additional countries whose IP protection systems are broadly similar to those of the UPOV members and, therefore, are also considered in our index. Some of these countries have initiated the procedure for acceding the UPOV convention, and some others have been in contact with the office of the UPOV for assistance in the development of laws based on the UPOV convention (see: UPOV, 2019). In particular, among the countries that could become members of UPOV, we have included the ones that have already implemented any type of IP protection for agriculture –either patents or plant breeders' rights– in order to be able to provide index scores for them. Finally, we have included countries that have plant variety protection legislation in force although they are not members of the UPOV convention nor they have contacted the UPOV, but still have comparable systems. Table 2 presents the list of countries for which we have annual data on our index:

[1]For further details on the methodology and robustness checks, see: Campi and Nuvolari (2015).

Table 1: Index components and scores

	Component	Score Range	Normalized Score
1	*Ratification of UPOV conventions*	0-3	[0,1]
	1961	0-1	
	1978	0-1	
	1991	0-1	
2	*Farmers' Exception*	0-2	[0,1]
	Limited	0-1	
	Not considered	0-1	
3	*Breeders' Exception*	0-1	[0,1]
	Essentially derived variety	0-1	
4	*Duration*	0-35	[0,1]
	At most 35 years	0-35	
5	*Patent Scope*	0-5	[0,1]
	Pharmaceuticals	0-1	
	Microorganisms	0-1	
	Food	0-1	
	Plants and Animals	0-1	
	Plant Varieties	0-21	
	Index	0-46	[0,5]

Table 2: List of countries

Developing countries
Albania; *Algeria*; Argentina; *Armenia*; Azerbaijan; *Barbados*; Belarus; *Belize*; Bolivia (Plurinational State of); *Bosnia and Herzegovina*; *Botswana*; Brazil; *Brunei Darussalam*; *Cambodia*; Chile; China; Colombia; Costa Rica; *Dominica*; Dominican Republic; Ecuador; *Egypt*; *Ethiopia*; Georgia; *India*; *Indonesia*; *Iran*; *Iraq*; Jordan; *Kazakhstan*; Kenya; Kyrgyzstan; *Lao People's Democratic Republic*; *Malaysia*; Mexico; *Montenegro*; Morocco; *Mozambique*; *Myanmar*; Nicaragua; North Macedonia; Oman; *Pakistan*; Panama; Paraguay; Peru; *Philippines*; Republic of Korea; Republic of Moldova; Russian Federation; *Rwanda*; *Saudi Arabia*; *Serbia*; Singapore; South Africa; *Tajikistan*; *Thailand*; Trinidad and Tobago; Tunisia; Turkey; *Turkmenistan*; *Ukraine*; *United Arab Emirates*; *United Republic of Tanzania*; Uruguay; Uzbekistan; Viet Nam; *Zambia*; *Zimbabwe*
Developed countries
Australia; Austria; Belgium; Bulgaria; Canada; Croatia; *Cyprus*; Czech Republic; Denmark; Estonia; Finland; France; Germany; Hungary; Iceland; Ireland; Israel; Italy; Japan; Latvia; Lithuania; *Malta*; Netherlands; New Zealand; Norway; Poland; Portugal; Romania; Slovakia; Slovenia; Spain; Sweden; Switzerland; United Kingdom; United States of America

Note: countries in italics were not considered in the previous version of the index.

Revision and sources: The index is constructed by a detailed study of the IP-related legislation at the country level using several sources. We have used new sources that have helped us to revise and update the index. Several documents of IP-related legislation, amendments, regulations, patent guidelines, and others, are now available online in different repositories (see Appendix A). We have also consulted several secondary sources such as Bent et al. (1987); WIPO (1988); Siebeck et al. (1990); Thorpe (2002); WIPO (2004); Park (2008); Baxter et al. (2018); Westlaw (2018). We have also revised the component of patent scope with the information contained in Park (2008) and ongoing updates of this work. Additionally, we have consulted with a number of experts of different countries in the cases of missing data or to confirm information. In particular, we had several exchanges with Walter Park looking for consistency on the patent scope component with the index of patent protection of Park (2008). Given that we found new online sources available for the years already covered by the previous version of the index, we have revised all the information from 1961 to 2018 introducing corrections or emendations when necessary.[2]

Extended information on farmers' exception component: While the first conventions of the UPOV considered the farmers' exception, the 1991 convention made it optional for their members. Unlike the 1978 Act, the 1991 version does not allow farmers to sell or exchange seeds with other farmers for propagating purposes. This limitation has been criticized for being inconsistent with the practices of farmers in several developing countries (Leskien and Flitner, 1997). Regarding the right to save seeds for their own use, rather than not allowing it, many countries have been limiting it for some crops, or for farmers of up to a certain size, or by demanding a lower price for the use of saved seeds. Therefore, in order to enrich the information of this component, we now evaluate whether the farmers' exception is considered, limited, or not considered in the related legislation.

3 The evolution of agricultural IPRs: trends and patterns

In this section, we discuss the evidence provided by the revised and updated index of IP protection. In Table B.1 of the Appendix B, we present the updated index scores for 104 countries and selected years.[3]

Figure 1 shows the evolution of IP protection for plant varieties for 35 developed countries (DCs) and 69 developing or least developed countries (LDCs) in selected years between 1965 and 2015.[4]

We observe that developed countries have been increasing their levels of IP protection since 1975, while for developing countries the main increase in the index scores started in 1995, possibly driven by the signing of the TRIPS agreement. Although countries classified as less developed were granted transition periods to implement the demands of the TRIPS, several of them started implementing these reforms before the expiration of these transition periods.[5] Therefore, we observe that in the group of LDCs there are

[2] Despite our best efforts, the data may still be affected by mistakes in the source data, errors induced by the conversion of images to readable documents, or translations.

[3] The data for all years and components is available at the Supplementary Material file. Updates and possible revisions, can be downloaded from: https://mercedescampi.wordpress.com/data/

[4] The classification of countries by development level is based on United Nations: http://unctadstat.unctad.org/EN/Classifications.html

[5] For example, in a study for the Commission on Intellectual Property Rights developed in 2002, Thorpe (2002) argued that very few developing countries were still denying patent protection for pharmaceutical

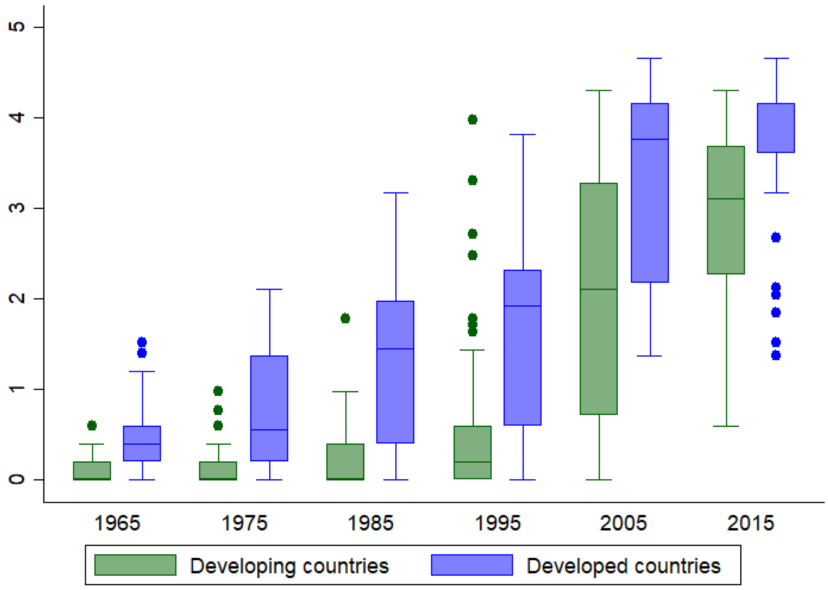

Figure 1: Evolution of the index of IP protection according to development level. 1965-2015

several outliers in 1995 and that the average level of IP protection notably increased in 2005.

In 2015, we observe that both groups have strong levels of IP protection and that dispersion between and within groups has decreased, although there are still differences between and within groups of countries.

This evidence suggests that the increase in IP protection at the country level is not related to their development levels, rather it seems to be driven by an exogenous process. This point emerges more vividly from Figure 2 that shows a scatter plot of the average of the GDP per capita and of the index of IP protection for the years before (1961-1994) and after TRIPS (1995-2018) for all the countries in our sample classified according to their development level.

We observe that all countries have significantly increased their levels of IP protection for plant varieties. But, while most developed countries have also increased their levels of GDP per capita between these two periods, most developing countries (with the exception of a few outliers) remain with relatively low levels of GDP per capita but with high levels of IP protection. While the empty dots suggest a sort of process in which as countries become richer they increase IP protection, the filled dots show an increase in the level of the index regardless the development level of countries. In other words, after TRIPS there seems to be no relation between the level of IPRs and the level of GDP per capita.

It is worth noticing that the level of economic development of countries not necessarily

products. He showed that all but three of the 30 least developed countries in Africa were apparently already providing patents for such products despite not having to do so until 2016 at that moment, period that was later extended until 2021.

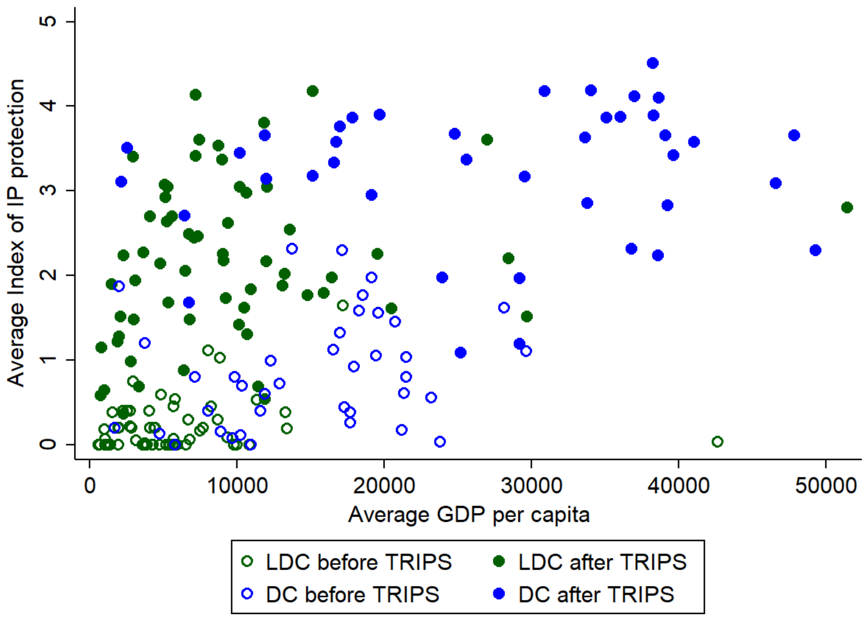

Figure 2: Average index of IP protection and average level of GDP per capita before and after TRIPS by development level of countries

reflects the level of development of their agricultural systems, which might be expected to be better linked to the evolution of their IPRs systems. Although there is no direct indicator of agricultural development, we consider that countries that can have a sufficient food supply for their population and an extra production that can be exported, also have more developed agricultural systems. Instead, countries that depend on external sources to achieve a sufficient food supply for their populations are usually countries with less developed agricultural production systems. Therefore, we also divide countries in two groups. The first one includes countries that are net exporters of agricultural products, while the second one includes those countries that are net importers of agricultural products.

Figure 3 presents the evolution of the average index of IP protection for plant varieties for net food-exporters (NFE) and net food-importers (NFI) in selected years between 1965 and 2015.[6] We observe that IPRs systems were weak in both types of countries, although on average slightly tighter for NFI, until the signing of the TRIPS, where all groups started increasing their levels of IPRs ending up with very similar levels of IP protection. Therefore, also considering this classification, it seems that the recent increase in IP protection is not necessarily related to specific characteristics of countries or agricultural systems, but with an external process that is driving the strengthening of IPRs systems.

Finally, Figure 4 illustrates the evolution of the index disaggregated by each of the five components for the 104 countries, for 1994 –before the signing of the TRIPS– and 2018.

[6]The classification of countries in net food-exporters and net food-importers is based on United Nations: http://unctadstat.unctad.org/EN/Classifications.html

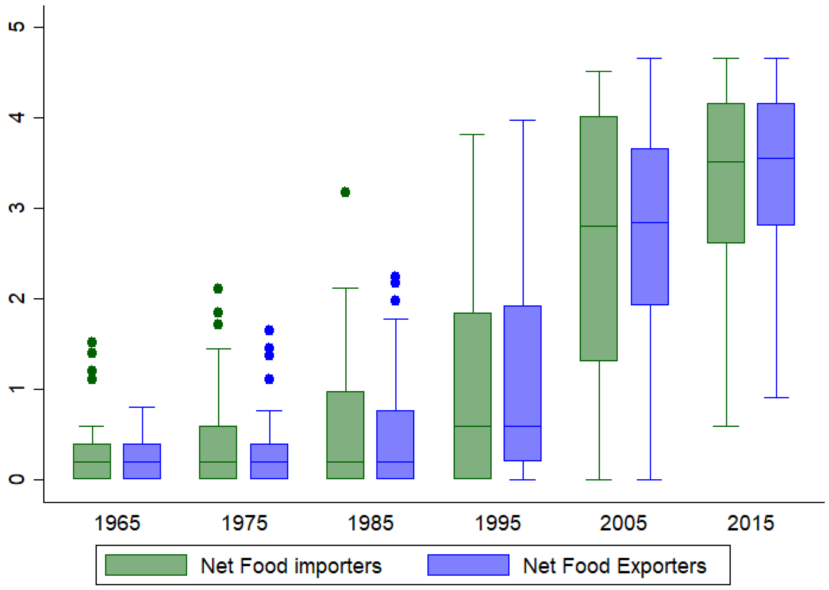

Figure 3: Evolution of the index of IP protection for net food-exporters and net food-importers. 1965-2015

Comparing both years, we clearly observe the general increase in the total scores of the index for all countries. In fact, many countries in our sample did not have IPRs systems in place before the signing of the TRIPS, particularly developing countries.

In addition, we observe that the general increase of the index is guided by an heterogeneous evolution of the components, although all of them contributed to the increase of the aggregated index. The component that indicates adherence to different versions of the UPOV convention has increased in several countries, reflecting the higher number of members. Another possible reason is that since 1998, new members of the UPOV are only allowed to adhere to the latest revision of the convention (1991). Therefore, countries that were not members of the UPOV before 1998 and adopted a *sui generis* system of IP protection based on the UPOV had to adhere to the latest version, which creates the highest possible score for this component. Comparing both years, we can claim that the limitation of the breeders' exception with the introduction of the concept of essentially derived variety is a recent phenomena since only a few countries considered it in 1994. Likewise, the farmers' exception has been limited or it is not considered in 2018 in many countries, while it was accepted in almost all countries in 1994. Also, we observe an increase in the length of protection for several countries. Finally, the component indicating patentability in agricultural-related domains has also increased in most cases, reflecting the necessity to adapt patent systems to the demands of the TRIPS agreement.

Overall, the evidence presented in this section illustrates the process that followed the signing of the TRIPS and that had different implications for developed and developing countries. While, DCs used to have in place relatively strong IPRs systems well before

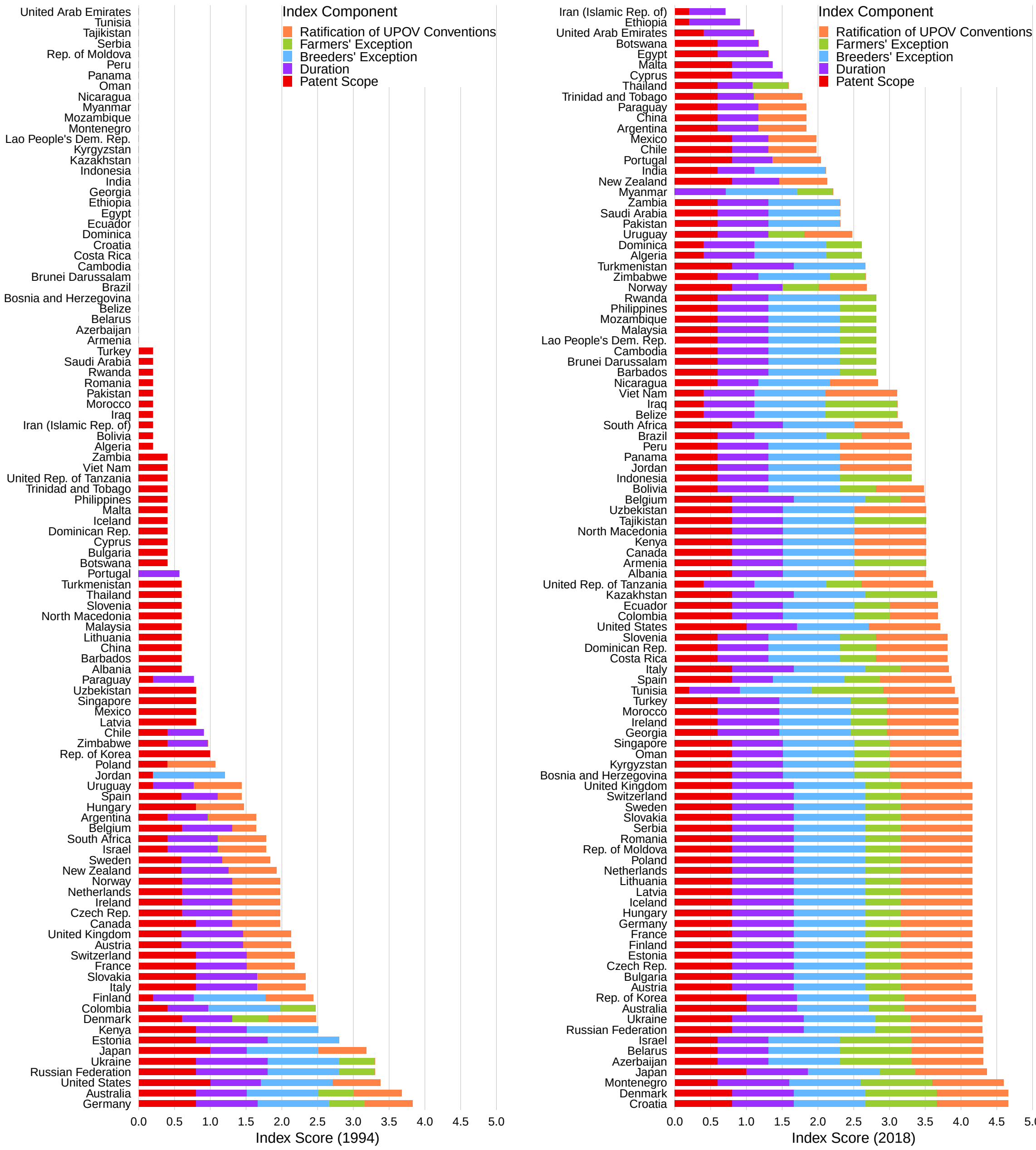

Figure 4: Evolution of the index scores by components. 1994 (left) and 2018 (right)

the TRIPS agreement, LDCs started adopting strong IP protection systems only more recently, guided by the demands of the TRIPS. Most LDCs were reluctant to tighten their IPRs systems and, therefore, the actual strengthening was not an endogenous response to domestic innovation. In contrast, several DCs were the ones pushing for uniform reforms across countries (Ivus, 2010; Delgado et al., 2013; Dutfield, 2019). Similar conclusions can be drawn if we classify countries by their agricultural development level.

Thus, the strengthening of IPRs systems can be regarded as an exogenous policy for developing countries because the TRIPS agreement was included in a package of agreements whose acceptance was a compulsory requirement of the World Trade Organization (WTO) membership. As a consequence, the decision of signing the TRIPS and the implications on IPRs systems might not be seen –in several cases– as determined at the country level but rather by an external body. In this sense, IPRs systems in the post-TRIPS period might be reasonable regarded as "exogenous". Despite this, the TRIPS agreement establishes certain minimum standards –which are quite high compared to the previous systems– but provides countries the freedom to choose the final design of their IPRs systems. This implies that there are still individual reasons for countries to adopt a certain level of IP protection and that a quantitative measure of the evolution of these systems can help addressing the effect of these decisions.

4 The determinants of IPRs in agriculture: a simple econometric model

As we observed above, the process towards stronger and more similar agricultural IPRs systems seems to have low relation with development levels of countries in recent decades. The reason is that, regardless of their development level, all countries are adopting stronger and more similar IP protection systems. In addition, we have speculated that the main drivers of this process might be the signing of the TRIPS agreements and of trade agreements that include IPRs chapters with TRIPS-Plus provisions. In this section, we provide a further assessment of the role played by TRIPS and TRIPS-plus taking into account also the effect of other factors.

Our benchmark model is the following:

$$IPR_{i,t} = \beta_0 + \beta_1 X_{it} + \beta_2 TRIPS_{i,t} + \beta_3 PTA(IP)_{it} + \gamma_i + \gamma_t + \mu_{i,t} \; ; \qquad (1)$$

where the dependent variable IPR is the index of agricultural IP protection for $t = \{1961, ..., 2018\}$ and for country i; β_0 is a constant term; $X_{it} = \{GDPpc_{i,t}, hc_{i,t}, ag\_prod_{i,t}, open_{i,t}, regul_{i,t}\}$ is a vector that contains a set of institutional and economic variables characterizing countries that could be possible determinants of their levels of IPRs: GDP per capita ($GDPpc$), which aims to capture the development level of countries; human capital (hc) that is an index based on the average years of schooling and an assumed rate of return to education, an indicator of education attainment that can be regarded as a proxy of the stock of human capital in each country; the net per capita agricultural production index (ag_prod), which aims to capture the effect of the relevance of agriculture in a given country;[7] openness to trade ($open$), defined as the sum of total exports and total imports of a country divided by its GDP, which is included because IPRs are increasingly related

[7]In constant 2004-2006 1,000 international dollars. The value of net production is computed by multiplying net production in physical terms by output prices at farm gate. Thus, value of production measures production in monetary terms at the farm gate level. See: FAO http://fenixservices.fao.org/faostat/static/documents/QV/QV_e.pdf.

to international trade; and, regulation ($regul$), which is an index that measures a set of areas regulating business activities.

We include two additional variables in order to test if they are driving the process of strengthening of agricultural IPRs. The first variable is $TRIPS$ that aims to capture the effect of the signing of the TRIPS on IPRs systems. Although all the countries in our sample have signed the TRIPS agreement and also became members of the WTO, signatory countries were given different time periods to apply the provisions of the TRIPS.[8] Thus, we expect that this difference in the time of compliance of the provisions of the TRIPS may have different impacts. We created this variable using data from Delgado et al. (2013), Park (2008), Maskus and Ridley (2016), WIPO, and WTO.[9] Thus, the variable $TRIPS$ is a dummy, which is specific for each country, and takes the value of 1 once the country has complied with the demands of the TRIPS and 0 otherwise. The second variable $PTA(IP)$ is the cumulative number of preferential trade agreements (PTAs) with legally enforceable provisions on the protection of IPRs in foreign markets that a country has in force. Undertakings may be in line with, deepen and/or broaden the scope of provisions specified in the TRIPS (Kohl et al., 2016). We consider PTAs from the year of entry into force. This variable aims to capture the effect of the so-called TRIPS-Plus and, in some specifications, it is lagged by two years.[10] The main reason is that the change in IPRs systems deriving from the entry into force of these PTAs might take a certain time to take place. However, PTAs are negotiated for several years during which countries usually start implementing the related reforms. An additional motivation for the lagged variable is that it could help addressing possible endogeneity of the signing of PTAs.

Finally γ_i and γ_t are country and time fixed effects, respectively, and $\mu_{i,t}$ are the residuals. All the estimations are carried out using robust standard errors. Table C.1 in the Appendix C shows the variables used in the econometric estimations and their sources.

Because countries of different development levels might have different agricultural systems and also different IPRs systems, we estimate the model for the full sample of countries and for two samples of developed and developing countries. In addition, we include an interaction variable between the level of IPRs and the date in which countries comply with the demands of the TRIPS, in order to better understand possible heterogeneous effects of the TRIPS. Table C.2 in the Appendix C presents the summary statistics of the explanatory variables for different samples.

Table 3 presents the estimation results. Model (1) is the benchmark model of

[8]Developed countries were granted a transition period of one year after the entry into force of the WTO Agreement, i.e. until 1 January 1996. Developing countries and transition economies were allowed a further period of four years (until 1 January 2000). Least-developed countries were granted a longer transition period of eleven years (until 1 January 2006), which was extended to 1 July 2021. See detailed information on transition periods at: www.wto.org/english/theWTO_e/whatis_e/tif_e/agrm7_e.htm, accessed on January 2019.

[9]See: www.wipo.int and www.wto.org.

[10]We also estimated the model with different numbers of lags and the results hold. Results are available upon request.

Equation (1) estimated using the full sample of countries, while models (2) and (3) restrict the sample to developed and developing countries, respectively. In model (4) we include interaction variables between the signing of the TRIPS and the level of development of countries. Models (5) to (8) are robustness checks including preferential trade agreements with legally enforceable IPRs lagged by two years.

Table 3: Determinants of agricultural IPRs systems

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sample	FS	DC	LDC	FS	FS	DC	LDC	FS
GDP per capita	-0.042	0.214	-0.129	-0.045	-0.044	0.252	-0.131	-0.045
	(0.153)	(0.373)	(0.163)	(0.144)	(0.152)	(0.366)	(0.162)	(0.145)
Human capital	1.208***	0.978**	1.202***	1.072***	1.223***	1.139**	1.206***	1.112***
	(0.265)	(0.415)	(0.312)	(0.242)	(0.266)	(0.431)	(0.313)	(0.248)
Agricultural production index	0.213**	0.155	0.257**	0.235**	0.200*	-0.003	0.252**	0.212**
	(0.104)	(0.374)	(0.101)	(0.102)	(0.105)	(0.353)	(0.101)	(0.104)
Openness to trade	0.301***	0.330**	0.187	0.251**	0.298***	0.327**	0.187	0.256**
	(0.101)	(0.147)	(0.136)	(0.104)	(0.101)	(0.150)	(0.135)	(0.105)
Index of regulation	0.151***	0.200**	0.134**	0.161***	0.152***	0.205***	0.137**	0.162***
	(0.044)	(0.074)	(0.052)	(0.043)	(0.044)	(0.073)	(0.052)	(0.043)
TRIPS	0.775***	0.412**	1.004***		0.799***	0.488***	1.006***	
	(0.134)	(0.187)	(0.172)		(0.132)	(0.178)	(0.170)	
PTAs with IPRs	0.036***	0.043**	0.046*	0.050***				
	(0.010)	(0.018)	(0.023)	(0.012)				
TRIPS * DC				0.498**				0.574***
				(0.195)				(0.185)
TRIPS * LDC				0.962***				0.970***
				(0.157)				(0.158)
PTAs with IPRs (t-2)					0.035***	0.036**	0.050**	0.046***
					(0.009)	(0.016)	(0.024)	(0.011)
Constant	-3.038***	-5.233*	-2.231*	-2.916**	-2.992**	-5.327*	-2.221*	-2.875**
	(1.136)	(2.978)	(1.227)	(1.135)	(1.140)	(3.003)	(1.224)	(1.138)
Observations	3,054	1,409	1,645	3,054	3,054	1,409	1,645	3,054
R-squared	0.715	0.774	0.670	0.720	0.715	0.770	0.670	0.719
Number of countries	92	39	53	92	92	39	53	92

Notes: The dependent variable is the index of IP protection in agriculture. FS: full sample. DC: developed countries. LDC: least developed or developing countries. Robust standard errors are in parenthesis. Significance level: *** $p<0.01$, ** $p<0.05$, * $p<0.10$.

Interestingly, GDP per capita turns out not significant in all the specifications. However, this is not surprising if we look at the evidence presented in Figure 2, where the development level seems to be uncorrelated with the level of IP protection, particularly for the post-TRIPS period.

Human capital is positive and statistically significant for all samples and in all specifications. A relevant share of agriculture and plant breeding has been shifting towards more science–based sectors, thus, countries with higher human capital can also have a more technologically advanced agriculture and, therefore, be more keen to adopt stronger IPRs systems.

The coefficients of the index of agricultural production are significant and positive for the full sample of countries and for developing countries, but are instead not significant for developed countries. This implies that those developing countries in which agriculture is relevant in economic terms have stronger IPRs systems.

Conversely, we estimate positive and significant coefficients for openness to trade when we use the full sample of countries and for the sample restricted to developed countries. Openness to trade is not significant for developing countries. The index of regulation is positive and statistically significant in all the estimated specifications, reflecting that countries with a better regulatory environment for business activities also have stronger IPRs systems.

The variable TRIPS is positive and significant in all the specifications. In the models that interact this variable with the level of development of countries (4 and 8), we observe that the effect of complying with the demands of the TRIPS is higher for developing countries. This reflects the significant impact of TRIPS for developing countries, most of which needed to implement agricultural IPRs after 1994. Although the TRIPS also had an effect on developed countries, many of them already had systems in place for which the effect is lower (see Figure 4). Finally, the variable that indicates the number of PTAs with legally enforceable IPRs turns out significant and positive in all specifications.

Overall, this is consistent with the evidence on the evolution of the index presented in Section 3. The TRIPS agreement is a relevant driver of stronger IPRs, particularly in developing countries, most of which had no IP protection systems in place or were reluctant to strengthen their level of protection before TRIPS. This agreement bound them to implement stronger IP regimes. For this reason the adoption of stronger IPRs was, up to a certain extent, an exogenous process not derived from the development level of countries. Similarly, developing countries often sign PTAs including trade-related provisions, such as those on IPRs, in order to access to trade benefits. Thus, the adoption of TRIPS-Plus reforms can also, up to a certain extent, be regarded as exogenous and not necessarily related to countries' characteristics and needs in terms of IP protection. Obviously, there are still endogenous reasons guiding the process and this is reflected in significant effects of certain features such as the regulatory environment, the level of human capital, the importance of agricultural production, and openness to trade.

5 Concluding remarks

The effect of intellectual property rights on economic development has been from the outset a very controversial matter. This is particularly true in sectors such as agriculture that deal with living organisms and provide inputs for food production.

Intellectual property rights are seen as a way to provide incentives to innovate and to solve the market failure that arises because the knowledge contained in an innovation has characteristics of a public good, which prevents the appropriation of innovation rents. However, IPRs also create social inefficiencies and do not always provide incentives to foster innovation. Thus, the effect of IPRs is ambiguous. In addition, the recent process of harmonization and strengthening of IPRs is likely to have an effect on countries that have exogenously adopted these systems seeking to comply with the TRIPS demands or with legally enforceable provisions included in trade or investment agreements.

However, there are no indicators considering the specific features of IP protection in agriculture. Thus, the revised and updated index of IP protection that we present in this paper, can help better understanding the evolution of IPRs regimes and addressing the effect of IPRs on several fields related to the agricultural sector.

The evidence provided by the index illustrates the process of strengthening and harmonization of IPRs systems in agriculture and seems to provide a reliable synthetic indicator of the evolution of agricultural IP protection.

The econometric exercise showed that the TRIPS and preferential trade agreements including legally enforceable IP provisions (TRIPS-Plus) were significant drivers of the process towards stronger and harmonized IPRs systems that started in the mid 1990s. Some features of countries, such as the regulatory environment, the level of human capital, the importance of agricultural production, and openness to trade, are also found to be significant determinants of agricultural IPRs systems, but GDP per capita indicating the level of development is instead a not significant determinant of IPRs systems.

Overall, we observe that all countries, regardless of their development level, have been tightening their IPRs systems driven by exogenous processes. This evidence is in line with that provided by other authors who show that the actual strengthening of IPRs is not a complete endogenous response to domestic needs (Delgado et al., 2013; Ivus, 2010). In this sense, Dutfield (2019) claims that developing countries are still policy takers instead of policy makers in the field of IPRs in agriculture. In doing so, these countries incur the risk of implementing IPRs regimes that are not appropriate to contexts in which traditional knowledge and collective invention are important components of farming practices.

In addition, regardless of the type of country, the effect of IPRs on agricultural performance is ambiguous. This is because IPRs have a trade-off: they are adopted with the aim of fostering innovation but because they provide a monopoly power on the use of innovations, they can lead to a decrease in the number of new products and to an increase in their price. In addition, this monopoly power might in turn reduce innovation because it restricts access to knowledge and innovations, which in the agricultural sector are particularly relevant because innovation depends on access to genetic material. Thus, the effect of IPRs depends on this trade-off and the net effect needs to be empirically determined.

Therefore, the index of IPRs for agriculture could help addressing the study of several relevant issues in agriculture and contribute to the open debate in the literature regarding the effect of IP protection and their role encouraging innovation.

In the first place, using different indicators of innovation –such as plant breeders' rights, patents, investment in agricultural R&D at the firm or country level, or the number and quality of new plant varieties–, the index could be used to investigate how stronger IPRs are actually affecting innovations in agriculture. Moreover, the index could be used to assess the effect of IPRs on indirect measures of innovation such as agricultural productivity and value added, considering also different stages of global value chains.

In addition, although plant breeding is an activity that has been developing during the last century, the application of techniques from molecular biology and modern biotechnology has radically changed it in the last three decades. The development of new plant varieties using techniques derived from modern biotechnology –genetically modified plant varieties and conventional plant varieties that are obtained using different and more precise techniques from modern biotechnology– is closely linked to the availability of stronger IPRs, which are widely used in an increasing concentrated industry dominated by a few multinational companies. This process has of course consequences on access to technology, costs of conducting research, and distribution of economic benefits (Pray and Naseem, 2007). The index could help us understanding the effect of IPRs on the development path of this industry.

Moreover, the recent process of harmonization and strengthening of IPRs systems is expected to have implications for global relations among countries (Maskus, 2012). However, the effect of IPRs on international trade, foreign direct investment, technology transfer, and mergers and acquisitions is not clear either from a theoretical perspective or from an empirical point of view (Maskus and Penubarti, 1995; Maskus, 2000; Foley et al., 2006; Campi and Dueñas, 2016). Several authors have studied how IPRs affect the manufacturing sector, but less evidence is available for biotechnology and agri-food sectors. Therefore, the index could be useful for empirical studies that could help disentangling the effect of IPRs on foreign direct investment in the agri-food sector and on international trade of seeds and agricultural products.

Last but not least, IPRs can affect food security, biodiversity, and sustainability. By creating incentives to produce certain types of commercial seeds and concentrating the market of seeds, IPRs can reduce agricultural biodiversity, risking food security and sustainability. A balance between providing incentives for investment and for conservation of biodiversity is needed (Kothari and Anuradha, 1999; Caixia and Yanping, 2012). In the context of climate change, this has become a relevant issue that deserves urgent attention and whose quantitative impact could be assessed by using an indicator of the strength of IPRs in the agricultural sector.

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Appendix

A Online databases of legislation on patent and plant variety protection

EBA Seed: https://eba.worldbank.org/en/data/exploretopics/seed
ECOLEX: www.ecolex.org
FAOLEX: www.fao.org/faolex/country-profiles/en/
Farmers' rights, legislation database: www.farmersrights.org/database/index.html
GRAIN: www.grain.org/en
InforMea: www.informea.org
PAHO: www.paho.org
Thomson Reuters Practical Law: https://uk.practicallaw.thomsonreuters.com
WHO: www.who.int/en
WIPO LEX: www.wipo.int/wipolex/en/
The World Law Guide: www.lexadin.nl/wlg/legis/nofr/legis.php

B Index of intellectual property protection for plant varieties

Table B.1: Evolution of the index of IP protection for plant varieties. Selected years

Country	1961	1965	1970	1975	1980	1985	1990	1995	2000	2005	2010	2015
Albania	0	0	0	0	0	0	0	0.6	0.6	3.31	3.51	3.51
Algeria	0	0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2.61	2.61	2.61
Argentina	0.2	0.2	0.2	0.77	0.77	0.77	0.77	1.64	1.84	1.84	1.84	1.84
Armenia								0	3.51	3.51	3.51	3.51
Australia	0.2	0.2	0.2	0.2	0.2	0.4	1.98	3.68	4.21	4.21	4.21	4.21
Austria	0.2	0.2	0.2	0.2	0.2	0.4	0.6	2.32	2.32	4.16	4.16	4.16
Azerbaijan								0	3.31	4.31	4.31	4.31
Barbados	0	0	0	0	0	0.6	0.6	0.6	0.6	2.81	2.81	2.81
Belarus								2.71	2.71	4.31	4.31	4.31
Belgium	0.4	0.4	0.4	1.11	1.45	1.45	1.65	1.65	1.65	1.85	1.85	3.49
Belize	0	0	0	0	0	0	0	0	3.11	3.11	3.11	3.11
Bolivia	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	1.07	3.28	3.48	3.48
Bosnia and Herzegovina								0	0	0.8	3.01	3.01
Botswana	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	1.17	1.17
Brazil	0	0	0	0	0	0	0	0	3.28	3.28	3.28	3.28
Brunei Darussalam	0	0	0	0	0	0	0	0	0	0	0	2.81
Bulgaria							0	0.4	3.76	3.76	4.16	4.16
Cambodia	0	0	0	0	0	0	0	0	0	0.4	2.61	2.81
Canada	0.2	0.2	0.2	0.2	0.2	0.6	1.31	1.98	1.98	1.98	1.98	3.51
Chile	0	0	0	0	0	0	0	0.91	1.58	1.78	1.98	1.98
China						0.2	0.2	0.6	1.84	1.84	1.84	1.84
Colombia	0	0	0	0	0	0	0	2.47	3.54	3.68	3.68	3.68
Costa Rica	0	0	0	0	0	0	0	0	0.4	0.4	3.81	3.81
Croatia								0	2.81	4.51	4.66	4.66
Cyprus	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.8	1.51	1.51	1.51
Czech Rep.								1.98	3.82	4.16	4.16	4.16
Denmark	0	0	0.33	0.33	0.33	1.07	2.48	2.48	4.66	4.66	4.66	4.66
Dominica	0	0	0	0	0	0	0	0	2.61	2.61	2.61	2.61
Dominican Rep.	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.6	0.6	3.81	3.81
Ecuador	0	0	0	0	0	0	0	0	3.68	3.68	3.68	3.68
Egypt	0	0	0	0	0	0	0	0	0	1.31	1.31	1.31
Estonia								2.8	4.16	4.16	4.16	4.16
Ethiopia	0	0	0	0	0	0	0	0.2	0.2	0.2	0.91	0.91
Finland	0	0	0	0	0	0.2	0.2	2.84	3.62	4.16	4.16	4.16
France	0.4	0.6	1.31	1.65	1.65	2.18	2.18	2.18	2.18	2.18	2.32	4.16
Georgia								0	2.6	2.6	3.96	3.96
Germany	0.4	0.4	1.65	1.85	1.85	1.99	2.32	3.82	4.16	4.16	4.16	4.16
Hungary							0.67	1.47	1.98	2.31	4.16	4.16
Iceland	0	0	0	0	0	0	0	0.4	0.6	3.16	4.16	4.16
India	0	0	0	0	0	0	0	0	0	2.11	2.11	2.11
Indonesia	0	0	0	0	0	0	0	0	3.31	3.31	3.31	3.31
Iran	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.71	0.71	0.71
Iraq	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4	3.11	3.11	3.11
Ireland	0	0.4	0.4	0.4	0.4	1.98	1.98	1.98	3.62	3.62	3.62	3.96
Israel	0.4	0.4	0.4	1.11	1.45	1.78	1.78	1.78	4.31	4.31	4.31	4.31
Italy	0.4	0.4	0.4	1.26	1.79	1.79	2.32	2.32	3.82	3.82	3.82	3.82
Japan	1.51	1.51	1.51	1.71	2.51	3.18	3.18	3.18	4.21	4.36	4.36	4.36
Jordan	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	2.31	3.31	3.31	3.31
Kazakhstan								0	3.66	3.66	3.66	3.66
Kenya	1.4	1.4	1.4	2.11	2.11	2.11	2.51	2.51	3.18	3.18	3.18	3.18
Kyrgyzstan								0	4.3	4.01	4.01	4.01
Lao People's Dem. Rep.	0	0	0	0	0	0	0	0	0	0	0.91	2.81
Latvia								0.8	0.8	4.16	4.16	4.16

Lithuania							0	0.6	1.66	4.16	4.16	4.16
Malaysia	0.4	0.4	0.4	0.4	0.4	0.4	0.6	0.6	0.6	2.81	2.81	2.81
Malta	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	1.37	1.37	1.37
Mexico	0	0	0	0	0	0	0	0.8	1.98	1.98	1.98	1.98
Montenegro											3.6	4.6
Morocco	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	2.61	2.61	3.76	3.96
Mozambique	0	0	0	0	0	0	0	0	0.2	0.2	1.81	2.81
Myanmar	0	0	0	0	0	0	0	0	0	0	0	2.21
Netherlands	0.71	0.71	1.45	1.45	1.45	1.78	1.98	2.18	3.51	3.66	4.16	4.16
New Zealand	0.4	0.4	0.4	0.4	0.4	1.72	1.72	1.92	1.92	1.92	1.92	2.12
Nicaragua	0	0	0	0	0	0	0	0	1.97	2.84	2.84	2.84
North Macedonia								0.6	0.6	0.6	2.51	3.51
Norway	0	0	0	0	0	0.2	0.2	1.98	1.98	1.98	2.68	2.68
Oman	0	0	0	0	0	0	0	0	1.31	1.31	4.01	4.01
Pakistan	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.6	0.6	0.6
Panama	0	0	0	0	0	0	0	0	1.98	1.98	1.98	3.31
Paraguay	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.77	1.44	1.84	1.84	1.84
Peru	0	0	0	0	0	0	0	0	2.11	2.11	2.31	3.31
Philippines	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.6	2.81	2.81	2.81
Poland							0.67	1.07	2.92	4.16	4.16	4.16
Portugal	0	0	0	0	0	0	0.57	1.84	1.84	2.04	2.04	2.04
Rep. of Korea	0.4	0.4	0.4	0.4	0.4	0.4	1	2.71	2.71	3.71	4.21	4.21
Rep. of Moldova								0.6	3.46	3.46	3.66	4.16
Romania							0	0.2	2.26	3.26	4.16	4.16
Russian Federation								3.3	4.3	4.3	4.3	4.3
Rwanda	0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.6	0.6
Saudi Arabia	0	0	0	0	0	0	0.2	0.2	0.2	2.31	2.31	2.31
Serbia											0.6	4.16
Singapore	0	0.6	0.6	0.6	0.6	0.6	0.6	0.8	0.8	4.01	4.01	4.01
Slovakia								2.32	3.82	3.82	4.16	4.16
Slovenia								0.6	3.81	3.81	3.81	3.81
South Africa	0.4	0.4	0.4	0.4	1.45	1.78	1.78	1.78	2.98	3.18	3.18	3.18
Spain	0.2	0.2	0.2	0.71	1.05	1.05	1.25	1.45	3.2	3.2	3.87	3.87
Sweden	0	0	0	0.9	1.3	1.84	1.84	1.84	3.96	4.16	4.16	4.16
Switzerland	0.2	0.2	0.2	0.2	1.45	1.78	2.18	2.18	2.18	2.18	4.16	4.16
Tajikistan								0	0	0.8	3.51	3.51
Thailand	0	0	0	0	0	0	0	0.6	1.59	1.59	1.59	1.59
Trinidad and Tobago	0	0.4	0.4	0.4	0.4	0.4	0.4	0.4	1.78	1.78	1.78	1.78
Tunisia	0	0	0	0	0	0	0	1.71	2.91	3.91	3.91	3.91
Turkey	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.4	0.6	2.96	3.96	3.96
Turkmenistan								0.6	0.6	0.6	0.8	2.66
Ukraine								3.97	3.97	3.97	4.3	4.3
United Arab Emirates	0	0	0	0	0	0	0	0	0	0.4	1.11	1.11
United Kingdom	0.4	1.11	1.45	1.45	1.65	2.12	2.12	2.12	4.16	4.16	4.16	4.16
United Rep. of Tanzania	0	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	2.11	2.11	3.61
United States of America	0.8	0.8	1.37	1.37	1.57	2.24	2.24	3.38	3.71	3.71	3.71	3.71
Uruguay	0.2	0.2	0.2	0.2	0.2	0.77	0.77	1.44	1.64	1.84	2.48	2.48
Uzbekistan								0.8	0.8	3.51	3.51	3.51
Viet Nam	0	0	0	0	0	0	0.4	0.4	0.4	2.11	3.11	3.11
Zambia	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	2.11	2.11
Zimbabwe	0.4	0.4	0.4	0.97	0.97	0.97	0.97	0.97	0.97	2.67	2.67	2.67

Notes: Missing scores are attached to countries that did not exist in those periods. A score of 0, instead, indicates that no IP protection was available at the time. The data for all years and components, as well as updates and possible revisions, can be downloaded from: https://mercedescampi.wordpress.com/data/

C Definition of variables, sources, and summary statistics

Table C.1: Variables used in the econometric estimations and sources

Name (Label)	Description	Source
TRIPS compliance ($TRIPS$)	Dummy variable that indicates for each country the year in which they comply with the demands of the TRIPs agreement	Delgado et al. (2013), Park (2008), Maskus and Ridley (2016)
PTAs with IP chapters ($PTA(IP)$)	Cumulative number of PTAs with legally enforceable IP chapters	Kohl et al. (2016)
GDP per capita ($GDPpc$)	GDP per capita	Feenstra et al. (2015)
Human capital (hc)	Index of human capital that considers the average years of schooling and the returns to education	Penn World Tables Version 9.0: Feenstra et al. (2015)
Net agricultural production index per capita ($lnpcpi$)	Net per capita agricultural production index in ln	FAOSTAT*
Openness to trade ($opne$)	Total exports plus total imports divided by GDP	Penn World Tables Version 9.0: Feenstra et al. (2015)
Index of regulation ($regul$)	Index that measures a set of areas that regulate business activities	Fraser Institute**

Notes: *www.fao.org/faostat/en, **https://www.fraserinstitute.org/

Table C.2: Summary statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
	Full sample				
GDP per capita	4,822	8.968	1.146	5.506	12.409
Agricultural production index	5,010	4.296	0.547	1.401	7.000
Openness to trade	4,822	-1.113	1.032	-11.164	2.736
Index of regulation	3,443	6.239	1.449	1	9.320
TRIPS	5,175	0.329	0.470	0	1
Number of PTAs with legally enforceable IPRs	6032	3.455	7.545	0	32
	Developing countries				
GDP per capita	2,950	8.515	1.091	5.506	12.409
Agricultural production index	3,104	4.201	0.622	1.401	7.000
Openness to trade	2,950	-1.350	1.055	-11.164	1.807
Index of regulation	1,863	5.959	1.372	1	9.320
TRIPS	3,276	0.250	0.433	0	1
Number of PTAs with legally enforceable IPRs	3,712	0.789	2.295	0	24
	Developed countries				
GDP per capita	1,872	9.682	0.822	6.744	11.084
Agricultural production index	1,906	4.451	0.343	2.615	5.314
Openness to trade	1,872	-0.739	0.874	-5.002	2.736
Index of regulation	1,580	6.568	0.469	1.58	9.160
TRIPS	1,899	.465	0.499	0	1
Number of PTAs with legally enforceable IPRs	2,320	7.721	10.491	0	32

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