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INTELLECTUAL PROPERTY RIGHTS AND KNOWLEDGE DIFFUSION IN THE GLOBAL ECONOMY

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Abstract. This paper reviews recent and novel findings in the research linking international trade and trade policy to global protection of intellectual property rights (IPRs). The bulk of this research uses data on patent rights, patent applications, and trade to analyze how responsive bilateral trade and patenting flows are to IPRs. Detailed sectoral and firm-level patents and trade are highly correlated, while both are positively affected in high-technology sectors by stronger patent rights. Preferential trade agreements are of growing importance in this area. There is far less research on the trade effects of other forms of IPRs, including copyrights, which is a major missing element in this research. However, recent research suggests that international licensing by multinational enterprises in copyright-intensive industries is influenced strongly by copyright laws. Considerably more research is needed to address important questions in this literature.

1. Introduction

In a major policy watershed, the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) at the World Trade Organization (WTO), founded 30 years ago, ushered in a new baseline for global intellectual property (IP) protection. That agreement requires all WTO members to establish in their laws and regulations certain minimum standards of protection across all forms of intellectual property rights (IPRs) recognized at that time. These comprehensive provisions are enforceable under the WTO dispute-settlement system and must be offered on a non-discriminatory basis to the nationals of all WTO countries. In consequence, TRIPS establishes a baseline set of standards that effectively globalized IP protection.

In the years since TRIPS was initiated, the IP system has become more comprehensive in subject matter and more internationalized. One channel is the additional norms, especially in digital copyrights, negotiated in treaties of the World Intellectual Property Organization (WIPO). Another is the hundreds of bilateral investment treaties (BITs) promulgated among countries, many of which define patents and other IPRs as investments

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deserving safeguards against policy actions that might dilute their value. Most important are the numerous and proliferating regional and mega-regional preferential trade agreements (PTAs) that embody so-called "TRIPS-Plus" protective standards that go beyond the WTO baseline and set expectations for stronger enforcement against infringement. Major examples include the Comprehensive and Progressive Agreement for Trans-Pacific Partnership, the US-Mexico-Canada Free Trade Agreement, and the Comprehensive Economic and Trade Agreement between the European Union and Canada. These many policy initiatives greatly have extended the depth and breadth of international IP protection and have constructed a complex architecture of rules.

To be sure, this system is not fully harmonized and many protective systems remain somewhat fragmented across countries. For example, the least-developed countries, which often have upgraded their legal protections, are not generally expected to exceed the TRIPS baseline norms, nor to invest in enforcement mechanisms. They are rarely invited to join PTAs with significant TRIPS-Plus expectations. In contrast, most emerging and middle-income countries have undertaken major policy reforms, pushing them close to the standards found in much of the developed world.[1]

More recently IP systems have been faced with the need to keep up with extensive technological changes, ranging from biogenetics and renewable energy to digital trade, data protection, and artificial intelligence. Many such issues implicate multiple policy regimes, including trade, investment, and domestic regulations. Prominent are the regulatory systems governing IPRs, which, while often struggling to adapt, must be fit into these broader frameworks. Little wonder that these new technologies dominate recent and current negotiations within PTAs.

Overall, the 30 years since TRIPS have seen the greatest global expansion and convergence of IPRs provisions in history, at least among developed and larger and technologically capable emerging countries (ECs). It is instructive to recall what this system was supposed to achieve, as argued by its proponents. A primary claim was that stronger IPRs would improve national and global environments for innovation and creative activity.

[1]See Maskus (2012) for an extensive discussion and quantification of these policy changes.

While innovation and technology diffusion are closely related, a discussion of the former lies beyond the scope of this paper.[2] Indeed, whether TRIPS and subsequent IPRs policies can be credited with increasing R&D investments and patenting is under active debate, with mixed messages in the empirical literature. To summarize, it is difficult to identify a trend increase in overall R&D or artistic and literary expression in the post-TRIPS era, though that macroeconomic observation says little about what role strong IPRs may play. There is some evidence that the strength of patent laws is positively correlated with the growth in real value added in high-technology manufacturing industries across developed and emerging countries (Hu and Png, 2013). Regarding innovation, one study found that national IPRs reforms in middle-income countries before TRIPS and in the early TRIPS era raised local R&D in pharmaceutical products for which patents were sought in the United States, but only for those countries above certain income and educational levels (Qian, 2007). Another found that expenditures on clinical trials of new medicines rose after patent reforms in both developed and certain middle-income economies, but only for drugs with a high prevalence in rich countries with large markets and not for diseases endemic in poor countries (Kyle and McGahan, 2012). In brief, there are microeconomic indications of an innovation response but only in countries that already had a sound basis for knowledge creation, with little activity in the poorest and smallest countries. Moreover, stronger patent rights may induce more R&D in goods with greater market potential but not in countries or goods with limited purchasing power or demand.

As for trademarks, the argument was that by deterring infringement, a common problem in developing countries, greater protection would incentivize more local business development and product entry. The limited econometric evidence available suggests that trademark rights are positively correlated with business development in emerging and developing countries, making it (and similar regimes such as geographical indications) a potentially useful development policy (Maskus, 2012). Similarly, improvements in copyright laws and related institutions were promoted as a means of reducing unauthorized copying and other forms of piracy. This problem, also common in developing nations,

[2]Maskus (2022) offers a comprehensive review.

likely limits the growth of software and music and other creative industries. Indeed, copyright protection correlates positively with the size of copyright-based sectors and may play a role in the development of creative enterprises in developing countries (WIPO, 2021).

The concern in this paper is how IPRs impact technology transfers across borders. This was, in fact, the primary justification for TRIPS because trade and foreign direct investment (FDI) embody knowledge about new goods, processes, and production techniques, which can create positive learning spillovers and inventive domestic adaptation. Article 7 of the agreement states plainly that "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..."[3]

The balance of the paper reviews important evidence about IPRs and technology diffusion from recent studies. At the outset, however, it must be noted that performing empirical research in this area is challenging for numerous reasons. First, IPRs, a catch-all term covering patents, industrial designs, copyrights, trademarks, geographical indications, trade secrets, and many sub-formulations of these policies, are complex policy devices that operate differently. They may have a variety of intricate incentive and disincentive effects, sometimes working at cross-purposes. In general, the function of IPRs is to address static and dynamic market failures and information problems of great variety and complexity. For example, patents provide exclusive and temporary rights to an inventor to exploit a new good or technology, attempting to overcome a dynamic free-rider problem. In contrast, trademarks certify the origin of goods and services, which should diminish the "lemons problem" in markets with extensive counterfeiting. Copyrights permit owners to prevent others from producing and selling copies of their artistic and literary expressions, including software and digital goods, but do not protect names or ideas from duplication.

This complexity has many implications, two of which are particularly important to note here. For one, the practice of economists to lump all these policies into a category called

[3]World Trade Organization, Agreement on Trade-Related Aspects of Intellectual Property Rights, Annex 1C, Article 7 (Objectives).

IPRs and expect it to have predictable impacts on economic activity can be significantly misleading. For another, because IPRs operate both statically and dynamically in an inherently distorted economic environment, policies that may encourage innovation or creation in one set of socioeconomic circumstances may reduce competition and build inefficient market power in another. These factors point to the need for research questions to be framed in a way that takes account of specific national and temporal conditions.

Second, IPRs differ from more familiar economic policies in several important ways. Most significant is that IPRs are national regulations faced by all economic activities and sectors, unlike sectoral taxes, subsidies, and import tariffs. Cutting specific taxes or input tariffs directly reduces costs and almost surely expands final output and trade. In contrast, if a country raises patent scope or the length of copyright terms the impacts will be different across countries and industries, with those effects depending on, among other factors, local skill supplies, depth of financial markets, and the quality of contracts. It is challenging to make sharp theoretical predictions about how national or global IP reforms may change economic activity.

Third, there are many data shortcomings in this area, particularly across countries at different levels of economic development. For example, we would like to know how differences in the strength of patent rights affect the cross-border flows of patents (whether as a measure of technology transfer or a protective device) and trade. However, it is difficult to develop measures of national patent protection designed specifically for this purpose. As noted later, early evidence found a strong positive correlation between an index of patent laws and trade in high-technology goods. But what is it about those patent rights at the microeconomic level that may induce more trade or investment? Another example is that there are few databases of global copyright ownership that might be used to track the impacts of copyright laws on trade or investment in merchandise, much less in digital goods and services, which generally go unreported except at the broadest level. Trademark data are also difficult to track and interpret, given the great variability in their economic value and the disparate names assigned in different countries.

Most challenging, however, is the essential difficulty of assigning causality from national IP reforms to both microeconomic responses and macroeconomic concepts such as economic growth, sectoral dynamism, and income inequality. These are critical issues that need far more research. The primary reason it is hard to establish causality is that there are many confounding factors that must be accounted for in empirical work. Among the challenges is that IP policy may be endogenous to those factors.

Despite these problems, economists have recently made progress in analyzing particular empirical propositions, thereby improving our understanding of how the evolving IP system alters economic outcomes, particularly at the microeconomic and sectoral levels. This research has additionally illuminated ways in which such effects are conditional upon other economic factors. Thus, this article offers a selective progress report, emphasizing the most recent and novel studies of international trade, investment, and strategic IP use. Almost inevitably, because of relative data scarcity, the review focuses on the impacts of policy change on international information diffusion through patents and trade, data on which are widely available. However, studies are emerging of the role of trademarks and copyrights in trade, which will be covered toward the end of the paper.

2. How Patent Rights and Trade Interact

Whether intellectual property rights are trade-related, in the sense that IPRs rules are a determinant of trade and cross-border patenting, has been the subject of empirical inquiry since the early days of TRIPS (Maskus and Penubarti, 1995; Smith, 2001; Ivus, 2010; Lerner, 2009). A broad consensus emerged from that literature, which may be summarized as follows. First, foreign firms rapidly increase their patent applications in emerging and larger developing countries that adopt significantly stronger patent laws. However, it takes considerably longer for domestic patent filings to rise. Second, middle-income and emerging countries with stronger legal patent regimes, typically measured by the count-based index developed by Ginarte and Park (1997), attract significantly larger imports of high-technology goods from developed countries than do those with weaker patents. Third, stronger patents are also positively correlated with inward flows of foreign direct

investment (FDI) and technology and production licensing in manufacturing (Park and Lippoldt, 2005). Thus, a baseline finding is that patent reforms contribute to technology diffusion to emerging economies, at least through market-mediated channels. However, this finding does not extend to such reforms in poor and small developing countries, where patents are of limited importance and high-technology multinational firms rarely operate (Maskus, 2012).

While informative, this early literature suffered from numerous shortcomings, including inadequately addressing policy endogeneity and the difficulty of assigning causation using highly aggregated patent indexes. Most problematic is that a correlation between trade or FDI and the strength of national IPRs cannot readily identify the mechanisms by which trade is stimulated or the relevant microeconomic characteristics of trade and production. The balance of this section reviews recent literature aimed more at these foundational questions.

2.1. **Patent-related export characteristics.** Recent research uses detailed trade data and firm-level variables to investigate the channels through which high-technology trade responds to patent rights. Such data can analyze whether the response is more at the intensive margin, in which exporters sell more of the existing products to the same countries, or at the extensive margin, where domestic firms become exporters or existing enterprises export to new markets. Another possibility is that as global IPRs strengthen firms invest in greater export quality, permitting products to enter more foreign countries at higher price markups.

Four notable studies, among others, analyze the characteristics of industry or product exports in relation to international differences in IP rights in both importing nations and exporters, in a variety of contexts. Ivus (2015) estimated the impacts of changes in destination-country patent rights (GP index) on bilateral US exports, accounting for policy endogeneity. The identification strategy relied on the fact that emerging economies that were former European colonies were required by TRIPS to tighten their patent standards

significantly less than others. The empirical analysis discovered significantly higher entry rates of new product varieties into emerging markets with greater expansion of patent rights in the 1990s. Indeed, such extensive-margin effects dominated export growth stimulated by importer IPRs, with a consequent welfare gain from greater access to new product varieties.

Next, Lin and Lincoln (2017) studied confidential firm-level US exports to different countries, matching the exports to patents granted by the United States Patent and Trademark Office (USPTO) to those firms. Remarkably, in 1997 just nine percent of US manufacturing firms owned at least one US patent. However, these enterprises were disproportionately large and export-oriented, accounting for 89 percent of US manufacturing exports. Thus, size, exports, and innovation are both concentrated and highly correlated. The authors estimated whether patent-owning firms were more likely to ship to countries with stronger patent rights. Incorporating numerous controls, they found that a rise in destination patent rights significantly raised the probability that a patent-owning firm would begin exporting to that country in comparison with other firms. Such enterprises paid higher wages than average and employed relatively more skilled workers. Combining the results of these two studies, it seems that a key reason for the positive export response of high-quality and IP-sensitive goods to foreign patent strength is that innovative exporting firms enter new markets.

Third, de Rassenfosse, et al (2022) studied relationships between firm-level patent ownership and trade. These authors employed highly detailed export-transaction level data for French firms, matched to patent ownership. They argued that a primary reason for registering a patent in foreign markets was that it would help secure the economic returns to exporting there. That is, patent ownership could be causal to bilateral exports. This was the first study to econometrically link micro-level exports to patent ownership abroad, an important milestone. Further, transactions data can be used to break down impacts on both export quantities and prices. A long-standing issue in the literature relating IPRs to trade is whether a positive impact of patent on trade is due to greater volumes or higher markups (Maskus, 2012). Employing a firm-level instrument to control the endogeneity

of patents to trade, the authors found that French firms have higher sales premiums in markets where they own patents. Further, most of the additional revenue is due to higher trade volumes, not markups.

The fourth study focused on how firms make export decisions to particular markets depending on local patent rules and enforcement (Palangkarya, et al, 2017). Rather than relate trade to some national patent index, these authors looked at patent examination records across nations and constructed measures of the difficulty of gaining protection in each location. These included bias at examination offices against foreign applicants and patents owned by others that might block imports. These variables were included as "trade costs" in a bilateral gravity trade model of detailed industry imports, estimated from 1976 to 1999 across 189 exporting nations to countries where examination and patent records were available. Industries were characterized by levels of technology use. The econometric analysis unearthed evidence of significantly negative impacts on trade of both examiner bias and the probability of patent blockage, with larger effects in high-technology and medium-technology sectors. This was the first demonstration that specific aspects of patent regulation have strong effects on bilateral trade, helping explain with microeconomic data why there is a correlation between exports and patent standards.

2.2. **Domestic patent rights and exports in emerging countries.** In addition to attracting more high-technology imports and higher-quality goods, patent reforms have the potential to increase exports in emerging and middle-income countries. This question has been extensively studied in theoretical settings (He and Maskus, 2012; Branstetter, et al, 2011). At the simplest level, stronger domestic IPRs could stimulate domestic innovation with a lag, building greater export potential. Perhaps more likely is that this policy would encourage more inward technology flows, raising the prospects for domestic learning and information spillovers that would raise productivity and increase exports. Further, a direct impact could be that foreign multinational enterprises would be more likely to share advanced technologies with affiliates and suppliers in reforming economies, leading to greater domestic export capacity.

Evidence has emerged supporting these claims, at least in emerging and middle-income countries with adequate capacity to absorb and adapt technology. Delgado, et al (2013) regressed industry-level imports or exports across countries on dummies for years following national compliance with TRIPS (which was phased in), plus their interactions with indicators for high-IP goods and dummies for high-income countries and emerging and developing countries (EDCs) over the period 1993-2009. The definition of high-IP goods included such high-IP clusters as biopharmaceutical products, medical devices, and information-communication technologies. Their regressions found significant increases in high-IP exports for both high-income nations and EDCs, with coefficients growing in magnitude over time. Their findings suggest that compliance with TRIPS strongly expanded exports of high-technology goods (relative to low-technology goods) from both country types.

While noteworthy, this result says little about the channels through which export growth could occur, the question raised in two additional studies. Maskus and Yang (2018) analyzed how exports of patent-intensive goods respond to variations in domestic patent strength, rather than membership in TRIPS. They used trade data across 102 countries in five-year increments from 1995 to 2010, along with several industry characteristics interacted with policy measures (including effective patent rights) and factor endowments. They found that exports of patent-intensive goods were significantly greater in countries with stronger domestic patent rights, which difference increased over time. The positive export coefficients were largest in developed economies but also significant in EDCS. In subsequent estimation they included policy interactions with three variables measuring technology transfer: the domestic stock of non-resident patent applications by technology class, within-firm imports from the United States of intermediate inputs at the sector level, and industry employment in affiliates of US MNEs. All these channels increased the responsiveness of exports to legal rights in patent-intensive sectors, suggesting that all are sources of learning, adaptation, and quality upgrading.[4]

[4]Liu, et al (2021) found evidence that the quality level of exports was larger for EDCs with stronger patent rights, but this elasticity depended strongly on the technological sophistication of each country. Put differently, as emerging

Lai, et al (2020) studied whether stronger IP enforcement stimulated greater innovation and export growth among Chinese manufacturing firms in the period after China joined the WTO in 2001. The econometric work was based on a model of heterogeneous firms that identified productivity cutoffs among firms that export, import new capital goods, and invest in new products. These decisions depended on both IPRs strength and tariff cuts, both of which experienced major changes at that time. The enforcement of IPRs was measured by the ratio of lawsuits in each province in which the court found for the IP owner in the early to mid-2000s. These figures were combined with firm-level data on exports, capital-goods imports, and new product development. The theory predicted that stronger IPRs enforcement would stimulate more of all three of these activities among the most productive firms, with most of the impacts coming at the extensive margins and less at the intensive margins. The empirical estimates strongly supported these claims, implying that trade liberalization and patent enforcement together pushed Chinese firms into both exporting and innovating more. These findings point to innovation induced by trade competition and IPRs as a primary channel for stimulating export growth.[5]

2.3. **Preferential trade agreements, trade, and patents.** As noted above, one of the strongest policy forces pushing stronger global IPRs standards is the proliferation of PTAs, which reduce tariffs and establish regulatory expectations in multiple areas among member countries. A central issue is whether "deep trade agreements" involving extensive regulatory commitments change international economic incentives. Maskus and Ridley (2021) studied the trade impacts of PTAs that require members to establish and enforce "TRIPS-Plus" IPRs standards, which go beyond the minimum provisions of the TRIPS Agreement. They labeled such accords "IP-related trade agreements," or IPAs, which became common after the mid-1990s. The authors designed an econometric model to identify the differences in IP-intensive sectoral trade volumes among countries that mutually joined such agreements versus those that did not, controlling for the date of TRIPS compliance. Thus, there was a control group of low-IP goods in countries that did not join an IPA

economies approached the global sophistication frontier the ability of patent rights to expand export quality became larger, suggesting a correlation between development stages and export growth, facilitated by IPRs.

[5]Aghion, et al (2015) found similar results with European data in the wake of the Single Market formation.

and a treatment group of goods in high-IP clusters, such as pharmaceuticals, medical devices, and information technologies, in countries that did. They estimated regressions using highly detailed bilateral trade statistics, accounting for endogeneity in the decision to join an IPA. A sample of 187 countries was included over the period 1995-20014, with nations broken into four groups based on per-capita GDP.

Two findings were sufficiently novel to discuss here. First, both TRIPS and IPAs had significant impacts on bilateral trade but were generally larger for the latter. Membership in IPAs significantly raised exports of most high-IP clusters from all country groups except the low-income group. Second, there was an evident trade impact based on comparative advantage, in that IPA membership tended to reduce exports of low-IP goods and raise exports of high-IP goods in comparison with the control countries.

While these trade impacts are noteworthy, IPAs likely have other important economic effects. Regarding technology diffusion, a central question is whether bilateral patent filings are responsive to membership in IPAs. The fact that so much negotiating capital is expended by the major nations, such as the United States and members of the European Union, to procure stronger IPRs in such trade agreements suggests that corporate innovators and creators in those locations see them as key means of achieving protection (Maskus, 2012). This issue was studied extensively by Howard, et al (2025). An essential feature of IPAs is that their provisions cannot discriminate between firms from member and non-member countries. However, IPAs also offer trade preferences among members, which could change relative incentives to patent across borders, leading to the possibility of "intellectual property creation" within the agreements and "intellectual property diversion" away from non-members. Further, IPAs embody other regulatory provisions that could affect patenting, especially rules on protecting foreign investment.

With this insight in mind, the authors set out an econometric model in which bilateral patent flows responded differently, depending on whether an origin country and a destination nation were members of an IPA and whether one was in an IPA and the other was not. Key to the identification was the designation of four kinds of treatment IPAs: (1) those with IP provisions that were considered by their language to be legally enforceable;

(2) whether one partner was the United States; (3) whether one partner was the EU or the European Free Trade Association (EFTA); and (4) whether they contained at least three core "TRIPS-Plus" standards in high-IP sectors. These definitions were based on the World Bank's Database of Deep Trade Agreements. The equations also included indicators of whether both nations were in an agreement with any IPR provision at all and whether they were both party to a bilateral investment agreement.

The authors assembled data on domestic and international patent applications for 187 source countries and 82 destination countries or patent offices over the period 1995-2015. The estimations were performed within a structural-gravity setup, including comprehensive fixed effects. The regressions identified some novel and intriguing findings. First, US-partnered IPAs, and agreements with three or more core TRIPS-Plus provisions, significantly increased bilateral patent applications between members, both in total and for such IP-intensive sectoral clusters as pharmaceuticals, medical devices, and information technologies. These IPAs may be considered the most rigorous in terms of elevating and enforcing standards, a strategy that stimulates within-agreement patent flows. Second, these two IPA types also significantly increased patent inflows from countries outside the agreements to emerging and developing economies inside them, again for both total bilateral applications and inflows within IP clusters. This outcome suggests that when EDCs are parties to more rigorous IPAs they become more attractive locations for patenting from the rest of the world. This impact was also significant but weaker for EU- and EFTA-partnered IPAs. Third, none of the IPA groups experienced significant growth in patents from member EDCs to non-member countries. Indeed, such flows diminished for several IP-intensive sectors, suggesting that local innovators focus their efforts more on applying for patents with partner nations. Finally, the existence of an investment agreement between partners significantly and consistently increased bilateral patenting flows.

3. Trademarks, Copyrights, and International Trade

The prior section reviewed recent empirical research relating patent rights and patents to trade. This emphasis reflects the fact that the great bulk of work on IPRs and trade uses

data on patents and patent policies, which are far more available globally than other forms of intellectual property. However, a literature is emerging relating two other canonical forms – trademarks and copyrights – to international trade.[6]

3.1. **Trademark protection and international trade.** It seems almost self-evident that international trademark registrations should correlate with trade flows and (perhaps) with export quality. After all, few products, even primary goods, are sold across borders without bearing a global or localized trademark or brand name. Further, the function of trademarks is to certify to users that the good purchased was produced legitimately by the trademark owner or its designated licensees. This linkage of goods with origin implicitly certifies an expected level of product quality and generally incentivizes product developers to sustain or improve quality over time. As discussed earlier, export quality correlates with patent protection, suggesting that it should be even more strongly associated with recognized trademarks. All this makes trademarks strong candidates for tracing quality and strategy in global markets and raises the question of whether their protection in importers or exporters expands trade.

Unfortunately, consistent international trademark data are not easy to come by and are difficult to work with empirically for several reasons. First, there is no readily available international trademark registration database that can be linked to firm, product or industry trade data. In contrast, there are readily available patent databases, exemplified by the PATSTAT system managed by the European Patent Office. Second, firms register trademarks abroad under different names and local agents across countries, meaning they may have quite variable product names, with multiple varieties linked to different registrations. Thus, trademarks are rarely registered uniquely with specific products because firms sell abroad under multiple marks and brands. Third, as noted, trademarks indicate the origins of good or services, rather than a definable set of technological claims.

[6]Geographical indications also now attract some attention, as indicated in the study by Duvaleix, et al (2021), which found that the products of French firms producing cheese and butter goods under Protected Designations of Origin enjoy higher prices in foreign markets due to perceived higher quality.

Thus, their documentation can be widely variable in its requirements and content. Further, trade facilitated by trademarks may not offer much information about technological content, raising questions about their role in diffusing new information across borders.

Despite these problems, a few basic studies found some evidence of a broad relationship between trademarks and exports or export quality. Fink, et al (2005) studied whether richer countries trade more intensively among themselves in brand-differentiated goods than do other countries. For this purpose they used international trademark registrations figures, extracted from data provided by the World Intellectual Property Organization (WIPO), aggregated to 22 industrial sectors. They found in a gravity estimation that the share of an exporting nation's trademarks in non-resident registrations within each sector in an importing country was positively related to the value of bilateral exports for consumer goods. However, this share was not related to exports of intermediate goods. The authors interpreted this finding to confirm that countries that produce a wide range of differentiated goods, and therefore register relatively larger trademarks abroad, export higher quality consumer goods.

An indirect test of the impact of trademark protection on the quality of trade is in Baroncelli, et al (2007). Using similar data, the authors asked whether trademark policy was a barrier to imports. This idea was motivated by the fact that in many EDCs the ratio of trademark registrations to applications is significantly higher for domestic firms than for foreign applicants, suggesting discrimination against the latter. The authors demonstrated in a simple model that the incentive to discriminate is greater when the quality of imports is most similar to that of domestic goods. This prediction was borne out in the empirical analysis of the registrations in a few EDCs, suggesting that protectionism in the use of trademarks is possible.

While interesting, such studies are questionable because of the data articulation problems mentioned above. However, these issues have begun to be addressed by technology specialists and economists in Australia, who have applied large-scale data analysis and matching algorithms to establish a new, internationally consistent database called TM-Link (Petrie, et al 2019). The database identifies "trademark equivalents" across

registration offices through matching textual passages, filing dates, entries from the Nice classification of trademarks, and applicant names. This painstaking process generates trademark families filed by a single firm in multiple countries. It produces many more families than could be achieved by prior brute-force methods, such as reading through filings under WIPO's Madrid Protocol. To put this into context, about nine percent of US trademarks filed by US firms were found to have equivalent trademarks in at least one other country.

In their empirical work the authors linked these international trademarks to exports across US states for detailed NAICS industries over the period 1996-2013. Their regressions show that, for the average state-industry pair, a ten-percent increase in the share of its international trademarks in total (US and international) registrations is associated with a growth in real state exports of approximately seven percent, or about $250 million. On this basis, it appears that international trademark registrations support significant export growth. Considerably more research could be done usefully with this database. For example, is this increase in trade volume associated more with quality increases, price markups, or real shipments? And does it occur more at the extensive margin, consistent with the earlier patent analysis, or at the intensive margin? The authors' data compilation opens a promising avenue for such work.

3.2. **Copyrights and international trade.** The emphasis in prior research on merchandise trade and foreign investment is important in understanding how technologies diffuse across borders through physical production processes. However, the nature of global trade has changed considerably over the last 20 years, from physical goods to exchanges of knowledge through digital processes. Digital products and services are critical in international trade in software, entertainment, information technologies, engineering and financial services, education, advanced scientific and business research, and government services. Some of this knowledge is protected by patents, but the scope of such protection varies considerably in digital services across countries. Moreover, trade in digital goods,

services, and knowledge is increasingly exchanges of licensed intellectual property, bundled with a range of producer, financial, and information services (Taubman, 2022). The complexity of "trade in BITS" also raises numerous policy challenges in terms of trade regulation (Burri, 2013). For example, recent major PTAs feature separate chapters on digital trade, data regulation, and data privacy.

Inevitably, copyrights have become increasingly important to firms seeking to sell digital goods or deploy knowledge abroad (Taubman, 2022). The issue for this paper is whether national copyright protection affects measures of international economic activity. This question has attracted little attention to date, largely due to data scarcity. Most fundamentally, copyrights need not be registered to be valid, making it difficult to establish meaningful databases of copyright ownership across countries. Further, copyrights protect specific expressions rather than ideas, making it difficult to attribute or measure the implicit knowledge transfer in their use, if any. These problems are magnified in the era of trade via digital files and downloads, the origin and destination of which can be difficult to ascertain.

Despite such challenges, economists have correlated measures of how multinational firms in various copyright sectors have served foreign markets with local IPRs. An early example was McCalman (2004), who noted that US film studios sold movies abroad either through an internal channel (distribution chains), called FDI, or an external channel (video sales), called licensing. The paper estimated whether the choice between these methods depended on the importer's level of IPRs, measured by the GP index. The author found that the choice was complicated and case-specific, suggesting that IPRs may not correlate well with the externalization decision of movie studios. While interesting, this inference can be challenged on several grounds, not least that the use of a patent-based IPRs measure to substitute for copyright rules could be misleading.

One recent study is considerably more informative about copyright protection and international licensing, which is the essential form of knowledge transfers in modern copyright sectors (Ivus and Park, 2022). As the authors note, the annual revenues US firms earn

from international licensing in these industries, including software, entertainment, broadcasting, books, internet, telecommunications, data processing, and related equipment, are now greater than corresponding licensing revenues in all manufacturing sectors. The authors analyze how licensing arrangements, which they consider knowledge transfers, of US-based multinational enterprises (MNEs) in these sectors to their affiliates depend on copyright protection across countries.

The empirical work is based on a simple theory, which notes the existence of a *market-expansion effect* of stronger local copyrights versus a *market-power effect* in deciding whether and how to license.[7] There are also costs of adapting creative works to meet the specific needs of each local market. One prediction is that more digital works will be distributed to larger markets, where the first effect would dominate and the fixed costs would be spread over higher volumes, and fewer works to smaller markets, where the second effect would be stronger and adaptation costs would be high per transfer contract. A more subtle prediction is that MNEs would transfer more technology via licensing to markets with stronger copyrights protection. However, the existence of fixed adaptation costs makes licensing more likely for digital products in high demand. Furthermore, this licensing will go more to affiliates and less to non-affiliates, favoring internal versus external knowledge transfers. Finally, stronger copyrights should also encourage licensing in complementary industries, such as telecommunications equipment.

The study uses firm-level data on the licensing decisions of US-based MNEs in the copyright-intensive sectors. The authors also develop a cross-country index of the existence or absence of copyright standards based on four categories: (1) coverage and duration of subject matter; (2) allowable exceptions and limitations in coverage; (3) enforcement mechanisms; and (4) membership in international copyright conventions. This index, which varies from zero to four, bears similar problems to the patent-based GP index, but at least is focused entirely on copyright laws.

In the empirical work the authors controlled for the decision to license, as opposed to other forms of market entry, and endogeneity of the choice between licensing to affiliates

[7]This terminology and analysis were first used in the IPRs context by Maskus and Penubarti (1995).

versus non-affiliates. The basic results were that an increase in local copyright protection, interacted with a measure of contract enforcement, had the following impacts. First, the policy raised the likelihood that US MNEs would engage in licensing to affiliates, with the strongest effect in the copyright-sensitive sectors. However, it would reduce the probability of licensing to unaffiliated firms. Note the implication that copyrights exert a positive "extensive margin" impact in licensing to affiliates, especially in sensitive industries. Second, conditional on the existence of positive licensing, the volumes of affiliated licensing revenues rose sharply in copyright-intensive industries but not in others. Accordingly, there was also a positive intensive-margin impact in firms that were already licensing, which were generally larger MNEs. Third, there was evidence in some of the complementary input industries, such as equipment, that in countries with stronger copyright protection there were expanded flows of affiliated licensing.

The authors interpreted their findings to mean that a largely harmonized global copyright system across countries would increase licensing opportunities at both margins for larger MNEs in copyright-based sectors. However, these increases would primarily be with local affiliates, due to the lower cost of adaptation, expanding knowledge diffusion to those firms. At the same time, stronger globalization of copyrights could diminish licensing opportunities in other countries, especially to non-affiliates in smaller economies. They argued that the result may support decisions by EDCs to sustain flexibility in their national protection systems, as applied to different sectors, to the extent that may be possible under WTO and PTA rules. Whatever the policy conclusion may be, it is evident that considerably more microeconomic research is needed in this area, linking parent firms in more countries to international licensing strategies.

4. Concluding Remarks

This paper has reviewed some major and novel findings from the recent literature linking global trade to intellectual property rights. Due to major differences in data availability, the great bulk of this research pertains to patent rights and trade, which is unfortunate for those interested in other forms of intellectual property, including copyrights. Nonetheless,

many of the techniques and insights from the patents-oriented research will be useful for economists seeking to engage in empirical research in the global economic aspects of copyright protection, which remains an understudied area in considerable need of further work. As data collection and dissemination improve across countries in, for example, digital trade in goods and related services, new avenues for additional research will open, particularly in the use of microeconomic information on investment and licensing. Many important questions remain unaddressed in this nascent literature. The research reviewed here will, one hopes, contribute to this important agenda.

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