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IPR Law Protection and Enforcement and the Effect on Horizontal Productivity Spillovers from Inward FDI to Domestic Firms: A Meta-analysis

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Abstract

We study the role of the strength of Intellectual Property Rights (IPR) law protection and enforcement in influencing horizontal productivity spillovers from inward FDI to domestic firms in host countries. While most WTO countries adopted strong IPR legislation due to exogenous pressure resulting from the signing of the Trade-Related Aspects of IPR (TRIPS) agreement, public IPR enforcement strength continues to vary significantly between countries. We meta-analyse 49 studies and find that public IPR enforcement strength has a direct positive effect on horizontal productivity spillovers from inward FDI to domestic firms and a negative moderating effect on the relationship between IPR law protection strength and horizontal productivity spillovers from inward FDI to domestic firms.

Keywords Intellectual property rights · Horizontal spillovers · Meta-analysis · Inward foreign direct investment

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1 Introduction

This study investigates the role of national Intellectual Property Rights (IPR) systems and particularly the strength of IPR law protection and the effectiveness of public IPR enforcement (e.g., judiciary, customs) in stimulating horizontal productivity spillovers from inward Foreign Direct Investment (FDI) to domestic firms. The strength of a host country's IPR system can determine the level of IPR risk that foreign Multinational Enterprises (MNEs) face when investing in the country and an MNEs decision to engage in the transfer of technological assets to a local subsidiary, invest in R&D activities, and license its IPR to domestic companies (Branstetter et al. 2007; de Faria and Sofka 2010; Smarzynska-Javorcik 2004a). Foreign MNEs strive to avoid having their IPR infringed in a host country since this can enable the domestic competitors to upgrade their capabilities while escaping heavy investments in R&D (Cappelli et al. 2014; Liang 2017). Foreign MNEs therefore are more likely to transfer high value technological IPR assets in countries where IPR protection is strong and public enforcement is effective. This in turn will impact the productivity of domestic firms through technology licensing and/or spillovers via e.g., observation and imitation (Berry 2017; Pavlínek and Žížalová 2014). The strength of the IPR system of a host country is generally expected to determine the extent to which domestic firms can access and exploit the IPR assets of foreign MNEs and the degree to which foreign MNEs can efficiently appropriate the economic returns from their innovations (deFaria and Sofka 2010; Teece 1986; Zhao 2006).

The strength of IPR systems depends on two distinct elements of a country's institutional environment, the strength of IPR law protection and the effectiveness of public IPR enforcement (Peng et al. 2017a). Existing studies on the effect of national IPR systems on inward FDI horizontal productivity spillovers to domestic firms however, focus solely on the effect of IPR law protection (Arora 2009) and are therefore likely to suffer from biased results. Studies ignoring the effect of the strength of public IPR enforcement are likely to systematically overestimate the effect of IPR law protection strength (Papageorgiadis and Sofka 2020). This could also explain the mixed results in the existing literature, such as the finding of negative (Iršová and Havránek 2013), positive (Yi et al. 2015), and insignificant (Smeets and de Vaal 2016) effects on FDI horizontal productivity spillovers from inward FDI. Focusing on only one element of IPR systems in their empirical modelling but arguing for the importance of IPR systems overall, existing studies de facto assumed that both IPR law protection and the effectiveness of public IPR enforcement developed equally over time and have a uniform effect on inward FDI horizontal productivity spillovers. This leads to biased estimates of the effect of IPR law protection in each respective study and the mixed findings across studies and hence handicaps research narratives of the impact of IPR protection on inward FDI horizontal productivity spillovers to domestic firms.

The contemporary context of IPR systems internationally after the signing of the Trade-Related Aspects of Intellectual Property Rights (TRIPS) agreement in 1995 is substantially different to the way it is theorized in the existing literature.

Although most countries have significantly increased the availability of IPR law protection in their IPR systems after TRIPS, the effectiveness with which the IPR laws and legal mechanisms are enforced in practice by public authorities continues to be questionable for many countries (Athreye et al. 2020; Papageorgiadis and McDonald 2019; Peng et al. 2017a, 2017b). This is because although the TRIPS agreement requires signatory countries to provide a number of specific legislative procedures in relation to enforcement mechanisms, it does not set any obligations/requirements regarding how effectively IPR laws are enforced by relevant public agents in practice (WTO 2017). Therefore, while most WTO countries nowadays offer IPR law protection that is generally comprehensive (Park 2008; Peng et al. 2017a), the levels of effectiveness of public IPR enforcement continue to vary significantly between countries (Brander et al. 2017; Papageorgiadis and McDonald 2019).

In this paper we contribute to the literature by integrating the public IPR enforcement element into the study of the effect of IPR systems on horizontal productivity spillovers from inward FDI to domestic firms. We do so by building on and extending the meta-analytical databases of horizontal productivity spillovers to domestic firms from inward FDI and approaches developed by Meyer and Sinani (2009) and Iršová and Havránek (2013). First, we introduce in the established theoretical and empirical frameworks the distinct effect of the strength of public IPR enforcement element of IPR institutions on horizontal productivity spillovers from inward FDI to domestic firms. The incorporation of the public enforcement element of IPR systems allows us to disentangle the effect of IPR enforcement from that of IPR law protection on horizontal productivity spillovers from inward FDI. We find that both the strength of public IPR enforcement and IPR law protection have a significant positive effect on horizontal productivity spillovers from inward FDI. This finding confirms the importance of considering the distinctive direct effect of public IPR enforcement strength on horizontal spillovers from inward FDI and international technology transfer, as accentuated by Arora (2009), Maskus (2004), and Brander et al. (2017).

Second, we contribute to the literature by conceptualizing and identifying the moderating role of public IPR enforcement strength on the effect that the strength of IPR law protection has on the horizontal productivity spillovers from inward FDI to domestic firms. Our empirical finding reveals that the effectiveness of public IPR enforcement has a negative moderating effect, indicating that in countries where both IPR law protection and public IPR enforcement are strong, the domestic firms may experience less horizontal productivity spillovers from inward FDI because foreign firms are able to exercise market power and stifle the competition from domestic firms (Fisher and Oberholzer-Gee 2013). This finding suggests that the diverging assertions and empirical findings of the previous studies probably relate to the uncaptured indirect effect of the second element of IPR systems in those studies. By identifying this distinctive moderating role of the strength of public IPR enforcement on the effect of the strength of IPR law protection, we gather important implications for policy making. The strengthening of both IPR law protection and public IPR enforcement in a host country are expected to boost horizontal productivity spillovers from inward FDI to domestic firms. However, policy makers need to monitor

closely the strengthening of IPR protection and enforcement in their country and seek to timely identify when the productivity spillovers start to be hindered by the potential existence of a technological monopoly of MNEs. This can be done through the monitoring of the overall functioning of specific industries by e.g., monitoring the number of IPRs owned by MNEs, large firms or/and business groups and the number of IPR litigation cases taking place within an industry. It can also be done by reducing the strength of IPR law protection (e.g., shorten the protection period) in areas where moderate protection is expected to be more conducive for innovation and firm productivity growth (Brander et al. 2017) or increasing the maintenance fee for patents that are not practiced, but owned for pre-emptive purposes.

2 Background to IPR Systems

IPR systems comprise of two distinct elements: (a) IPR protection and (b) public IPR enforcement (Khoury et al. 2014; Peng et al. 2017a). The IPR protection element relates to the availability of IPR law as this appears in the statutes of a country's legislative framework. The range of IPR law in a country determines which intellectual assets can receive IPR protection, the duration of IPR protection (e.g., typically 20 years for patents) and the available legal sanctions that can be used by IPR enforcement agents (OECD 2014). For example, IPR law in a country determines the level and range of fines that IPR infringers may be sentenced with if convicted for IPR violation. Countries offering strong IPR protection generally provide legislative frameworks that offer IPR protection coverage to a wide type of IPR assets and a wide number of legal enforcement mechanisms for use by the IPR enforcement agents (Ginarte and Park 1997). In contrast, weak IPR law protection relates to the provision of some IPR protection however, protection may not be available for many other types of IPR that receive protection in other countries. There are differences in the availability and range of IPR law protection between countries internationally such as country specific legal exemptions or lack of IPR law availability for specific IPR assets e.g., the patentability of software and plant and animal varieties (Park 2008). Therefore, while IPR owners may be awarded IPR protection in one country they may not be able to register and protect their rights in another country. In addition, the available laws related to the enforcement of IPR may not provide a range of legal options to IPR enforcement agents to carry out their operations effectively. For example, this can relate to the potential lack of legislation that allows IPR enforcement agents to award and enforce preliminary injunctions in IPR infringement cases.

The way that law is enforced (or not) in practice is distinct to the existence of law on the books since enforcement depends on the behaviour of public agents (Dixit 2009). While IPR law in a country is codified and evidenced in writing in the legislative books of its IPR system, it is subject to the interpretation of the judiciary and other public IPR enforcement agents such as customs, police and trading standards. This is because the application of IPR law in practice is at the discretion of IPR enforcement agents who are bounded by the legislative norms of their perspective country (Hebert and McLemore 1973). The extent to which the public IPR enforcement agents will effectively engage and enforce IPR will be influenced

by their ‘shared sets of beliefs’ about IPR infringement and if they consider an IPR infringing activity to be illegal. Also, even if the IPR legislative framework in a host country includes laws that enable punitive sanctions to IPR infringers, these may never be utilized by the judiciary or not enforced in practice by the customs officials. The same IPR laws available in two different countries may be applied differently depending on the way that the IPR law is decoded and interpreted by the IPR enforcement agents of the country (e.g., punitively in one country and non-punitively in another). Strong public IPR enforcement is expected to prevail in countries where public IPR enforcement agents effectively prosecute IPR infringement and judiciary independently and transparently apply IPR law in practice (Pajunen 2008). In contrast, weak public IPR enforcement is expected to be witnessed in countries with opaque, arbitrary and ineffective judiciary and enforcement authorities who are more receptive to corrupt practices and/or unlikely to enforce the IPR laws in practice because of lack of legislative/social norms conducive to law enforcement (Maskus 2004).

Distinguishing between the strength of IPR law protection and the strength of public IPR enforcement in a country is particularly important in the years after the implementation of the TRIPS agreement. The TRIPS agreement entered into force in 1995 and set the minimum standards for IPR law protection among the member countries of the WTO (WTO 2017). The implementation of the TRIPS agreement brought a significant change to the availability of IPR law protection in the legislative framework of WTO member countries (Alexiou et al. 2016). However, TRIPS did not set obligations for WTO countries regarding the effectiveness with which IPR law is enforced by public enforcement agents (Maskus 2015). It should be also noted that while the WTO signatory countries now have legislative frameworks that offer a wide range of available IPR legislation, there is a mismatch between the new TRIPS required IPR laws and the dominant norms towards IPR in countries where the strengthening of IPR laws was largely a result of external political pressure and not due to internal forces (Brander et al. 2017). This mismatch leads to the ineffective enforcement of the law by public IPR enforcement agents in practice. This is the case for countries like China, where it is generally acclaimed that its IPR law protection framework is well crafted, however the actual enforcement of IPR by public agents in the country is weak (Peng et al. 2017b). The mismatch has become particularly evident in the years after TRIPS, when the gap between the strength of IPR protection and the effectiveness of public IPR enforcement emerged in many WTO countries.

3 Hypothesis Development

3.1 Inward FDI Horizontal Productivity Spillovers and MNE Responses

FDI activity in a host country is generally expected to generate horizontal knowledge spillovers that will benefit the performance and productivity of local firms operating in the same industry (Javorcik and Spatareanu 2008). One of the reasons that enable MNEs to engage in FDI and compete in a foreign market is their capability to access,

develop, transfer, and exploit advanced knowledge assets such as IPR (Almeida and Phene 2004). MNEs pool such IPR assets from their innovation activities at home and abroad (Chang et al. 2012; Gupta and Govindarajan 2000) and use them as the spearheads for successfully entering and competing internationally. The transfer of advanced IPR and other knowledge assets to their foreign affiliates enables MNEs to overcome the liability of foreignness in the host country through the exploitation of IPR assets that are more advanced than these of domestic firms. The transfer of MNE knowledge in a host country in the form of intangible assets such as patents, trademarks, and knowhow however, can allow domestic firms to benefit from the potential knowledge leakage attached to these assets and help them to enhance their productivity and competitiveness. Due to the public good nature of knowledge, once it is accessed, it can be transferred at zero or low marginal cost to more recipients. Accessing advanced IPR and knowhow can therefore enable domestic firms to benefit from the use of an MNE's knowledge and avoid the monetary liabilities to the legal owners of the IPR (Kogut and Zander 1993).

Knowledge spillovers from the FDI of MNEs in a host market can occur directly, in terms of knowledge that is leaked from the MNE, or indirectly through the exposure of the domestic firms to the products and practices of the MNE. Knowledge can directly diffuse in a host country through employee mobility, when employees of the MNE in the host country move on to work for domestic firms (Berry 2017). This process allows the domestic firms to directly access the IPR and knowhow of the MNE and utilize it to improve their own practices and competitive offering (Aitken and Harrison 1999; Gorg and Strobl 2001). Domestic firms can also experience direct productivity spillovers by licensing-in the IPR assets of the MNEs or by entering in joint venture agreements with them. There are two main indirect channels with which domestic firms benefit from accessing the IP, knowledge and knowhow of MNEs: (a) the demonstration channel and (b) the competition channel (Gorg and Greenaway 2003; Liu et al. 2009; Yi et al. 2015). The demonstration channel relates to domestic firms' reverse engineering and attempting to imitate the proprietary technology of foreign MNE affiliates (Gorg and Greenaway 2003; Meyer and Sinani 2005). The competition channel relates to the presence of MNEs in a host country, which leads to the intensification of the competition in the industry through the higher number of competitors and by introducing new ways of competing (Meyer and Sinani 2009). This helps domestic firms to increase their productivity by attempting to reduce their inefficiency and/or invest more in R&D and knowledge generation/acquisition. A domestic firm's investment in R&D can also aim to invent around and develop similar (legally registered or unregistered) IPR assets to those of the MNE, while avoiding the legal infringement of the MNE's IPR assets. In addition, domestic firms can seek to gain a license of the MNE's advanced technology in exchange for a licensing fee and annual royalties. Licensing can allow a domestic firm to increase their productivity by legally accessing IPR assets while this is also beneficial for the MNE. The extent to which domestic firms can increase their productivity will depend on their capability to absorb and reconfigure advanced knowledge and knowhow (Cantwell 2017; Cohen and Levinthal 1990; Escribano et al. 2009).

MNEs pursue two different approaches to safeguard against the leakage of their proprietary knowledge and reduce the unintended spillovers from the unauthorised exploitation of their IPR by domestic firms. The first approach relates to the development of internal mechanisms in the MNE's subsidiary to control the extent of IPR and knowhow leakage (de Faria and Sofka 2010). Further to registering the IPR assets in the host country, such internal mechanisms include secrecy measures within the subsidiary and the use of complex designs that require other knowhow and expertise held outside the subsidiary (de Faria and Sofka 2010). In addition, to retain a tighter grip on the potential unintended leakage of parent firm knowledge, MNEs can employ expatriate managers, because of their corporate loyalties and knowledge of parent firm assets, priorities and routines, in the host country to facilitate the knowledge transfer to the subsidiary and implement IPR control policies within the subsidiary (Berry 2017).

The second approach relates to MNE attempts to limit the unintended spillovers in cases that their proprietary IPR knowledge is found to be used by domestic firms. In the process of identifying and fighting against IPR infringement, MNEs need to engage with the public enforcement agents including the judiciary, the police and customs agents (Bessen and Meurer 2008; Yang et al. 2008). The effectiveness of the public IPR enforcement agents in a host country can determine if e.g., police and customs agents will effectively prosecute a suspected IPR infringement case, and the extent to which the IPR law is applied in a timely, non-discriminatory, and effective manner to penalise domestic IPR infringing firms (Ahammad et al. 2018; Papageorgiadis and Sofka, 2020). In countries where the MNEs are able to engage with public IPR enforcement agents and stop or punitively penalise IPR infringement with their support, the MNEs will be able to limit the unintended spillovers from unauthorised IPR exploitation, even if the proprietary IPR and knowhow of the MNE has been leaked to domestic companies.

While the effectiveness of public IPR enforcement agents in a host country can determine the extent to which domestic firms in the same industry benefit from spillovers, this element of the institutional fabric of host countries has not received much scholarly attention in the literature to date. Over the last years, a large number of studies focused on different host country and firm characteristics and examined their influence on the knowledge transfer and spillovers to domestic firms in a host country (Aitken and Harrison 1999; Audretsch and Feldman 1996; Blomstrom and Sjöholm 1999; Brouthers 2002; Meyer and Sinani 2009; Sjöholm 1999). However, there has been limited research on the role of the effectiveness of IPR systems in generating inward FDI horizontal productivity spillovers to domestic firms (Arora 2009). Existing studies in this area mainly focused on the role of the strength of IPR law in a host country in stimulating or discouraging horizontal productivity spillovers from inward FDI and found mixed results (Iršová and Havránek 2013; Smeets and de Vaal 2016; Yi et al. 2015). Existing research therefore focused on one of the two elements of IPR systems, but did not consider the role of the effectiveness of public IPR enforcement agents, neither the way that public IPR enforcement may moderate the effect that the strength of IPR law has on inward FDI horizontal productivity spillovers to domestic firms.

3.2 IPR Law Protection and Inward FDI Horizontal Productivity Spillovers

The strength of IPR protection in terms of the availability of IPR law in a host country is a significant determinant of FDI activity (Branstetter et al. 2007; Khoury and Peng, 2011; Ushijima 2013) and investments on high value MNE activities (Berry 2017) such as the establishment of R&D centres (Maskus et al. 2005). Strong IPR law protection in a host country can enable MNEs to formally register and transfer their IPR assets and advanced technological and managerial know-how to their foreign affiliates (Branstetter 2006; Yi et al. 2015). MNEs are positively influenced by increases in the availability of IPR law in a host country and they are found to respond by increasing their patenting activity there (Khoury et al. 2014). Their increased patenting activity relates to both IPRs already registered in their home country and innovations developed in the host country.

Since MNEs are institutional outsiders when entering a host country, they are expected to face high information costs due to their unfamiliarity with the local institutional environment and practices (Hennart 2012; Khoury et al. 2014). When MNEs find familiar aspects in the IPR systems of a host country such as strong IPR law protection, they perceive it as a positive signal that can enable them to register, legally protect, and potentially enforce their legal rights against IPR infringement (Khoury et al. 2014). This is especially the case in host countries with strong location advantages (e.g., large market size, low cost or highly skilled labour) where accessing and benefiting from these advantages may be considered to be a priority for the overall success of the MNE. Strong IPR law protection is expected to lead MNEs to increase their patenting activity in a host country (Khoury et al. 2014), thereby also increasing the amount and quality of IPR assets and knowhow transferred to the subsidiaries of the MNEs (Berry 2017). In contrast, domestic firms may not experience an increase in their patenting activities due to the strengthening of IPR law protection. Domestic firms are well embedded in the information networks of the country and they may see the strengthening of IPR law protection as merely a ‘window dressing’ for attracting FDI (Peng et al. 2017a, 2017b) and therefore do not respond to it positively. Despite this, strong IPR law protection in general offers an incentive to domestic firms to develop innovative capabilities aligned with their resource endowments and/or in areas that they are able to compete with market leaders (Teece 2017). This can further enhance their absorptive capacity and potentially increase their ability to engage with MNE knowledge spillovers (Chen and Puttitanun 2005; Yi et al. 2015).

FDI inflow is expected to boost the quality and quantity of technology transferred to the host country in the form of IPR assets and knowhow, generating positive spillovers to the domestic firms. Domestic firms can directly (labour mobility channel) or indirectly (demonstration and competition channel) access the IPR of foreign firms. This is the case even if the subsidiaries of MNEs utilize internal mechanisms aimed to limit knowledge leakage. While the availability of IPR law protection enables the MNEs to position their IPR assets in the technological landscape of legally protected IPR, domestic firms can illegally access the know-how of foreign firms through IPR infringement. This is because the strength of IPR law in a country does not automatically constrain IPR infringement activities (Bessen and Meurer 2008;

Brander et al. 2017). To stop IPR infringement, MNEs need to become aware of the infringement of their IPR by the competing firms, engage with the public IPR enforcement agents by attempting to gain their support, and rely on them to stop and penalise the infringers. We therefore expect that:

Hypothesis 1: The strength of IPR law protection in a host country positively affects the horizontal productivity spillovers from inward FDI to domestic firms.

3.3 Public IPR Enforcement and Inward FDI Horizontal Productivity Spillovers

The strength of public IPR enforcement of a host country can determine the extent to which domestic firms can improve their productivity by legally or illegally gaining access to the IPR assets of MNEs. The ability of an MNE to effectively defend the IPR that it registers in and transfers to a host country against IPR infringement, depends on the effectiveness of public IPR enforcement agents. After transferring and actively engaging in the internal or external exploitation of their IPR assets, MNEs actively monitor the IPR landscape of the host country to identify the potential infringement of their rights (Oxley 1999). When a competitor infringes on a MNE's IPR asset, the MNE can engage with the public IPR enforcement agents of the host country and aim to seize and desist the activities of the infringing party (Yang et al. 2008). The MNE can also aim for a preliminary injunction by taking the case to the judiciary through IPR litigation as well as engage with other public IPR enforcement agents such as customs and police to take legal actions (e.g., civil remedies, boarder measures) against the infringing parties and stop them from continuing the illegal activities (Keupp et al. 2010).

In countries where public IPR enforcement is strong, MNEs can expect that the enforcement agents will effectively deter the IPR infringement activities and that the IPR infringers will be effectively prosecuted, receiving punitive sanctions and penalties (Papageorgiadis and Sofka 2020; Papageorgiadis et al. 2014). This can act as a deterrent of IPR infringing activities, discouraging the opportunistic behaviour of domestic firms that might consider to infringe the IPR of an MNE but eventually refrain from doing so due to the high risk of being prosecuted and penalized. In contrast, in countries where public IPR enforcement is weak, even if an MNE pursues a litigation case against infringers, the firm will find it difficult and problematic to effectively enforce its rights in practice (Papageorgiadis et al. 2019b, 2020; Yang et al. 2008). This is because the judiciary may delay the delivery of a judgement on an IPR case and, if the defendant is found guilty, award penalties that are not punitive and/or of limited impact on the operations of the infringer (Brander et al. 2017). Furthermore, other public IPR enforcement agents such as the police authorities may not actively enforce the judiciary's rulings or do so ineffectively, allowing the IPR infringers to continue operating in a country. Therefore, in countries where public IPR enforcement is strong, MNEs can anticipate that they will be able to successfully defend their IPR in the case of IPR infringement. MNEs can limit the direct knowledge spillovers from former MNE employees illegally transferring their

acquired knowledge to a domestic firm as well as reduce the indirect spillovers from the demonstration channel (Agarwal et al. 2009).

While strong public IPR enforcement can curb FDI productivity spillovers to domestic firms from illegal channels, it is expected to boost the positive spillovers through the legal direct and indirect channels. With regards to the direct channels, strong public IPR enforcement levels can allow MNEs to confidently and efficiently utilize and monetize higher value IPR assets in external markets, through licensing-out to non-affiliate firms and the formation of joint ventures with domestic firms (Branstetter 2006; Ivus et al. 2017). Stronger levels of IPR enforcement provide confidence to the IPR owning MNEs that their rights will be effectively protected and defended in case of licensees infringing the IPR (Arora and Ceccagnoli, 2006; Oxley 1999; Papageorgiadis et al. 2013). Therefore, domestic firms collaborating with MNEs can increase their productivity by legally accessing the IPR assets, and advanced technological and managerial know-how of the MNEs leading to positive FDI horizontal productivity spillovers (Javorcik and Spatareanu 2008; Smarzynska-Javorcik 2004b). The legal indirect channels to positive FDI productivity spillovers occur through the competition effect. The exploitation of high value IPR assets by MNEs in a host country can offer them a competitive advantage against their domestic competitors in terms of cost and differentiation (advanced products). This can apply strong competitive pressure to the domestic firms which need to react and adapt their strategy in order not to be marginalized. Strong public IPR enforcement conditions in a country incentivizes domestic firms to develop their innovative capabilities by engaging in R&D activities (Chen and Puttitanun, 2005; Yi et al. 2015). Domestic firms can continue to reverse engineer the more advanced technological assets of MNEs but are expected to engage in more complex innovation activities since they need to manoeuvre around the technological landscape and avoid infringing the IPR of MNEs (Maskus 2005). This can lead them to upgrade their capabilities and IPR assets and improve their productivity. Overall, domestic competitor firms are expected to benefit from accessing the advanced IPR of MNEs through the legal direct and indirect channels and improve their productivity. We therefore expect that:

Hypothesis 2: The strength of public IPR enforcement in a host country positively affects the horizontal productivity spillovers from inward FDI to domestic firms.

3.4 The Role of Public IPR Enforcement on the Effect of IPR Law Protection on Horizontal Productivity Spillovers from Inward FDI

Although the two elements of IPR systems individually are expected to have a positive impact on the direct and indirect channels of FDI horizontal spillovers, strong IPR law protection supported by strong public IPR enforcement, as set out by TRIPS, has the potential to provide strong market power to an MNE and affect the industry dynamics in a host country (Brander et al. 2017). Strong IPR enforcement can enable foreign MNEs to gain a dominant, nearly monopolistic, position in a host market with strong IPR law protection by transferring their entire IPR portfolios and

seeking to appropriate them by blocking competition (Maskus 2000; Smeets and de Vaal 2016). For example, an MNE that holds a number of interlocking patents protecting the development of a technological product, can aggressively seek to halt the exploitation of similar substitute products by domestic competitors, in the anticipation that the strong public IPR enforcement will support its strategy (Grimpe and Hussinger 2013). This specific type of favourable IPR appropriability conditions would not have been possible in other types of IPR systems where IPR law protection is strong, but public IPR enforcement is relatively weak (and vice versa).

Such IPR conditions can limit the horizontal productivity spillovers from inward FDI to domestic firms via both the direct and indirect channels. With regards to the direct channels, the more effective enforcement of their IPR in the host country can enable MNEs to achieve higher prices when exploiting their IPR (Bessen and Meurer 2008). This suggests that MNEs have the option to exploit their IPR assets internally. For example, under such conditions, they can import new technologies that are rooted in their unique organisational and local environments. Such imported technologies tend to be more complex and difficult to duplicate by others, which enables them to charge a premium price for their products and/or further strengthen their market position in the host country (Barney 2001; Brandt and Thun 2010), leaving limited scope for technological productivity spillovers. MNEs can also appropriate the returns from their innovations or license-out their IPR to non-affiliate domestic firms by charging premium royalty fees (Maskus 2000). This means domestic firms who pay a premium license to gain direct legal access to the MNE's IPR assets (available to them because of strong IPR law protection) are likely to operate with thinner margins that impact their productivity in terms of e.g., the amount of financial resources available for marketing activities or the extent of reinvesting in research and development. Both options restrict the horizontal productivity spillovers and the associated benefits to domestic firms. Stronger public IPR enforcement is also expected to limit the knowledge and knowhow spillovers from the opportunistic behaviour of former employees of MNEs who are aware that their former employer will seek to enforce the restrictive contracts signed when they joined the MNE (Agarwal et al. 2009).

The indirect channels of inward FDI horizontal productivity spillovers to domestic firms are also expected to be more constrained by stronger public IPR enforcement levels in countries where IPR law protection is strong. The strong market power of MNEs resulting from stronger public IPR enforcement levels is expected to divert more market demand away from domestic firms leading to a decline in their profitability and productivity (Aitken and Harrison 1999). The near monopolistic position of MNEs can limit the ability of domestic firms to respond to the competitive pressures by investing in research and development, or finding alternative approaches to increase their market share (Iršová and Havránek 2013; Smeets and de Vaal 2016). Importantly, the prospect of competing in a tight technological landscape where a domestic firm's investments on R&D are more likely to be jeopardised by MNEs' domination and IPR infringement actions, acts as a disincentive for domestic firms (Branstetter and Saggi 2011; Maskus 2000). Research on innovation at the firm level has shown that innovation (and imitation) increasingly requires combining technological components and complementary knowledge from multiple

sources (Leiponen and Helfat 2010). The tight control of key technologies and associated complementary knowledge by MNEs can drive the innovation cost curve to a point that the costs of pursuing innovation override its benefits (Xia and Liu 2017). This is also the case for IPR imitating/infringing domestic firms, which can choose to divert their focus to production activities of low R&D intensive or/and low valued added, in order to avoid the anticipated sanctions and penalties.

In sum, strong IPR law protection incentivises foreign MNEs to transfer their IPR assets to the host country and stimulates domestic firms to develop innovative capabilities to compete with market leaders. When this is coupled with strong public IPR enforcement however, negative effects may increase due to reduced competition from the higher blocking of rival entries by MNEs, higher cost for accessing and/or developing the technology by local firms etc., thus reducing the scope for positive inward FDI productivity spillovers to domestic firms. We therefore expect that:

Hypothesis 3: Strong public IPR enforcement in a country weakens the positive relationship between IPR law protection and horizontal productivity spillovers from inward FDI to domestic firms.

4 Methodology

We performed a meta-analysis by extracting the findings from existing primary empirical research and using the extracted data to assess the effect of the strength of IPR law protection and the strength of public IPR enforcement on inward FDI horizontal productivity spillovers to domestic firms. Meta-analysis provides a systematic approach to reviewing an existing body of literature by statistically integrating the results of a large set of studies on a particular topic, in one single empirical analysis (Lipsey and Wilson 2001; Mayer-Haug et al. 2013; Meyer and Sinani 2005). Moreover, in research topics where existing empirical studies provide inconclusive results, a meta-analysis can be “a powerful tool to identify the moderating effects of contextual variables and thus to establish the boundary conditions of scientific knowledge” (Meyer and Sinani 2009, p. 1076). Our study builds on and extends the work of the two existing meta-analyses in the area of inward FDI horizontal productivity spillovers to domestic firms, by Meyer and Sinani (2009) and Iršová and Havránek (2013). We extend their work by considering the separate effect of the second element of IPR systems, the strength of public IPR enforcement, as well as the moderating effect of public IPR enforcement on the relationship between IPR law protection and FDI horizontal productivity spillovers.

4.1 Selection of Primary Literature

Following the guidelines for meta-analyses by Havranek et al. (2020) we adopted a four-stage approach in the process of selecting the most appropriate primary literature and establishing a comprehensive database for this study. First, we identified studies on inward FDI horizontal productivity spillovers to domestic firms (published and unpublished) in the reference lists of the two previous meta-analytical

studies by Meyer and Sinani (2009) and Iršová and Havránek (2013) and of the review paper by Crespo and Fontoura (2007). Second, we expanded our search with the use of keywords and searched in three established scientific databases (Proquest, Science direct, EconLit databases) and the scientific search engine Google Scholar. In line with the keywords used by Meyer and Sinani (2009), we used combinations of the following keywords: “foreign direct investment/FDI spillover*”, “foreign direct investment/FDI horizontal spillover*”, “productivity spillover*”, “productivity horizontal spillover*”, “knowledge spillover*”, “technolog*spillover*”, “knowledge transfer spillover*”, and “knowledge transfer horizontal spillover*”. These two stages yield 112 studies on inward FDI horizontal productivity spillovers to domestic firms. Third, we applied the following inclusion criteria to ensure the data availability for all the variables used in our study: (1) studies with at least one estimation on inward horizontal spillovers, (2) studies with regression coefficients, sample size, standard errors and t-statistics, (3) studies covering the years 1998–2011 and (4) studies specific to one or more of 49 developed and developing countries covered in Papageorgiadis et al. (2014). Criteria 3 and 4 are applied because the public IPR enforcement measure is adopted from Papageorgiadis et al. (2014) and is only available for this specific time period and country range. This reduced our sample coverage from 112 to 47 (published and unpublished) empirical studies on inward FDI horizontal productivity spillovers to domestic firms, of which 20 studies identified in stage 1 and 27 in stage 2. Finally, we extracted data on the variables, including outcome statistics, sample sizes, study characteristics and also collected the data for the country level variables such as trade openness, tertiary education, R&D expenditures and financial development. Table 1 provides a summary of the characteristics of each of the studies that are included in the dataset, in terms of the country of focus, the year studied and the level of focus of each study. Overall, we collected 1560 inward FDI horizontal productivity spillovers to domestic firms estimates, as reported in 47 empirical studies.

4.2 Dependent Variable and Estimation Method

In this study, we use a categorical effect size dependent variable to distinguish between significantly negative, insignificant and significantly positive estimates of inward FDI horizontal productivity spillovers to domestic firms. Due to the diverse set of measures and estimation methods used in existing inward FDI horizontal productivity spillovers to domestic firms studies in the literature, meta-analysis studies on inward FDI horizontal productivity spillovers to domestic firms normally regress the t statistics, instead of inward FDI presence variable coefficients, on a set of moderators (Gorg and Strobl 2001; Meyer and Sinani 2005; Wooster and Diebel 2010). However, using t statistics may lead to erroneous inference regarding the spillovers. In order to avoid this potential pitfall, we classify the estimates based on ‘sign and significance’ into three categories: significantly positive, insignificantly different from zero and significantly negative based on t values and p values reported in each study. This means that the effect size is captured by a categorical variable that indicates the probability of study outcomes at each level. This approach has been widely

Table 1 The empirical studies on inward FDI horizontal productivity spillovers to domestic firms that are included in the meta-analysis

Study	Country	Data year	Aggregation
Hamida (2013)	Switzerland	2001–2004	Firm level
Hamida and Gugler (2009)	Switzerland	1998–2001	Firm level
Blake et al. (2009)	China	2000	Firm level
Buckley et al. (2007a)	China	2001	Industry level
Buckley et al. (2007b)	China	2001	Industry level
Chang and Xu (2008)	China	1998–2005	Firm level
Chang et al. (2007)	China	2002–2005	Firm level
Crespo et al. (2007)	Portugal	1996–2000	Firm level
Du et al. (2012)	China	1998–2007	Firm level
Erdogan (2011)	Turkey	2004–2008	Firm level
Fu (2012)	UK	1998–2004	Firm level
Gersl (2008)	Czech Rep	2002–2005	Firm level
Gersl et al. (2008)	Czech Rep., Hungary, Poland, Slovakia, Romania	2000–2005	Industry level
Girma and Gong (2008)	China	1999–2002	Firm level
Gonçalves (2004)	Brazil	1997–2000	Firm level
Hagemejer and Kolasa (2011)	Poland	1996–2005	Firm level
Halpern and Muraközy (2007)	Hungary	1996–2003	Firm level
Javorcik and Spatareanu (2008)	Romania	1998–2003	Firm level
Javorcik and Spatareanu (2011)	Romania	1998–2003	Firm level
Javorcik et al. (2004)	Romania	1998–2000	Firm level
Jeon et al. (2013)	China	1998–2007	Firm level
Khalifah and Adam (2009)	Malaysia	2000–2004	Firm level
Marcin (2008)	Poland	1996–2003	Firm level
Laenarts and Merlevede (2011)	Romania	1996–2005	Firm level
Liang (2017)	China	1998–2005	Firm level
Liu et al. (2009)	China	1998–2001	Firm level
Lutz and Talavera (2004)	Ukraine	1998–1999	Industry level
Mariotti et al. (2011)	Italy	1999–2005	Firm level
Mebratie and Bedi (2013)	S. Africa	2003	Firm level
Merlevede and Schoors (2007)	Romania	1996–2001	Firm level
Merlevede and Schoors (2009)	Romania	1996–2001	Firm level
Merlevede et al. (2014)	Romania	1996–2005	Industry level
Nicolini and Resmini (2010)	Poland	1998–2003	Firm level
Qiu et al. (2009)	China	2001–2006	Industry level
Reganati and Sica (2007)	Italy	1997–2002	Firm level
Sarkar and Lai (2009)	India	2005	Firm level
Schoors and van der Tol (2002)	Hungary	1997–1998	Firm level
Sun (2011)	China	2003	Firm level
Tang (2008)	China	1998–2001	Firm level
Tian (2007)	China	1996–1999	Industry level
Tomohara and Yokota (2006)	Thailand	1999–2001	Firm level

Table 1 (continued)

Study	Country	Data year	Aggregation
Wang and Yu (2007)	China	2001	Industry level
Wang and Zhao (2008)	China	2000–2002	Industry level
Wang et al. (2012)	China	1998–2006	Industry level
Wei and Liu (2006)	China	1998–2001	Industry level
Xu and Sheng (2012)	China	2000–2003	Industry level
Zhang et al. (2010)	China	1998–2003	Firm level

applied in the literature (Card et al. 2010; de Groot et al. 2016; Koetse et al. 2009) with the use of ordered probit models (Koetse et al. 2009). Specifically, the model assumes the presence of a latent variable, in our study— $CSig_{ij}^*$, that is explained by a set of moderators (independent variables):

$$y_{ij}^* = \sum_{k=1}^{22} \beta_k Z_{k,ij} + \varepsilon_{ij}$$

in which $Z_{k,ij}$ is a vector of independent variables included; ε_{ij} the error term that is normally and *iid* distributed; and lower case k, I, j refers to the kth variable, ith estimate and jth study respectively. The latent variable $CSig_{ij}^*$ is constructed as follows:

Category A: $y=0$ if an estimate of inward FDI horizontal productivity spillovers to domestic firms is negative and statistically significant (applying 5% significance level),

Category B: $y=1$ if an estimate of inward FDI horizontal productivity spillovers to domestic firms is statistically insignificant (either negative or positive, 5% significance level),

Category C: $y=2$ if an estimate of inward FDI horizontal productivity spillovers to domestic firms is positive and statistically significant (5% significance level).

4.3 Independent Variables

To approximate for the strength of IPR law protection we employ the widely used index of patent protection strength developed by Park (2008). This index measures the availability of patent related legislation in 122 countries for the years 1960–2005 (Park 2008). The scores of the index range from 0 to 5, with higher values indicating stronger levels of patent law protection in a country (Ginarte and Park 1997). It is important to note that the focus of this index is on the availability of patent laws and legal mechanisms (such as the laws that enable the enforcement of IPR), however it does not capture the level of effectiveness with which the law is enforced in practice by public IPR enforcement agents (Arora 2009; Brander et al. 2017; Papageorgiadis et al. 2019a; Park 2008).

To approximate for the strength of public IPR enforcement we employ the IPSS index developed by Papageorgiadis et al. (2014). The IPSS measures the level of transaction costs that patent owners face when engaging with the public patent enforcement agents in an IPR system. It is a longitudinal composite measure that provides annual scores for the time period 1998–2011, for 48 countries. The index scores range from 0 to 10 with high scores indicating to patent systems where public patent enforcement agents effectively implement patent law in practice and low scores indicate to countries where public patent enforcement levels are weak (Papageorgiadis et al. 2014). It is important to note that the IPSS is a composite indicator that uses ten secondary variables to proxy for the transaction costs that patent owners face when engaging with ten different components of public patent enforcement in a country. It consists of three constructs informed by transaction costs theory, namely: (i) monitoring costs determined by the effectiveness and strength of police and border enforcement agents as well as influenced by the societal attitudes and public commitment towards the enforcement of patent rights; (ii) property rights protection costs related to the strength, impartiality, and effectiveness of judicial aspects of a patent institution as well as to the strength of judicial enforcement in a country; and (iii) servicing costs related to the quality and effectiveness of public agencies that are responsible to effectively administer patent laws and regulations or private companies that enable the administration of patents within a country. Therefore, using this index enables us to go beyond approximating for only one aspect of the strength of public patent enforcement, and allows us to capture the combined effectiveness of this multifaceted element of IPR systems.

4.4 Control Variables

Our meta-analytical model includes four different groups of control variables: (a) country level effects, (b) study specific characteristics, (c) model specific characteristics, and (d) estimation method characteristics of the studies in the dataset. First, we incorporate three country level variables that are theoretically expected to have a positive effect on the productivity of domestic firms, namely: (i) financial development (Iršová and Havránek 2013), (ii) labour quality using two proxies (R&D expenditure and tertiary education), and (iii) trade openness (as an indicator of technological inflows in host country) (Iršová and Havránek 2013; Meyer and Sinani 2009; Wooster and Diebel 2010). Second, we control for the characteristics of the studies that comprise the dataset. Differences in the research design across studies may have an effect on the size of the coefficient found in the studies on inward FDI horizontal productivity spillovers to domestic firms (Gorg and Greenaway 2003; Gorg and Strobl 2001; de Groot et al. 2016; Meyer and Sinani 2009). We therefore consider the effect of: (i) data characteristics with two variables (cross-sectional/panel data and industry/firm level data); (ii) the length of the period covered in the study (time span); (iii) sample size, the number of observations used for each estimation; and (iv) two model specification characteristics: (1) if a study controls for the technological gap between domestic and foreign firms (technological gap), using one dummy and (2) foreign presence measurement in the model specification

characteristics of a study, using two dummies, one for studies using the share in employment and the other for studies using foreign equity share in an industry (Gorg and Greenaway 2003). Third, we introduce five dummy variables to control for the estimation method used in the studies in our dataset such as; (a) Olley-Pakes, (b) OLS, (c) GMM, (d) year fixed and (e) sector fixed. Fourth, we introduce three dummy variables to control for the effect of publication characteristics on inward FDI horizontal productivity spillovers to domestic firms namely; (a) peer reviewed articles (Stanley and Doucouliagos 2012), (b) inward FDI vertical productivity spillovers (Smarzynska-Javorcik 2004a, 2004b), and (c) Amadeus database (Eapen 2013). Table 2 provides the definition of all the variables included in the study and the data sources used to measure them.

5 Results and Discussion

Table 3 provides the descriptive statistics of all the variables included in the empirical estimation and Table 4 the correlation table. The correlations among the variables is low. The average value of the VIF test is 1.23 and the correlation between public IPR enforcement and IPR law protection is 0.125 and statistically insignificant. Overall, multicollinearity does not seem to be a problem.

Table 5 presents the ordered probit estimates. These estimates are accompanied with their corresponding marginal effects which show the change in the probability of finding a specific outcome (Koetse et al. 2009; Verbeek 2017). Since the results of the marginal effects are fully consistent with the ordered probit estimates, we focus our discussion of findings mainly based on the ordered probit estimates for brevity. With regards to the results in relation to hypothesis 1, we find that the strength of IPR law protection has a positive and statistically significant (4.097, $p < 0.001$ in Model 1) effect on inward FDI horizontal productivity spillovers to domestic firms. This finding therefore supports hypothesis 1 regarding the positive impact of IPR law protection strength on the effect of inward FDI on the productivity spillovers to domestic competitors. This result is not surprising given that the signing of the TRIPS agreement in 1995 was underpinned by the expectation that improving the strength of IPR law protection in a country will boost FDI and technology transfer levels globally. As the result related to Hypothesis 1 reveals, domestic firms in the host countries benefit from this boost by gaining access to more advanced IPR assets and improving their productivity. This result however challenges the findings of the previous meta-analytic study by Iršová and Havránek (2013) who found that the IPR law protection reduces the magnitude of inward FDI horizontal productivity spillovers to domestic firms and Smeets and de Vaal (2016) who found an insignificant relationship. The discrepancy in the results may be due to the non-consideration of the effects of public IPR enforcement strength in their empirical analyses. This explanation is consistent with Smeets and de Vaal's (2016) acknowledgement that the variation in national IPR system strength is limited in their sample of countries because they are all (fairly) well developed and have more standardised de jure protection, as reflected in the IPR indicators used.

Table 2 Definition of variables and sources of data

Variable	Definition	Data source
C_{sig}	Categorical dependent variable: = 0 if inward FDI horizontal productivity spillovers to domestic firms estimates are negative, = 1 if inward FDI horizontal productivity spillovers to domestic firms estimates are insignificant, = 2 if inward FDI horizontal productivity spillovers to domestic firms estimates are positive	
IPR law protection	Park (2008) patent protection index. The index ranges from 0 to 5 with higher values indicating stronger levels of IPR protection.	Park (2008)
Public IPR enforcement	Papageorgiadis et al. (2014) index. The index ranges from 0 to 10 with higher scores indicating stronger IPR enforcement levels.	Papageorgiadis et al. (2014)
Trade openness	Trade (%GDP)	World Development indicators, World bank
Tertiary education	The tertiary school enrolment rate in the country	World Development indicators, World bank
R&D expenditure	R&D expenditures (%GDP)	World Development indicators, World bank
Financial development	Domestic credit provided by financial sector (% of GDP)	World Development indicators, World bank
Cross sectional data	= 1 if cross sectional are used, = 0, otherwise	World Development indicators, World bank
Industry level data	= 1 if industry level data are used, = 0, otherwise	
No. of observations	The number of observations used in each study	
Time span	The number of years of the data used	
Foreign presence in employment	= 1 if proxy for foreign presence is measured in terms of employment share, = 0, otherwise	
Foreign presence in equity	= 1 if proxy for foreign presence is measured in terms of equity share, = 0, otherwise	
Technological gap	= 1 if the study controls for technological gap, = 0, otherwise	
Olley-Pakes	= 1 if the Olley-Pakes method is used for the estimation of total factor productivity, = 0 otherwise	
OLS	= 1 if the Ordinary Least Squares method is used for the estimation of total factor productivity, = 0 otherwise	
GMM	= 1 if the system General Method of Moments estimator is used for the estimation of spillovers, = 0 otherwise	
Year fixed	= 1 if year fixed effects are included, = 0 otherwise	

Table 2 (continued)

Variable	Definition	Data source
Sector fixed	= 1 if sector fixed effects are included, = 0 otherwise	
Amadeus	= 1 if the Amadeus database is used, = 0 otherwise	
Publication	= 1 if paper published in a peer reviewed journal, = 0 otherwise	
Vertical spillovers	= 1 if inward FDI vertical productivity spillovers to domestic firms' variable is included in the regression, = 0, otherwise	

Table 3 Descriptive statistics

Variable	Observations	Mean	Std. Dev	Min	Max
C _{sig}	1524	0.41	2.49	− 8.50	9.71
Public IPR enforcement	1567	4.26	1.08	3.40	8.85
IPR law protection	1567	3.41	0.51	2.12	4.60
Public IPR enforcement × IPR law protection	1567	14.73	5.75	8.90	39.68
Trade openness	1560	61.23%	24.32%	20.02%	205.54%
Financial development	1566	77.21%	53.36%	15.59%	192.66%
Tertiary education	1566	22.86%	14.95%	0.00%	59.72%
R&D	1566	0.76%	0.35%	0.26%	2.68%
Cross sectional data	1567	0.07	0.25	0.00	1.00
Industry level data	1567	0.30	0.46	0.00	1.00
Time span	1567	6.70	2.85	1.00	10.00
Ln no. of observations	1566	10.31	2.56	3.30	15.09
Foreign presence_employment	1567	0.39	0.49	0.00	1.00
Foreign presence_equity	1567	0.16	0.36	0.00	1.00
Technological gap	1567	0.10	0.30	0.00	1.00
Vertical spillovers	1567	0.81	0.39	0.00	1.00
Olley-Pakes	1567	0.17	0.37	0.00	1.00
OLS	1567	0.58	0.49	0.00	1.00
GMM	1567	0.22	0.41	0.00	1.00
Sector fixed	1567	0.24	0.43	0.00	1.00
Year fixed	1567	0.47	0.50	0.00	1.00
Publication	1566	0.45	0.50	0.00	1.00
Amadeus	1567	0.34	0.47	0.00	1.00

The testing of hypothesis 2 reveals that the strength of public IPR enforcement has a positive and statistically significant (3.693, $p < 0.001$ in Model 1) impact on inward FDI horizontal productivity spillovers to domestic firms. While the role of the strength of the public IPR enforcement element of IPR systems in stimulating inward FDI horizontal productivity spillovers to domestic firms has been ignored in the existing literature, the results of our study showcase a significant direct positive effect. This provides support to the expectation that strong public IPR enforcement can significantly support the establishment of lawful co-operation and knowledge transfer between MNEs and competitor domestic firms, boosting the productivity spillovers of the latter. This finding reveals a new IPR institutional mechanism that affects inward FDI horizontal productivity spillovers to domestic firms, demonstrating the importance for future studies in the literature to consider the theoretically distinct effects of the strength of public IPR enforcement. In addition, this result provides further support to the perspective of Brander et al. (2017) who conceptually highlighted the differences between the strength of the availability of IPR law protection as it appears on the books and the actual strength of public IPR enforcement,

Table 4 Correlation table

	1	2	3	4	5	6	7	8	9	10	11
(1) Public IPR enforcement	1										
(2) IPR law protection	0.125246	1									
(3) Interaction term	-0.13577	-0.3858	1								
(4) Trade openness	0.118595	-0.20254	0.175899	1							
(5) Tertiary education	0.097619	-0.0671	-0.06481	-0.04878	1						
(6) Financial development	0.009282	0.105736	0.166415	0.267599	-0.22762	1					
(7) R&D expenditure	-0.10734	0.373961	0.097785	0.140473	0.229357	-0.03107	1				
(8) Cross-sectional data	0.015596	-0.0681	0.084283	-0.05818	0.076836	0.119428	-0.24031	1			
(9) Industry level data	0.141615	0.036283	0.023794	0.07632	-0.00808	-0.24026	-0.10466	0.077751	1		
(10) Ln number of observations	-0.01337	-0.01266	0.157519	-0.06206	0.245954	0.097431	-0.06276	0.19152	0.085873	1	
(11) Time span	-0.01567	0.070073	-0.14927	-0.10585	0.12757	-0.14981	0.140735	-0.0595	-0.15696	0.0991	1
(12) Foreign presence_employment	0.030958	0.153427	-0.01999	0.226679	-0.10657	-0.28523	0.152273	0.007887	0.075548	-0.00435	0.159567
(13) Foreign presence_equity	0.12665	0.35215	-0.02092	-0.06108	0.087082	-0.18855	0.202779	-0.28816	-0.34909	0.263406	-0.26334
(14) Technology gap	0.127269	0.023607	0.075556	-0.24357	-0.11975	0.035566	-0.08187	0.105789	0.126717	-0.39614	-0.02838
(15) Olley-Pakes	-0.09153	-0.12181	-0.12084	0.027803	-0.01355	0.032561	-0.05113	-0.17666	-0.09015	0.027397	0.054664
(16) OLS	0.011109	0.077254	0.015402	-0.12735	0.133644	0.200345	-0.11596	-0.13681	0.071082	0.205076	-0.18908
(17) GMM	0.209767	-0.24294	0.088839	0.097015	0.045164	-0.13244	0.026317	0.080701	-0.1994	-0.19512	-0.24429
(18) Year fixed	-0.10072	0.356273	0.010407	0.085521	0.115232	0.036497	-0.06287	0.050621	0.185288	-0.00178	0.212367
(19) Sector fixed	0.150699	0.061571	-0.21775	-0.06182	0.11959	-0.06641	-0.092	0.03056	-0.21761	0.011937	-0.16565
(20) Publication	0.046922	0.197288	-0.12517	0.009071	0.034854	-0.33373	-0.03172	-0.0299	0.03625	-0.0846	-0.08311
(21) Amadeus	-0.11559	0.215982	0.259961	0.030084	-0.12592	0.085622	0.087189	-0.0574	-0.02337	0.075196	0.019348
(22) Vertical spillovers	-0.1384	0.111245	0.046154	0.045315	-0.18865	0.107035	0.187048	-0.08881	-0.03094	-0.13276	0.148491
	12	13	14	15	16	17	18	19	20	21	22
(1) Public IPR enforcement											
(2) IPR law protection											

Table 4 (continued)

	12	13	14	15	16	17	18	19	20	21	22
(3) Interaction term											
(4) Trade openness											
(5) Tertiary education											
(6) Financial development											
(7) R&D expenditure											
(8) Cross-sectional data											
(9) Industry level data											
(10) Ln number of observations											
(11) Time span											
(12) Foreign presence_employment	1										
(13) Foreign presence_equity	-0.02571	1									
(14) Technology gap	0.047207	0.269503	1								
(15) Olley-Pakes	-0.06419	-0.22697	0.10001	1							
(16) OLS	-0.2497	-0.13706	0.140922	0.378571	1						
(17) GMM	0.101307	-0.02671	0.193666	0.204765	-0.09838	1					
(18) Year fixed	-0.18518	-0.04534	-0.13653	-0.03287	-0.12597	-0.02434	1				
(19) Sector fixed	0.048397	-0.04216	0.255858	0.107646	-0.00627	-0.04363	0.050379	1			
(20) Publication	0.160162	0.11306	-0.16627	0.171437	0.044739	0.021482	0.000337	0.240788	1		
(21) Amadeus	0.288568	0.020538	0.106867	-0.01669	0.026724	-0.11486	-0.00766	-0.0434	-0.13228	1	
(22) Vertical spillovers	0.172762	0.028945	0.106197	-0.07498	-0.08138	0.251597	-0.08335	-0.06495	-0.01535	0.064164	1

Table 5 Empirical estimation and associated marginal effects of meta-analysis ordered probit model

	Ordered Probit Model (1)	Significantly negative	Insignificant	Significantly positive
Public IPR enforcement	3.693*** (− 5.71)	− 0.836** (− 2.63)	− 0.365 (− 1.72)	1.201* (− 2.46)
IPR law protection	4.097*** (− 5.52)	− 0.927** (− 2.64)	− 0.405 (− 1.77)	1.332** (− 2.51)
Public IPR enforcement × IPR law protection	− 0.877*** (− 5.73)	0.199** (− 2.62)	0.867 (− 1.74)	− 0.285* (− 2.47)
Trade openness	0.317 − 1.23	− 0.072 (− 0.69)	− 0.031 (− 0.68)	0.103 (− 0.7)
Tertiary education	2.82*** − 4.35	− 0.640 (− 1.35)	− 0.279 (− 1.13)	0.919 (− 1.31)
Financial development	− 0.779*** (− 3.45)	0.176* − 2.33	0.077 − 1.55	− 0.253** (− 2.15)
R&D expenditure	0.482* − 2.1	− 0.109 (− 1.13)	− 0.048 (− 1.00)	0.157 (− 1.11)
Cross sectional data	− 0.288 (− 1.13)	0.065 (− 0.5)	0.029 (− 0.54)	− 0.094 (− 0.52)
Industry-level data	1.181*** − 5.75	− 0.267** (− 2.59)	− 0.118* (− 1.64)	0.384** (− 2.37)
Ln no. of observations	0.0006 − 0.02	− 0.0001 (− 0.01)	− 0.0001 (− 0.01)	0.0002 (− 0.01)
Time span	− 0.125*** (− 4.79)	0.284* (− 2.29)	0.012 (− 1.69)	− 0.041* (− 2.23)
Foreign presence_employment	− 0.267* (− 2.20)	0.060 (− 1.12)	0.026 (− 1.02)	− 0.087 (− 1.11)
Foreign presence_equity	0.730*** − 6.11	− 0.165* (− 2.68)	− 0.072* (− 2.24)	0.237* − 2.9
Technological gap	− 0.856*** (− 4.00)	0.194* (− 2.12)	0.085 (− 1.62)	− 0.278* (− 2.08)
Olley-Pakes	− 0.396** (− 3.01)	0.090 (− 1.4)	0.039 (− 1.33)	− 0.129 (− 1.43)
OLS	− 0.741*** (− 7.08)	0.168* (− 2.38)	0.073 (− 1.72)	0.241* (− 2.31)
GMM	− 1.101*** (− 4.87)	0.249** (− 2.32)	0.109** (− 1.56)	− 0.358* (− 2.15)
Year fixed	− 0.741*** (− 6.69)	0.168*** (− 3.18)	0.733 (− 2.21)	− 0.241*** (− 3.29)
Sector fixed	0.381* − 2.38	− 0.086 (− 0.80)	− 0.038 (− 0.68)	0.124 (− 0.77)
Publication	− 0.461** (− 3.66)	0.104 (− 1.68)	0.046 (1.3)	− 0.150 (− 1.61)
Amadeus	0.644***	− 0.146	− 0.064	0.210

Table 5 (continued)

	Ordered Probit Model (1)	Significantly negative	Insignificant	Significantly positive
	– 3.36	(– 1.30)	(– 1.14)	(– 1.28)
Vertical spillovers	– 0.109	0.025	0.011	– 0.0351
	(– 0.72)	(– 0.36)	(– 0.35)	(– 0.36)
Number of observations	1560			

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

as well as the potential benefits that host countries experience from the strengthening of public IPR enforcement.

With regards to hypothesis 3, we find that strong public IPR enforcement weakens the positive relationship between IPR law protection and inward FDI horizontal productivity spillovers to domestic firms (-0.877 , $p < 0.001$ in Model 1). The results therefore support hypothesis 3 and reveal a second previously unexplored institutional mechanism of the functioning and effects of IPR systems. In countries where both IPR law protection and public IPR enforcement are strong, MNEs enjoy stronger market power than in countries with strong IPR law protection but relatively weak public IPR enforcement (and vice versa). In such IPR systems, domestic firms, on the one hand, can be restricted to competing in a tight technological landscape that restricts them from responding to the competitive pressures, given that investments in R&D may be endangered by IPR litigation activity from the MNEs. On the other hand, they have less negotiating power when attempting to collaborate and achieve a suitable licensing rate for accessing the IPR assets of an MNE, which has a negative impact on their productivity. As a result, domestic firms may also devote less effort in exploring tacit knowledge and developing organisational routines for innovation. This finding reconciles previous positive and negative assertions (e.g., Iršová and Havránek 2013; Smeets and de Vaal 2016; Yi et al. 2015) in the literature on the relationship between IPR protection and inward FDI horizontal productivity spillovers to domestic firms. Overall, the findings suggest that future studies need to consider the effects of the two elements of an IPR system simultaneously on inward FDI productivity spillovers to domestic firms and other economic phenomena (depending on the focus of a study).

The results relating to the effect of the control variables are mainly in line with the findings in the existing literature. With regards to the country level variables, financial development has a significant negative effect whereas both proxies of labour quality (tertiary education and R&D expenditure) are found to have a significant positive effect on inward FDI horizontal productivity spillovers to domestic firms (in line with: Iršová and Havránek 2013). However, trade openness is found to have an insignificant effect. With respect to the study specific characteristics, the industry/firm level variable of data characteristics has a positive effect on the dependent variable (in line with Meyer and Sinani 2009) while the cross-sectional/panel data variable is found to have an insignificant effect. Furthermore, the estimation characteristics (time span) has a significant negative effect, but the publication sample

size (number of observations) is found to have an insignificant effect. With regards to the model specification variables, we find that studies using proxies of technological gap and foreign presence in employment have a significant negative effect on the dependent variable. The use of foreign presence in equity variables however, is found to have a positive effect. With regards to the control variables relating to the estimation methods, we find that the use of Olley-Pakes, OLS, GMM and year fixed effect estimations have a negative effect whereas the sector fixed effect estimation method variable is found to have a positive effect. Finally, with regards to the three variables capturing the publication characteristics of existing studies, we find that the publication variable (publication in peer reviewed journal) has a significant negative effect, the Amadeus database a significant positive effect, and the inward FDI vertical productivity spillovers to domestic firms variable an insignificant effect.

6 Conclusions

This paper builds on and extends the meta-analytical work on inward FDI horizontal productivity spillovers to domestic firms of Meyer and Sinani (2009) and Iršová and Havránek (2013) by incorporating in the theoretical and empirical framework the distinct direct and moderating effect of the strength of public IPR enforcement in a host country. Although the public enforcement element of IPR systems has increased in importance in the years after the signing of the TRIPS agreement (Brander et al. 2017; USTR 2017), studies on inward FDI horizontal productivity spillovers to domestic firms have only considered the direct effect of the strength of IPR law protection to proxy for the overall effect of IPR systems, finding mixed results (Iršová and Havránek 2013; Smeets and de Vaal 2016; Yi et al. 2015). We argue that the mixed empirical evidence in the existing literature may be due to the non-consideration of the strength of public IPR enforcement and overestimating the effect of the strength of IPR law protection in a country. Both issues can introduce bias to the results of existing studies.

The results of our study reveal that the strength of public IPR enforcement has a direct positive effect on inward FDI horizontal productivity spillovers to domestic firms. Furthermore, we find that strong levels of public IPR enforcement negatively moderate the effect of strong IPR law protection on inward FDI horizontal productivity spillovers to domestic firms. This result showcases that in countries where MNEs are able to receive strong legal protection for their IPR assets and can effectively enforce their IPR in case of infringement, they are expected to gain strong market power in their respective industries and stifle the productivity of domestic firms. Therefore, the results of the study identify two new institutional mechanisms that were previously unknown to the literature. This reconciles the diverging assertions and mixed results found by previous studies, since these focused on only one of the two elements that comprise the strength of IPR systems, this of the strength of IPR law protection. The results of the study highlight the need to recalibrate the theoretical and empirical focus of future studies on FDI productivity spillovers to domestic firms by considering the direct and indirect effects of the strength of public IPR enforcement. This is especially the case for studies focusing on the effect of

IPR systems in the years after the signing and implementation of the TRIPS agreement which altered the institutional conditions in the IPR systems of WTO countries globally.

Given that the strengthening of the two elements of IPR systems continues to be an important aspect in the international policy making negotiations and national policies, the results of this study have important policy making implications (FT 2018). Our findings suggest that the strengthening of both IPR law protection and public IPR enforcement in a country are expected to boost inward FDI horizontal productivity spillovers to domestic firms. Countries with strong book-law protection and public IPR enforcement are expected to benefit in terms of productivity, especially in relation to accessing the IPR assets of foreign MNEs. However, policy makers need to be cognizant of the off-setting effect of strong IPR law protection and public IPR enforcement on inward FDI spillovers and monitor closely the strengthening of public IPR enforcement in their country to timely identify when the productivity spillovers start to be hindered by a potential technological monopoly of MNEs. This can be done through the monitoring of the overall functioning of specific industries by e.g., monitoring the number of IPRs owned by MNEs, large firms or/and business groups and the number of IPR litigation cases taking place within an industry and the way that the judiciary, customs and police enforcement agents behave in cases where an MNE's allegation that its IPR is infringed by a domestic firm's R&D activity is exaggerated. In areas where the link between IPR protection and technology transfer and diffusion breaks down, policy makers should consider the options of moderate protection, such as shortening protection period and imposing maintenance fee for patents that are not practiced but owned for pre-emptive purposes.

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