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In this paper, we analyze whether the recent global process of strengthening and harmonization of intellectual property rights (IPRs) affects decisions of cross-border mergers and acquisitions (M&As). We investigate if IPRs have a differential effect across sectors of different technology content and for countries of different development level. Also, we study how imitation abilities of target countries interact with the tightening of IPRs. Using data for the post-TRIPS period (1995-2010), we estimate an extended gravity model to study the bilateral number of M&As, including a measure of the strength of IPRs systems on target countries and a set of control variables usually considered as determinants of M&As. The estimation results verify the gravity structure for M&As and show that IPRs –and enforcement– influence decisions of cross-border M&As in all sectors regardless of their technological content. However, IPRs are more important in countries with high imitation abilities and in sectors of high-technology content. Furthermore, a strengthening of IPRs leads to a larger increase of M&As in developing countries than in developed countries. These results call the attention on the possible implications for least developed economies and challenge the adequacy of a globally harmonized IPRs systems.

Keywords: Intellectual Property Rights; Mergers and Acquisitions; Gravity Model; Technological Intensity; Imitation; International Comparison

JEL Classifications: O34; G34; O13; O14

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1. Introduction

The recent process of harmonization and strengthening of intellectual property rights (IPRs) systems is expected to have implications for global relations among countries (Maskus 2012). However, the effect of IPRs on international trade, foreign direct investment (FDI), technology transfer, and mergers and acquisitions (M&As) is not clear either from a theoretical perspective or from an empirical point of view (Maskus and Penubarti 1995; Maskus 2000; Foley et al. 2006; Campi and Dueñas 2016).

In the case of cross-border M&As, intellectual property (IP) assets are often a relevant part of the value of the target firm and the desire of a firm to access them might be a significant driving force behind a deal. Nevertheless, economic theory sheds an ambiguous light on the relation between IPRs and M&As, especially, at the country level. The effect of IPRs on M&As is mediated by several trade-offs that explain the difficulty of determining the expected effects. Also, IPRs affect not only the decisions of firms to engage in M&As but also to license technologies or export, which can be complementary or substitutes. In addition, the threat of imitation that derives from different capabilities of countries is often identified as a critical feature shaping the effects of IPRs (Smith 1999; Connolly 2003; Helpman 2006). Moreover, the technology content of sectors (Mansfield 1995), and the development level of countries (Helpman 1993) that imply a set of particular features, are also likely to differently influence M&As.

In the last decades, the growth of FDI at higher growth rates than trade and GDP has been one of the main characteristics of the process of globalization (Feenstra 1998; Brakman et al. 2010). Cross-border M&As account for a large share of FDI.[1] Simultaneously, the signing of the agreement on Trade-Related Aspects on Intellectual Property Rights (TRIPS) in 1994 led to a process of global diffusion and tightening of IPRs systems. In this process, developed countries (DCs) have increased the level of existing IP protection and developing or less developed countries (LDCs) have either adopted new systems or adapted their existing systems to the "minimum standards" demanded by the TRIPS. The scope of IP protection has also been broadened, reaching sectors or products, such as plant varieties, micro-organisms, and pharmaceutical products, which were often excluded from IP protection.

This paper explores whether the strengthening of IPRs systems during

[1] According to UNCTAD (2001), M&As represented around 80% of the world FDI in 2000.

the post-TRIPS period (1995-2010) has affected decisions of M&As using an extended gravity model and considering the strength of IPRs systems in target countries as a possible determinant of cross-border M&As. We analyze this phenomenon at the country level as we are interested both in the global diffusion of IPRs systems and cross-border M&As as part of a more general globalization process.

We use a large set of countries and include control variables usually considered as determinants of M&As, as well as country and country-pairs fixed effects in order to control for endogeneity derived from unobserved characteristics. With the aim of providing more robust evidence, we consider the technological content of sectors, an indicator of enforcement of IPRs, the imitation abilities of countries, and their development levels.

The effect of IPRs is usually sector-specific (Mansfield 1995; Cohen et al. 2000; Smarzynska 2004; Nunnenkamp and Spatz 2004). For example, some sectors of high-technology content, such as pharmaceuticals, are expected to be more affected by changes in IPRs. In order to take into account a possible differential effect of IPRs for different sectors, we split our data on M&As into four groups of different technology content: (i) agri-food; (ii) low-technology industries; (iii) medium-technology industries; and (iv) high-technology industries. In order to consider specific features of manufactures and agricultural products, we use two different measures of IPRs systems: the index of patent protection of Ginarte and Park (1997), updated by Park (2008), for the manufacturing sector, and the index of IP protection for the agri-food sector, developed by Campi and Nuvolari (2015). We also control for differences in the enforcement of IPRs using an indicator of the strength of the legal system and property rights, and analyzing its interaction with the strength of IPRs systems.

In addition, we consider the interaction between IPRs systems and imitation abilities of target countries. We argue that this interaction will depend on the technology content of sectors because high imitation abilities in the target countries might be more likely to discourage firms from doing cross-border M&As, trade, or technology transfer in sectors of medium- and high-technology content. In these sectors, an increase in IP protection could be more important for firms engaging in M&As. Conversely, in sectors in which products can be easily copied, regardless of the imitation abilities of countries, the interaction could be less relevant.

Finally, we consider that the effect of IPRs might also depend on the development level of countries. This may happen for several reasons. Firstly, the relevance of agriculture and manufactures of different technology content is different for DCs and LDCs. Secondly, DCs used to have in place strong IPRs systems well before the TRIPS agreement, while LDCs are more recently adopting strong IP protection systems. Most LDCs were reluctant to tighten their IPRs systems and the actual strengthening was not an endogenous response to domestic innovation, while several DCs were the ones pushing for uniform reforms across countries (Delgado et al. 2013). And, thirdly, several studies have found differential effects of IPRs for DCs and LDCs (Seyoum 1996; McManis 1997; Kalanje 2002).

Overall, we find that the strengthening of IPRs systems increases the number of cross-border M&As, for all the sectors considered regardless of their technological content. These results are robust when we consider a proxy of the enforcement capacity of countries together with their IPRs systems. We also find that the positive effect of IPRs on M&As is stronger when the increase in IPRs takes place in a LDC, compared with DCs. Finally, we find that the effect of stronger IPRs depends on the imitation abilities of countries –being more relevant in countries with high imitation abilities– but also that this interaction is more important in sectors of medium- and high-technology content.

These results are robust to different specifications that control for endogeneity and allow to conclude that differences in technologies, imitation abilities, and development levels of countries are important to determine the effect of IPRs on M&As. This has relevant implications in the context of the global strengthening and harmonization of IPRs systems.

In the first place, both the threat of imitation and the development level of countries influence decisions of M&As in response to national differences in IPRs. The interaction between imitation abilities of target countries and technological content of sectors is heterogeneous, being more important for sectors of high-technology content (see: Shin et al. 2016, for the case of trade). Moreover, the effect on developing countries is stronger compared to the effect on developed countries. All this implies that specific features of countries and sectors are relevant for the design of IPRs systems and challenges the idea of a one size fits all system as the one promoted by the TRIPS. In other words, given the heterogeneous effects, the results challenge the adequacy of globally harmonized IPRs systems that do not consider technological capabilities and development levels of countries.

Finally, given that whether FDI is beneficial for developing countries does not have a unique answer and is a matter of debate (Helpman 1993; Yi and Naghavi 2017), a concerned policy maker should consider whether M&As are a desirable form of investment for different LDCs. In particular, considering that stronger IPRs attract more M&As in LDCs compared with DCs, and that the increase of M&As derived from stronger IPRs is observed across all sectors and not necessarily imply technology transfer.

The remaining of the paper is organized as follows. In the next section, we briefly discuss the possible determinants of M&As, we analyze how IPRs are expected to influence firms' decisions of M&As, and review the empirical evidence. In Section 3, we analyze the data. In Section 4, we explore the effect of IPRs on bilateral flows of M&As. Finally, in Section 5, we discuss the main findings and provide general conclusions.

2. Determinants of M&As and the effect of IPRs

A firm that aims to access a foreign market faces different choices. It can export a product, manufacture it locally by undertaking FDI –which in turn can mean doing a greenfield or a brownfield investment–, license the product to a firm in the host country, or undertake a joint venture involving joint production or a technology-sharing agreement (Fink and Maskus 2005; Helpman 2006). These decisions are not made independently from each other, nor they are exclusive.

Several empirical studies have investigated the determinants of M&As and FDI (for an extensive survey see: Blonigen 1997). Most of the existing contributions focus on the macroeconomic causes of FDI and the obstacles to capital flows, such as financial markets failures and asymmetric information, and on specific features of countries (Hyun and Kim 2010).

Empirical studies find that the more relevant determinants of M&As are: 1) GDP and market size (Brakman et al. 2010), 2) geographical distance as a proxy of transportation and transaction costs (Brakman et al. 2010), 3) cultural differences (Erel et al. 2012), 4) financial market development (Di Giovanni 2005), 5) openness to trade and economic integration (Cuevas et al. 2005; Hyun and Kim 2010), 6) quality of institutions (Rossi and Volpin 2004; Courdacier et al. 2009; Hyun and Kim 2010; Hur et al. 2011), and 7) exchange rates volatility (Blonigen 1997; Brakman et al. 2010).

In addition, intangible assets such as patents, trademarks, and trade secrets are a part of the value of the target firm in M&As. Therefore, several scholars agree that a relevant driving force behind M&As deals is the acquirer's desire to obtain the target's IP assets (Bryer and Simensky 2002; Marco and Rausser 2002). For example, Marco and Rausser (2002) show that M&As of major agricultural business suppliers are designed to expand the IPRs portfolio. This is not surprising if we consider certain firms' behaviors related with IPRs such as patent blocking or the creation of patent thickets, which can generate incentives for firms to acquire other firms that hold strategic IPRs (Bessen 2003; Cohen et al. 2000). Then, we might expect that not only access to IPRs assets but also IPRs systems protecting these assets might induce M&As.

Being a relevant part of the general regulatory system, IPRs systems can affect the investment climate (Fink and Maskus 2005). However, Maskus (2000) argues that IPRs systems alone cannot explain how firms decide to invest, trade, or license a product to a certain country, as firms' decisions are influenced by other factors, such as internationalization advantages that derive from market power, market size, as well as transportation, transaction, and labor costs. These factors, together with financial variables and the institutional system, are usually different in countries of different development level. Thus, the effect of IPRs on M&As may also be affected differently by the level of development of the countries involved in the deals.

Theoretically, the relation between IPRs and FDI, including M&As, is ambiguous. Strong IPRs may encourage firms with IP assets or knowledge intensive products to trade, invest, and license because IPRs reduce the risk of imitation. But the effect of lower imitation risk of licensed technologies may reduce incentives for FDI and, instead, increase incentives to trade (Yang and Maskus 2001).

In order to study the welfare effects of tighter IPRs systems, Helpman (1993) builds a model of general equilibrium of two regions, North and South, where innovation takes place in the North while the South imitates technologies invented in the North. He shows that strengthening IPRs increases FDI in both regions, but he concludes that whether this is desirable, cannot be answered theoretically. Tighter IPRs hurt the South, while the effect in the North depends on the existence of small imitation rates. Likewise, Yi and Naghavi (2017) show that in less developed countries, IPRs should be just strong enough to induce FDI since international technology spillovers are the dominant source of technological development. Instead, a stronger level of IP protection is recommended for more advanced emerging economies as a tool to exploit the potential of their domestic innovators.

Empirically, the effect of IPRs on M&As has been less thoroughly studied.

The evidence is mostly gathered from FDI data and it is not conclusive. Several authors find a positive effect of IPRs on FDI. Using a gravity model, Smith (2001) finds a positive link between IPRs and both FDI and licensing of US firms, although this holds for middle-income countries and large LDCs, but not for small and low-income countries. Both Lesser (2002) and Adams (2010) find a positive correlation among IPRs and FDI inflows to LDCs. Foley et al. (2006) study the effect of IPRs reforms on US multinationals, finding that stronger IPRs increase technology transfer and the level and growth rate of non-resident patenting. Ahammad et al. (2018) find that the greater the strength of IP protection in target economies and higher the target firms' research and development (R&D) capabilities, the more likely it is for multinational companies of Brazil, Russia, India, and China to undertake partial, rather than full acquisitions.

On the contrary, other authors find a negative or not significant correlation between IPRs and FDI. Seyoum (1996) explores the relation between IPRs and FDI before the signing of the TRIPS. He finds no significant relation for LDCs, but he observes a positive effect of trademarks and copyrights and a negative effect of patent protection, on investment decisions for DCs. Fink (2005) investigates the effect of IPRs on exports, FDI, and licensing arrangements made by German and American multinationals. He finds no effect of stronger IPRs, except for a negative link between IPRs and sales in the chemical industry. Nicholson (2007) estimates the impact of IPRs on the composition of sector-specific multinational activity. He argues that firms in industries with high capital costs are more likely to maintain control over production knowledge through FDI in countries with weak IP protection. Conversely, firms in industries that are intensive in R&D are more likely to engage in licensing when IPRs systems are strong.

Overall, IPRs systems may affect the decisions of firms to trade, invest, or license technologies in several ways. From the acquirers' perspective, IPRs can reduce imitation threat inducing M&As. But imitation abilities depend not only on IP protection but also on the capabilities of firms to master new technologies and both tacit and codified knowledge. Therefore, the effect of IP protection systems needs to consider imitation abilities of target countries because the interaction between imitation threat and IPRs systems is likely to affect the decisions of firms to export or to invest abroad. For the case of trade, Smith (1999) shows that, depending on the sector, low and high imitation threat, and weak and strong IPRs systems, can produce a market expansion effect –increasing exports–, a market power effect –decreasing exports–, or could have an ambiguous effect that needs to be empirically determined.

In fact, when imitation abilities are low, weak IPRs could be beneficial for both partners because this combination might encourage foreign firms to engage in joint-ventures and license agreements with domestic firms, as well as simply trade, promoting technology transfer to the domestic market. However, the market power that derives from IPRs might induce firms to reduce sales and increase prices, preventing access to new technologies and hindering further innovation. How IPRs influence decisions of firms is mediated by several trade-offs, which explain the difficulty to predict this effect *a priori*.

In addition, the effect of IPRs usually depends on the sector. Mansfield (1995) shows that firms in the chemical, electrical equipment, pharmaceutical, and machinery sectors are more likely to be affected by IPRs. Smarzynska (2004) argues that weak IPRs systems have the largest deterring effect on FDI in four technology-intensive sectors: drugs, cosmetics and health care products, chemicals, machinery and equipment, and electrical equipment. Moreover, the decision to trade, undertake FDI, or license can also be sector-specific. Nicholson (2007) argues that firms with natural barriers to imitation tend to choose licensing, while firms vulnerable to imitation tend to choose FDI. Stronger IPRs systems can cause substitution between these modes.

Since the effect of IPRs remains ambiguous, we contribute to this literature with further empirical evidence on whether IPRs systems in target countries affect decisions of M&As. We use a gravity model to explain cross-border M&As including IPRs systems and a set of control variables. To our knowledge, this is the first study that considers the strength of IPRs systems in target countries as a possible determinant of M&As using a gravity specification for a large set of countries. Also, while most studies focus on a few variables that affect M&As, we include a set of variables, which are considered determinants of M&As in the related literature. In addition, we assess the effect of IPRs on M&As in sectors with different technology content and we study the interaction between IPRs systems and imitation abilities as well as development levels of countries.

3. Data

3.1. *Mergers and acquisitions*

Data of M&As are from Worldwide Mergers, Acquisitions, and Alliances Databases SDC Platinum (Thomson Reuters). The database reports both the number of transactions and their values in nominal dollars, although in a large number of cases, firms do not disclose the value of the deals. We deflated cross-border flows of M&As using the US imports price index provided by the US Bureau of Labor Statistics and we obtain M&As in constant 2000 dollars.[2]

Factors driving both the number and value of M&As are expected to be very similar. In fact, the correlation of their evolution in our database is as high as 0.91. We use both the number of transactions and their values for the empirical analysis, and we use the number of transactions for the econometric estimations in order to have a higher number of observations.

Figure 1 depicts the evolution of the volumes in millions (MM) of US dollars (left axis) and the number of total cross-border M&As (right axis) between 1995 and 2010, for the full sample of countries (left), for inflows to DCs (middle), and to LDCs (right).[3]

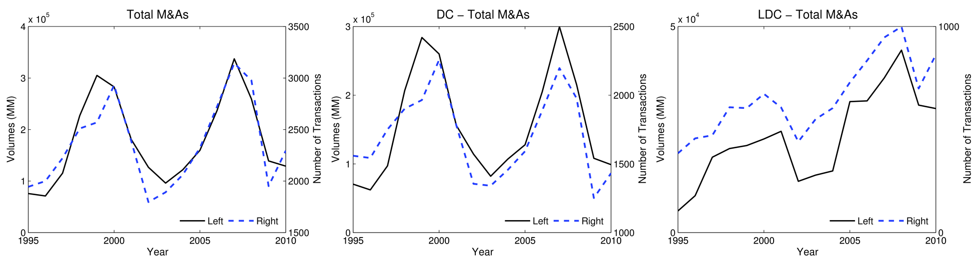

Figure 1.: Evolution of inflows of cross-border M&As. Total (left), developed countries (center), and developing countries (right)

The time series display two peaks, which derive from the "wave-like" behavior of cross-border M&As, characterized by substantial variation over time, produced by periods of rapid growth and periods of rapid decline (Brakman et al. 2010). Cross-border M&As increased between 1995 and 2000, and then decreased until 2003. After this downturn, M&As recovered until

[2] http://www.bls.gov/web/ximpim/beaexp.htm, accessed on February 2015.

[3] The classification of countries according to development level is based on United Nations. See: http://www.un.org/en/development/desa/policy/wesp/wesp_current/2012country_class.pdf (accessed on March 2015). See Appendix A for the list of countries).

2007 and decreased thereafter. This behavior characterizes the evolution of both the number and the value of transactions. Inflows of M&As to DCs almost replicate the behavior of total M&As and inflows to LDCs have been increasing, especially since 2002, before the beginning of the second wave.[4]

Following the classification of Lall (2000) and OECD (2011) as a baseline, we have classified the data in four groups of M&As: (i) agri-food; (ii) low-technology industries; (iii) medium-technology industries; and (iv) high-technology industries.

There exist several ways of categorizing industries by technology intensity. Pavitt (1984) made a relevant effort, distinguishing between resource-based, labour-intensive, scale-intensive, differentiated and science-based manufactures. Lall (2000) improved this classification, arguing that the analytical distinctions of Pavitt are unclear and present large overlaps among categories. The OECD (2011) uses four categories: high-, medium-high, medium-low, and low technology. This classification is based on direct R&D intensity, and R&D embodied in intermediate and investment goods (Hatzichronoglou 1997).

We must highlight that Lall (2000) considers the technological content of products while our classification is for industrial sectors. In order to create our groups, we first connected the sectors identified by SIC codes in the M&As database and the groups defined by the OECD (2011) that correspond to the ISIC Rev.3.[5] As both Lall (2000) and the OECD (2011) warn, there is a certain amount of subjectivity in assigning industries to categories. For example, high-technology industries can produce a variety of products ranging between low- and high-technology. Also, countries might have slightly different classifications using the same method. However, all these possible drawbacks are present in any given classification and are not expected to affect our research. See Appendix B for the classification.

3.2. *Intellectual property rights systems*

To measure the strength of IPRs systems, for the manufacturing sector, we consider the widely used patent protection index of Ginarte and Park (1997)

[4]This process was deepened in more recent years, see: Gaffney et al. (2016).

[5]To do this, we applied a concordance between the ISIC and the NAICS, and between the NAICS and the SIC codes, since there is no direct concordance between the SIC and the ISIC. See: `http://www.macalester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources/TradeConcordances.html`, accessed on December 2015.

and updated by Park (2008). For the agri-food sector, we use a yearly index developed by Campi and Nuvolari (2015), which is an indicator of the strength of IP protection in agriculture that considers its specific features.[6] These indexes aggregate different components that indicate the strength of each country's IP protection system in the manufacturing sector and the agri-food sector, respectively.[7]

The index of Ginarte and Park (1997) considers five categories of the patent laws in each country: (i) extent of coverage, (ii) membership in international patent agreements, (iii) provisions for loss of protection, (iv) enforcement mechanisms, and (v) duration of protection. Similarly, the index of Campi and Nuvolari (2015) consists of five components that define the strength of IP protection in the agricultural sector: (i) ratification of UPOV conventions; (ii) farmers' exception; (iii) breeders' exception; (iv) protection length; and (v) patent scope, which defines whether patents are accepted in five related domains (food, micro-organisms, plant and animals, pharmaceutical products, and plant varieties).

In both indexes, each of the categories or components were scored with a normalized value ranging from 0 to 1. The unweighted sum of these five values constitutes the overall score of each index, which ranges from 0 to 5, with higher values of the indexes indicating stronger levels of IP protection. The main advantage of using these two indexes is that they provide a yearly measure of the strength of IP protection for a large sample of countries.[8]

Table 1 shows an increase in the average values of the indexes over time. IPRs in LDCs have been increasing at higher growth rates and, although the gap between the level of IPRs in DCs and LDCs has narrowed, the last five-years period still shows a higher average level of IP protection in DCs. Also, there has been a decrease in the within variation –observed in the standard deviations. This evolution reflects the process of strengthening and harmonization of IPRs systems that has been taking place since the signing of the TRIPS. Given that

[6]Dealing with living organisms, the agri-food sector presents specificities (compared to manufacturing sectors), which derive in the use of specific related IPRs. For example, plant varieties are mainly protected by plant breeders' rights, rather than by patents.

[7]Both indexes of IPRs probably capture different dimensions of a general IP attitude existing in each country and, therefore, they are positively correlated. However, each index was constructed considering specific features of the sectors and for this reason it is more appropriate to use them for each corresponding sector. We conducted several robustness checks that prove the advantage of using the indexes as we do. The results are available upon request.

[8]Although the index of Ginarte and Park (1997) is available at five-year intervals, we have assumed that the index remains unchanged during the intervals and replicated the values for the missing years. For example, we have used the value of the index in 1995 for all the years between 1996 and 1999. This allows us to take advantage of all available data on M&As flows.

Table 1.: Average value of intellectual property protection

	Agriculture			Manufacture		
	All countries	DCs	LDCs	All countries	DCs	LDCs
1995-1999	1.81(0.99)	2.31(0.89)	1.46(0.91)	2.58(1.09)	3.90(0.76)	2.17(0.82)
2000-2004	2.60(1.01)	2.93(0.83)	2.36(1.08)	3.06(1.01)	4.19(0.54)	2.72(0.85)
2005-2009	3.05(0.92)	3.20(0.78)	2.94(1.01)	3.37(0.89)	4.38(0.34)	3.05(0.76)

Note: Standard deviations in parenthesis.

we are interested in whether IPRs attract M&As, we consider the indexes of the target countries.

3.3. *Enforcement*

It is important to note that the indexes of IPRs systems measure their regulatory aspect but do not address how the enforcement related aspects work in practice (Papageorgiadis and McDonald 2018). Although, enforcement necessarily determines the overall effect of the regulatory aspects of IPRs systems, systematic information on the actual enforcement at the country level is not available. A few studies addressing the application of enforcement mechanisms are only available for a limited number of countries or years (for example, see: Papageorgiadis et al. 2014).

Probably, a good proxy of enforcement could be constructed using data on litigation for IPRs infringement. However, most IPRs infringement cases are settled out of court, often prior to official filing and only a few countries have data on the cases that are actually filled in courts of law (Connolly 2003).

An alternative proxy would be provided by the application of the rule of law at a more general level given that we might expect enforcement of IPRs to be correlated with the rule of law and general regulatory enforcement of countries (Brander et al. 2017).

Thus, we use as a proxy of enforcement an indicator of the strength of the legal system and property rights, which is an index that considers: (i) judicial independence, (ii) impartial courts, (iii) protection of property rights, (iv) military interference in rule of law and politics, (v) integrity of the legal system, (vi) legal enforcement of contracts, (vii) regulatory costs of the sale of real property, (viii) reliability of policy, and (ix) business cost of crime. The index ranges from 0 to 10 with higher values indicating stronger legal systems for policy enforcement.[9] We normalize the value of the index dividing it by 10 in order to have a scaling factor between 0 and 1 that allows us to correct the level of the strength of IPRs by the enforcement.

3.4. *Imitation abilities*

Following Smith (1999, 2001), we use data of R&D expenditure as a percentage of the GDP to classify countries in two groups with high imitation abilities (R&D/GDP>0.5) and with low imitation abilities (R&D/GDP≤0.5). Given that data are not available for all years and countries, we construct a dummy variable to classify countries in these two groups, taking the average of the information reported for the period 1995-2010. The data are from the World Development Indicators and UNESCO Institute for Statistics.[10]

Not surprisingly, according to this classification, most DCs have high imitation abilities given that their investments in R&D as a percentage of the GDP is well above the threshold of 0.5. For example, on average for 1995-2010, investments reached 3.45% in Sweden, 3.22% in Finland, 3.05% in Japan, and 2.59% in the United States. Instead, most LDCs have low imitation abilities, but also many of them invest more than 0.5% of their GDP. For example, China (1.1%), Brazil (1.04%), India (0.75%), and Hong Kong (0.65%).

We use this proxy for imitation abilities to explore the interaction of this feature with the strengthening of IPRs at the country level. We expect that a strengthening of IPRs in countries with low imitation threat would have a lower impact on attracting M&As compared to a tightening of IPRs in countries with high imitation threat.

But also, we expect that the interaction between IPRs and imitation abilities will depend on the technology content of sectors. We argue that a strengthening of IPRs in sectors of low-technology content will have a similar effect on countries of both low and high imitation abilities. This is because the threat of imitation is not expected to be very different if products can be easily copied. Thus, the effect would be ambiguous, depending on other country characteristics. Meanwhile, in sectors of high-technology content, a strengthening of IPRs system will be expected to have a higher impact on countries of high imitation abilities compared to a tightening of IPRs in

[9] See: www.fraserinstitute.org

[10] See WDI: http://databank.worldbank.org/ and UNESCO Institute for Statistics (UIS): data.uis.unesco.org/.

countries of low imitation abilities. This is because, for the acquirer firm, the threat of imitation on a country with low imitation abilities is already low, even in the presence of weak IPRs.

4. M&As and IPRs: a gravity model

The gravity model has been largely used to explain bilateral trade flows using GDP and the geographical distance between two countries as the main explanatory variables (see Anderson 2011, for a review). In addition, gravity models allow for the consideration of other possible determinants at the country level, such as trade barriers, openness to trade, cultural differences, trade agreements, and transaction and transportation costs.

Only recently, the gravity model started being used to explain cross-border M&As given that market size, trade barriers, and economic distance are critical for understanding bilateral flows (see, for example: Di Giovanni 2005; Courdacier et al. 2009; Brakman et al. 2010; Dueñas et al. 2017). Given the volatility of M&As time series, explaining them with gravity specifications might be more challenging than in the case of trade (Herger et al. 2008; Wong 2008). However, a number of studies have succeeded in fitting and predicting M&As reasonably well with a gravity model (see: Blonigen 2005).

4.1. *Methodology*

In this section, we perform a gravity model estimation to explore the possible effect of IPRs on the number of M&As.[11] We use as our benchmark specification the following equation:

$$MA_{ij,k}(t) = \exp\{x_{ij,k}(t) \cdot \beta_k\}\eta_{ij,k}(t), \tag{1}$$

where $MA_{ij,k}(t)$ denotes the number of M&As from the acquirer country i to the target country j, in sector k, in the year t, and

$$x_{ij,k}(t) = \{Z_i, Z_j, D_{ij}, IP_{j,k}, W_i, W_j, XR_{ij}, \gamma_i, \gamma_j, \gamma_{ij}, \gamma_t\}; \tag{2}$$

[11] We also performed econometric estimations using the value of M&As finding complementary results, which are available upon request.

$i, j = 1, ..., N$; $Z = \{\log(\text{GDP}), \log(\text{pop})\}$ is a vector of country-specific variables including GDP and total population; $D = \{\log(dist), \text{contig}, \text{comlang}, \text{comcol}, \text{colony}\}$ is a vector with bilateral-specific variables that includes geographical distance ($dist$), and variables indicating geographical, economic, and cultural barriers between both countries (contiguity, common language, common colonizer, colonial link); and $IP_{j,k} = \{\text{IPR}_{j,k}\}$ includes two indexes of IP protection of the target country j, that are used in independent estimations for sectors k, the index of Campi and Nuvolari (2015) for the agri-food sector, and the index of Ginarte and Park (1997), updated by Park (2008), for the three manufacturing sectors of low-, medium- and high-technological content. To control for other determinants of M&As, we use $W = \{\log(\text{open\_tra}), \text{fin\_open}, \text{h\_cap}, \text{polity}\}$, a vector with country-specific variables that includes openness to trade, an index of financial openness, human capital, and political system; and $XR = \{xr\}$ that is the coefficient of variation of the bilateral exchange rate. Finally, γ_i and γ_j are country dummies for the acquirers and the targets, respectively, γ_{ij} is a set of dyadic dummies, and γ_t is a set of time dummies. It is assumed that $E[\eta_{ij}|Z_i, Z_j, D_{ij}, ...] = 1$.

We include GDP and population as indicators of market size, which is usually associated with a positive effect on M&As. The effect of distance is expected to depend on the type of products. Some models predict that sectors like agri-food and low-technology manufactures might be more affected by distance because these sectors include perishable and relatively bulkier goods (Frankel et al. 1995). Also, distance can have both a negative or a positive effect on M&As depending on the motivation for the transaction. For example, tariff-jumping investment could be positively associated with distance, because it can reduce the transportation costs of exporting. Conversely, market-seeking or outsourcing investments could be negatively related to physical distance, because they are complementary to trade (Hyun and Kim 2010). Other variables that indicate cultural and geographical proximity and are expected to increase bilateral trade flows are contiguity, sharing a common language, or having a common colonizer or a colonial link.

The coefficient of variation of the bilateral exchange rates is computed yearly using monthly data of bilateral exchange rates. We use it as an indicator of macroeconomic volatility, which is expected to negatively affect M&As. Openness to trade may both increase or decrease M&As given that it also affects firms' exports decisions. Financial openness is an index that measures the degree of capital account openness of a country. It is based on binary dummy variables that codify the tabulation of restrictions on cross-border financial transactions (Chinn and Ito 2008, 2014). Financial openness is expected to increase M&As.

Human capital is an index that considers the average years of schooling and the returns to education. We use it as an indicator of the capabilities of a country and probably of imitation abilities. As such, it could have both a positive or a negative effect, because imitation abilities could discourage M&As but higher capabilities could increase M&As. Finally, political system is an indicator that measures the degree of democracy versus autocracy and we use it as a proxy of the quality of institutions, which might increase M&As. Table 2 describes the variables, data sources, and the expected effects.

The estimation of Equation (1) involves some econometric challenges mainly derived from its non-linearity. Borrowing from the empirical evidence on international trade, difficulties might be due to heteroscedasticity, the need of a special treatment for zero-valued flows (Santos Silva and Tenreyro 2006; Dueñas and Fagiolo 2013), endogeneity, and omitted-variable bias (Baldwin and Taglioni 2006). These difficulties rule out OLS estimates given that they require a log-linearization of the gravity equation that might lead to biased and inefficient estimations.

One possible source of endogeneity in our model may be IPRs systems. However, there are no theoretical reasons to believe that the indexes are not independent from the level of M&As, neither that M&As are likely to cause the level of IPRs. Several authors agree that the increase in IP protection after the signing of the TRIPS agreement can be considered exogenous (Ivus 2010; Delgado et al. 2013). The main reason is that the TRIPS agreement was included in a package of agreements whose acceptance was a compulsory requirement of the World Trade Organization (WTO) membership. Thus, the decision of signing the TRIPS and the implications on IPRs systems might not be seen as determined at the country level, but rather by an external body. In this sense, IPRs systems in the post-TRIPS period might be reasonable regarded as "exogenous" (Delgado et al. 2013).

Thus, endogeneity is not a problem up to a certain extent. In fact, the TRIPS agreement establishes certain minimum standards –which are quite high compared to the previous systems– and provides countries the freedom to choose the final design of their IPRs systems. This implies that there are individual reasons for countries to adopt a certain level of IP protection. In order to control for this possible source of endogeneity and also to reduce the

Table 2.: Variables: expected effects, description, and sources

Label	Related to	Expected effect	Description	Source
MA	Bilateral		Number of M&As	SDC Platinum (Thomson Reuters)
IPRs systems				
$IPR_{agri\text{-}food}$	Country	+	Index of agricultural IPRs	Campi and Nuvolari (2015)
$IPR_{manuf.}$	Country	+	Index of patent protection	Ginarte and Park (1997); Park (2008)
Enforcement	Country	+	Index of legal system and property rights	Fraser Institute[1]
Country-specific variables				
GDP	Country	+	Gross domestic product	Feenstra et al. (2013)
pop	Country	+	Country population	CEPII[2]
Geographical and cultural variables				
dist	Bilateral	+/-	Distance between two countries, based on bilateral distances between the largest cities of those two countries, weighted by the share of the city in the overall country's population	CEPII[2]
contig	Bilateral	+	Contiguity dummy equal to 1 if two countries share a common border	CEPII[2]
comlang	Bilateral	+	Dummy equal to 1 if both countries share a common official language	CEPII[2]
comcol	Bilateral	+	Dummy equal to 1 if both countries have had a common colonizer	CEPII[2]
colony	Bilateral	+	Dummy equal to 1 if both countries have ever had a colonial link	CEPII[2]
Control variables				
xr	Bilateral	-	Bilateral exchange rate coefficient of variation	International Financial Statistics (IMF)[3]
fin_open	Country	+	Index of financial openness	Chinn and Ito (2008, 2014)
open_tra	Country	+/-	Openness to trade (Trade % of GDP)	WDI[4]
h_cap	Country	+/-	Index of human capital	Feenstra et al. (2013)
polity	Country	+	Political System	Systemic Peace[5]

Note: 1: www.fraserinstitute.org, 2: www.cepii.fr, 3: www.imf.org/en/Data, 4: http://databank.worldbank.org/, 5: http://www.systemicpeace.org/polity/polity4.htm

probability of omitted variable bias, we include several time varying covariates, which are theoretically expected to influence M&As. Additionally, in order to avoid an omitted variable bias, we perform robustness exercises using different specifications that control if the coefficient estimates are stable. We also use origin and destinations dummies (fixed effects) to control individual reasons of countries to adopt stronger IPRs, and dyadic dummies in order to control bilateral fixed effects.

Finally, the presence of zeros in the database is very high, even if we use the number of transactions. Thus, we perform the estimations using a count data model for the number of M&As, including zeros. Count data models are in advantage of log-linearized models because they better control heteroscedasticity and the presence of zeros (Santos Silva and Tenreyro 2006).[12] The statistical tests determined that the Poisson Pseudo Maximum Likelihood (PPML) estimation performs better than the Negative Binomial (NB) estimation for all sectors and specifications.[13] Then, we have performed independent estimations of Equation (1) using a PPML method for the four samples of M&As classified according to technology intensity.

4.2. *Estimation results*

Table 3 displays the results of the PPML estimations of the number of M&As. We have estimated two models for each of the four sectors. In model (1), we used the baseline specification of the gravity model extended with the IPRs indexes. In model (2), we also included the set of control variables that are expected to influence M&As.

The estimated coefficients of IPRs in the baseline specifications (1) show that the strengthening of IPRs systems increases the number of M&As in all sectors regardless their technological content. It is interesting to note that when we include the set of control variables in models (2), the effect of IPRs is still positive and significant for all the sectors, except for agri-food. This means that IPRs systems affect M&As even when considering other factors that also influence decisions of M&As.

In both specifications, we observe that most of the usual variables related to the gravity equation are significant and present the expected signs. A higher GDP, an indicator of market size or potential demand, of both the acquirer and the target, leads to a higher number of deals. M&As decrease when the population of the target grows, while population of the acquirer is not significant, except in the low-technology sector.

For all sectors, the estimated coefficients of distance are negative, which

[12] Another possible way of dealing with the excess of zeros would be to estimate the gravity model using a Zero-Inflated Count Data Model, as suggested by Burger et al. (2009) for the case of trade. However, for our data and given that we use country and bilateral fixed effects, it was not possible to achieve convergence in most specifications of the model.

[13] The over-dispersion parameter (α) of the NB estimation was always statistically not different from zero. Therefore, the PPML estimation method is preferred over the NB.

Table 3.: PPML estimations of the number of cross-border M&As with country dummies ($MA_{ij,k} \geq 0$)

Sector	Agri-food		Low-technology		Medium-technology		High-technology	
Model	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
IPRs systems								
$\text{IPR}_{j,agri-food}$	0.181***	0.100						
	(0.051)	(0.062)						
$\text{IPR}_{j,manufacture}$			0.663***	0.558***	0.682***	0.370***	0.497***	0.436***
			(0.090)	(0.113)	(0.083)	(0.078)	(0.104)	(0.098)
Country-specific variables								
$\ln(\text{GDP}_i)$	0.518**	0.769***	1.364***	1.472***	1.451***	1.453***	1.030***	1.286***
	(0.212)	(0.240)	(0.182)	(0.222)	(0.157)	(0.172)	(0.212)	(0.241)
$\ln(\text{GDP}_j)$	1.312***	1.914***	0.629**	0.865**	1.466***	1.663***	1.376***	1.378***
	(0.381)	(0.492)	(0.318)	(0.403)	(0.269)	(0.131)	(0.389)	(0.191)
$\ln(\text{pop}_i)$	0.144	0.445	-0.520	1.132**	-0.728	-0.421	-0.125	0.482
	(0.624)	(0.431)	(0.325)	(0.519)	(0.608)	(0.271)	(0.786)	(0.947)
$\ln(\text{pop}_j)$	0.414	-0.589	0.134	0.581	-0.807	-0.450***	-1.471*	-0.488***
	(0.618)	(1.161)	(0.592)	(0.513)	(0.537)	(0.101)	(0.792)	(0.141)
Geographical and cultural variables								
ln(dist)	-0.933***	-0.853***	-0.835***	-0.793***	-0.621***	-0.571***	-0.465***	-0.409***
	(0.031)	(0.036)	(0.024)	(0.030)	(0.021)	(0.025)	(0.025)	(0.033)
contig	0.321***	0.473***	0.064	0.083	0.132**	0.056	0.160*	0.063
	(0.081)	(0.087)	(0.066)	(0.072)	(0.058)	(0.061)	(0.083)	(0.087)
comlang	0.661***	0.964***	0.804***	0.925***	0.660***	0.764***	0.544***	0.721***
	(0.075)	(0.087)	(0.055)	(0.063)	(0.050)	(0.059)	(0.055)	(0.070)
comcol	0.235	-0.634	0.316*	0.014	0.433***	0.731***	0.428***	0.579***
	(0.309)	(0.505)	(0.161)	(0.197)	(0.142)	(0.167)	(0.128)	(0.194)
colony	0.660***	0.483***	0.543***	0.457***	0.388***	0.296***	0.456***	0.328***
	(0.073)	(0.084)	(0.054)	(0.062)	(0.048)	(0.055)	(0.052)	(0.063)
Control variables								
xr		0.342		-1.046**		-0.860*		-1.351*
		(0.591)		(0.522)		(0.457)		(0.767)
fin_open_i		-0.173		-0.125		-0.035		-0.473**
		(0.179)		(0.162)		(0.141)		(0.212)
fin_open_j		0.688		0.258		0.658***		-0.620**
		(0.460)		(0.315)		(0.236)		(0.267)
$\ln(\text{open\_tra}_i)$		-0.403*		0.298*		-0.017		-0.151
		(0.206)		(0.177)		(0.136)		(0.177)
$\ln(\text{open\_tra}_j)$		0.124		0.713***		1.029***		0.539***
		(0.284)		(0.201)		(0.123)		(0.162)
h_cap_i		0.742		0.201		0.234		0.725**
		(0.456)		(0.337)		(0.309)		(0.334)
h_cap_j		0.836*		0.065		-0.087		-0.600**
		(0.452)		(0.305)		(0.195)		(0.254)
polity_i		0.010		0.023		-0.001		-0.016
		(0.020)		(0.016)		(0.014)		(0.033)
polity_j		0.046		-0.005		0.096***		0.079***
		(0.080)		(0.042)		(0.013)		(0.017)
Country dummies	yes	yes	yes	yes	yes	yes	yes	yes
Time dummies	yes	yes	yes	yes	yes	yes	yes	yes
Observations	58,884	29,709	59,594	32,632	64,532	34,480	37,782	22,478

Note: IPR denotes the index of Campi and Nuvolari (2015) for the agri-food sector, and the index of Ginarte and Park (1997) for low-, medium-, and high-technology manufacturing sectors. Robust standard errors are in parenthesis. Significance level: *** p<0.01, ** p<0.05, * p<0.10.

agrees with a significant part of the literature, and it is against the view of FDI as a means to avoid trade costs (Di Giovanni 2005). Also, we found that sharing a common language, an indicator of cultural proximity, is positively related with M&As. Regarding other bilateral-specific variables indicating barriers to trade, they all increase M&As when they turn out to be significant: contiguity (contig), as well as sharing a common colonizer (comcol) and holding colonial links (colony), both of which might be proxies of institutional similarity.

The control variables, when they are significant, present the expected signs.[14] In contrast to Brakman et al. (2010) who find no significant effect, we observe that the coefficient of variation of the bilateral exchange rates decreases M&As in the manufacturing sectors. An improvement in the index of financial openness is not significant in most cases, although we found a positive significant effect of the index of the target countries in the medium-technology sector. In contrast to the findings of Di Giovanni (2005), we observe that when financial openness of both the acquirer and the target improve, M&As in high-technology manufactures decreases.

Openness to trade of the acquirer in the agri-food sector decreases M&As. This could indicate that a firm from a more open economy might decide to export rather than to invest in the agri-food sector. We observe the opposite in the low-technology sector. Likewise, a more open target country increases M&As in the manufacturing sectors, regardless their technological level.

The level of human capital is only significant in agri-food and high-technology manufacturing and we observe that a higher level of human capital in the target country increases M&As in agri-food and decreases M&As in high-technology manufacturing. Conversely, the level of human capital of the acquirer is associated with greater M&As in the high-technology sector. We should recall that human capital could be an indicator of the imitation abilities and of its absorptive capacity. Thus, the results can imply that firms might be less willing to do M&As in sectors of high-technology if the imitation abilities of the target are high, but acquirers of high human capital levels might be more likely to do M&As in high-technology sectors.

Finally, the estimated coefficients of the index of political system in the target countries are positive in the medium- and high-technology industries, meaning that an improvement in political institutions fosters M&As in those sectors. This agrees with Hur et al. (2011), who argue that the quality of institutions is a relevant determinant of M&As.

As a robustness check, Table 4 displays the results of the PPML estimations for each of the four groups of M&As with dyadic dummies that capture the

[14]Note that, in order to deal with a possible omitted variables bias, we performed all the estimations using country dummies (origin and destination) fixed effects. Therefore, the variables that are country-specific and that do not strongly change over time, such as the set of control variables and also IPRs systems, are relatively less stable because country fixed effects are able to capture, up to a certain extent, their effect.

Table 4.: PPML estimations of the number of cross-border M&As with country and dyadic dummies ($MA_{ij,k} \geq 0$)

Sector	Agri-food	Low-technology	Medium-technology	High-technology
IPRs systems				
$\text{IPR}_{j,agri-food}$	0.111*			
	(0.058)			
$\text{IPR}_{j,manufacture}$		0.598***	0.642***	0.606***
		(0.102)	(0.093)	(0.107)
Country-specific variables				
$\ln(\text{GDP}_i)$	0.759***	1.277***	1.441***	1.378***
	(0.213)	(0.200)	(0.158)	(0.206)
$\ln(\text{GDP}_j)$	1.904***	0.762**	1.709***	1.802***
	(0.465)	(0.302)	(0.293)	(0.352)
$\ln(\text{pop}_i)$	-0.508**	-0.371**	-0.474	-0.673**
	(0.259)	(0.179)	(0.463)	(0.274)
$\ln(\text{pop}_j)$	-1.473***	0.844	-0.819**	-2.630***
	(0.530)	(0.519)	(0.369)	(0.513)
Control variables				
xr	0.473	-1.178**	-0.963**	-0.751
	(0.623)	(0.557)	(0.451)	(0.786)
fin_open_i	-0.205	-0.141	-0.040	-0.392**
	(0.171)	(0.155)	(0.129)	(0.186)
fin_open_j	0.729*	0.253	0.783***	0.033
	(0.433)	(0.293)	(0.238)	(0.277)
$\ln(\text{open\_tra}_i)$	-0.397**	0.301*	0.016	-0.197
	(0.195)	(0.171)	(0.124)	(0.166)
$\ln(\text{open\_tra}_j)$	0.144	0.728***	0.244	-0.079
	(0.258)	(0.179)	(0.182)	(0.189)
h_cap_i	0.837**	-0.115	0.151	0.619**
	(0.412)	(0.287)	(0.241)	(0.282)
h_cap_j	0.796*	-0.128	0.180	-0.716**
	(0.429)	(0.248)	(0.222)	(0.281)
polity_i	0.013	0.035**	-0.007	0.002
	(0.019)	(0.014)	(0.012)	(0.028)
polity_j	-0.002	-0.000	-0.050**	-0.109***
	(0.068)	(0.040)	(0.025)	(0.039)
Country dummies	yes	yes	yes	yes
Dyadic dummies	yes	yes	yes	yes
Time dummies	yes	yes	yes	yes
Observations	29,709	32,632	34,480	22,478

Note: IPR denotes the index of Campi and Nuvolari (2015) for the agri-food sector, and the index of Ginarte and Park (1997) for low-, medium-, and high-technology manufacturing sectors. Robust standard errors are in parenthesis. Significance level: *** p<0.01, ** p<0.05, * p<0.10.

country pairs fixed effects. The signs of the estimated coefficients do not change with respect to the ones reported in the estimations with country fixed effects. The main exception is that the political system of the target country turns out to be negative in the estimations for the sectors of medium- and high-technology, while in the previous estimations they were positive.

Likewise, the coefficients of IPRs are positive and significant at the 1% level in the manufacturing sectors and at a lower level of significance in the agri-food sector (10%). These robustness checks confirms our previous results regarding IP protection: an increase in IPRs generates an extension of the number of M&As in all the sectors considered.

Table 5.: PPML estimations of the number of cross-border M&As with country dummies ($MA_{ij,k} \geq 0$)

Sector	Agri-food		Low-technology		Medium-technology		High-technology	
Model	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
IPRs systems								
$Enf_j \times IPR_{j,agri-food}$	0.094	0.109*						
	(0.066)	(0.062)						
$Enf_j \times IPR_{j,manufacture}$			0.373***	0.404***	0.435***	0.462***	0.437***	0.416***
			(0.093)	(0.082)	(0.078)	(0.074)	(0.094)	(0.089)
Country-specific variables								
$\ln(GDP_i)$	0.755***	0.752***	1.460***	1.342***	1.339***	1.512***	1.338***	1.444***
	(0.242)	(0.214)	(0.224)	(0.203)	(0.166)	(0.164)	(0.252)	(0.201)
$\ln(GDP_j)$	1.928***	1.935***	1.104***	0.724***	1.563***	1.807***	1.348***	1.608***
	(0.492)	(0.464)	(0.386)	(0.246)	(0.148)	(0.285)	(0.210)	(0.336)
$\ln(pop_i)$	0.196	-0.495*	1.204**	-0.339*	-0.516	0.185	0.546	-0.687***
	(0.827)	(0.253)	(0.533)	(0.185)	(0.362)	(0.488)	(0.467)	(0.246)
$\ln(pop_j)$	-0.371	-1.517***	0.935	1.116***	-0.377***	-0.778**	-0.467***	-1.215***
	(0.911)	(0.546)	(0.612)	(0.430)	(0.109)	(0.339)	(0.150)	(0.370)
Geographical and cultural variables								
ln(dist)	-0.853***		-0.790***		-0.574***		-0.413***	
	(0.036)		(0.030)		(0.025)		(0.033)	
contig	0.472***		0.088		0.057		0.061	
	(0.087)		(0.071)		(0.061)		(0.087)	
comlang	0.964***		0.923***		0.756***		0.722***	
	(0.087)		(0.062)		(0.059)		(0.070)	
comcol	-0.631		0.007		0.720***		0.554***	
	(0.505)		(0.195)		(0.168)		(0.194)	
colony	0.483***		0.454***		0.300***		0.332***	
	(0.084)		(0.062)		(0.055)		(0.063)	
Control variables								
xr	0.356	0.486	-0.957*	-1.011*	-0.646	-0.680	-1.095	-0.640
	(0.592)	(0.623)	(0.523)	(0.556)	(0.461)	(0.453)	(0.771)	(0.796)
fin_open_i	-0.177	-0.208	-0.135	-0.165	-0.045	-0.024	-0.460**	-0.376**
	(0.180)	(0.171)	(0.162)	(0.154)	(0.140)	(0.128)	(0.210)	(0.187)
fin_open_j	0.692	0.738*	0.290	0.352	0.702***	0.905***	-0.537**	0.030
	(0.463)	(0.437)	(0.321)	(0.298)	(0.244)	(0.238)	(0.261)	(0.273)
$\ln(open\_tra_i)$	-0.415**	-0.402**	0.267	0.247	-0.030	-0.030	-0.228	-0.249
	(0.208)	(0.195)	(0.181)	(0.174)	(0.139)	(0.125)	(0.181)	(0.168)
$\ln(open\_tra_j)$	0.168	0.181	0.952***	0.938***	1.046***	0.500***	0.602***	0.217
	(0.276)	(0.256)	(0.192)	(0.172)	(0.121)	(0.171)	(0.156)	(0.176)
h_cap_i	0.756*	0.840**	0.195	-0.076	0.146	0.342	0.843***	0.668**
	(0.457)	(0.411)	(0.338)	(0.288)	(0.300)	(0.246)	(0.314)	(0.285)
h_cap_j	0.811*	0.749*	0.030	-0.219	-0.128	-0.027	-0.685***	-0.770***
	(0.452)	(0.430)	(0.316)	(0.250)	(0.205)	(0.234)	(0.264)	(0.299)
$polity_i$	0.010	0.013	0.021	0.033**	-0.002	-0.006	-0.017	-0.011
	(0.020)	(0.019)	(0.016)	(0.014)	(0.014)	(0.012)	(0.032)	(0.027)
$polity_j$	0.041	-0.004	0.003	0.016	0.100***	-0.036	0.079***	-0.055
	(0.077)	(0.070)	(0.042)	(0.039)	(0.014)	(0.025)	(0.018)	(0.043)
Country dummies	yes	yes	yes	yes	yes	yes	yes	yes
Dyadic dummies	no	yes	no	yes	no	yes	no	yes
Time dummies	yes	yes	yes	yes	yes	yes	yes	yes
Observations	29,709	29,709	32,256	32,256	33,865	33,865	22,319	22,319

Note: IPR denotes the index of Campi and Nuvolari (2015) for the agri-food sector, and the index of Ginarte and Park (1997) for low-, medium-, and high-technology manufacturing sectors. Robust standard errors are in parenthesis. Significance level: *** p<0.01, ** p<0.05, * p<0.10.

As an additional robustness check, we include a proxy of enforcement of IPRs and analyze the interaction with the level of IP protection. We include an interaction term $\text{Enf}_j \times \text{IPR}_j$ that is expected to reveal the effective level of IP protection because it discounts the enforcement mechanisms from the formal or legislative IP protection level for each country. Table 5 shows the estimation results using country (1) and also dyadic dummies (2) for each sector.

We observe that this indicator of effective IP protection also increases M&As. The coefficients of the interaction term $\text{Enf}_j \times \text{IPR}_j$ are significant and positive in the same cases as in Tables 3 and 4. This means that an increase in the level of IP protection that considers both the legislative increase and the effective enforcement mechanisms, increases M&As.

Therefore, the indexes of IP protection seem to be reflecting in a proper way the effect of IPRs on M&As. Even more because we use country and dyadic dummies in order to control for unobserved characteristics, including differences in enforcement at the country level.

4.3. *Interactions between IPRs and imitation abilities of countries*

Next, we consider the interaction between imitation abilities of countries and the strengthening of their IPRs systems. We consider two groups of countries with low and high imitation abilities and analyze how this feature interacts with IPRs, adding the interaction variable $\text{Low-IA}_j \times \text{IPR}_j$, which is meant to capture the effect of tightening IPRs in countries with low imitation abilities, using as the base countries with high imitation abilities. We analyze whether strengthening IPRs attracts more M&Ass in countries with low imitation abilities compared to countries with high imitation abilities, or otherwise. We expect this interaction to have different effects depending on the sector.

Table 6 shows the estimation results. For each sector, we estimate a model that includes time and country dummies (1), and a model that also includes dyadic dummies (2). Geographical, cultural, and control variables display the same signs as the ones reported in the previous estimations.

The index of IPRs is significant in all the estimations –except in model (1) for the agri-food sector. Including the interaction between the index of IPRs and imitation abilities of countries reveals an interesting feature of the effect of IPRs systems on M&As. We find that increasing the strength of IPRs in countries with low imitation abilities does not have a significantly

Table 6.: PPML estimations of the number of cross-border M&As. Interaction between imitation abilities and IPRs systems

Sector	Agri-food		Low-technology		Medium-technology		High-technology	
Model	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
IPRs systems								
$\text{IPR}_{j,agri-food}$	0.094	0.106*						
	(0.061)	(0.058)						
$\text{Low-IA}_j \times \text{IPR}_{j,agri-food}$	0.312	0.215						
	(0.489)	(0.396)						
$\text{IPR}_{j,manufacture}$			0.489***	0.552***	0.464***	0.664***	0.554***	0.662***
			(0.122)	(0.109)	(0.081)	(0.102)	(0.106)	(0.106)
$\text{Low-IA}_j \times \text{IPR}_{j,manufacture}$			0.395	0.352	-0.435***	-0.083	-0.581***	-0.970***
			(0.279)	(0.240)	(0.062)	(0.206)	(0.110)	(0.274)
Country-specific variables								
$\ln(\text{GDP}_i)$	0.766***	0.753***	1.438***	1.490***	1.446***	1.435***	1.274***	1.407***
	(0.240)	(0.212)	(0.223)	(0.208)	(0.173)	(0.158)	(0.240)	(0.204)
$\ln(\text{GDP}_j)$	1.922***	1.929***	1.015**	0.809***	1.016***	1.592***	0.536**	1.595***
	(0.488)	(0.468)	(0.417)	(0.268)	(0.172)	(0.305)	(0.269)	(0.343)
$\ln(\text{pop}_i)$	0.427	-0.504**	0.461	-0.627***	-0.404	-0.491	0.543	-0.800***
	(0.410)	(0.256)	(0.796)	(0.214)	(0.275)	(0.469)	(0.931)	(0.286)
$\ln(\text{pop}_j)$	-0.456	-1.346**	0.666	0.952**	-0.174	-0.689**	-0.122	-2.274***
	(0.758)	(0.636)	(0.620)	(0.447)	(0.124)	(0.342)	(0.184)	(0.531)
Geographical and cultural variables								
ln(dist)	-0.852***		-0.793***		-0.572***		-0.410***	
	(0.036)		(0.030)		(0.025)		(0.033)	
contig	0.473***		0.082		0.055		0.064	
	(0.087)		(0.072)		(0.061)		(0.088)	
comlang	0.964***		0.925***		0.756***		0.710***	
	(0.087)		(0.063)		(0.059)		(0.069)	
comcol	-0.633		0.021		0.613***		0.482***	
	(0.505)		(0.198)		(0.159)		(0.184)	
colony	0.483***		0.456***		0.302***		0.337***	
	(0.084)		(0.062)		(0.055)		(0.063)	
Control variables								
xr	0.334	0.449	-1.016*	-1.134**	-0.858*	-0.983**	-1.296*	-0.748
	(0.589)	(0.624)	(0.523)	(0.558)	(0.458)	(0.451)	(0.765)	(0.785)
fin_open_i	-0.173	-0.206	-0.132	-0.160	-0.029	-0.037	-0.476**	-0.397**
	(0.179)	(0.171)	(0.163)	(0.154)	(0.141)	(0.129)	(0.212)	(0.186)
fin_open_j	0.679	0.703	0.261	0.302	0.759***	0.748***	-0.545*	-0.059
	(0.453)	(0.434)	(0.319)	(0.293)	(0.243)	(0.241)	(0.285)	(0.277)
$\ln(\text{open\_tra}_i)$	-0.400*	-0.389**	0.283	0.272	-0.007	0.019	-0.136	-0.211
	(0.206)	(0.194)	(0.178)	(0.170)	(0.136)	(0.124)	(0.177)	(0.166)
$\ln(\text{open\_tra}_j)$	0.152	0.149	0.753***	0.715***	1.002***	0.235	0.509***	-0.098
	(0.276)	(0.259)	(0.204)	(0.182)	(0.118)	(0.185)	(0.155)	(0.189)
h_cap_i	0.741	0.834**	0.143	-0.025	0.178	0.142	0.681**	0.671**
	(0.455)	(0.411)	(0.339)	(0.287)	(0.309)	(0.242)	(0.335)	(0.276)
h_cap_j	0.835*	0.790*	0.093	-0.012	-0.493**	0.157	-0.935***	-0.678**
	(0.448)	(0.428)	(0.307)	(0.245)	(0.211)	(0.225)	(0.267)	(0.283)
polity_i	0.010	0.012	0.022	0.024*	-0.001	-0.007	-0.016	0.004
	(0.020)	(0.019)	(0.016)	(0.015)	(0.014)	(0.012)	(0.033)	(0.028)
polity_j	0.010	-0.011	-0.020	-0.004	0.061***	-0.049*	0.034**	-0.091**
	(0.097)	(0.095)	(0.041)	(0.038)	(0.013)	(0.027)	(0.017)	(0.041)
Country dummies	yes	yes	yes	yes	yes	yes	yes	yes
Dyadic dummies	no	yes	no	yes	no	yes	no	yes
Time dummies	yes	yes	yes	yes	yes	yes	yes	yes
Observations	29,709	29,709	32,632	32,632	34,480	34,480	22,478	22,478

Note: IPR denotes the index of Campi and Nuvolari (2015) for the agri-food sector, and the index of Ginarte and Park (1997) for low-, medium-, and high-technology manufacturing sectors. Robust standard errors are in parenthesis. Significance level: *** p<0.01, ** p<0.05, * p<0.10.

different effect compared to strengthening IPRs in countries with high imitation abilities in sectors in which imitation is relatively easy, such as agri-food and low-technology manufacturing.[15] This implies that in sectors where imitation

[15]Imitation in agriculture can be easy because, generally, access to genetic material provides the

abilities do not play a relevant role, the strengthening of IPRs is likely to attract M&As regardless of the imitation abilities of countries.

Instead, in sectors of medium- and high-technology, tightening IPRs systems in countries with high imitation abilities increases more the number of M&As than in countries of low imitation abilities. Probably, this is because countries with low imitation abilities are less likely to imitate a medium- or high-technology product, regardless of the IP protection provided for those products. Instead, in countries with high imitation abilities, a stronger IPRs system –and obviously stronger enforcement of those IPRs– are more relevant to encourage M&As.

This implies that the incentive provided by strong IPRs systems in sectors of medium and high-technology content is lower when the risk of imitation is low. Interestingly, if we look at the estimated effect observed in model (2) for M&As in the high-technology sector, we observe that, for countries of low imitation abilities, the net estimated effect of an increase in the index of IPRs is negative. A plausible explanation for this could be that other characteristics of these countries, in addition to low imitation abilities, might make this type of countries not attractive for M&As regardless of their IPRs systems. For example, given their low capabilities, these countries might not have interesting firms to be acquired in high-technology sectors. In this case, the negative effect on an increase in the index of IPRs might be reflecting an incentive to export to that market rather than to engage in M&As.

4.4. *Interactions between IPRs and development level of countries*

Finally, as another robustness check, we explore possible heterogeneity on the effect of IPRs depending on the development level of countries. Although most countries with low imitation abilities are LDCs, there exist severe differences in the capabilities of those LDCs to attract M&As and to benefit from technology transfer (Yi and Naghavi 2017).

Thus, we estimate a new specification of the model that includes an interaction variable between IPRs and the level of development, that aims to control for possible link specificities that may derive from some observed stylized facts: (i) most cross-country M&As are done by DCs, (ii) since 2002, cross-border M&As towards LDCs have been increasing steadily, and (iii) after

necessary for the reproduction of products. Simplifying, once a producer access a seed, it is highly probable that he will be able to reproduce it without needing a technological effort.

the signing of the TRIPS, IP protection has been increasing at higher growth rates in LDCs.

Table 7.: PPML estimations of the number of cross-border M&As with interaction variables, country dummies, and dyadic dummies ($MA_{ij,k} \geq 0$)

Sector	Agri-food		Low-technology		Medium-technology		High-technology	
Model	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
IPRs systems								
$\text{IPR}_{j,agri-food}$	-0.029	-0.044						
	(0.081)	(0.075)						
$\text{LDC}_j \times \text{IPR}_{j,agri-food}$	0.259**	0.305***						
	(0.110)	(0.103)						
$\text{IPR}_{j,manufacture}$			0.203	0.213	0.209*	0.845***	0.214	0.907***
			(0.213)	(0.182)	(0.108)	(0.206)	(0.144)	(0.257)
$\text{LDC}_j \times \text{IPR}_{j,manufacture}$			0.477**	0.460**	0.200**	-0.240	0.268**	-0.362
			(0.225)	(0.179)	(0.083)	(0.204)	(0.114)	(0.264)
Country-specific variables								
$\ln(\text{GDP}_i)$	0.711***	0.678***	1.471***	1.255***	1.462***	1.441***	1.308***	1.379***
	(0.242)	(0.213)	(0.223)	(0.200)	(0.171)	(0.158)	(0.245)	(0.206)
$\ln(\text{GDP}_j)$	1.799***	1.762***	0.808**	0.910***	1.843***	1.790***	1.593***	1.889***
	(0.484)	(0.465)	(0.399)	(0.287)	(0.166)	(0.299)	(0.229)	(0.361)
$\ln(\text{pop}_i)$	-0.022	-0.480*	1.049**	-0.370**	-0.441	-0.455	0.567	-0.673**
	(0.820)	(0.257)	(0.499)	(0.178)	(0.269)	(0.467)	(0.459)	(0.274)
$\ln(\text{pop}_j)$	-0.815	-1.456***	0.356	0.963**	-0.613***	-0.854**	-0.699***	-2.590***
	(0.556)	(0.514)	(0.661)	(0.485)	(0.130)	(0.379)	(0.183)	(0.514)
Geographical and cultural variables								
ln(dist)	-0.852***		-0.793***		-0.574***		-0.411***	
	(0.036)		(0.030)		(0.025)		(0.033)	
contig	0.472***		0.082		0.053		0.060	
	(0.087)		(0.071)		(0.061)		(0.087)	
comlang	0.963***		0.925***		0.760***		0.719***	
	(0.086)		(0.063)		(0.059)		(0.070)	
comcol	-0.626		0.014		0.708***		0.557***	
	(0.505)		(0.197)		(0.164)		(0.192)	
colony	0.484***		0.457***		0.299***		0.328***	
	(0.084)		(0.062)		(0.055)		(0.063)	
Control variables								
xr	0.306	0.338	-1.057**	-1.230**	-0.847*	-0.929**	-1.387*	-0.700
	(0.594)	(0.626)	(0.525)	(0.563)	(0.459)	(0.447)	(0.773)	(0.781)
fin_open_i	-0.167	-0.180	-0.117	-0.118	-0.030	-0.046	-0.470**	-0.393**
	(0.180)	(0.171)	(0.163)	(0.157)	(0.141)	(0.129)	(0.210)	(0.186)
fin_open_j	0.649	0.665	0.307	0.315	0.753***	0.746***	-0.531*	0.035
	(0.451)	(0.428)	(0.323)	(0.302)	(0.240)	(0.239)	(0.278)	(0.272)
$\ln(\text{open\_tra}_i)$	-0.397*	-0.370*	0.290	0.302*	-0.025	0.018	-0.171	-0.193
	(0.207)	(0.192)	(0.177)	(0.171)	(0.136)	(0.124)	(0.178)	(0.166)
$\ln(\text{open\_tra}_j)$	0.035	0.060	0.648***	0.708***	0.869***	0.254	0.377**	-0.044
	(0.274)	(0.257)	(0.207)	(0.180)	(0.139)	(0.180)	(0.173)	(0.187)
h_cap_i	0.754*	0.816**	0.189	-0.111	0.255	0.159	0.784**	0.631**
	(0.457)	(0.410)	(0.337)	(0.287)	(0.310)	(0.241)	(0.310)	(0.281)
h_cap_j	0.736*	0.685	0.235	0.183	0.143	0.074	-0.370	-0.888***
	(0.443)	(0.423)	(0.321)	(0.275)	(0.232)	(0.236)	(0.280)	(0.302)
polity_i	0.008	0.006	0.022	0.034**	-0.001	-0.007	-0.015	0.002
	(0.019)	(0.019)	(0.016)	(0.014)	(0.014)	(0.012)	(0.032)	(0.028)
polity_j	0.011	-0.040	-0.014	-0.005	0.113***	-0.045*	0.097***	-0.101***
	(0.077)	(0.065)	(0.041)	(0.039)	(0.016)	(0.026)	(0.020)	(0.038)
Country dummies	yes	yes	yes	yes	yes	yes	yes	yes
Dyadic dummies	no	yes	no	yes	no	yes	no	yes
Time dummies	yes	yes	yes	yes	yes	yes	yes	yes
Observations	29,709	29,709	32,632	32,632	34,480	34,480	22,478	22,478

Note: IPR denotes the index of Campi and Nuvolari (2015) for the agri-food sector, and the index of Ginarte and Park (1997) for low-, medium-, and high-technology manufacturing sectors. Robust standard errors are in parenthesis. Significance level: *** p<0.01, ** p<0.05, * p<0.10.

In order to consider the possible implications of these features, we include the interaction variable $\text{LDC}_j \times \text{IPR}_j$, which is meant to capture the effect of strengthening IPRs in LDCs independently of the level of development of the acquirer country. This aims to investigate whether LDCs attract more M&As as a consequence of a tightening of their IPRs system compared to DCs.

Table 7 displays the estimation results. In model (1) we use country dummies and in model (2) we also include dyadic dummies. Note that geographical, cultural, and control variables, all display the same signs reported by the previous estimations. The index of IPRs looses significance in some specifications, but the interaction terms are positive and significant in all sectors. These estimations conclude that, when LDCs tighten their IPRs systems, they receive a higher number of M&As compared to DCs, in all sectors, regardless of their technological content.

5. Concluding remarks

Considering the recent global process of strengthening and harmonization of IPRs systems and the significance of cross-border M&As as the most relevant form of FDI, we have analyzed the effect of IPRs on M&As using a gravity model for the post-TRIPS period.

The estimation results confirm that market size, geographical factors, trade barriers, and cultural proximity among countries are important determinants of cross-border M&As. The strengthening of IPRs systems increases M&As, not only in sectors that are likely to be more IP-intensive, but also in all the sectors regardless their technological content: agri-food, low-, medium-, and high-technology manufactures. These results are robust when considering the effective IP protection by discounting the effect of enforcement mechanisms.

Several authors have shown that access to IP assets is one of the driving forces for firms to engage in M&As (Bryer and Simensky 2002; Marco and Rausser 2002). In line with this evidence, at the country level, our estimations show that IPRs systems protecting these IP assets also affect decisions on cross-border M&As.

In addition, we found that the effect of stronger IPRs depends on the imitation abilities of countries –being more relevant in countries with high imitation abilities– but also that this interaction is more important in sectors of medium- and high-technology content. In line with the findings of Smith (1999) for the case of trade, we observe that the effect of IPRs interacts with imitation abilities of countries. Finally, we found that the increase in M&As derived from a strengthening of IPRs systems is higher for developing countries compared with developed countries. These results indicate that both imitation abilities and the level of development of countries influence firms' responses to national differences in IPRs systems.

These results should be interpreted with caution for two main reasons. First, the decision of a firm to engage in M&As is closely related to the decision of exporting, and these processes can be complementary or substitute. Therefore, the interaction between imitation threat and IPRs systems not only affects M&As but also can have an impact on firms' exports and license that we are not able to observe in this analysis. Similarly to the empirical study of Smith (2001) for the case of the US, a possible interesting research extension would be to empirically investigate how stronger IPRs simultaneously affect trade, licensing, FDI, and technology transfer, at the country level. Secondly, although most products of high-technology content are relatively more difficult to be copied, some of them, such as pharmaceutical products, can be easily imitated and they are one of the most IP-intensive products. The sectoral aggregation estimates the average effect, but studies using more disaggreated data would be useful.

However, the robustness of the results allows us to stress the relevant role of IPRs in attracting cross-border M&As and that this role depends on sectoral and countries' characteristics. Our analysis has some relevant implications for the design of IPRs systems, especially for developing countries.

Firstly, the different effects of IPRs imply that a more cautious approach towards the process of harmonization of IPRs systems should be in place as there might be no unique system optimal for all countries. This challenges the adequacy of globally harmonized IPRs systems that do not consider technological capabilities and development levels of countries.

Secondly, considering that stronger IPRs mainly increase M&As directed to the developing world, one should examine whether and how beneficial it is for LDCs to attract more investments in the form of M&As. Several economic models and empirical analysis argue that FDI would bring benefits to LDCs, especially by transferring technology and by generating economic growth. However, our estimations show that M&As in sectors or medium- and high-technology transfer are less likely to increase with a strengthening of IPRs when the imitation abilities of countries are low, which is frequently observed in LDCs.

Also, several scholars have raised concerns regarding FDI that derive from the frequent and unexpected reversals of FDI flows, the transfer of control of domestic companies, which can lead to problems of adverse selection or excessive leverage, or the concentration of IP assets in foreign companies (see, for example, Albuquerque 2003; Krugman 2000). Thus, the increase in M&As derived from tightening IPRs systems could be beneficial for DCs but could instead hurt LDCs, as suggested by Helpman (1993), although this would be determined by imitation, innovation, and market features of the countries.

Finally, because IPRs systems are likely to affect not only decisions of firms related to M&As but also trade and licensing, the design of IPRs systems should also consider the possible effect on these decisions and the implications for countries in terms of innovation, technology transfer, and development.

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Appendix A

List of Acquirer Countries

Developed Countries

Australia; Austria; Canada; Czech Republic; Denmark; Estonia; Finland; France; Germany; Greece; Hungary; Iceland; Ireland; Italy; Japan; Latvia; Lithuania; Malta; Netherlands; New Zealand; Norway; Poland; Portugal; Slovak Republic; Slovenia; Spain; Sweden; Switzerland,Liechtenstein; United Kingdom; United States.

Developing Countries

Albania; Angola; Azerbaijan; Argentina; Bangladesh; Bolivia; Brazil; Bulgaria; Belarus; Cameroon; Central African Republic; Sri Lanka; Chad; Chile; China; Colombia; Costa Rica; Croatia; Cyprus; Dominican Republic; Ecuador; El Salvador; Ethiopia; Fiji; Gabon; Georgia; Ghana; Grenada; Guatemala; Honduras; Hong Kong SAR, China; Indonesia; Iran, Islamic Rep.; Israel; Cte d'Ivoire; Jamaica; Jordan; Kenya; Korea, Rep.; Kyrgyz Republic; Madagascar; Malawi; Malaysia; Mauritania; Mauritius; Mexico; Taiwan; Moldova; Morocco; Mozambique; Oman; Nepal; Niger; Nigeria; Pakistan; Panama; Paraguay; Peru; Philippines; Russian Federation; Rwanda; Saudi Arabia; Senegal; Sierra Leone; India; Singapore; Vietnam; South Africa; Zimbabwe; Thailand; Togo; Trinidad and Tobago; Tunisia; Turkey; Uganda; Ukraine; Macedonia, FYR; Egypt, Arab Rep.; Tanzania; Uruguay; Uzbekistan; Venezuela; Zambia.

List of Target Countries

Developed Countries

Australia; Austria; Canada; Czech Republic; Denmark; Estonia; Finland; France; Germany; Greece; Hungary; Iceland; Ireland; Italy; Japan; Latvia; Lithuania; Malta; Netherlands; New Zealand; Norway; Poland; Portugal; Slovak Republic; Slovenia; Spain; Sweden; Switzerland,Liechtenstein; United Kingdom; United States.

Developing Countries

Azerbaijan; Argentina; Brazil; Bulgaria; Belarus; Sri Lanka; Chad; Chile; China; Colombia; Congo, Rep.; Costa Rica; Croatia; Cyprus; Ecuador; El Salvador; Fiji; Gabon; Ghana; Guatemala; Honduras; Hong Kong SAR, China; Indonesia; Israel; Jamaica; Jordan; Kenya; Korea, Rep.; Malaysia; Mauritius; Mexico; Taiwan; Moldova; Morocco; Oman; Nigeria; Pakistan;

Panama; Paraguay; Peru; Philippines; Russian Federation; Saudi Arabia; India; Singapore; Vietnam; South Africa; Zimbabwe; Thailand; Trinidad and Tobago; Tunisia; Turkey; Uganda; Ukraine; Macedonia, FYR; Egypt, Arab Rep.; Uruguay; Venezuela; Zambia.

Appendix B: Technological classification of industries

Classification	Industrial Sectors - Products	SIC Codes
Agri-food		
-Agricultural Products	Crops, livestock and animal specialities, agricultural services, forestry	01, 02, 07, 08
-Food	Food and kindred products, preparation of meats/fruits, beverages, vegetable oils, tobacco manufacturing	20, 21
Low-technology industries		
-Textile/fashion cluster	Textile fabrics, clothing, headgear, footwear, leather manufactures, travel goods	22, 23, 31
-Other low technology	Pottery, simple metal parts/structures, wood products, furniture, jewelry, toys, plastic products	24, 25, 26, 27, 30 (except 3011, 3087, 3089), 3631, 3652, 39
Medium-technology industries		
-Automotive products	Transportation equipment, passenger vehicles and parts, commercial vehicles, motorcycles and parts	37 (except 3721, 3724, 3728, 3761, 3764, 3769)
-Medium-technology process industries	Synthetic bres, chemicals and paints, fertilizers, plastics, iron, pipes/tubes, petroleum refining and related industries	28 (except: 2833-2836), 29, 32, 33, 34
-Medium-technology engineering industries	Engines, motors, industrial machinery, pumps, switch-gear, ships, watches	3011, 3087, 3089, 35 (except 3511, 3571, 3572, 3575, 3577), 36 (except 3631, 3652, 3663, 3669, 3671, 3672, 3674-3676, 3679), 3821
High-technology industries		
-Electronics and electrical products	Office/data processing/telecommunications equipment, TVs, transistors, turbines, power-generating equipment	3511, 3571, 3572, 3575, 3577, 3661, 3663, 3669, 3671, 3672, 3674-3676, 3679
-Other high-technology	Pharmaceuticals, aerospace, optical/measuring instruments, cameras	2833-2836, 38 (except 3821), 3721, 3724, 3728, 3761, 3764, 3769