ERASMUS UNIVERSITY ROTTERDAM

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Bachelor Thesis [programme IBEB - Strategy]

The Correlations between Patent Protection and Imports, Exports, and Foreign Direct Investment

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Abstract

The effect of intellectual property rights protection (IPR) on international trade is ambiguous. This paper analyzes the relationships between patent protection strength and three dimensions of international trade: import, export, and foreign direct investment. The OLS regressions cover the 19 countries of the G20 group over a decade from 2008 to 2017. The findings indicate that the correlation between the IPR index and exports is negative, and the coefficients of the IPR index on imports and FDI are positive and insignificant. The findings do not support the hypothesis that strengthening IPR protection will increase any component of international trade: imports, exports, or foreign direct investment.

Introduction

The opportunity of export enterprises to increase profits from international trade may be constrained due to the behavior of other local producers who replicate the technologies or patents. Exporters' incentives to export goods to jurisdictions with 'weak' patent systems are reduced as a result of the threat of copying (Palangkaraya et al., 2017). Countries are less likely to attract exports if imitations always happen and they do not have related regulations which are strong enough to regulate this kind of behavior, which could cause a profit decrease for export companies. Weak IPR protection in a country reduces incentives for others to export to it. Although this situation would benefit some domestic producers who compete directly for domestic consumers with import companies, it can inflict a cost on other domestic producers who rely on imported inputs for their production. Hence, the profits of these domestic producers can be increased if better patent protection can induce imports. One of the aims of this thesis is to find out how the strength of intellectual property rights affects imports (attractiveness for export enterprises). Governments need to make sure whether there is any relationship or causal effect between IPR and imports if they want to attract imports to improve the profits of domestic businesses. This research is of great importance scientifically for the process of making patent regulations and improving imports.

A country can not only gain profit in imports through improving IPR protection, but it can also benefit from exports during this improvement. One crucial reason why I chose to look at exports as a dependent variable is because of its positive relationship with economic growth (Emery, 1967). If the level of patent protection of the origin country is lower than the destination country, the products which are going to be exported might be suspected of imitation or infringement in the destination market even though they are legal and free of any plagiarism and infringement in the domestic countries. Such a situation would force export companies to pay substantial unexpected costs on litigation and arbitration, and even give up the foreign market where they have already invested plenty of effort and money. Therefore, firm managers and governments must know the relationship between intellectual property rights protection and exports. This research targets to estimate the effect of IPR

protection on exports and provide academic support for policy-makers in this field.

Foreign direct investment (FDI) is another important component of international economic relations. Receiving foreign funds and acquiring foreign businesses can benefit domestic economics in many ways. For instance, being bought or acquired by foreign companies for expanding their operations into a new region is beneficial for a company facing bankruptcy. Unnecessary unemployment is avoided by foreign direct investment and thus problems caused by bankrupting of both the domestic economy and society can be solved to a certain degree. In this case, foreign direct investment which can be a cure for certain kinds of economic or social problems is attractive for governments who want to develop their economies. Investing companies have to assess the target environment before they enter. If a market with strong intellectual property rights protection can attract more foreign direct investment to inflow, policy-makers would have a clue about how to increase the amount of foreign direct investors and achieve economic growth. As a result, the third research question of this paper is to explore whether there is an association between patent protection strength and foreign direct investment.

I use OLS regressions to estimate the relationship between the level of IPR and imports, exports, and FDI in the G20 countries from 2008 to 2017. I choose the data of this period because the data about IPR in 2017 is the latest one that is available. Furthermore, I will use some variables which are related to both the dependent variables (imports, exports, and foreign direct investment) and the independent variable (IPR index) as control variables. The estimates about the correlations between IPR and imports, exports, and foreign direct investment in my research would contribute to the process of making relative policies.

Many previous studies have dealt with the relationship between patent protection and international trade. However, most of these studies in the field of IPR have only focused on one kind of trade. For instance, the studies about the correlation between IPR and international trade by Hsu & Tiao (2015), Kondo (1995), and Seyoum (2006) are limited to

the effect of IPR on foreign direct investment (FDI). Chien (2008) and Rafiquzzaman (2002) only focus on imports or exports. Such expositions are unsatisfactory because they only focus on one kind of trade and did not present a complete view of the effect of patent protection on international trade. In this case, discussion including three dimensions of international trade (imports, exports, and foreign direct investment) is one of the improvements of this research. Thus, there are three main dimensions to find out the relationship between patent protection and international trade:

I. Is the strength of intellectual property rights (IPR) protection in a country correlated with its imports?

II. Is the strength of intellectual property rights (IPR) protection in a country correlated with its exports?

III. Is there a correlation between intellectual property rights (IPR) and foreign direct investment (FDI)?

Literature review and hypotheses

Background

In general, the relationship between the strength of IPR protection and imports has not been a frequent research topic. While Maskus and Penubarti (1995) focus strictly on the effect of patent law on bilateral sectoral trade between countries and find out that strengthening patent protection benefits bilateral industrial imports of developing economies countries. Only a couple of papers investigated a topic similar to this research. Nevertheless, Palangkaraya et al. (2017) use data on 189 countries from 1991-1999 and found that income, trade obstacles, and patent laws all influence the departures of bilateral sectoral imports. Yet as the data is over 20 years old and the situation of imports, as well as the strength of IPR protection, has changed tremendously, the result of their findings may have changed. I plan to use OLS regressions to find out the relationship between IPR and imports in the G20

countries from 2008 to 2017. The data about IPR in 2017 is the latest one that is available. Furthermore, I will use some variables which are related to both dependent variables and IPR as control variables. The estimates about the correlation in my research between IPR and imports would contribute to the process of making relative policies.

On the other hand, Awokuse and Yin (2010) find that increased IPR protection promotes imports to China and they also examined the influence on bilateral trade flows after stricter IPR protections were introduced in China and the impacts of IPR protection on imports in the aggregate and particular product categories levels. Their research focuses on China, but my research will cover the countries of the G20, which include both developing and developed countries, such that the findings can be applied to more countries. For the field of foreign direct investment, the findings of Lee & Mansfield (1996), Maskus (2000), and Tanaka & Iwaisako (2014) indicate that the lack of IPR protection has a considerable detrimental influence on the placement of foreign direct investment.

Compared to IPR effects on imports and foreign direct investment, the effect of IPR protection on export is studied less. Most of the existing research studies the relationship between exports and FDI under different levels of IPR protection. Zhang and Xing (2018) find that in both developing and developed countries, FDI impacts the quality of exports most significantly under medium-high IPR protection. In this case, we cannot make sure whether the IPR level can influence exports directly from those prior papers. Hence, one of the goals of this research is to try to find out if there is a correlation between the IPR index and exports.

Predictions

For the first research question, the results of Maskus and Penubarti (1995) indicate that strengthening patent protection promotes bilateral manufactured imports into developing countries. This research includes not only manufactural imports and developing countries

but also other kinds of imports and several developed countries, the hypothesis for the first research question should be like this:

H1: There is a positive correlation between the level of intellectual property rights protection and imports.

Research is rarely focused on the effects of the IPR index on exports, but the influence of FDI on exports is a popular topic. The findings of Rhee and Belot (1990) indicate that FDI can stimulate the export of multinational companies, and the research of Zhang and Xing (2018) also depicts a spillover effect of FDI on exports. According to the previous research, we have evidence that the relationship between FDI and exports tends to be positive. On the other hand, this research also sets a hypothesis of the positive correlation between the strength of patent protection and FDI (which is revealed in the next paragraph). In this case, it is reasonable to assume that the relationship between IPR and exports is also positive in the hypothesis:

H2: There is a positive correlation between the level of intellectual property rights protection and exports.

Finally, only a few papers were written on the topic of the correlation between patent protection and foreign direct investment. Seyoum (2006) indicates that patent protection is a significant factor in foreign direct investment flows. The empirical findings of Hsu and Tiao (2015) suggest that, while various nation characteristics may have diverse implications on FDI, enhancing patent rights protection in host countries can improve FDI inflows to Asian countries. The conclusions of the above-mentioned papers depict that stricter patent laws can improve foreign direct investment inflow. Therefore, to clarify the findings of the research in this area, the third hypothesis is formulated:

H3: The relationship between the strength of IPR protection and foreign direct investment is

positive in a country.

Data

I use the data from countries of the G20 between 2008 to 2017. These are the largest economies in the world in a relatively recent decade. Kirton (2016) demonstrates clearly that G20 has already developed and implemented a model of systemic hub governance, and its performance has matured to successfully control the globalized economic world in the 21st century. The findings based on them would be more representative and not obsolete. I only include the 19 autonomous countries of the G20 in this research and exclude the EU economy. However, France, Germany, and Italy are included as three of the biggest economies in the EU. The reason why this research cannot consider the EU economy inside is that the database I chose for the most important variable IPR does not show the index of the EU. I will give the reasons for choosing this database in the following parts. Fortunately, it is not a serious problem in this research, since the EU economy consists of many countries and these countries cannot be seen as a single economy in many cases, especially when it comes to research about intellectual property rights.

Moreover, the reason for this study to focus on data from 2008 to 2017 is also related to the data sources of IPR. The most popular index to measure intellectual property rights of a country is the Ginarate-Park index which has been used by many researchers about patent laws, for example, Palangkaraya et al. (2017) and Branstetter et al. (2011). Nevertheless, the Ginarate-Park index can only provide data before 1990 which is too old to reflect the recent situation regarding the protection of intellectual property rights. Park (2008) also provides an index of patent protection which is an updated form of index for 1960 – 1990 for 110 countries. However, the updated index by Park in 2008 (which only provides data before 2005) is 17 years ago from today and is also too old for recent studies. The intellectual property protection index of GovData360 produced by the World Economic Forum (2020) is the newest data about IPR, which collected data about intellectual rights protection before

2017. As a result, this research chooses to base on this data source and focus on the ten years from 2008 to 2017.

The dependent variables of these three models are Imports (M_{it}), Exports (X_{it}), and foreign direct investment (FDI_{it}). The main independent variable is the level of intellectual property rights protection in each country and year (IPR_{it}). There are also some control variables in these regressions: they are gross GDP, total population, tariff rates, and the unemployment rate for all of these three models. Unemployment (U_{it}) refers to the share of the labor force that is without work but available for and seeking employment. Billington (1999) finds that lower salaries can be accepted by the employees in a country with higher unemployment. In this case, higher unemployment can lead to cheaper labor costs and attracts more foreign firms. Unemployment has been used as a control variable in the research about the effect of patent protection on FDI by Seyoum (2006). Furthermore, Dutt et al. (2009) and Jin et al. (2019) find that the relationship between imports and unemployment is that imports or international trade have an impact on unemployment. Therefore, unemployment (U_{it}) is included in the regressions in this research as a control variable. Moreover, fixed effect variables are added to the models: $year_t$ and $country_i$. Multicollinearity problems can be avoided in this case.

Two main databases are used in this research. The World Development Indicators is one of the most authoritative data sources and is widely used by the economic academic community (World Bank, 2022). The data of Imports (M), Export(X), and Foreign Direct Investment (FDI), the dependent variables of my three models, all come from this data source. Firstly, the dependent variable for the first model, Import (M), represents the value of all products and other market services received from the rest of the world, including the value of merchandise, freight, insurance, transportation, travel, royalties, license fees, and other services including communication, construction, financial, information, business, personal, and government services. Employee remuneration, investment income (previously known as factor services), and transfer payments are not included. In this database, I choose

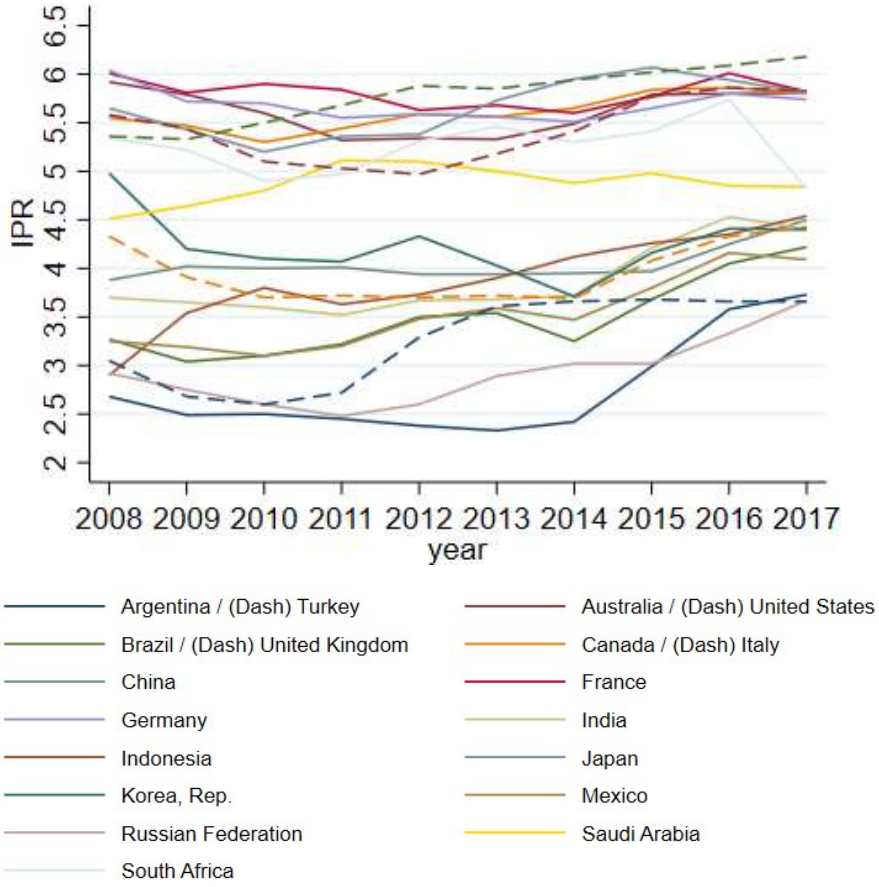
the data about imports measured by value in constant 2015 US dollars among all those different measurements (for example, percentage of GDP, volume, LCU, current US$, etc.) because using the value in constant US$ to measure imports in the researches related to international trade is the most recognized method (e.g., Kasahara & Lapham, 2013; Maskus & Penubarti, 1995; and Palangkaraya et al., 2017). In a similar vein, the data of Export (X) is also measured by the value of goods and services in constant 2015 US$ as the dependent variable of the second model. It represents the value of all products and services provided to other jurisdictions, including merchandise, freight, insurance, transportation, travel, royalties, license fees, and other services including communication, construction, financial, information, business, personal, and government services, which are the same as the measurement of imports. The third dependent variable is the foreign direct investment (FDI). This variable is defined as net inflows of investment to acquire long-term management control (10% or more of voting shares) in a company running in an economy other than the investors. It is the aggregate of capital investment, earnings reinvestment, and the other long-term and short-term capital as represented in the trade balance. FDI is also be presented in constant 2015 US$ as the same as the other two dependent variables. Additionally, I use the GDP per capita, tariff rate, population, and unemployment rate data from the World Development Indicators by the World Bank (2022) as well. The variable Y for GDP per capita represents the gross domestic product valued in constant 2015 US$ divided by the total population. The data of tariff rates is the simple mean applied tariff of country i in year t, which represents the unweighted average of effectively applied rates for all items subject to tariffs determined for all traded goods. The unemployment rate represents the percentage of the unemployment labor force out of the total labor force on the national level.

The other database is the Global Competitiveness Index of GovData360 produced by the World Economic Forum (2020) which was mentioned in the second paragraph of the data part. The index of IPR protection, which comes from this database, is measured by the strength of intellectual property protection which shows to what extent is intellectual

property protected. The index of IPR responses to the survey by the World Economic Forum (2020) “In your country, to what extent is intellectual property protected?” is distributed from 1 to 7. If the IPR index of a country is equal to 7, intellectual property must be protected greatly and the patent laws are extremely complete in this country. However, the index will be 0 if a country does not protect intellectual property at all. Table A.2 in the appendix shows the specific IPR indexes in each country and each year.

Figure 1

The trend of IPR in 19 countries, 2008-2017.



The trends of the IPR index in 19 countries are shown in figure 1. In 2008, Germany had the best protection for intellectual property protection, and its index of IPR is 6.04. On the other hand, the lowest index is from Argentina, which is 2.68. Germany, Japan, Australia, Canada, France, and the United Kingdom remained at a good level of intellectual property protection,

their IPR index fluctuated but was always higher than 4.8 during the decade from 2008 to 2017. Saudi Arabia and South Africa fluctuated around 5 and also showed quite good intellectual property rights protection during this decade. Additionally, figure 1 reveals that there has been a marked increase in the index of IPR in Indonesia, Japan, Turkey, and the Russian Federation from 2008 to 2017. The peak IPR index at 6.18 was reached by the United Kingdom in 2017. Furthermore, 19 countries all reached indexes higher than 3.5 and most of them showed improving trends during this period. Only two countries got indexes in 2017 lower than the beginning year: Korea Rep. (4.98 to 4.40) and South Africa (5.34 to 4.82). In 2017, the IPR index of the United Kingdom turned to 6.18 and the UK became the country with the strongest patent protection. Finally, the IPR index of Turkey (3.66) was the lowest one among the 19 countries in 2017.

Table 1

Descriptive statistics about IPR and international trade, year and country, 2008.

Variable	Mean	Standard Deviation	Minimum	Maximum
Intellectual Property Right (Index from 1 to 7)	4.51	1.09	2.33	6.18
Imports of goods and services (Constant 2015 US$ billion)	443.2	305.2	46.29	2,003
Foreign Direct Investment (constant 2015 US$ billion)	58.25	90.55	-7.781	511.4
Exports of goods and services (constant 2015 US$ billion)	538.4	517.6	63.67	2,371
GDP per capita (Constant 2015 US$)	23,857.51	17,567.34	1,093.08	58,215.41
Population, total (million)	220.81	365.31	21.25	1,324.66
Tariff rates (%)	3.74	2.22	1.54	8.59
Unemployment (%)	6.88	4.12	2.96	22.41

N = 190, number of countries = 19, number of years = 10.

Table 1 demonstrates a brief statistical summary of the data used in this research. The mean

protection index of intellectual property right in this data set is 4.51. The standard deviation of the IPR index among 19 countries from 2008 to 2007 is 1.09. Throughout this decade, the maximum IPR index among these countries is 6.18 and the minimum is only 2.33. The minimum foreign direct investment is negative (US$ -7.781 billion), but the maximum FDI is positive (US$511.4 billion). Finally, the mean tariff rate is 3.74% and these tariff rates distribute between 1.54% and 8.59%. The lowest unemployment rate is only 2.96% and the average unemployment rate is 4.12%, but the highest rate reaches 22.41%.

Methods

To evaluate and determine the influence of the IPR protection level on international trade, the models which include the control variables influencing the IPR index, imports, exports, and foreign direct investment are designed. After referring to the equation of imports formulated by Bao (2014) and the ordinary least squares regression about the effect of patent protection on FDI by Seyoum (2006), I generate an ordinary least squares (OLS) regression formula to test the influence of the IPR protection level on imports, exports, and FDI during the ten years between 2008 to 2017. The gravity model is one of the most popular models among studies in the international trade field such as the research by Palangkaraya et al. (2017) and Smith (2002). This research does not choose the gravity model because it is more suitable for the study of bilateral trade which means the originating country (the country on the selling side during exportation) and the destination country should be separated in this model. However, this study does not distinguish between the originating country and the destination country but rather explores the impact of patent protection levels on the international trade of countries from the perspective of their governments. As a result, the OLS regression model is more suitable for this research.

The basic regression for three models would be written as follow:

$$logZ_{it} = \alpha + \beta\, logY_{it} + \gamma\, P_{it} + \delta T_{it} + \theta U_{it} + \lambda_t year_t + \eta_i country_i + \mu IPR_{it} + \varepsilon_{it};$$

where:

i indicates 19 countries in G20; *t* indicates years between 2008 to 2017;

Z_{it} = M_{it} , X_{it}, or FDI_{it};

M_{it} = the value of imports of goods and services of country i, year t;

X_{it} = the value of exports of goods and services of country i, year t;

FDI_{it} = the net inflow of the foreign direct investment in country i, year t;

IPR_{it} = the strength of intellectual property protection of country i, year t;

Y_{it} = gross GDP per capita of country i, year t;

P_{it} = total population of country i, year t;

T_{it} = tariff rate of country i, year t;

U_{it} = percentage of total unemployment of total labor force of country i, year t;

$year_t$ = year dummy variable with 2008 used as the reference;

$country_i$ = country dummy variable with Argentina used as the reference;

ε_{it} = error term.

I estimate three versions of each model. The first versions include the independent variable (IPR index) and a dependent variable (imports, exports, or foreign direct investment) without any control variable. The second versions add control variables based on the first versions: GDP per capita (Y), population (P), tariff rate (T), and unemployment rate (U). Finally, the third versions are complete and include not only control variables but also the fixed effect variables: $year_t$ and $country_i$.

Results

As I mentioned before, OLS regression is used to analyze the relationships between the patent protection level and three different kinds of international trade in countries. The

estimated results of these three models are illustrated in the three tables below. Table 2.1 demonstrates the estimation results of the coefficients of the IPR index on imports of 19 countries in the G20 from 2008 to 2017. Table 2.2 illustrates how is the IPR protection level associated with exports of countries in this period. The relationship between IPR and foreign direct investment is shown in table 2.3. There are three columns in each table for every research question. The first columns are regressions of log dependent variables on only the IPR index; the second columns are regressions adding all the control variables but no fixed effect variables; the last columns are the complete regressions with all the control variables including fixed effect variables for year and country.

First model and hypothesis

The results of the first model and hypothesis, effects of IPR on imports are exhibited in table 2.1. Column (1) shows the correlation between the IPR index and imports. This result reveals that the IPR index is positively partial associated with imports of goods and services with the coefficient of the IPR in column (1) being 0.276 and significant at the $p < 0.001$ level, which implies that if the IPR index of a country increases by 1 unit, its imports of goods and services would increase by approximately 27.6%. In column (2), four control variables are included, they are gross GDP per capita (Y), tariff rates (T), population (P), and unemployment rate (U). The coefficient of IPR is still positive but insignificant in column (2). As for the control variables, the coefficient of log GDP per capita is significant at the $p = 0.001$ level, which means that each 1% increase in GDP per capita would lead to around 49.1% increase in imports of goods and services. Additionally, after adding fixed effect variables – years and countries as dummy control variables, the coefficient of IPR remains positive and insignificant in column (3). These coefficients of IPR in columns (2) and (3) are statistically insignificant as their p-values are higher than 0.05 and thus we can conclude that there is a lack of evidence to determine a positive association between the IPR index and imports exists from these two columns. As for the control variables in column (3), the coefficient of log gross GDP per capita is positive and significant at $p < 0.05$ level and implies that a 1%

growth in GDP per capita can lead to approximately 39.4% climb in imports. The negative and significant coefficient of the unemployment rate implies that each 1% increase in the unemployment rate would lead to around 2.2% decline in imports. Hence, in this case, although the coefficients of the IPR index in all three versions are positive, we still cannot conclude that the correlation between the IPR index and imports is positive because of the insignificant results from the second and third versions of this model.

Table 2.1

OLS regression model estimates of effects of IPR on imports in 19 countries, 2008–2017.

Variables	(1)	(2)	(3)
Dep variable: Imports	logM	logM	logM
IPR	0.276***	0.0388	0.0352
	(0.0459)	(0.0573)	(0.0268)
logY		0.491***	0.394*
		(0.0706)	(0.157)
T		-0.0264	0.00513
		(0.0265)	(0.00726)
P		0.00121***	-0.00141
		(0.000338)	(0.00214)
U		-0.0255*	-0.0220***
		(0.0104)	(0.00522)
_cons	4.602***	0.969	0.477
	(0.214)	(0.688)	(1.483)
Year fixed effects	No	No	Yes
Country fixed effects	No	No	Yes
N	181	163	163
R^2	0.168	0.397	0.992
adj. R^2	0.163	0.378	0.990

Notes: Standard errors in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Second model and hypothesis

Table 2.2 illustrates the relationship between the intellectual property rights index and exports of a country. A positive and significant coefficient of the IPR index (0.429) on exports is found in Column (1) without any control variable, which means that every 1 unit increase in the IPR index will cause about 42.9% increase in exports. After adding gross GDP per

capita, tariff rate, population, and the unemployment rate as control variables in column (2), the coefficient of the IPR index remains positive but significant at a lower level than the first version: $p < 0.01$. This coefficient (0.153) implies that each 1 unit climb in the IPR index of a country can lead to approximately 15.3% increase in its exports. The coefficients of log GDP per capita and population are significant at $p < 0.001$ level: GDP per capita climbs 1%, the exports can increase around 62.1%; a million increase in population can lead to 0.194 percent decline in exports. The coefficient of the unemployment rate is 0.1218 which is significant at 5% level but the coefficient of the tariff rate is insignificant in this version.

The further analysis in column (3) shows a negative coefficient of the IPR index on exports and it is inconsistent with the hypothesis. This version concludes not only GDP per capita, tariff rate, population, and the unemployment rate as control variables, but also the fixed effect variables ($year_t$ and $country_i$) which can control the bias caused by time and different countries. This coefficient of IPR is significant at the $p < 0.05$ level and implies that every unit increase of the IPR index would lead to about 3.87 percent decrease in exports in a country. Hence, for the second research question, the negative coefficient on IPR is inconsistent with the hypothesis that the correlation between the level of IPR protection and exports is positive. The negative coefficient might be because of bias created by the confounding effect of time-varying unobservable variables that are associated with higher IPR and lower exports. Furthermore, the result of the GDP per capita stays positive and significant, but coefficients of population and unemployment rate are not significant anymore. The coefficient of GDP per capita means that each 1% increase of GDP per capita in a country would lead to about 70.2 percent increase in its exports of goods and services.

Table 2.2

OLS regression model estimates of effects of IPR on exports in 19 countries, 2008–2017.

Variables	(1)	(2)	(3)
Dep variable: Exports	logX	logX	logX
IPR	0.429***	0.153**	-0.0387*
	(0.0496)	(0.0555)	(0.0186)
logY		0.621***	0.702***
		(0.0683)	(0.109)
T		-0.0391	0.000486
		(0.0257)	(0.00504)
P		0.00194***	-0.000152
		(0.000327)	(0.00148)
U		0.0218*	0.00400
		(0.0101)	(0.00362)
_cons	3.973***	-1.145	-2.392*
	(0.231)	(0.667)	(1.029)
Year fixed effects	No	No	Yes
Country fixed effects	No	No	Yes
N	181	163	163
R^2	0.295	0.588	0.997
adj. R^2	0.291	0.575	0.997

Notes: Standard errors in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Third model and hypothesis

The third model is used to test whether better IPR protection is likely to lead to more foreign direct investment in a country (question 3). The results of three versions of this regression model are illustrated in table 2.3.

It can be observed that the coefficient of the IPR index is 0.0695 with a p-value > 0.05 (insignificant) in column (1). The coefficient of IPR turns negative and significant in column (2) when gross GDP, tariff rate, population, and unemployment rate are added as control variables, and the coefficients of GDP per capita, tariff rate, and population are significant. It implies that each unit increase in the IPR index can cause approximately 40.1% decline in foreign direct investment. In this case, the significant result of the second version demonstrates that the correlation between the IPR index and foreign direct investment is

negative which is inconsistent with the hypothesis. However, the coefficient of IPR turns back to positive and insignificant after including the fixed effect variables – $year_t$ and $country_i$ in column (3). Additionally, for control variables, we can see that all the coefficients of control variables (GDP per capita, tariff rate, population, and unemployment rate) are also insignificant in column (3). This situation might be caused by time-varying unobserved factors which can affect both the IPR index and foreign direct investment but are not included in this regression.

Table 2.3

OLS regression model estimates of effects of IPR on foreign direct investment (FDI) in 19 countries, 2008–2017.

Variables	(1)	(2)	(3)
Dep variable: FDI	logFDI	logFDI	logFDI
IPR	0.0695	-0.401***	0.367
	(0.0894)	(0.110)	(0.265)
logY		0.855***	0.270
		(0.133)	(1.536)
T		-0.148**	-0.0934
		(0.0515)	(0.0731)
P		0.00229***	-0.00949
		(0.000357)	(0.0158)
U		-0.0370	-0.0940
		(0.0201)	(0.0545)
_cons	2.963***	-2.920*	0.840
	(0.414)	(1.294)	(14.40)
Year fixed effects	No	No	Yes
Country fixed effects	No	No	Yes
N	188	167	167
R^2	0.003	0.319	0.750
adj. R^2	-0.002	0.298	0.690

Note: Standard errors in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Discussion and conclusion

This paper provides statistical analyses of the correlations between the intellectual property

protection level and imports, exports, and foreign direct investment. The second hypothesis that assumes a positive correlation between the IPR index and exports is inconsistent with the findings of the second model. Moreover, for the research questions about imports and foreign direct investment, I find no significant associations in the complete versions with control variables and fixed effect variables such that no support for these two hypotheses is provided.

In summary, the first hypothesis stating that the correlation between the protection of intellectual property rights and imports is positive cannot be supported by this regression analysis. The result of the first version in table 2.1 shows that the coefficients between the IPR and imports of a certain country are positive and significant, the results of the second and third versions in this model are insignificant but still positive. In this case, the results are not significant. I cannot reject the hypothesis of no association between the IPR index and imports. There might be some unobservable variables that can both affect the IPR protection level and imports but are not included in this regression. Hence, the results of this paper cannot provide support for governments attempting to use IPR policies to increase imports.

The second hypothesis which states that there is a positive correlation between the protection level of patents and exports of a certain country can be partly supported by the second model. The results show positive coefficients in the first and second incomplete versions of this model. However, the coefficient of the IPR index on exports changes from positive to negative after adding the fixed effect variables. The negative coefficient of IPR in the third complete version with covariates and year and country (fixed effects variables) is significant but inconsistent with the hypothesis. The negative result might imply that the IPR protection level is negatively associated with exports, which would be a concern for regulators and governments. Nevertheless, this result could also be caused by omitted variable bias. In this case, there is no support provided for regulators trying to implement the IPR policies to increase exports.

The third model cannot conclude that the correlation between patent protection and foreign direct investment does exist. The reason why the result of the third version is statistically insignificant might be because there are still confounders affecting both the IPR index and the FDI that are not included in this regression. The result is insignificant but still positive and consistent with the findings by Seyoum (2006) which examines that the correlation between IPR and FDI is positive.

Protection of intellectual property rights is necessary for international economic activities, the findings propose an option of promoting their international trade and developing their economies by implementing patent protection related policies. Especially, modifications to the level of patent protection in a country might be useful in adjusting its exports.

Based on the findings in this research paper, the result for the first hypothesis is positive, so it still can be linked to the findings of Maskus and Penubarti (1995) that imports can be stimulated by improving patent protection. The improvement of this paper based on the research of Maskus and Penubartuin (1995) is that they focused on the bilateral manufacturing industry and developing countries in 1995. This research uses the data of a recent period (from 2008 to 2017) of general imports and the countries in G20 such that it might be more recent and applicable from a macro perspective. Additionally, for the results of the second hypothesis, the findings can be linked to the research conducted by Yang and Huang (2009), which find that there are both positive and negative export consequences of IPR, according to several classification methods used to determine the degree of danger of imitation among nations. The findings of this paper also indicate both positive and negative coefficients between IPR and exports in different versions and the accurate association between IPR and exports can be analyzed based on this research in the future. Finally, the results of the last research question about foreign direct investment can be linked to the prior findings of Lee & Mansfield (1996), Maskus (2000), and Tanaka & Iwaisako (2014), which conclude that there is a positive correlation between the IPR index and FDI.

With regards to the limitations, in the regression models there is still potential for bias due to unobservable factors affecting both the independent variable (IPR index) and dependent variables. In my opinion, the control variables are not enough or appropriate. As we can see, the first version of the first model, with the only independent variable (IPR index) and the dependent variable (imports) showing a significant coefficient, and adding control variables and fixed effect dummy variables in columns (2) and (3) turns it into insignificant results. In this case, further research can pay more attention to choosing more appropriate confounders to control more unobserved bias or turn to other research methods instead of OLS regression.

In addition, this research can be greatly extended in two dimensions. Firstly, this research focuses on 19 countries of the G20, thus further research could extend the number of objects (including more countries) to reach wider applicability or only focus on a single country to improve internal validity. Secondly, imports, exports, and FDI are studied at the general level in this paper without focusing on any industry dimension. Many prior papers choose a special industry to analyze, for instance, Smith (2002) focuses on biological products, medicinals and botanicals, and pharmaceuticals when studying patent rights and trade. Further researchers can choose a certain industry and study the relationship between the IPR protection level and international trade in this industry.

Appendix

Table A.1 - Code and country.

Code	Country	Code	Country
1	Argentina	11	Korea, Rep.
2	Australia	12	Mexico
3	Brazil	13	Russian Federation
4	Canada	14	Saudi Arabia
5	China	15	South Africa
6	France	16	Turkey
7	Germany	17	United States
8	India	18	United Kingdom
9	Indonesia	19	Italy
10	Japan		

Table A.2 - IPR index of 19 countries from 2008 to 2017

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Argentina	2.68	2.49	2.50	2.45	2.38	2.33	2.42	2.99	3.58	3.73
Australia	5.92	5.79	5.60	5.32	5.34	5.33	5.49	5.79	5.80	5.81
Brazil	3.27	3.04	3.10	3.22	3.50	3.54	3.25	3.68	4.05	4.22
Canada	5.55	5.47	5.30	5.44	5.59	5.56	5.65	5.84	5.86	5.81
China	3.88	4.02	4.00	4.01	3.94	3.94	3.95	3.97	4.25	4.50
France	6.01	5.81	5.90	5.84	5.63	5.68	5.60	5.77	6.01	5.82
Germany	6.04	5.72	5.70	5.55	5.59	5.56	5.51	5.65	5.80	5.74
India	3.70	3.65	3.60	3.52	3.67	3.68	3.72	4.21	4.53	4.41
Indonesia	2.90	3.54	3.80	3.63	3.73	3.90	4.12	4.26	4.35	4.54
Japan	5.65	5.43	5.20	5.36	5.38	5.73	5.95	6.07	5.94	5.81
Korea, Rep.	4.98	4.20	4.10	4.07	4.33	4.03	3.71	4.16	4.41	4.40
Mexico	3.25	3.19	3.10	3.20	3.48	3.59	3.47	3.80	4.16	4.09
Russian	2.92	2.75	2.60	2.48	2.60	2.89	3.02	3.02	3.33	3.67
Saudi Arabia	4.51	4.64	4.80	5.11	5.10	5.00	4.88	4.98	4.85	4.84
South Africa	5.34	5.22	4.90	4.97	5.31	5.46	5.30	5.41	5.74	4.82
Turkey	3.05	2.68	2.60	2.72	3.29	3.61	3.66	3.68	3.66	3.66
US	5.58	5.44	5.10	5.03	4.97	5.18	5.41	5.77	5.86	5.83
UK	5.36	5.33	5.50	5.68	5.88	5.85	5.94	6.02	6.09	6.18
Italy	4.33	3.91	3.70	3.72	3.70	3.72	3.69	4.08	4.33	4.43

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