Are strong copyrights a stimulus to U.S. exports?

---An empirical study based on cross-country data.[①]

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Abstract: This paper assesses the effects of foreign copyrights on U.S exports in core copyright industries, with application of the gravity model using cross-country data. We find that the market expansion and market power effects that have been confirmed in the relations between patent rights and trade flows also apply to copyrights. The findings show that strong copyrights stimulate the market expansion of U.S. exports in core copyright industries across countries on all income levels. Weak copyrights in countries with strong imitative threat (weak copyrights & strong imitative abilities) are barriers to U.S exports in core copyright industries. If copyrights in these countries are strengthened, market expansion effect is induced, boosting U.S exports in core copyright industries. Alternatively, the strengthening of copyrights in countries with strong copyrights and weak imitative abilities significantly enhance the market power effect, reducing U.S exports due to the monopoly bestowed by copyrights.

Key words: Trade Flow; Copyrights; Threat of imitation

1. Introduction

According to the statistics of The International Intellectual Property Alliance (IIPA) , the output of core copyright industries in the U.S. stood at $819.06 billion in 2005, making up 6.56% of the U.S.'s annual GDP. (By Stephen Siwek for IIPA).The annual sales value of the U.S.'s core copyright industries in overseas markets was over $116 billion in 2006, reaching $126 billion in 2007. It exceeded the overseas sales figures of the U.S.'s other industries including aeroplane ($95.6 billion),

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automobile ($56.8 billion), farm produce ($48.1 billion), foodstuff ($39.4 billion), pharmaceuticals ($27.9 billion).(By Stephen Siwek for IPI). However, foreign infringements cost the U.S.'s trade flows for $15.469 billion, $16.123 billion and $17.134 billion in 2006, 2007 and 2008 respectively.

Although the TRIPs agreement of the WTO covers the protection of various kinds of intellectual property rights such as copyrights, patent rights and trademarks, only patent rights related policies have aroused widespread concerns. Literature on the impact of patent rights on technology innovation, technology transfer, economic development, FDI and trade is relatively abundant. However, while copyrights are expected to have a significant impact on international trade and economic development, empirical literature in this field is nascent. Smith et al. (2009) analyzes the effects of copyrights on economic development and international trade. With the notion of copyright-related capital (CRC), they carry out an empirical research using cross-country data and find that 1. "a country's CRC contributes positively to its economic development"; 2. "the relative harmonization of copyright policies between countries has a positive effect on bilateral trade in core copyright industries"; 3. "a two-stage process where a country's CRC contributes positively to its economic development (stage 1), which then contributes positively to its trade (stage 2)" .

We assess the effects of foreign copyrights on U.S trade flows in core copyright industries[②], with the application of the gravity model using cross-country data. We examine 1. whether the market expansion effect and market power effect (Maskus and Penubarti,， 1995，pp229-30) that have been confirmed in the relations between patent rights and trade flows also apply to copyrights; 2. the relations between the trade flows in the U.S.'s core copyright industries and the copyrights across countries with different levels of development; 3. the relations between trade flows in the U.S.'s core copyright industries and the copyrights of the four kinds of countries grouped by threat of imitation. We initiate the Threat of Imitation Index in Copyright-Related Industries based on the definition of copyright-related capital (Smith et al. 2009) and provide empirical evidence on the relationship between the U.S.'s trade flows in

[②] UNESCO (2005, appendix V, table B, p. 91).

copyright industries and the market expansion/power effects of copyrights in the four kinds of countries grouped by threat of imitation.

The article is organized as follows. The first section is the introduction. The second section presents the model and specifications. The third section provides the method and data. The forth section reports results. The final section is the conclusion.

2. Model Specifications

The basic model of this research is the commonly used Model of Gravity in the analysis of international trade flows. The gravity model stems from the principle of "universal gravitation" in physics, namely the gravity between two objects is proportional to their mass and inversely proportional to the distance between them. Tinbergen（1962）and Poyhonen（1963）who are the pioneers in applying the gravity model in international trade studies. They point out that bilateral trade flow is proportional to the total output of the two economies and inversely proportional to the distance between them. The output of the exporting economy represents the potential supply capability, while the output of the importing economy represents the potential demand. In contrast, their distance, with a connotation of transportation cost, forms a barrier to trade. Linnemannn（1966）Then it introduces the population variable into the model. Anderson (1979) developes an early study of the theoretical foundations of the Gravity model. Bergstrand (1985), (1989), (1990); Helpman and Krugman (1985, p. 167) and Deardorff (1998) assess the compatibility of gravity model and trade theories, which can be derived from Heckscher-Ohlin as well as the Linder and Helpman-Krugman hypotheses. Possessing a simple formation, the Model of Gravity has achieved a great deal in international trade studies since 1960s. It's been widely implemented in the fields of trade pattern analysis, boundary cost estimation of trade barriers and the effects of trade groups, to name but a few, and largely explained a substantial amount of real-world economic phenomena.

2.1 The Basic Form

To begin with, the basic version of Gravity model expresses bilateral trade by commodity as:

$$X_{ijk} = a_{0i}(Q_j/N_j)^{a1i}(N_j)^{a2i}(Q_k/N_k)^{a3i}(N_k)^{a4i}(D_{jk})^{a5i}(A_{ijk})^{a6i}e_{ijk} \quad (1)$$

where X_{ijk} is exports of region j to region k in industry i commodities; (Q_j/N_j) and (Q_k/N_k) are the per capita GDP of regions j and k; N_j and N_k are the populations (sizes) of regions j and k; D_{jk} is the geographic distance between regions j and k; A_{ijk} represents distortional factors that augment or reduce trade, which include the copyrights of importing regions and each region's dependence on foreign trade in this study; and e_{ijk} is a log normally distributed error term. Eq. (1) says that bilateral trade depends on the per capita incomes and populations of the importing and exporting regions, the distance between them, and distortional factors that impede or augment trade.

The statistical specification is derived by taking natural logs of Eq. (1) and defining trade distortions to include indices representing the copyrights in importing regions as well as each region's openness to trade. The resulting expression is:

$$\ln(X_{ijk}) = a_{0i} + a_{1i}\ln(Q_j/N_j) + a_{2i}\ln(N_j) + a_{3i}\ln(Q_k/N_k) + a_{4i}\ln(N_k) + a_{5i}\ln(D_{jk}) + a_{6i}\ln(Op_k) + a_{7i}\ln(Cp_k) + e_{ijk} \quad (2)$$

Where Op_k is openness to trade in region k, $Op_k = (\text{Export} + \text{Import})/\text{GDP}$, Cp_k is the strength of copyrights in region k. As the U.S. is the only exporter, the U.S. terms can be integrated into the intercept, which gives us equation (3):

$$\ln(X_{ijk}) = a_i + a_{3i}\ln(Q_k/N_k) + a_{4i}\ln(N_k) + a_{5i}\ln(D_{jk}) + a_{6i}\ln(Op_k) + a_{7i}\ln(Cp_k) + e_{ijk} \quad (3)$$

The new intercept $a_i = a_{0i} + a_{1i} \ln(Q_j/N_j) + a_{2i} \ln(N_j)$. In accordance with the Gravity model, the parameters on the income per capita (Q_k/N_k) and population terms (N_k) are positive elasticities, indicating higher demands for exports driven by higher level of economic development of the exporters. The parameter on distance is negative when the costs of trade (e.g. transportation) increase with the distance between trading regions j and k. The parameter on openness to trade (Op_k) is positive when a higher dependence on foreign trade stimulates bilateral trade flow. The parameter on the index of copyrights is positive when bilateral trade flows are boosted by decreasing infringements in correspondence with the strengthening of copyrights in importing regions.

2.2 Development Specifications

During our research process, we find a significant effect of a region's development level on its strength of copyrights. Generally speaking, a certain level of development is a necessary condition for a region to possess the basic technological ability to protect copyrights, and further to attach importance to copyright protection. Copyright protection won't be a stimulus to economic development and bilateral trade flows until that level of development has been reached. In this context, we predict that the response of bilateral trade which flows to the strength of copyrights will differ across the four groups of countries characterized by level of development.

Based on the World Bank categorization of income (in U.S. dollars, 2005) per capita, we divide the 91 countries into four groups: High income (HI); Upper middle income (UMI); Lower middle income (LMI); Low income (LI). Then we re-define equation (3) as:

$$\ln(X_{ijk}) = a_i + a_{3i} \ln(Q_k/N_k) + a_{4i} \ln(N_k) + a_{5i} \ln(D_{jk}) + a_{6i} \ln(Op_k) + a_{7i} HI * \ln(Cp_k) + a_{8i} UMI * \ln(Cp_k) + a_{9i} LMI * \ln(Cp_k) + a_{10i} LI * \ln(Cp_k) + e_{ijk} \quad (4)$$

Where HI, UMI, LMI, LI are dummy variables for the four groups of countries.

We predict that strong foreign copyrights enhance the market power of U.S. exporters across high and upper middle income countries. That is to say, strengthening copyrights reduce bilateral trade flows which leads to a negative parameter on the index of copyrights. Alternatively, strong foreign copyrights stimulate the market expansion of U.S. exports across lower middle and low income countries. That is to say, strengthening copyrights boost bilateral trade flows which mean a positive parameter on the index of copyrights of these countries.

2.3 Threat of Imitation Specifications

According to the study of Smith (1999), the market power and market expansion effects are countervailing in the relationship between patent rights and bilateral trade flows. To be specific, market expansion means an increase in bilateral trade flows while market power means a decrease, so that the direction of the relationship between patent rights and trade flows is determined by the prevailing one. Based on the above analysis, Smith (1999) originates the notion of Threat of Imitation, separating various kinds of countries into the four groups characterized by their strength of patent rights as well as their imitative abilities (i.e. Smith's Notion), and then tests its rationality. In our research, we assume that Smith's Notion also goes with the effect of copyrights on trade flows, and divide the 91 countries into four groups of countries in accordance with their strength of copyrights and imitative abilities. Table 1 summarizes this categorization based on Threat of Imitation and the relative strength of market power and market expansion effects in different groups of countries.

Table 1 Smith's Notion

	Strong Copyright Protection	Weak Copyright Protection
Strong Imitative Abilities	Moderate Threat of Imitation Ambiguous Effect(+/-)	Strong Threat of Imitation Market Expansion Effect(+)
Weak Imitative Abilities	Weak Threat of Imitation	Moderate Threat of Imitation

	Market Power Effect(-)	Ambiguous Effect(+/-)

Resource: Smith(1999), pp156

According to Smith's notion, we divide all countries into categories by their Threat of Imitation. The threat of imitation is strongest in countries that have strong imitative abilities and weak copyrights. For these countries, the strengthening of copyrights can accelerate the growth of trade flows into these countries, generating the market expansion effect. Therefore we expect a positive parameter on their index of copyright protection. The threat of imitation is weakest in countries that have weak imitative abilities and strong copyrights. Strengthening copyrights in these countries cannot stimulate the growth of trade flows, but in turn reduce trade flows by generating a relatively strong market power effect. Therefore we expect a negative parameter on the index of copyright protection of these countries. The threat of imitation is moderate in countries with weak imitative abilities and weak copyrights, or strong imitative abilities and strong copyrights. The effects of copyrights on trade flows are ambiguous, depending on the relative importance of the market power and market expansion effects, leaving the signs of the parameters on the index of copyright protection of these countries indeterminate.

Introducing the Threat of Imitation theory to the Gravity model, we transform equation (3) into equation (5):

$$\ln(X_{ijk}) = a_i + a_{3i}\ln(Q_k/N_k) + a_{4i}\ln(N_k) + a_{5i}\ln(D_{jk}) + a_{6i}\ln(Op_k) + a_{7i}\mathrm{HPHI} * \ln(Cp_k) + a_{8i}\mathrm{HPLI} * \ln(Cp_k) + a_{9i}\mathrm{LPHI} * \ln(Cp_k) + a_{10i}\mathrm{LPLI} * \ln(Cp_k) + e_{ijk} \quad (5)$$

where **HPHI, HPLI, LPHI, LPLI** are threat-of-imitation dummy variables for high copyrights & high imitative ability, high copyrights & low imitative ability, low copyrights & high imitative ability and low copyrights & low imitative ability.

Table 2 Predicted Parameter Signs of Equation (3), (4) and (5)

Variable	Abbreviation	Equation		
		(3)	(4)	(5)
GDP per capita	$\ln(Q_k/N_k)$	Positive	Positive	Positive
Population	$\ln(N_k)$	Positive	Positive	Positive
Distance	$\ln(D_{jk})$	Negative	Negative	Negative
Openness	$\ln(Op_k)$	Positive	Positive	Positive
Copyright Protection	$\ln(Cp_k)$	Positive		
HI*CP	$HI * \ln(Cp_k)$		Negative	
UMI*CP	$UMI * \ln(Cp_k)$		Negative	
LMI*CP	$LMI * \ln(Cp_k)$		Positive	
LI*CP	$LI * \ln(Cp_k)$		Negative	
HPHI*CP	$HPHI * \ln(Cp_k)$			Ambiguous
HPLI*CP	$HPLI * \ln(Cp_k)$			Negative
LPHI*CP	$LPHI * \ln(Cp_k)$			Positive
LPLI*CP	$LPLI * \ln(Cp_k)$			Ambiguous

3. Method and Data

First, we estimate the equations on aggregate levels using cross-sectional data on U.S. exports of copyright-related products to 91 countries in 2005. The variables includes U.S.'s aggregate trade flows of core copyrights products, per capita GDP and population of the importing countries, physical distance between U.S. and the importers, openness to trade and copyright protection of the importing countries. At last, we estimate the equations on commodity levels. Table 3 is the definitions of

copyright-related products US exports to other countries.[③]

Table 3 The definitions of copyright-related products US exports to other countries

SITC REV 3 CODE	Definition
8966	Antiques of an age exceeding 100 years
892(15,16,19,12)	Books
8922	Newspapers and periodicals
892(85,13,14,4,84,87)	Other printed matter
898(71,61,65,67)	Recorded media
8961	Paintings
896(2,3),6662	Other Visual arts
883	Cinema
89431	New media

The data of the U.S.'s exports in copyright core industries comes from the United Nations Comtrade database (UN Comtrade, SITC REV 3). For the lack of Code 89431 New media, the following empirical study excludes this category of products. The data of per capita GDP and population in 2005 come from World Bank's World Development Indicator. We utilize the World Bank categorization of income (in U.S. dollars, 2005) per capita, dividing the 91 countries into four groups: High income (HI); Upper middle income (UMI); Lower middle income (LMI); Low income (LI). Table 4 shows the categorization.

Table 4 Countries grouping on income per capita 2005

Low income	Lower middle income	Upper middle income	High income
Bangladesh	Algeria	Argentina	Australia
Benin	Angola	Brazil	Austria
Congo, Dem. Rep.	Bolivia	Chile	Belgium
Ghana	Cameroon	Colombia	Canada

[③] UNESCO (2005, appendix V, table B, p. 91).

Kenya	China	Costa Rica	Cyprus
Liberia	Ecuador	Dominican Republic	Denmark
Malawi	Egypt, Arab Rep.	Gabon	Finland
Mali	El Salvador	Jamaica	France
Nepal	Guatemala	Lithuania	Germany
Rwanda	India	Malaysia	Greece
Senegal	Indonesia	Mauritius	Hong Kong, China
Sierra Leone	Iran, Islamic Rep.	Mexico	Hungary
Tanzania	Jordan	Panama	Iceland
Togo	Morocco	Peru	Ireland
Uganda	Nigeria	Poland	Italy
Vietnam	Pakistan	Romania	Japan
Zambia	Paraguay	Russian Federation	Korea, Rep.
Zimbabwe	Philippines	Turkey	Malta
	Sri Lanka	Uruguay	Netherlands
	Sudan	Venezuela, RB	New Zealand
	Thailand		Norway
	Tunisia		Portugal
	Ukraine		Saudi Arabia
			Singapore
			Slovak Republic
			Spain
			Sweden
			Switzerland
			Trinidad and Tobago
			United Kingdom

Data resource: World Development Indicator 2005

The distance between the U.S. and other countries comes from Forum for

Research in Empirical International Trade (FREIT), which measures the distance between Washington, DC and the capital of the importing countries; The index of openness to trade comes from the data collated by the Center for International Comparisons in the University of Pennsylvania （Penn World Table 6.3, PWT 6.3）with 2005 as the base period (Openness in Current Prices), calculated by the formula: Openness to Trade = (Exports + Imports)/GDP. For raw data and data resource, see Appendix.

The copyright protection index used in this research comes from Professor Walter G. Park in American University, Department of Economics.[④]Professor Park's index is calculated every five years, with a minimum of 0 and a maximum of 1. Higher values come with stronger copyright protection. In the following research, we group the countries by the strength of copyrights, with whose index > 0.5 belongs to high copyright protection countries, <0.5 belongs to low copyright protection countries. Table 5 presents the descriptive statistics of the 91 countries in our research.

Table 5 Description of copyright protection

Copyright Protection	Number of countries	cumulative number of countries
<0.20	1	1
0.30～0.20	2	3
0.40～0.30	7	10
0.50～0.40	15	25
0.60～0.50	19	44
0.70～0.60	15	59
0.80～0.70	16	75
0.90～0.80	16	91
Total	91	91

[④] We really appreciate the data providing by professor Park.

The innovation and difficulty of our research are highlighted on the initiation of the Threat of Imitation Index in Copyright-Related Industries. Although the literature on Smith's Notion is booming, it focuses on the impact of patent rights or intellectual property rights on international trade flows, with R&D expenditure as a percentage of GDP or the number of patents obtained as a proxy for imitative ability.

Literature focusing on copyright-related industries is scant. Smith et al. (2009) examines the effects of copyrights on economic development and international trade, providing the basis for our research. Although Smith et al. (2009) doesn't present a measurement of the imitative ability of a country's copyright-related industries, it does provide a feasible approach for us to build an index to measure it. The main idea of Smith et al. (2009) can be divided into two stages. In the first stage, they analyze the effects of copyright policies on development in the production process of core copyright industries with the introduction of "copyright-related capital" (CRC). In the second stage, they apply the gravity model of international trade to examine the effects of copyright policies on bilateral trade. At last, they integrate the two stages and conclude that copyright policies have a huge impact on the trade flows in core copyright industries. The analysis of the first stage, particularly the introduction of copyright-related capital (CRC), enables our building of Threat of Imitation Index in Copyright-Related Industries. Copyright-related capital (CRC) originated by Smith et al.(2009) consists of four components: Human capital (measured by the weighted-average of Gross enrollment rate and Adult literacy rate), Computers per person, International internet bandwidth bits per person and Secure internet servers per person. The Threat of Imitation Index in Copyright-Related Industries in our research is based on the four kinds of Copyright-related capital (CRC) and is calculated by the equation:

$$Y_i = 7.43 + 0.26 * \ln(\text{Computer}) + 0.13 * \ln(\text{Bandwidth}) + 0.07 * \ln(\text{Servers}) + 0.55 * \ln(\text{Human capital}) \quad (6)$$

Which stems from the analysis of Smith et al.(2009) on the production process of copyright-related industries.

In equation (6), Gross enrollment rate and Adult literacy rate of each country come from Human Development Report 2007/2008. Computers per person, International internet bandwidth bits per person and Secure internet servers per person come from World Development Indicator database of the World Bank.

Existing literature, both at home and abroad, doesn't provide a detailed method to measure the imitative ability of copyright-related industries. Therefore, our calculation is the first index to measure it. Because it's the first index, controversy may be aroused. But we firmly believe it's a relatively reasonable index compared with the existing measurements of imitative ability of copyright-related industries. The lack of upper and lower bounds of this index is resulted from the weighted average approach in calculating, but it's surely that with high value comes high imitative ability. In the following research, we take 8.5 as a criterion to separate countries into different groups by their imitative ability. To be specific, countries with a imitative ability < 8.5 is labeled as weak imitative ability; countries with a imitative ability > 8.5 is labeled as strong imitative ability. Table 6 presents the description of imitative abilities of each country calculated through our method.

Table 6 Description of imitative abilities

Imitative Abilities	Number of countries	cumulative number of countries
<7.0	3	3
7.0～7.5	11	14
7.5～8.0	8	22
8.0～8.5	8	30
8.5～9.0	14	44
9.0～9.5	17	61
9.5～10	11	72
10 以上	19	91

Total	91	91

Based on the above categorization of the 91 countries by copyrights and we imitative abilities respectively, we divide the 91 countries by using Smith's Notion into four categories characterized by Threat of Imitation, namely: low copyrights & high imitative ability (Strong Threat of Imitation), high copyrights & high imitative ability (Moderate Threat of Imitation), low copyrights & low imitative ability (Moderate Threat of Imitation) and high copyrights & low imitative ability (Weak Threat of Imitation). Table 7 demonstrates the categorization by Smith's notion for the 91 countries.

Table 7 Smith' notion

Smith's notion		Imitative abilities	
		High	Low
Copyright protection	High	Argentina Australia Austria Belgium Brazil Canada Chile China Colombia Costa Rica Cyprus Denmark Ecuador El Salvador Finland France Gabon Germany Greece Hong Kong SAR Hungary Iceland Ireland Italy Jamaica Japan	Benin Bolivia Cameroon Dominican Republic Guatemala India Kenya Liberia Morocco Nigeria Togo Ukraine Zambia Zimbabwe

		Korea, Lithuania Malta Mauritius Netherlands New Zealand Norway Panama Paraguay Peru Philippines Poland Portugal Singapore Slovak Republic Spain Sweden Switzerland Romania Russian Federation Trinidad and Tobago Turkey Tunisia United Kingdom Uruguay Venezuela, R.B. de	
	Low	Iran, Islamic Rep. of Jordan Malaysia Mexico Saudi Arabia Thailand Vietnam	Algeria Angola Bangladesh Congo, Dem. Rep. of Egypt, Ghana Indonesia Malawi Mali Nepal Pakistan Rwanda Senegal Sierra Leone Sri Lanka Sudan Tanzania Uganda

Table 8 Statistical Description of variables

Variables	Unit	Medium	standard	maximum	minimum	N

			deviation			
Total	Dollar	97624590	361193560.9	2731043088	5562	91
Antiques	Dollar	7789012	27388034.1	177261775	7500	43
Books	Dollar	24012476	108141094.4	970443512	5562	91
Newspapers and periodicals	Dollar	18528690	114399797.1	907495473	4820	63
Other printed matter	Dollar	7283802	32615172.36	276097414	3720	77
Recorded media	Dollar	1187593	3602973.368	25917218	3190	68
Paintings	Dollar	47081423	174036761.2	1096215236	3500	70
Other Visual arts	Dollar	8787203	25191655.02	136780754	2700	61
Cinema	Dollar	427330.2	948278.4397	5769990	3000	60
GDP per capita	Dollar	12086.13	15828.80065	65324.02673	120.24	91
Population	person	60127844	177957172.6	1303720000	296750	91
Openness		88.75747	61.35808755	446.06	26.65	91
Distance	kilometer	8553.937	3549.954038	16370.82	733.89	91
Copyright protection		0.610989	0.166112779	0.87	0.19	91

4. Regression Analysis

4.1 Preliminary Regression

We first estimate equation (3) using aggregate cross-sectional data on U.S. exports of copyright-related products to 91 countries in 2005 by weighted least squares (WLS). Table 9 reports the results.

The first column contains the variables affecting U.S. exports of copyright-related products: per capita GDP of the importers, population, openness to trade, copyright protection and the distance between U.S. and the importers. The significantly negative intercepts indicate that some unobserved distortion factors (e.g. tariff, non-tariff barriers) reduce U.S. exports in core copyright industries. As expected, parameters on per capita GDP and population are positive, indicating higher trade flows are in correspondence with higher levels of economic development which

signal larger demands. Also as expected, parameters on openness to trade is positive, indicating trade flows are stimulated when a country's dependence on foreign trade is high. In addition, the parameter on the distance variable is negative, with a connotation of high trade costs (transportation costs etc.) come with long distance.

The parameter of interest is the parameter on copyright protection. In line with the analysis above, in general, strong copyrights stimulate trade flows by preventing infringements, indicating a positive parameter on copyright protection, which is confirmed by our empirical study. In the aggregate level estimation, the parameter on copyright protection is significantly positive, revealing an obvious market expansion effect. Down to the estimation of the commodity version, the empirical results support our theory on the whole in spite of a tiny difference of the relative strength of market power and market expansion effects in different industries. Six out of eight copyright-related products possess positive parameters (parameters on paintings and cinema are insignificant), despite the remaining two have negative ones (Antiques, Newspapers and periodicals). The market expansion effect prevails among the exports of the first six products. Possible reasons of boosted trade may include increasing exclusiveness of these products and decreasing possibility of imitation and technology spillovers driven by strong copyrights. The market power effect dominates in the exports of the remaining two, with possible reasons of market segmentation (Newspapers and periodicals) and lack of substitutions (Antiques). Our empirical results are consistent with Smith et al.(2009), namely strong copyrights have a positive effect on bilateral trade flows.

Table 9 Empirical results of Equation (3)

	Total	Antiques	Books	Newspapers and periodicals	Other printed matter
Constant	-2.887***	-24.640***	-0.815	0.954	-2.809***
	(-4.621)	(-21.508)	(-0.828)	(1.097)	(-6.188)

GDP per capita	1.078***	1.756***	0.811***	0.711***	1.255***
	(61.624)	(25.906)	(39.661)	(16.464)	(121.791)
Population	1.043***	1.170***	0.996***	0.714***	0.966***
	(46.840)	(22.724)	(104.935)	(23.395)	(59.950)
Openness	0.832***	0.523***	0.796***	0.969***	0.746***
	(23.092)	(4.287)	(8.932)	(12.702)	(19.924)
Copyright protection	0.916***	-0.932*	0.290*	-0.320***	0.173***
	(5.607)	(-2.006)	(1.387)	(-6.869)	(6.121)
Distance	-1.264***	-0.125**	-1.290***	-1.157***	-1.626***
	(-12.602)	(-2.044)	(-12.978)	(-25.727)	(-44.831)
R-squared	0.996	0.994	0.998	0.954	0.998
N	91	43	91	63	77

Table 9 continued:

	Recorded media	Paintings	Other Visual arts	Cinema
Constant	-0.633	-25.265***	-19.262***	-12.410***
	(-0.663)	(-20.913)	(-14.160)	(-7.998)
GDP per capita	0.828***	1.962***	1.852***	0.963***
	(17.964)	(54.222)	(31.562)	(17.695)
Population	0.927***	1.271***	1.135***	0.818***
	(32.909)	(25.210)	(63.451)	(18.528)
Openness	0.402***	0.595***	0.904***	0.450***
	(3.684)	(5.811)	(10.210)	(4.867)
Copyright protection	0.430*	0.333	0.550*	0.156
	(1.465)	(1.062)	(1.624)	(0.646)
Distance	-1.340***	-0.251*	-0.820***	-0.053
	(-12.763)	(-1.548)	(-8.797)	(-0.300)
R-squared	0.981	0.992	0.993	0.927
N	68	70	61	60

Note: *** significant at 1%, ** significant at 5%, * significant at 10%

4.2 Development Interactions

Table 10 reports the results of our estimation on equation (4) using aggregate cross-sectional data on U.S. exports of copyright-related products to 91 countries in 2005.

It is found that parameters on per capita GDP, population, openness to trade and the distance term have expected signs (The insignificant positive sign on the distance term of Cinema is an exception).

We expect negative parameters on copyright protection of high income and upper middle income countries. These countries already have a high level of economic development and technology as well as copyright protection, so that strengthening copyrights can't generate significant market expansion effect. On the contrary, prevailing market power effect results to a reduction in trade flows. In the estimation on aggregate level, we find parameters on HI and UMI countries are significantly positive, bias from our expectation. Down to the commodity version, differences occur in the signs of the parameters. Among the HI countries, five out of eight are negative (significant in Books and Paintings), the other three are positive (significant in Other Visual art). Among the UMI countries, five are negative (three out of five are significant), the remaining three are positive (significant in Books and Paintings). The possible explanations for the differences may include the interaction of American corporation's competitiveness and the market contraction effect imposed by the strength of copyrights in other HI & UMI countries.

In the aggregate level estimation for LMI and LI countries, parameters on copyrights are all positive, indicating market expansion effects as results of strengthening copyright protection. Among the eight categories of products, for LMI countries only Antiques has a negative but insignificant parameter on copyright protection and for LI countries five parameters out of eight are significantly positive albeit the three negative ones. The findings show that, the strength of copyrights in

LMI & LI countries is conducive to the growth of U.S. exports in core copyright industries with the strong competitiveness of U.S. copyright-related products as a possible reason.

Smith (1999) finds that market expansion effect prevails only in LMI countries, and market power effect dominates in the remaining in her examination on the effects of patent rights on U.S. trade flows to countries grouped by income levels. In contrast, market expansion effect prevails in countries with ALL income levels in our research of copyright protection. However, specify to the commodity version, market power effect dominates in some cases. We further find that the market expansion effect is more significant in LMI countries with Antiques as an exception, which is in line with Smith (1999). To be specific, the 1% increase in copyright protection of LMI countries drives up exports by 1.848% in the correspondent sectors. While the figures for HI, UMI and LI countries are 0.072%, 0.795% and 0.618% respectively.

Table 10 Empirical results of Equation (4)

	Total	Antiques	Books	Newspapers and periodicals	Other printed matter
Constant	-3.809***	-28.690***	-1.195	4.233**	-3.020***
	(-4.249)	(-3.790)	(-0.980)	(2.141)	(-3.372)
GDP per capita	0.999***	2.098***	0.613***	0.378***	1.113***
	(25.492)	(5.014)	(15.228)	(3.552)	(21.250)
Population	1.119***	1.265***	1.086***	0.702***	1.020***
	(67.462)	(5.738)	(78.367)	(8.999)	(28.153)
Openness	0.966***	0.790*	0.758***	1.320***	0.896***
	(10.581)	(1.486)	(16.685)	(7.111)	(7.544)
Distance	-1.298***	-0.317	-1.217***	-1.332***	-1.624***
	(-12.378)	(-0.687)	(-8.664)	(-5.790)	(-27.128)
High income	0.072**	0.501	-1.678***	-0.541	0.075

	(0.177)	(0.330)	(-16.826)	(-0.641)	(0.436)
Upper middle	0.795***	-0.211	0.532**	-0.162	-0.295**
income	(3.605)	(-0.122)	(1.711)	(-0.335)	(-1.780)
Lower middle	1.848***	-1.189	1.382***	0.387	1.150***
income	(11.483)	(-0.655)	(5.282)	(0.883)	(6.023)
Low income	0.618***	-3.656**	0.531**	2.139***	1.065***
	(3.108)	(-1.749)	(1.832)	(3.202)	(5.880)
R-squared	0.994	0.656	0.997	0.964	0.994
N	91	43	91	63	77

Table 10 continued:

	Recorded media	Paintings	Other Visual arts	Cinema
Constant	-0.503	-26.743***	-21.959***	-12.029***
	(0.477)	(-16.199)	(-4.757)	(-8.061)
GDP per capita	0.670***	2.222***	2.150***	0.907***
	(8.648)	(43.383)	(9.346)	(11.877)
Population	0.942***	1.311***	1.166***	0.787***
	(31.541)	(50.127)	(8.419)	(29.066)
Openness	0.310**	0.656***	0.976***	0.258**
	(2.294)	(3.725)	(2.405)	(1.854)
Distance	-1.190***	-0.424**	-0.918***	0.106
	(-11.673)	(-2.561)	(-2.712)	(0.510)
High income	-0.795	1.919***	1.609*	-0.434
	(-1.045)	(2.731)	(1.368)	(-1.037)
Upper middle	-0.451**	1.301***	0.792	-0.927**
income	(-2.212)	(3.627)	(0.744)	(-1.894)
Lower middle	0.854***	0.937***	0.340	0.448
income	(2.756)	(2.999)	(0.364)	(1.105)
Low income	1.631***	-1.869***	-2.398**	0.411

	(6.096)	(-4.096)	(-1.907)	(0.819)
R-squared	0.990	0.996	0.818	0.991
N	68	70	61	60

Note: *** significant at 1%, ** significant at 5%, * significant at 10%

4.3 Threat of Imitation

In this section, we consider the link between threat of imitation and export sensitivity to copyrights.

We find that parameters on copyright protection index for countries with strong threat of imitation (low copyrights & high imitative ability) and weak threat of imitation (high copyrights & low imitative ability) are consistent with our expectation. Our results confirm the idea that the exports respond positively to the strength of copyrights for countries with strong threat of imitation in aggregate level. Only three out of eight of the parameters (Newspapers and periodicals, Recorded media, Cinema) are significantly negative, which is inconsistent with our expectation. As can be seen from Table 11, for countries with weak threat of imitation, the negative parameters (Newspapers and periodicals and Other Visual arts are exceptions) indicate the prevailing of market power effect.

Theory tells us little about which effect dominates in countries with moderate threat of imitation (high copyrights & high imitative ability or low copyrights & low imitative ability). The empirical results show a strong market power effect in countries with high copyrights & high imitative ability, as the parameters are negative except for Other printed matter. In contrast, market expansion effect prevails in countries characterized by low copyrights & low imitative ability in aggregate level. But down to the commodity version, five out of eight are positive parameters and the other three are negative, which presents some incongruence.

Our empirical results are consistent with Smith (1999). Export elasticity on copyrights is 1.142 for countries with strong threat of imitation (low copyrights & high imitative ability).

Table 11 Empirical results of Equation (5)

	Total	Antiques	Books	Newspapers and periodicals	Other printed matter
Constant	-4.568***	-28.653***	-4.559***	5.122***	-2.230***
	(-4.640)	(-15.655)	(-4.270)	(3.073)	(-2.651)
GDP per capita	1.059***	2.021***	0.935***	0.480***	1.289***
	(25.842)	(33.858)	(26.759)	(6.094)	(88.516)
Population	1.019***	1.272***	1.023***	0.762***	0.931***
	(49.062)	(21.132)	(49.159)	(15.480)	(30.442)
Openness	0.753***	0.674***	0.723***	0.893***	0.595***
	(11.526)	(4.361)	(7.175)	(5.334)	(9.071)
Distance	-1.006***	-0.269**	-1.062***	-1.538***	-1.573***
	(-10.754)	(-1.763)	(-9.237)	(-7.955)	(-43.291)
HPHI	-0.242	-2.388***	-0.946***	-3.683***	0.530***
	(-0.871)	(-6.401)	(-2.931)	(-5.557)	(3.827)
HPLI	-0.664**	-2.274***	-2.656***	-0.283	-0.371**
	(-1.971)	(-3.425)	(-5.856)	(-0.398)	(-1.850)
LPHI	1.142***	1.217***	0.159	-1.784***	1.142***
	(4.399)	(3.430)	(0.411)	(-2.932)	(5.102)
LPLI	1.107***	-3.629***	0.092	0.091	0.096***
	(4.557)	(-12.471)	(0.300)	(0.178)	(0.824)
R-squared	0.994	0.995	0.983	0.889	0.998
N	91	43	91	63	77

Table 11 continued:

	Recorded media	Paintings	Other Visual arts	Cinema
Constant	-2.419*	-27.589***	-18.801***	-11.867***

	(-1.540)	(-31.716)	(-15.812)	(-5.594)
GDP per capita	0.842***	2.306***	1.871***	1.006***
	(16.403)	(34.558)	(31.382)	(12.870)
Population	0.990***	1.330***	1.134***	0.793***
	(20.277)	(34.342)	(49.263)	(12.195)
Openness	0.231**	0.637***	0.851***	0.195*
	(1.439)	(6.256)	(11.876)	(1.383)
Distance	-1.273***	-0.536***	-0.895***	-0.039
	(-17.504)	(-3.626)	(-10.312)	(-0.158)
HPHI	-2.252***	-0.554	-0.272	-1.413***
	(-6.612)	(-1.101)	(-0.571)	(-2.369)
HPLI	-1.191**	-3.145***	-0.191	-1.189*
	(-3.267)	(-4.758)	(-0.299)	(-1.318)
LPHI	-0.467	0.875**	1.847***	-0.263
	(-0.979)	(2.065)	(3.350)	(-0.578)
LPLI	0.189***	-2.641***	0.084	-0.082
	(0.844)	(-3.804)	(0.187)	(-0.158)
R-squared	0.997	0.996	0.818	0.905
N	68	70	61	60

Note: *** significant at 1%, ** significant at 5%, * significant at 10%

5. Conclusion

This paper assesses the effects of foreign copyrights on U.S exports in core copyright industries, with application of the Gravity model using cross-country data. We find that the market expansion and market power effects that have been confirmed in the relations between patent rights and trade flows also apply to copyrights. The findings show that strong copyrights stimulate the market expansion of U.S. exports in core copyright industries across countries on all income levels. Weak copyrights in countries with strong imitative threat (weak copyrights & strong imitative abilities)

are a barrier to U.S exports in core copyright industries. If copyrights in these countries are strengthened, market expansion effect is induced, boosting U.S exports in core copyright industries. Alternatively, the strengthening of copyrights in countries with strong copyrights and weak imitative abilities significantly enhance the market power effect, reducing U.S exports due to the monopoly bestowed by copyrights.

Considering it's the first imitative ability index for copyright-related industries, its robustness is waiting to be examined by more empirical studies. Furthermore, we'd like to study the effect of copyrights on bilateral trade flows in comparative static or dynamic contexts so as to support our conclusion.

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