THE IMPACT OF DIGITAL PIRACY ON BILATERAL INTERNATIONAL TRADE IN CULTURAL GOODS

by

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Abstract

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The study analyzes the impact of digital piracy on bilateral international trade in three groups of good in Cultural and Creative Industry such as Film, Audiovisual, and New Media industries. The thesis re-estimates findings by Lionetti and Patuelli (2009) with the newest UNCTAD panel data for 2002-2015 years using augmented log-transformed gravity model and Poisson specification with the eigenvector spatial filtering technique. According to the half of zero trade flows, the pooled Poisson regression better describes the trade data in the Film industry. In contrary, the ordinary pooled OLS model is sufficient to use for trade flows in Audiovisuals and New Media industries due to the low presence of "zeros". The results claim that five out of six coefficients have a negative association with exports. The higher level of digital piracy in both domestic and destination country decreases exports in Audiovisuals and New Media industries. However, when digital piracy in the destination country negatively associated with higher export in the Film industry, the higher level of digital piracy in the domestic country is associated positively. Thus, reducing the digital piracy of the economy decreases the level of exports in the Film industry and increases exports in Audiovisuals and New Media industries.

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GLOSSARY

BSA – Business Software Association

CCI – Cultural and Creative Industries

CEPII – Centre d'Etudes Prospectives et d'Informations Internationales. The main French institute for research into international economics.

GLMM – generalized linear mixed model

OLS – ordinary least squares

PPML – Poisson Pseudo Maximum Likelihood

UNESCO – United Nations Educational, Scientific and Cultural Organization

UNCTAD – United Nations Conference on Trade and Development

WTO – World Trade Organization

Chapter 1

INTRODUCTION

With the development of technology and the digital revolution, the creative and knowledge-based industries became an essential part of the world economy. According to UNESCO (2015), creative sectors include production and sales of films, design, art, crafts, books, paintings, festivals, music, drawings, digital animation, and video games. In 2013 the total amount of produced cultural and creative goods was 2,250 billion US dollars, or 3% of world GDP (UNESCO, 2015). Cultural and creative industries (CCI) revenue worldwide surpassed telecom services (1,570 billion US dollars globally) and exceeded India's GDP (1,900 billion US dollars). CCI provide 29.5 million jobs worldwide (1% of the world's active population), particularly, 6.73 million positions — in visual arts, 3.67 million positions — in books and 3.98 million in music. The highest revenue was generated in TV broadcast (477 billion US dollars), visual arts (391 billion US dollars), and newspapers & magazines (354 billion US dollars). Over 2003-2012, the sector showed a steady growth at the annual rate of 8.6% despite the 2008 crisis and economic slowdown in the global economy.

The sector generates substantial revenues through trade. UNCTAD (United Nations Conference on Trade and Development) reports that in 2012 the global trade market for creative goods and services amounted to 547 billion US dollars (UNSTAD 2016), which is a quarter of the global production of CCI. Moreover, it is comparable to the Swedish GDP, which was 539 billion US dollars in 2017. From 2002 to 2011, the value of trade in creative goods and services doubled, and the top exporter became China (UNESCO 2013). This is a less significant growth compared to growth in the value of overall world trade, which was tripled in these years (WTO). However, this dynamic demonstrates the strength and sustainability of the sector. Moreover, export from developing economies, especially from Asian ones, is growing faster than from the developed economies.

Cultural and creative industries drive the online economy, contributing 200 billion US dollars to global digital sales in 2013. Cultural and creative content increases sales of digital devices, which were 530 billion US dollars in 2013. Besides, digital cultural goods are the most significant revenue source for the digital economy, which generated 66 billion US dollars of B2C sales in 2013 and 21.7 billion US dollars of advertising revenue for free streaming websites and online media (UNESCO).

At the same time, the development of the creative economy has been accompanied by a rather impressive digital piracy. According to the Business Software Association (2018), 37 percent of software installed on personal computers worldwide is still unlicensed with only for software industry a commercial loss value of 46.3 billion US dollars globally. In 2017 Ukraine was included in the TOP25 countries with the highest digital piracy level (80% for Ukraine).

Economic theory predicts that piracy should have a negative effect on CCI development. Right owners, who have invested time and money in producing films, sound recordings, books, and computer software, suffer losses in revenue. Ncube (2018) suggests that the possible reasons for the piracy behavior are poverty, high cost of genuine products, poor distribution networks, the slow judicial system, and lack of a regulatory agency in the creative sector.

Despite the fact that digital piracy is a terrible phenomenon and the government ought to protect the international property rights, digital piracy has a positive effect on some fields of creative economy (Lionetti and Patuelli 2009) and cross-industry in complement sector (Liu 2015). We checked the hypothesis that an exporter of CCI good is firmly against her product being illegally copied. According to this, the producer will not have an incentive to export the good to the countries with a high level of piracy. However, it is not consistent with the Film industry, which can be explained that piracy is advertising for the legal source of the film distribution.

Given the lack of papers, which studies the trade in cultural goods, the thesis's aim is to reconsider how digital piracy affects international trade in cultural goods. We use the gravity model of trade and a panel of international trade in creative goods for 2002-2015 between 26 countries with a different level of piracy and trade. The data are collected from the United Nations Conference on Trade and Development.

The main finding of this study is the positive association of digital piracy in the domestic country with the higher export of films to foreign box-offices. Moreover, we found that the exporter of cultural goods cares more about the level of piracy in the domestic economy than in destination one.

Further study is structured as followed. Chapter 2 describes the literature on the impact of digital piracy on the CCI and trade model issues; Chapter 3 provides the methodology of the analysis and model specifications; Chapter 4 reviews data sources; Chapter 5 presents the main empirical results; Chapter 6 summarizes all findings and provide venues for further studies.

Chapter 2

LITERATURE REVIEW

This chapter offers a comprehensive discussion about digital piracy and its impact on the economy. It begins with the studies on drivers behind piracy. Then, papers looking at the impact of digital piracy on trade are considered. Finally, it offers a discussion of the model estimation issues of trade flows.

2.1. Piracy motivation

One of the critical questions is "Why do people pirate?", to which some non-economic researchers try to provide an answer. For instance, Koklic et al. (2014) studied the perception of the adult people at the digital piracy and found that consumer perceptions regarding the moral intensity of unauthorized downloading had a significant adverse effect on both consumers' overall attitudes to digital piracy and their intention to pirate. Thus, they confirmed that stronger consumer beliefs about the magnitude of consequences caused by piracy could significantly determine the attitudes and intentions to engage in digital piracy.

On the other hand, Leung (2011) analyzed 281 Hong Kong's high colleges and found that the most students would switch to Internet piracy from local pirate market, and the government might well overestimate the gain from reducing piracy as many as nine times.

However, when the digital piracy is treated as a crime and governments call the people, who use pirated creative goods criminals, Cvetkovski (2014) argues that given the sheer volume of illegal traffic it is difficult to evaluate the share of users, who deliberately participate in illegal consumption thereby immoral, anti-cultural or criminal. Especially, when the share of people who care about breaking copyright laws is not significant.

Trying to explain digital piracy behavior, Stephen Taylor (2012) evaluated intentions on engaging in digital piracy. He suggests that the reason for the predicament should involve the lack of a clear understanding of the social psychological underpinnings of digital piracy behaviors. He argues that the current focus on deterrent strategies seems relatively ineffective. Especially, when the use of illegal soft reduces the operational costs of the enterprise, which is also an incentive to use pirated goods.

2.2. Piracy effect on trade

There are very few papers, which analyze international trade in cultural goods. On the other hand, there is a considerable body of empirical literature about the effects of digital piracy on CCI legitimate sales.

There is much convincing evidence that piracy undermines the development of the creative and cultural industry. Siwek (2007) analyzed the global and the US-based piracy of sound recordings and found that this sort of piracy caused the US economy 12.5 billion US dollars of losses in total output annually. The author argues that the US economy loses 71,060 jobs and 2.7 billion US dollars of workers' earnings each year. According to the amounts, the US annually lose 422 million US dollars in tax revenue: 131 million US dollars loss in corporate income and production taxes, and 291 million US dollars — in personal income taxes. Additionally, the negative impact of piracy was also found in the film industry. Ma et al. (2014) found that pre-release piracy causes a 19.1% decrease in revenue for box offices compared to piracy, which occurs post-release.

However, Liu (2015) discusses the cross-industries effects of digital piracy on revenues. He argues that the deadweight loss in music consumption could simultaneously increase the prices of its complements and incur the deadweight losses in the complement sector. For instance, Leung (2015) found that digital piracy in the music industry contributed 12% to iPods sales.

One of the few empirical papers, which studies the influence of digital piracy on international trade was the paper by Lionetti and Patuelli (2009), who found that digital piracy had some positive effect on films and new media and a negative one — in music. They studied the impact of digital piracy on international trade by using the gravity model and data for 1996-2006. Making an attempt against a potential bias due to the lack of control for spatial autocorrelation and "zero" trade flows, they re-estimated the final model as a generalized linear mixed model (GLMM), by means of Laplace approximation as a Poisson regression using the eigenvector spatial filter (Griffith 2003). These findings should be treated with caution because the methodology of BSA (Business Software Alliance) piracy indicator changed in 2002. Thus, their research may be undermined by the data inconsistency.

The authors offer explanations that digital piracy in the Film industry should be treated as advertising for the legal source of distribution. On the other hand, Lobato (2012) also tried to explain the positive impact of digital piracy on the film industry. Even though the income is not returned to the rights holders, distribution activities seem to be economically viable. The government, while *de jure* supporting copyright enforcement, *de facto* closes eyes on this trade and regards it as a driver of tax revenue and employment.

Additionaly, Ndubuisi and FosterMcGregor (2018) found that intellectual property rights protection is trade-related. They also found that the level of protecting the intellectual property rights protection in the exporting country mattered more to the exporter than the level of intellectual property rights protection in the importing country. Thus, it can be a tool for stimulating exports in both developing and developed countries.

Thereby, this study determines a possible impact of digital piracy on bilateral international trade of digital products, when there are a lot of empirical examples on the effect of piracy on legitimate sales of digital products.

2.3. Gravity model estimation issues

Due to its logarithmic transformation for the estimation purposes, the gravity model of trade can have a problem with "zero" trade flows in observation, but there are some approaches, which address the problem. For instance, Martin and Pham (2015) recommend the PPML (Poisson Pseudo-Maximum-Likelihood) as a good estimation for the gravity model for models of aggregate trade flows, which helps to avoid misspecification of the gravity model.

Additionaly, Ndubuisi and FosterMcGregor (2018), who studied the impact of intellectual property right protection on trade, used the gravity model and PPML for estimations too. However, they also suggest dropping the observation with "zero" trade flows and estimating a log-linear version of the equation with OLS, but only if "zeros" are randomly distributed.

Recent studies reveal that controlling the spatial autocorrelation improves gravity models in log-linear or Poisson regression estimation techniques. Trade flows which structured as a panel data set from multiple time-periods can present the spatial autocorrelation within each time-period as well as correlation within each measurement unit. Thus, gravity models should be explicitly specified to account for these two different types of correlation structure, why Chun and Griffith (2011) advice to use the eigenvector spatial filtering technique to mitigate misspecification.

This paper contributes to the literature on digital piracy and international trade in cultural goods by re-estimating Lionetti and Patuelli (2009) with new and consistent data for 14 years (2002-2015) between 26 countries and applying as well as more appropriate estimation accounting for zero trade flows.

Chapter 3

METHODOLOGY

The estimation we use is based upon the gravity model of trade. The most simple specification, introduced by Tinbergen (1962), describes the value of bilateral trade as a function of the economic size of the exporter and importer, and the distance occurring between them:

$$T_{ijk} = G \frac{Y_i^{\alpha} Y_j^{\beta}}{D_{ij}^{\theta}}, \quad (1)$$

The dependent variable (*Tijk*) is the value of trade, for the chosen cultural good *k*, from countries *i* to a country *j*. A separate regression will be estimated for each cultural good. On the right-hand side, destination- and origin-market size are included and measured as GDP (*Yi* and *Yj*) as well as an indicator for the distance between two states (*Dij*).

3.1. The log-transformed and augmented gravity model

The equation is log-transformed and augmented with a set of bilateral variables so as to take into account the geographical and cultural relationships between countries. This set includes, among other variables, a digital piracy level measures in both countries. The list of these variables includes,

- contiguity (*Cij*), which indicates if two countries share a border;
- a common language (*CLij*), which indicates if two countries share an official common language;
- colony (*COLij*), which indicates if countries were linked colonially;

- common colonizer (*CCij*), which indicates if countries had a common colonizer;
- colonial link after 1945 (*C45ij)*, which indicates if those countries have had a colonial relationship after 1945;
- same country (*SCij*), which indicates if two countries formerly belonged to the same country;

Thus, the general form of the estimation equation is:

$$\ln T_{ijk} = \beta_0 + \beta_1 \ln Y_i + \beta_2 \ln Y_j + \beta_3 \ln D_{ij} + \beta_4 C_{ij} + \beta_5 CL_{ij} + \beta_6 COL_{ij} + \beta_7 CC_{ij} + \beta_8 C45_{ij} + \beta_9 SC_{ij} + \beta_{10} \ln BSA_i + \beta_{11} \ln BSA_j + \varepsilon_{ijk} \quad (2)$$

All variables are expected to have a positive sign except distance and piracy levels.

3.2. Poisson specification

For the reason to capture zero trade flows, which are presented in the data, the empirical model specification was based on the pooled Poisson regression as Ndubuisi and Foster-McGregor (2018) did in their study.

The Poisson estimator has several properties for using gravity models. First, the Poisson estimator naturally includes observations with zero trade. Because the logarithm of zero is undefined, such observations are dropped from the OLS model. In whatever way, zeros in the trade matrix are relatively common, since not all countries trade all products with all partners. Dropping zero observations leads to sample selection bias, which happening with using ordinary OLS. Thus, it can be a problem for estimating the trade in the Film industry with approximately half of zero trade flows. Thus, this ability of Poisson regression to include zero observations without additions to the basic model is highly appropriate.

Second, a lot of nonlinear maximum likelihood estimators have not understandable properties in the presence of fixed effects. Thus, the Poisson estimator can use fixed dummy variables as in a simple OLS, while most theory-consistent models include fixed effects by the exporter and importer.

Third, the Poisson model is easy to interpret as in the same way as an ordinary OLS. The dependent variable for the Poisson regression is specified as exports in levels when the coefficients of logarithmic independent variables are interpreted as simple elasticities.

Thus, the Poisson gravity model looks like:

$$T_{ijt} = exp(\beta_t + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} + \beta_3 \ln D_{ij} + \beta_4 C_{ij} + \beta_5 CL_{ij} + \beta_6 COL_{ij} + \beta_7 CC_{ij} + \beta_8 C45_{ij} + \beta_9 SC_{ij} + \beta_{10} \ln BSA_{it} + \beta_{11} \ln BSA_{jt} + b_{ij}) + \varepsilon_{ijt} \quad (3)$$

where b_{ij} is a random-effect for contries *i* and *j*.

3.3. The eigenvector spatial filtering

For capturing spatial autocorrelation were used the eigenvector spatial filtering technique by Chun and Griffith (2011).

The eigenvector spatial filtering technique became popular in recent years as a trade estimation tool for capturing the fixed effects of the model without the significant dropping of degrees of freedom. Griffith (2003) firstly described it, and then eigenvector spatial filtering became actively used by Patuelli et al. (2006), Lionetti and Patuelli (2009), and Chun and Griffith (2011). The extracted eigenvectors are independent and mutually orthogonal with zero-centered map patterns implied by the relationships of the neighborhood between the countries.

Based on the set of k-nearest neighbors were constructed spatial weight matrix $\mathbf{V}$ with size $n \times n$. Because of the bilateral data, this matrix should be extended to the matrix $\mathbf{M} = \mathbf{V} \otimes \mathbf{V}$, which now has the size $n^2 \times n^2$. Then, this matrix $\mathbf{M}$ transformed into:

$$\mathbf{C} = (\mathbf{I} - \mathbf{1}\mathbf{1}^{\mathbf{T}}/n)\, \mathbf{M}\, (\mathbf{I} - \mathbf{1}\mathbf{1}^{\mathbf{T}}/n) \tag{4}$$

where $\mathbf{I}$ — identity matrix and $\mathbf{1}$ — identity vector. From the new matrix $\mathbf{C}$ was extracted a subset of n^2 eigenvectors, which should be selected on the basis of a minimum-correlation range, for instance, $MI(e_i)/max(MI) > 0.25$, where $max(MI)$ is the Moran's I of the first extracted eigenvector and $MI(e_i)$ corresponds to the Moran's I value of the *i-th* eigenvector.

Then, the eigenvectors were copied for each year of the dataset and used as pseudo-omitted variables, which capture the fixed effects of the model. Using the algorithm based on the optimization of Bayesian information criterion (BIC) there should be chosen the most significant eigenvectors. In conjunction with the Poisson regression, the estimation technique should capture fixed effects at the same time.

Now, the final estimation model can be presented as:

$$T_{ijt} = \exp(\beta_t + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} + \beta_3 \ln D_{ij} + \beta_4 C_{ij} + \beta_5 CL_{ij} + \beta_6 COL_{ij} + \beta_7 CC_{ij} + \beta_8 C45_{ij} + \beta_9 SC_{ij} + \beta_{10} \ln BSA_{it} + \beta_{11} \ln BSA_{jt} + \textstyle\sum_k \alpha_k e_{k,ij} + b_{ij}) + \varepsilon_{ijt} \tag{5}$$

where β_t is a set of dummy coefficient of year controls, α_k are coefficients of the eigenvectors e_k.

Then, the final model by Lionetti and Patuelli (2009) was estimated as a generalized linear mixed model (GLMM), by means of Laplace approximation as a Poisson regression. However, GLMM coefficients could be biased for significant variance or small means. Moreover, if we data transformable to normality there is no much evidence to use GLMM regression (Bolker, et al. 2009). Thus, the pooled Poisson regression can describe the trade data of Film industry better, and for Audiovisuals and New Media industries are sufficient to use the ordinary pooled OLS (Ndubuisi and Foster-McGregor 2018).

Despite everything, we also use GLMM for the aim to compare our results with the results by Lionetti and Patuelli (2009).

C h a p t e r 4

DATA DESCRIPTION

The dataset used in this study is provided by UNCTAD. It is a panel of international trade in creative goods for 14 years (2002-2015) between 26 countries (both developed and developing) with a different level of piracy. It gives a combination of 9,100 observations (14*26*25= 9,100) for each creative good. The countries included in the study are Australia, Austria, Belgium, Canada, China, Czech Republic, Denmark, France, Germany, Hong Kong, India, Italy, Japan, Mexico, The Netherlands, Norway, Russian Federation, South Africa, South Korea, Spain, Sweden, Switzerland, Thailand, Ukraine, United Kingdom, United States. Figure 1 shows the spatial points of the sample counties. Thus, there can exist the spatial autocorrelation between international bilateral trade flows.

The dataset represents the set of top producers, exporters, and importers in creative goods. It also includes developed, developing, and transit countries in different regions of the world and also contains countries with the highest and the lowest piracy rate. The chosen dataset represents most of the trade flows in the creative economy, which can be consistent with the total trade in the chosen industries cover from 85 to 95 percent of it. However, it should be said that the data did not count a virtual trade and do not replicate electronic trade in the official statistics. Thus, the further estimated results should be interpreted with accuracy for increasing the use of e-business and ITC tools in the virtual trade.

Nevertheless, the data covers the major developed countries like EU, US, Japan, and Canada, who are the largest importers of creative good in recent years. Moreover, at the same time, China becomes one of the top creative good exporters in the world (UNCTAD).

Figure 1. The map with the selected countries.

The original models by Lionetti and Patuelli (2009) included a free-trade agreement, which measured participation in WTO. According to the data sample, there are only two countries from the sample who joined WTO after 2002: Ukraine (since 2008) and Russian Federation (since 2012). Thus, this variable was omitted from the study.

BSA piracy indicator for each country was the primary explanatory variable. Other variables included are GDP, which is taken from the World Bank, and distance, contiguity, and colonial links obtained from CEPII. In Table 1 and Table 2 are presented the basic descriptive statistics.

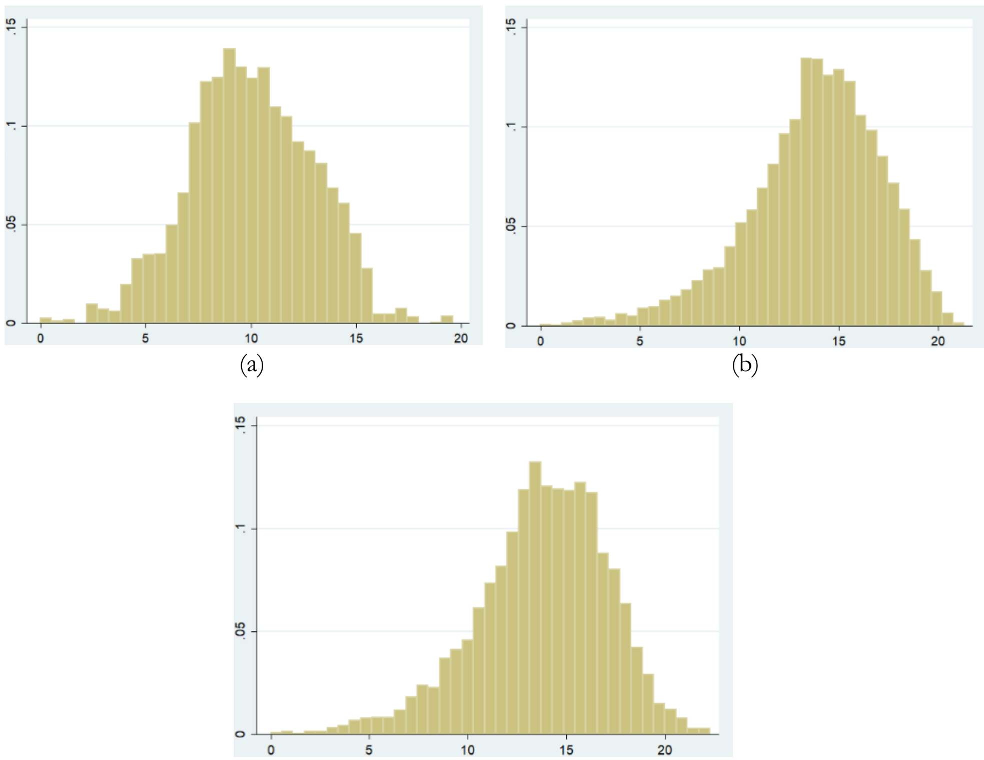
4.1. Dependent variables: Film, Audiovisuals and New Media

The dependent variables are Film, Audiovisuals, and New Media, which classification codes and description can be found in Appendix A. For each of sub-industry were estimated the set of separated regressions.

Figure 2 illustrates that trade flows in creative industries are distributed approximately log-normally; however, the problem of zero trade flows remains.

According to the data, trade flows in the Film industry have 48.8% of zero trade flows, in Audiovisuals industry — 3.5% and in the New Media industry — 7.5%. To eliminate the possible biases, we use the Poisson panel regression mentioned above, which is a common practice for the empirical trade studies (Ndubuisi and Foster-McGregor 2018).

The dynamic graphs for each creative good are presented in Figure 3-5.



(c)

Figure 2. Densities of the trade flow in creative industries, in logs of US dollars for Film (a), Audiovisuals (b), and New Media (c)

Film industry composes from video, music, television, Internet, and satellite rights, box-office sales, and merchandising. The United States is leading in film importing when at the same time, Hollywood has a share of 27% of all box-office revenue worldwide (UNESCO). However, the world's largest film producer is India, which makes about 2,000 commercial films annually, but mostly distributes it to the domestic market (UNESCO).

On the other hand, Audiovisuals include CDs, DVDs, tapes, etc., which is only one material storage medium in the creative sub-industry sample.

Table 1. Panel descriptive statistics of export flows in creative goods

Variable		Mean	S.D.	Min	Max
Film	overall	0.62	9.71	0.00	333.99
	between		8.06	0.00	201.17
	within		5.43	–200.38	133.44
Audiovisuals	overall	23.30	82.10	0.00	1783.87
	between		74.49	0.00	1075.26
	within		34.63	–518.38	731.92
New Media	overall	32.60	190.88	0.000	4810.29
	between		165.80	0.000	2760.18
	within		94.80	–2030.69	2477.71
GDP	overall	27.49	1.19	24.47	30.53
	between		1.15	25.41	30.30
	within		0.31	26.28	28.41
Distance	overall	8.33	1.10	5.15	9.78
	between		1.10	5.15	9.78
	within		0	8.33	8.33
BSA piracy	overall	41.10	19.90	17.00	92.00
	between		19.52	19.93	85.29
	within		3.93	30.39	57.67

Notes: Values of common variables are reported for Film dataset. Film, Audiovisuals and New Media provided in levels of millions USD. GDP and Distance provided in logs. BSA piracy index provided in percents. For every variable: N = 9,100; n = 650; T = 14.

New Media products should be defined accurately because official definition "recorded media for the sound/image, and video games" does not help well. New Media is a creative product defined as a digitalized form of creative content such as cartoons, software, and interactive products as video games. Sometimes it is hard to distinguish a creative product between New Media or

Film industries. For instance, a digitalized cartoon film is a part of both industries at the same time.

Thus, the data provided from UNCTAD should be treated with accuracy, because the Harmonized System product classification changed in 2007 and 2012, which caused breaks in the time series, depending on the versions of the classification used by the reporting countries and the years of their introduction.

Table 2. Descriptive statistics of dummy variables

Variable	Mean
Contigiuity	0.074
Common language	0.138
Colony	0.042
Common colonizer	0.003
Colony after 1945	0.012
Same country	0.011

Notes: Values of variables are reported for Film dataset.

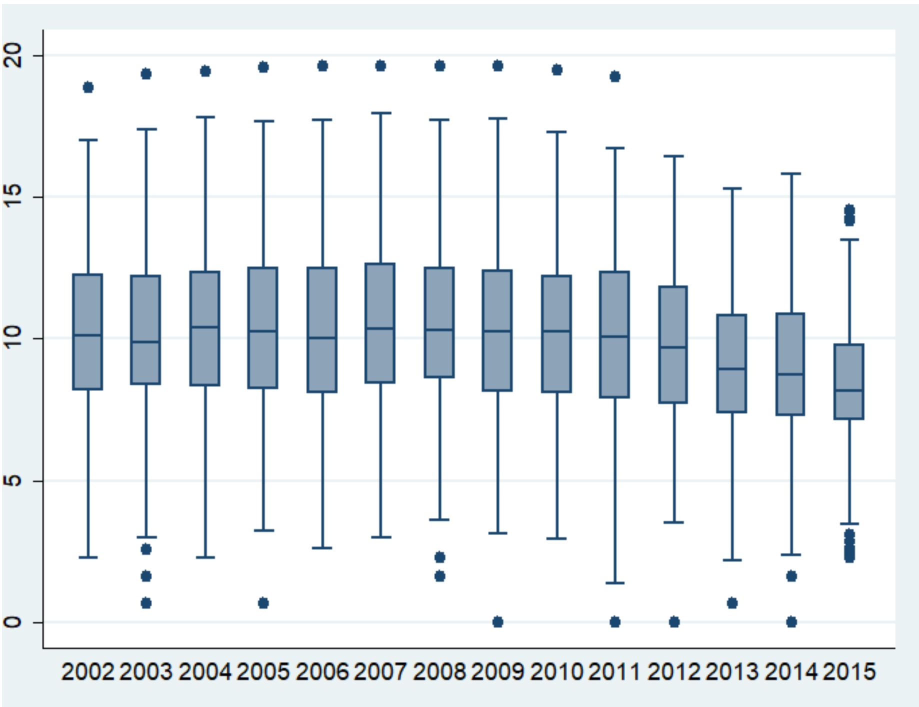


Figure 3. Trade in Film industry by years in logs

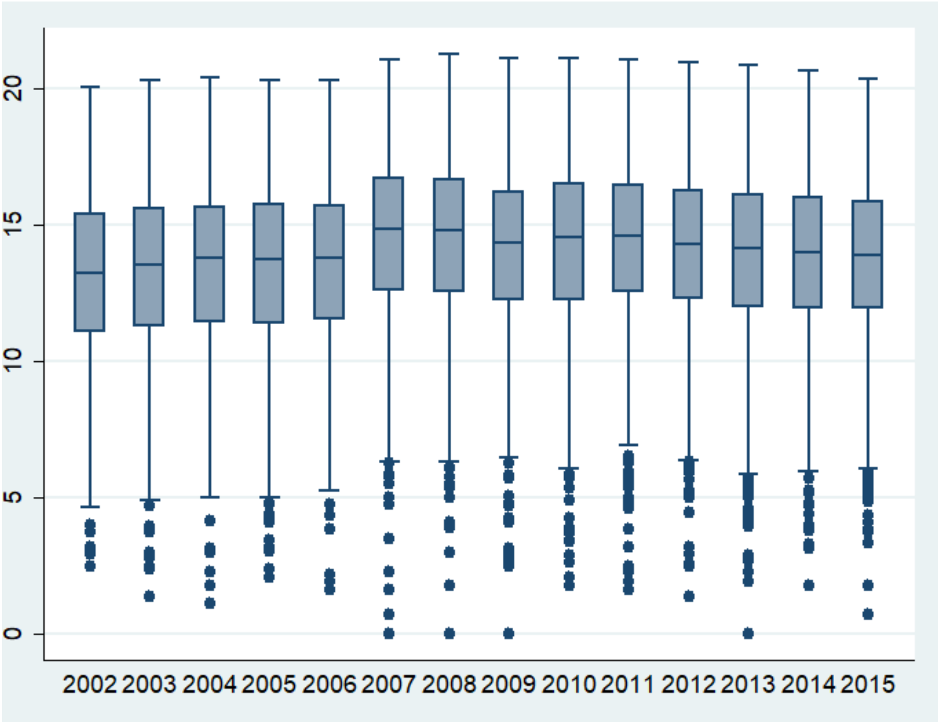


Figure 4. Trade in Audiovisuals industry by years in logs

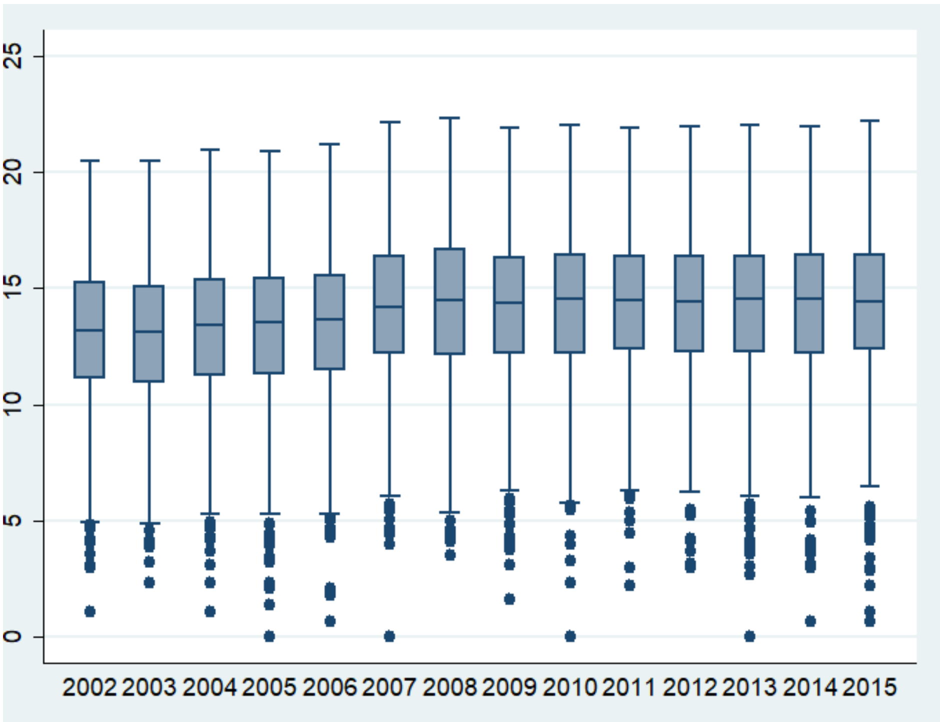


Figure 5. Trade in New Media industry by years in logs

4.2. Key independent variable: digital piracy BSA indicator

The primary variable of interest is the piracy level by BSA indicator, which is calculated as the percent of unlicensed software installed on PCs (Business Software Organization). Since 2002 BSA changed the methodology and consultants of evaluating the piracy level, it is criticized as biased toward software developing industry piracy. Additionally, BSA index estimation can be biased on a cross-country basis. Moreover, since 2011 BSA provides the evaluation only once in two years. Thus, their data for 2012 and 2014 years do not exist. To address this problem, the index for 2012 and 2014 was linearly approximated using the arithmetic average of two near indicators. In general, Figure 2 shows the smooth downsloping trend of the world digital piracy level in time.

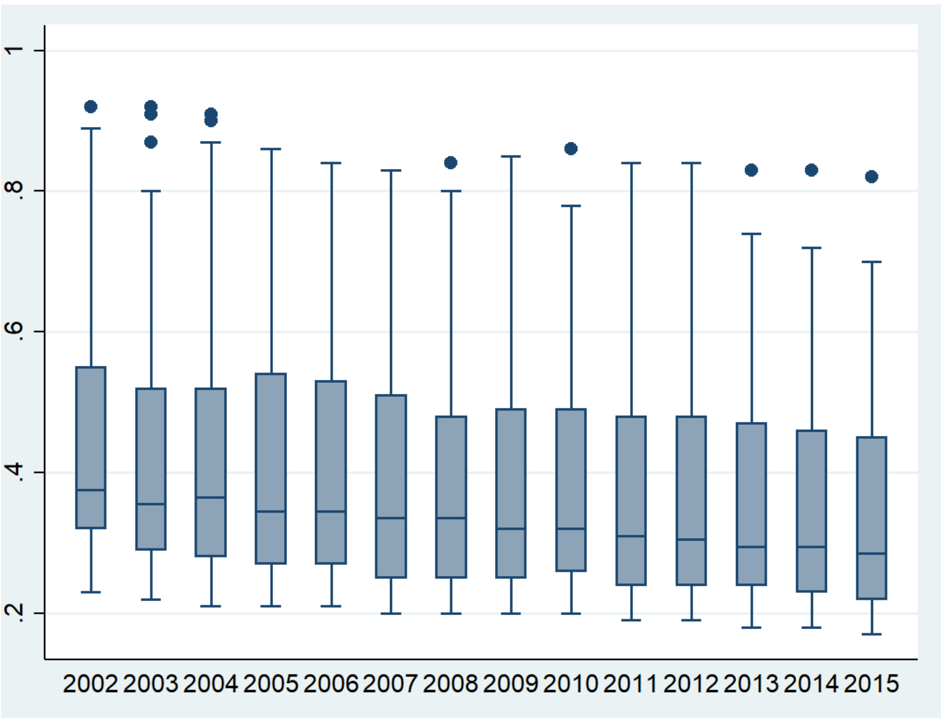


Figure 6. BSA indicator by years.

BSA digital piracy index is not perfect, but it is one which freely available in long data series. It is more accurately reflects the New Media industry, which includes recorded media and digital games than for Film and Audiovisuals industries. However, for them BSA piracy indicator can be used as a proxy of the digital piracy level in the same way as Lionetti and Patuelli (2009) did in their study.

Thus, taking into account the mentioned above problems with data as not counted virtual and electronic trade, changes in the Harmonized System product classification and no existing BSA for 2012 and 2014 years, we will carefully interpret the results obtained.

C h a p t e r 5

ESTIMATION RESULTS

We begin with comparing the previous results of Lionetti and Patuelli (2009) with the results of the recent study. For this, we also use a generalized linear mixed model (GLMM), by means of Laplace approximation and a Poisson specification with the eigenvector spatial filtering technique. This comparison can be found in Table 3. However, the results of the final models were specified as a pooled Poisson and OLS regressions with the eigenvector spatial filtering presented below in Table 4. For each of regression used a specific set of eigenvectors, which individually fitted to the data. Additionally, in Appendix B one can find different regression specification with pooled and panel Poisson as well as OLS estimations. The significant amount of zero trade flows presence only in the Film industry — 48.8%; thus, it makes sense to use Poisson regression only for the Film industry, when for Audiovisuals and New Media industries we can use ordinary OLS.

5.1. Comparing results with Lionetti and Patuelli (2009)

Using completely the same theoretical and empirical approach, the results of this thesis only partially consistent with the findings of Lionetti and Patuelli (2009) — see Table 3.

According to a generalized linear mixed model (GLMM), by means of Laplace approximation and a Poisson specification, key variables of the gravity model are significant and have the expected signs, i.e., the coefficients are positive for GDP levels and negative — for the distance. Thus, we can conclude that the augmented log-transformed gravity model is appropriate to the data.

Table 3. Empirical results from GLMM Poisson specification with spatial filtering by Lionetti and Patuelli (2009) and the study (2019)

	Film		New Media	
Model	Lionetti and Patuelli (2009)	The study (2019)	Lionetti and Patuelli (2009)	The study (2019)
Piracy BSA of exporter	0.803*** (0.168)	–0.082 (0.223)	0.072 (0.050)	0.128* (0.060)
Piracy BSA of importer	–0.188 (0.179)	–0.308 (0.247)	0.897*** (0.049)	1.368*** (0.048)
Distance	–0.757*** (0.110)	–0.994*** (0.211)	–1.235*** (0.206)	–1.112*** (0.102)
GDP exporter	0.861*** (0.088)	1.349*** (0.106)	4.793*** (0.044)	0.270*** (0.008)
GDP importer	0.600*** (0.084)	0.675*** (0.094)	0.035 (0.088)	0.448*** (0.013)
Common Border	–0.389 (0.373)	–0.084 (0.465)	–1.755 (0.908)	0.397 (0.374)
Common language	1.481*** (0.282)	1.685*** (0.338)	1.440* (0.697)	1.190*** (0.265)
Colony	0.744 (0.446)	0.277 (0.576)	–1.716 (1.218)	0.546 (0.478)
Common colonizer	–1.140 (1.437)	–0.336 (2.162)	2.008 (3.456)	1.040 (1.388)
Colony after 1945	–0.152 (0.801)	0.935 (0.961)	0.035 (2.284)	0.298 (0.831)
Same country	–0.959 (0.779)	0.352 (1.003)	1.896 (1.981)	2.701*** (0.833)
N	6600	9100	6600	9100
BIC	3021	6031	35708	103952
Pseudo R2	0.734	-	0.406	-
Eigenvectors (out of 60)	2, 18, 31, 33, 34, 44, 45	1, 4, 5, 7, 30, 34	9, 11, 13, 15, 44, 56	4, 5, 6, 7, 12, 16, 30, 59

Notes: Estimated coefficients provided. Piracy BSA exporter, Piracy BSA importer, Distance, GDP importer, GDP exporter are in logs. Regression coefficients for eigenvectors and year dummies are omitted. Standard errors in parentheses: * $p<0.05$, ** $p<0.01$, *** $p<0.001$

The new data with completely the same methodology show that piracy haven't any impact on the trade in Film industry when in New Media its impact have become stronger. In 1996-2006 one percent increase in the index of digital piracy in destination country increased export in the New Media industry by 0.897%. In 2002-2015 the magnitude became higher, and today one percent increase in the index of digital piracy in destination country increases export in the New Media industry by 1.367%. Additionally, in 2002-2015 the coefficient for digital piracy in the domestic country has become positively significant at 95% of the confidence interval. According to this, one percent increase in the index of digital piracy in the domestic country increases export in the New Media industry by 0.128%.

However, GLMM estimated coefficients could be biased for significant variance or small means. Lionetti and Patuelli (2009) did not use robust standard errors and did not catch heterogeneity in data. Moreover, if data transformable to normality, there is no much evidence to use GLMM regression (Bolker, et al. 2009). Thus, the pooled Poisson regression can describe the trade data of Film industry better (Ndubuisi and Foster-McGregor 2018). At the same time, an ordinary pooled OLS is more sufficient to use for Audiovisuals and New Media industries trade flows.

According to the low presence of the zero trade flows in Audiovisuals — 3.5% and New Media — 7.5% industries, we suggest to use ordinary OLS coefficients, because there is no evidence to use Poisson estimator for the low presence of zeros. Thus, we cannot appropriately compare the impact of the piracy level on trade in New Media industry with the previous study. We will treat the pooled Poisson and OLS results as less biased and more appropriate.

5.2. Pooled Poisson and OLS specifications

Taking to the point the strong assumptions of the GLMM models (Bolker, et al. 2009), we will concentrate on the pooled Poisson and OLS specification.

Due to the Film industry has 48.8% of zero trade flows, we will use pooled Poisson regression. However, according to the low presence of the zero trade flows in Audiovisuals — 3.5% and New Media — 7.5% industries, we use ordinary OLS coefficients, because there is no evidence to use Poisson estimator for the low presence of zeros.

According to regressions, the key variables of the gravity model are significant and have the expected signs, i.e., the coefficients are positive for GDP levels and negative — for the distance. Thus, we can conclude that the augmented log-transformed gravity model is appropriate for the data.

In terms of our key research question, the piracy level in both exporting and importing country is significant for trade in all three types of cultural goods. However, for the trade in the Film industry, the level of digital piracy has a negative slope in the destination country, and positive — in domestic. Thus, the increase by one percent in the level of piracy in the domestic country will increase export in the Film industry by 0.506%. On the other hand, the increase by one percent in the level of piracy in the destination country will decrease export in the Film industry by 0.48%.

For the trade in Audiovisuals industry, the level of digital piracy has a negative slope in both destination and domestic country. Thus, the increase by one percent in the level of piracy in the domestic country will decrease export in Audiovisuals industry by 2.281%. Moreover, the increase by one percent in the level of piracy in the destination country will decrease export in Audiovisuals industry by 0.413%.

For the trade in New Media, the level of digital piracy also has a negative slope in both destination and domestic country. Thus, the increase by one percent in the level of piracy in the domestic country will decrease export in the New Media industry by 0.410%. Moreover, the increase by one percent in the level of piracy in the destination country will decrease export in the New Media industry by 0.208%.

Table 4. Empirical results for the pooled Poisson and OLS specification with the eigenvector spatial filtering technique

Model	Film (Poisson)	Audiovisuals (OLS)	New Media (OLS)
Piracy BSA of exporter	0.506*** (0.142)	–2.281*** (0.069)	–0.410*** (0.083)
Piracy BSA of importer	–0.480** (0.151)	–0.413*** (0.060)	–0.208** (0.070)
Distance	–1.466*** (0.070)	–1.179*** (0.024)	–1.144*** (0.033)
GDP exporter	0.717*** (0.058)	1.006*** (0.022)	1.054*** (0.030)
GDP importer	1.213*** (0.048)	0.982*** (0.021)	0.655*** (0.027)
Common Border	–0.283 (0.219)	0.181 (0.099)	0.274* (0.111)
Common language	0.678*** (0.173)	0.865*** (0.071)	0.900*** (0.089)
Colony	0.175 (0.250)	0.119 (0.120)	0.346** (0.130)
Common colonizer	–0.254 (0.364)	4.182*** (0.370)	2.515*** (0.359)
Colony after 1945	–0.402 (0.400)	1.128*** (0.210)	1.152*** (0.213)
Same country	–0.619 (0.358)	1.746*** (0.258)	3.054*** (0.216)
const	–42.44*** (2.385)	–20.84*** (0.884)	–21.75*** (1.266)
N	9100	8779	8457
BIC	12268	38215	39573
R2	0.762	0.600	0.439
Eigenvectors (out of 60)	1, 5, 7, 30, 52	2, 6, 7, 9, 12, 16, 30, 59	5, 6, 7, 12, 16, 30, 59

Notes: Estimated coefficients provided. Film in levels. Audiovisuals, New Media, Piracy BSA exporter, Piracy BSA importer, Distance, GDP importer, GDP exporter are in logs. Regression coefficients for eigenvectors and year dummies are omitted. Robust standard errors in parentheses: * p<0.05, ** p<0.01, *** p<0.001

Additionally, the digital piracy rate has a higher magnitude in all three goods for exporting country than for importing country, which confirms the findings by Ndubuisi and Foster-McGregor (2018) that the exporter cares more about the domestic piracy level than for the level of digital piracy in the destination country.

Analyzing control variables for all three creative sub-industries the common language is positively associated with higher trade. For the trade in Film industry, any colonial links are not significant. For the trade in Audiovisuals and New Media industries, the factor of the common colonizer, colonial links after 1945 and formerly belonging to the one country has a positive association with higher export. Additionally, for the trade in New Media industry the factors of the common border and colonial link, become positively significant.

According to Ndubuisi and Foster-McGregor (2018), the pooled Poisson and OLS regressions describe trade flows for log-transformed augmented gravity model better than the GLMM model. Thus, the pooled regressions are our main estimations for the study.

5.3. Robustness check and tests

Robustness tests in Appendix B include different regression specification, where coefficients for digital piracy level of exporter have a positive coefficient in the trade of Film industry overall. The estimated panel regressions with fixed effects make the sign of digital piracy coefficient positive (for an importer for trade in Film and Audiovisuals industries, and for and exporter for trade in Film industry) or insignificant (for the exporter for Audiovisuals and New Media industries). However, it can be explained by misspecification due to dropping significant fixed variables such as colonial links and low time-frequency and variability of the data. Additionally, the fixed effects are not appropriate to use for the gravity model of trade, due to absorption of the key variable of the theoretical model — distance (Ndubuisi and Foster-McGregor 2018).

The estimated models use robust standard errors to mitigate heteroscedasticity. Post-estimation tests (Appendix C) show that the pooled Poisson specification for Films industry passes goodness-of-fit tests, but does not pass the Ramsey RESET test. Additionally, models still have an autocorrelation in the residuals, which spatial filtering does not reduce. Thus, the data have another source of autocorrelation except for spatial autocorrelation. According to the lack of controls and the theoretical basis, we address the problem with omitted variables and heterogeneity to the further researches.

C h a p t e r 6

CONCLUSIONS

This paper investigates the impact of digital piracy on bilateral international trade in cultural goods. It repeats the study by Lionetti and Patuelli (2009) with recent data and consistent BSA digital piracy indicator. The thesis concentrates on three types of cultural goods in Film, Audiovisuals, and New Media industries. We use augmented log-transformed gravity model, which is appropriate to the provided trade data. For mitigating "zero" trade and spatial autocorrelation are used Poisson Pseudo-Maximum-Likelihood estimations with the eigenvector spatial filtering technique. Even so, Lionetti and Patuelli (2009) used the generalized linear mixed model (GLMM), by means of Laplace approximation and a Poisson specification. However, in our study we use Poisson and OLS pooled regressions since the GLMM has several limitations and can be biased for significant variance or small means. For robustness check, we use pooled, fixed and random effects for both PPML and OLS specifications.

We found that almost all coefficients have a negative signs for the impact of digital piracy on the bilateral international trade in Film, Audiovisuals, and New Media industries. Despite that, one coefficient out of six has a positive sign, which is the impact of the level of digital piracy in the domestic country on exports in the Film industry.

Nevertheless, there is some possible explanation of this positive coefficient. Lionetti and Patuelli (2009) suggested that we should threat piracy as an advertisement for the legal source of distribution of the Film industry. On the other hand, Lobato (2012) argue that the government closes eyes on illegal trade and regards it as a driver of tax revenue and employment. However, we have own possible explanation for this phenomena, that the domestic film producers observe a high level of piracy in domestic country and decide to export their production more abroad, which directly increases the trade between countries.

Despite that, the question is still opened, why the positive slope exists only for the Film industry and do not for others. The possible explanations are, firstly, the existence of a high threshold for entry into the Film industry. Secondly, the data did not count a virtual trade and did not replicate electronic trade in the official statistics, which can be sensitive because of the rising of streaming companies such as Netflix, Amazon, etc.

The findings of this study suggest several contributions to the international trade and culture economics literature, especially to the sphere of protection of intellectual property rights. First, we provide the extension of Lionetti and Patuelli (2009) study by recent data from 1996-2006 to 2002-2015. The issue of re-estimating the provided results is the broken consistency in the primary independent variable — BSA piracy index. Business Software Association changed the methodology and consultants in calculating this index, which possibly could influence previous results. We re-estimated completely the same log-transformed gravity model by a generalized linear mixed model (GLMM), by means of Laplace approximation and a Poisson specification. We find that the new data with completely the same methodology show that piracy haven't any impact on the trade in the Film industry more. However, in New Media industry its impact is still positive and become stronger.

Second, despite that and taking into account strong assumptions of GLMM, we reject it and use the pooled Poisson and OLS approach. We find that the digital piracy of exporting country has a significant positive association with the export of the Film industry, but contrary negative with exports in Audiovisuals and New Media industries. This confirms the results of Lionetti and Patuelli (2009) for trade in Film industry, but for New Media industry, the sign changed to negative. On the other hand, the digital piracy of the importing country has a negative association with international trade in all three goods.

Third, we confirm the results of Ndubuisi and Foster-McGregor (2018), that digital piracy in the domestic country has a higher influence on the exporter, that on the importer. In our study, the digital piracy of exporter country has a higher magnitude of coefficient than in importing country for all three creative industries.

However, according to the data, provided results should be treated with accuracy because UNCTAD had changes in Harmonized System product classification in 2007 and 2012, which caused breaks in the time series, depending on the versions of the classification used by the reporting countries and the years of their introduction. Additionally, BSA index is biased to the software developing industry interest, and BSA estimation can be biased on a cross-country basis. Also, the final regressions have problems with autocorrelation, which were not sufficiently reduced by the eigenvector spatial autocorrelation technique. They also have problems with endogeneity and omitted variables, which cannot be reduced to the lack of controls or using different empirical specification. This and other problems are addressed to further researches.

The results of the thesis can be used for the policy maker in the field of protecting intellectual property rights and controlling of the trade balance. For instance, reducing the digital piracy of the economy decreases the level of exports in the Film industry and increases exports in Audiovisuals and New Media industries.

WORKS CITED

Bolker, B. M., M. E. Brooks, C. J. Clark, S. W. Geange, J. R. Poulsen, M. H. H. Stevens, and J-S. S. White. 2009. "Generalized linear mixed models: a practical guide for ecology and evolution." *Trends in Ecology & Evolution* 24 (3): 127-135.

Chun, Y., and D. A. Griffith. 2011. "Modeling Network Autocorrelation in Space-Time Migration Flow Data: An Eigenvector Spatial Filtering Approach." *Annals of the Association of American Geographers* 101 (3): 523-536.

Cvetkovski, T. 2014. "The farcical side to the war on media piracy: a popular case of Divine Comedy?" *Media, Culture & Society* 36 (2): 246–257.

Griffith, D. A. 2003. *Spatial autocorrelation and spatial filtering: gaining understanding through theory and scientific visualization.* Berlin: Springer-Verlag Berlin Heidelberg.

Koklic, M. K., I. Vida, D. Bajde, and B. Culiberg. 2014. "The study of perceived adverse effects of digital piracy and involvement: insights from adult computer users." *Behavior and Information Technology* 33 (3): 225-236.

Leung, T. 2015. "Music piracy: Bad for record sales but good for the iPod?" *Information Economics and Policy* 31: 1-12.

Leung, T. 2011. "What is the True Loss Due to Piracy?: Evidence from Microsoft Office in Hong Kong." *Review of Economics and Statistics* 95 (3): 1018-1029.

Lionetti, S., and R. Patuelli. 2009. "Trading Cultural Goods in the Era of Digital Piracy." *Rimini Centre for Economic Analysis. Working Paper* 40-09: 31.

Liu, J. 2015. "Copyright Complements and Piracy-Induced Deadweight Loss." *Indiana Law Journal* 90 (3): 35.

Lobato, R. 2012. "A sideways view of the film economy in an age of digital piracy." *NECSUS. European Journal of Media Studies.* (Amsterdam University Press) 1 (1): 85-97.

Ma, L., A. L. Montgomery, P. V. Singh, and M. D. Smith. 2014. "An Empirical Analysis of the Impact of Pre-Release Movie Piracy on Box Office Revenue." *Information Systems Research* 25 (3): 590-603.

Martin, W. J., and C. S. Pham. 2015. "Estimating the Gravity Model When Zero Trade Flows Are Frequent and Economically." *Policy Research Working Paper Series 7308* 1: 61.

Ncube, A. 2018. "Combating piracy and the creative industries." *Chronicle.* https://www.chronicle.co.zw/combating-piracy-and-the-creative-industries/.

Ndubuisi, G., and N. Foster-McGregor. 2018. "Domestic intellectual property rights protection and the margins of bilateral exports." *UNU-MERIT Working Papers* 035: 34.

Patuelli, R., D. Griffith, D. Tiefelsdor, and N. Nijkamp. 2006. "The Use of Spatial Filtering Techniques: The Spatial and Space-Time Structure of German Unemployment Data." *Tinbergen Institute Discussion Paper* 06-049 (3): 24.

Siwek, S. 2007. "The true cost of sound recording piracy to the U.S. economy." *Institute for Policy Innovation: Policy Report* 188: 28.

Tailor, S. 2012. "Evaluating digital piracy intentions on behaviors." *Journal of Services Marketing* (Emerald Group Publishing Limited) 26 (7): 472–483.

Tinbergen, J. 1962. *Shaping the World Economy: Suggestions for an International Economic Policy*. New York: Twentieth Century Fund.

Web resources:

Business Software Alliance (BSA) (https://www.bsa.org/)

Centre d'Etudes Prospectives et d'Informations Internationales (CEPII) (http://www.cepii.fr/)

The Penn World Table (https://www.rug.nl/ggdc/productivity/pwt/)

World Trade Organization (WTO) (https://www.wto.org/)

United Nations Conference on Trade and Development (UNCTAD) (https://unctad.org/)

United Nations Educational, Scientific and Cultural Organization (UNESCO) (https://en.unesco.org/)

APPENDIX A

Creative economy product groups

Table 5. Creative economy product groups

Label	UNCTAD classification Code	Comment
Film	CER015	Box-office sales, satellite and television rights, music rights, video, and Internet rights, merchandising, etc.
Audiovisual	CER003	CDs, DVDs, tapes and etc.
New Media	CER005	Internet creativity sites, recorded media, software, video games, cartoons, etc.

Source: UNCTAD Harmonized System product classification, as of April 03, 2019 / https://unctadstat.unctad.org/EN/Classifications/DimCreativeProducts_Creatives_Hierarchy.pdf

APPENDIX B

Robustness check: different specification of regression

Table 6. Different specification for trade in Film industry (Poisson specification)

Model	Pooled (1)	Pooled (2)	Pooled (3)	Panel FE (4)	Panel RE (5)
Piracy BSA of exporter	1.181*** (0.159)	0.506*** (0.142)	0.190 (0.292)	4.408*** (0.505)	4.047*** (0.551)
Piracy BSA of importer	-0.470** (0.166)	-0.480** (0.151)	-0.664* (0.327)	6.245*** (1.153)	4.618 (2.360)
Distance	-1.199*** (0.069)	-1.466*** (0.070)	-1.387*** (0.157)		-1.282*** (0.379)
GDP exporter	0.986*** (0.055)	0.717*** (0.058)	0.767*** (0.120)	2.478*** (0.556)	1.463* (0.669)
GDP importer	1.400*** (0.069)	1.213*** (0.048)	1.201*** (0.106)	-0.189 (0.440)	0.658*** (0.195)
Common border	-0.174 (0.231)	-0.283 (0.219)	-0.459 (0.489)		-0.288 (0.739)
Common language	1.561*** (0.158)	0.678*** (0.173)	0.781* (0.385)		2.208* (0.980)
Colony	-1.346*** (0.211)	0.175 (0.250)	0.0101 (0.542)		0.840 (0.446)
Common colonizer	-0.283 (0.346)	-0.254 (0.364)	-0.740 (0.713)		-6.645*** (1.736)
Colony after 1945	1.486*** (0.304)	-0.402 (0.400)	-0.472 (0.863)		-2.659** (0.959)
Same country	-1.278*** (0.231)	-0.619 (0.358)	-0.202 (0.760)		-0.418 (2.442)
const	-60.71*** (2.805)	-42.44*** (2.385)	-42.21*** (5.016)		-80.54*** (23.31)
N	9100	9100	1950	9100	9100
BIC	16473	12268	2448	5340	7909
Pseudo R2	0.678	0.762	0.751	-	-
Eigen-vectors (out of 60)	-	4, 13, 30, 34, 52	4, 13, 30, 34, 52	-	4, 13, 30, 34, 52

Notes: Estimated coefficients provided. Piracy BSA exporter, Piracy BSA importer, Distance, GDP importer, GDP exporter are in logs. Regression coefficients for eigenvectors and year dummies are omitted. Pooled (3) only for 2002, 2008, and 2015 years. Robust standard errors in parentheses: * p<0.05, ** p<0.01, *** p<0.001

Table 7. Different specification for trade in Audiovisuals industry (Poisson specification)

Model	Pooled (1)	Pooled (2)	Pooled (3)	Panel FE (4)	Panel RE (5)
Piracy BSA of exporter	-1.094*** (0.086)	-0.862*** (0.096)	-0.993*** (0.228)	0.373 (0.775)	0.309 (0.728)
Piracy BSA of importer	-0.150 (0.078)	-0.113 (0.080)	-0.097 (0.181)	1.767*** (0.438)	1.750*** (0.404)
Distance	-0.649*** (0.027)	-0.727*** (0.027)	-0.693*** (0.059)		-0.925*** (0.108)
GDP exporter	0.679*** (0.022)	0.818*** (0.022)	0.802*** (0.049)	0.597*** (0.136)	0.620*** (0.127)
GDP importer	0.653*** (0.028)	0.808*** (0.027)	0.824*** (0.062)	1.313*** (0.116)	1.265*** (0.111)
Common border	0.741*** (0.073)	0.378*** (0.066)	0.384** (0.147)		0.269 (0.364)
Common language	0.128* (0.056)	0.348*** (0.064)	0.304* (0.140)		0.787** (0.288)
Colony	-0.887*** (0.069)	-0.704*** (0.084)	-0.658*** (0.179)		0.581 (0.465)
Common colonizer	2.961*** (0.238)	3.119*** (0.245)	2.828*** (0.676)		1.598* (0.645)
Colony after 1945	1.133*** (0.127)	0.991*** (0.141)	0.857* (0.341)		-0.484 (0.599)
Same country	1.039*** (0.175)	1.735*** (0.202)	1.883*** (0.449)		0.676 (0.532)
const	-24.75*** (1.162)	-33.31*** (0.969)	-33.11*** (2.201)		-49.64*** (5.196)
N	9100	9100	1950	9058	9100
BIC	277219	209842	50924	69223	76366
Pseudo R2	0.664	0.746	0.745	-	-
Eigen-vectors (out of 60)	-	2, 6, 7, 9, 12, 16, 30, 35, 45	2, 6, 7, 9, 12, 16, 30, 35, 45	-	2, 6, 7, 9, 12, 16, 30, 35, 45

Notes: Estimated coefficients provided. Piracy BSA exporter, Piracy BSA importer, Distance, GDP importer, GDP exporter are in logs. Regression coefficients for eigenvectors and year dummies are omitted. Pooled (3) only for 2002, 2008, and 2015 years. Robust standard errors in parentheses: * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table 8. Different specification for trade in New Media industry (Poisson specification)

Model	Pooled (1)	Pooled (2)	Pooled (3)	Panel FE (4)	Panel RE (5)
Piracy BSA of exporter	0.910*** (0.088)	0.988*** (0.084)	1.092*** (0.172)	-0.836 (0.507)	-0.759 (0.463)
Piracy BSA of importer	-0.449*** (0.103)	-0.318** (0.099)	-0.520* (0.209)	1.421* (0.629)	1.343* (0.616)
Distance	-0.172*** (0.048)	-0.194*** (0.055)	-0.158 (0.126)		-0.552* (0.223)
GDP exporter	0.904*** (0.051)	0.863*** (0.056)	0.903*** (0.129)	0.523*** (0.101)	0.523*** (0.099)
GDP importer	0.772*** (0.045)	0.869*** (0.048)	0.836*** (0.100)	1.018*** (0.181)	1.015*** (0.172)
Common border	0.935*** (0.125)	0.725*** (0.131)	0.862** (0.298)		-0.014 (0.342)
Common language	0.714*** (0.097)	0.866*** (0.107)	0.763** (0.240)		1.119** (0.373)
Colony	-1.270*** (0.137)	-1.217*** (0.099)	-1.202*** (0.208)		-0.133 (0.716)
Common colonizer	0.714* (0.312)	0.696* (0.293)	0.555 (0.676)		0.105 (0.469)
Colony after 1945	1.105*** (0.219)	1.424*** (0.192)	1.270** (0.435)		0.352 (0.854)
Same country	2.372*** (0.155)	2.529*** (0.166)	2.421*** (0.381)		3.070** (0.944)
const	0.910*** (0.088)	0.988*** (0.084)	1.092*** (0.172)	-0.836 (0.507)	-0.759 (0.463)
N	9100	9100	1950	9100	9100
BIC	623154	536500	129058	126467	133793
Pseudo R2	0.592	0.648	0.662	-	-
Eigen-vectors (out of 60)	-	4, 5, 6, 7, 12, 16, 30, 59	4, 5, 6, 7, 12, 16, 30, 59	-	4, 5, 6, 7, 12, 16, 30, 59

Notes: Estimated coefficients provided. Piracy BSA exporter, Piracy BSA importer, Distance, GDP importer, GDP exporter are in logs. Regression coefficients for eigenvectors and year dummies are omitted. Pooled (3) only for 2002, 2008, and 2015 years. Robust standard errors in parentheses: * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table 9. Different specification for trade in Film industry (OLS specification)

Model	Pooled (1)	Pooled (2)	Pooled (3)	Panel FE (4)	Panel RE (5)
Piracy BSA of exporter	1.161*** (0.096)	0.476*** (0.106)	0.723** (0.228)	4.688*** (0.586)	2.025*** (0.241)
Piracy BSA of importer	-0.283** (0.091)	-0.362*** (0.091)	-0.350 (0.207)	5.853*** (0.573)	1.861*** (0.218)
Distance	-0.718*** (0.038)	-0.866*** (0.071)	-0.877*** (0.146)		-0.701*** (0.195)
GDP exporter	1.297*** (0.033)	1.227*** (0.033)	1.201*** (0.069)	1.147*** (0.207)	0.667*** (0.079)
GDP importer	0.502*** (0.032)	0.559*** (0.033)	0.588*** (0.070)	0.108 (0.169)	0.017 (0.079)
Common border	0.0551 (0.145)	0.246 (0.137)	0.069 (0.309)		0.471 (0.411)
Common language	1.254*** (0.108)	1.190*** (0.108)	1.432*** (0.222)		1.775*** (0.334)
Colony	0.366* (0.166)	0.362* (0.173)	0.160 (0.366)		1.854** (0.588)
Common colonizer	-0.216 (0.264)	-0.111 (0.287)	-1.045 (0.627)		-2.024*** (0.548)
Colony after 1945	0.778** (0.250)	0.621* (0.260)	0.651 (0.549)		-1.209 (0.825)
Same country	-0.199 (0.394)	0.482 (0.393)	0.459 (0.701)		-1.524 (0.839)
const	-36.20*** (1.505)	-31.46*** (1.627)	-32.44*** (3.492)	-62.65*** (7.659)	-18.49*** (3.880)
N	4656	4656	937	4656	4656
BIC	21469	21258	4308	17079	-
R2	0.347	0.381	0.423	0.152	-
Eigen-vectors (out of 60)	-	1, 5, 7, 30, 52	1, 5, 7, 30, 52	-	1, 5, 7, 30, 52

Notes: Estimated coefficients provided. Film, Piracy BSA exporter, Piracy BSA importer, Distance, GDP importer, GDP exporter are in logs. Regression coefficients for eigenvectors and year dummies are omitted. Pooled (3) only for 2002, 2008, and 2015 years. Robust standard errors in parentheses: * p<0.05, ** p<0.01, *** p<0.001

Table 10. Different specification for trade in Audiovisuals industry (OLS specification)

Model	Pooled (1)	Pooled (2)	Pooled (3)	Panel FE (4)	Panel RE (5)
Piracy BSA of exporter	-2.494*** (0.067)	-2.281*** (0.069)	-2.488*** (0.153)	0.154 (0.370)	-0.912*** (0.190)
Piracy BSA of importer	-0.370*** (0.059)	-0.413*** (0.060)	-0.524*** (0.127)	1.989*** (0.352)	0.987*** (0.159)
Distance	-1.136*** (0.025)	-1.179*** (0.024)	-1.136*** (0.050)		-1.282*** (0.082)
GDP exporter	1.017*** (0.022)	1.006*** (0.022)	0.976*** (0.047)	0.566*** (0.134)	0.728*** (0.069)
GDP importer	0.954*** (0.021)	0.982*** (0.021)	0.978*** (0.043)	1.517*** (0.115)	0.989*** (0.061)
Common border	0.350*** (0.100)	0.181 (0.099)	0.207 (0.209)		0.198 (0.368)
Common language	0.882*** (0.067)	0.865*** (0.071)	0.732*** (0.166)		1.287*** (0.240)
Colony	0.024 (0.118)	0.119 (0.120)	0.296 (0.255)		0.280 (0.418)
Common colonizer	4.158*** (0.369)	4.182*** (0.370)	3.404*** (0.757)		2.643*** (0.684)
Colony after 1945	1.308*** (0.214)	1.128*** (0.210)	0.803* (0.396)		0.574 (0.705)
Same country	1.631*** (0.225)	1.746*** (0.258)	1.867** (0.594)		1.191 (0.721)
const	-20.20*** (0.897)	-20.84*** (0.884)	-19.08*** (1.863)	-51.26*** (4.878)	-23.25*** (2.613)
N	8779	8779	1853	8779	8779
BIC	39046	38215	8045	29427	-
R2	0.557	0.600	0.621	0.122	-
Eigen-vectors (out of 60)	-	2, 6, 7, 9, 12, 16, 30, 35, 45	2, 6, 7, 9, 12, 16, 30, 35, 45	-	2, 6, 7, 9, 12, 16, 30, 35, 45

Notes: Estimated coefficients provided. Audiovisuals, Piracy BSA exporter, Piracy BSA importer, Distance, GDP importer, GDP exporter are in logs. Regression coefficients for eigenvectors and year dummies are omitted. Pooled (3) only for 2002, 2008, and 2015 years. Robust standard errors in parentheses: * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table 11. Different specification for trade in New media industry (OLS specification)

Model	Pooled (1)	Pooled (2)	Pooled (3)	Panel FE (4)	Panel RE (5)
Piracy BSA of exporter	-0.783*** (0.077)	-0.410*** (0.083)	-0.505** (0.181)	-0.658 (0.472)	-0.608** (0.228)
Piracy BSA of importer	-0.326*** (0.068)	-0.208** (0.070)	-0.164 (0.156)	0.876 (0.494)	0.115 (0.215)
Distance	-1.002*** (0.029)	-1.144*** (0.033)	-1.165*** (0.071)		-1.265*** (0.098)
GDP exporter	1.124*** (0.026)	1.054*** (0.030)	1.111*** (0.063)	1.514*** (0.170)	1.239*** (0.084)
GDP importer	0.709*** (0.025)	0.655*** (0.027)	0.701*** (0.057)	0.675*** (0.161)	0.715*** (0.079)
Common border	0.453*** (0.109)	0.274* (0.111)	0.196 (0.238)		-0.043 (0.374)
Common language	0.875*** (0.085)	0.900*** (0.089)	0.881*** (0.197)		1.053*** (0.294)
Colony	0.369** (0.122)	0.346** (0.130)	0.381 (0.276)		0.282 (0.462)
Common colonizer	2.745*** (0.358)	2.515*** (0.359)	1.996* (0.888)		2.588*** (0.542)
Colony after 1945	0.956*** (0.224)	1.152*** (0.213)	0.851 (0.478)		1.280 (0.748)
Same country	2.831*** (0.232)	3.054*** (0.216)	2.737*** (0.491)		3.294*** (0.703)
const	-24.35*** (1.117)	-21.75*** (1.266)	-24.18*** (2.646)	-47.34*** (5.854)	-28.24*** (3.402)
N	8457	8457	1782	8457	8457
BIC	40094	39582	8403	31493	-
R2	0.399	0.439	0.467	0.132	-
Eigen-vectors (out of 60)	-	4, 5, 6, 7, 12, 16, 30, 59	4, 5, 6, 7, 12, 16, 30, 59	-	4, 5, 6, 7, 12, 16, 30, 59

Notes: Estimated coefficients provided. New Media, Piracy BSA exporter, Piracy BSA importer, Distance, GDP importer, GDP exporter are in logs. Regression coefficients for eigenvectors and year dummies are omitted. Pooled (3) only for 2002, 2008, and 2015 years. Robust standard errors in parentheses: * $p<0.05$, ** $p<0.01$, *** $p<0.001$

Table 12. Empirical results from GLMM Poisson specification (Laplace approximation) with spatial filtering

Model	Film	Audiovisuals	New Media
Piracy BSA of exporter	-0.082 (0.223)	-1.856*** (0.054)	0.128* (0.0603)
Piracy BSA of importer	-0.308 (0.247)	-0.161** (0.050)	1.368*** (0.048)
Distance	-0.994*** (0.211)	-0.927*** (0.067)	-1.112*** (0.102)
GDP exporter	1.349*** (0.106)	0.394*** (0.018)	0.270*** (0.008)
GDP importer	0.675*** (0.094)	1.067*** (0.016)	0.448*** (0.013)
Common border	-0.084 (0.465)	0.482 (0.283)	0.397 (0.374)
Common language	1.685*** (0.338)	0.647** (0.200)	1.190*** (0.265)
Colony	0.277 (0.576)	0.133 (0.380)	0.546 (0.478)
Common colonizer	-0.336 (2.162)	4.350*** (1.059)	1.040 (1.388)
Colony after 1945	0.935 (0.961)	0.961 (0.650)	0.298 (0.831)
Same country	0.352 (1.003)	1.841** (0.651)	2.701** (0.833)
const	-49.08*** (4.722)	-24.35*** (0.863)	-16.58*** (0.958)
N	9100	9100	9100
BIC	6031	64134	103952
Eigenvectors (out of 60)	1, 4, 5, 7, 30, 34	2, 6, 7, 9, 12, 16, 30, 35, 45	4, 5, 6, 7, 12, 16, 30, 59

Notes: Estimated coefficients provided. Piracy BSA exporter, Piracy BSA importer, Distance, GDP importer, GDP exporter are in logs. Regression coefficients for eigenvectors and year dummies are omitted. Standard errors in parentheses: * p<0.05, ** p<0.01, *** p<0.001

APPENDIX C

Post-estimation tests for pooled Poisson specification

Table 13. Goodness-of-fit tests (Pooled Poisson regression)

Dependent variable	Test results
Film	Deviance goodness-of-fit = 8923 Prob > chi2(4627) = 0.863 Pearson goodness-of-fit = 51584 Prob > chi2(4627) = 0.000
Audiovisuals	Deviance goodness-of-fit = 186312 Prob > chi2(8747) = 0.000 Pearson goodness-of-fit = 388710 Prob > chi2(8747) = 0.000
New Media	Deviance goodness-of-fit = 514017 Prob > chi2(8426) = 0.000 Pearson goodness-of-fit = 1750821 Prob > chi2(8426) = 0.000

Table 14. Ramsey RESET tests

Dependent variable	Test results
Films	chi2(2) = 375.04 Prob > chi2 = 0.0000
Audiovisuals	chi2(2) = 998.86 Prob > chi2 = 0.0000
New Media	chi2(2) = 432.32 Prob > chi2 = 0.0000