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Using the Gravity Model to Determine the Impact of Hallyu on International Students' Decisions to Attend South Korean Universities

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Abstract

This paper attempts to investigate the impact of Hallyu on international students' decisions to attend South Korean universities using the gravity model. Specifically, the Poisson pseudo maximum likelihood (PPML) gravity model was used to study the effect of the Korean Wave. The data was collected in 195 countries from 1999 to 2019. The results show that Hallyu influenced international students' decisions to choose a South Korean university at a statistically significant level. More specifically, the Korean Wave had a statistically significant impact on international students attending one of the top 5 Korean universities, as well as enrolling in universities located within Seoul. Furthermore, Hallyu had a larger effect on female international students than male international students. Lastly, Hallyu had an impact on international students majoring in social science, pursuing an undergraduate degree, and completing language training at a statistically significant level.

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I. Introduction

Hallyu, the Korean Wave, is described as the growing global popularity of South Korean culture. It includes popular Korean cultural content and products in the industries of drama, movie, game, music, animation, food, fashion, and cosmetics (Ganghariya & Kanozia, 2020). Hallyu could be divided into four stages: Hallyu 1.0, Hallyu 2.0, Hallyu 3.0, and Hallyu 4.0. In the late 1990s, the term Hallyu 1.0 was first used by the Chinese media to explain the increasing popularity of Korean media content in Asia, such as Korean dramas and movies (Bae et al., 2017). Moreover, Hallyu 2.0 started during the early 2000s when technological developments allowed Korean pop music (K-POP) to gain popularity through social media platforms (Jin & Yoon, 2016). As a result, technological advancements played a big role in spreading K-POP to Western countries. During this era, an interest in K-POP artists sparked curiosity in other areas of Korean culture, such as hangul (Korean language), hansik (Korean food), and hanok (traditional Korean house) among K-POP fans (Kim, 2017). While Hallyu 3.0 focuses on Korean mat (taste) and mut (style), the rising Hallyu 4.0 describes the Korean corporate culture led by industry giants–Samsung, Hyundai, Kia, LG, etc.

Hallyu has a ripple effect on Korea's economy by increasing exports of cultural and consumer goods. The Korean Wave drives up the export amount of cultural goods because fans of Hallyu celebrities buy products affiliated with them, such as K-POP artists' albums. Moreover, individuals get introduced to Korean consumer goods while watching Hallyu-related content, such as K-dramas. This exposure to Korean consumer goods sparks curiosity and encourages them to purchase the products, such as soju (Korean alcoholic beverage) and K-beauty items. Statistically, Korea's total export amount increased by 5.4% in 2018; annually, the percentage increased by 1.4% since 2014 (Kim, 2019). Specifically, Korea's export amount

of cultural goods increased by 8.8% from $6.9 billion to $7.5 billion in 2018. From 2014 to 2018, the export amount increased by 9.2% annually. The exports from the game industry increased by 56.5%, which reached $4.23 billion in 2018. The music and broadcasting industries' export amounts also increased by 11% since 2017. Hallyu plays an important role in facilitating international trade between Korea and its trading countries.

Furthermore, Hallyu contributes to the Korean economy by attracting tourists to the country. In 2019, 61.3% of the inbound tourists visited to explore a variety of Korean cuisine (Korea Tourism Organization). Moreover, 23.6% of tourists visited Korea to experience Korea's traditional culture and to learn about Korean history, such as visiting hanok. Lastly, 12.7% of them visited to attend Hallyu artists' performances and fan meetings as well as to tour places where the artists filmed their Hallyu-related content, such as film studios. To attract more tourists, the Korean government has been advertising Hallyu by providing more funding to the entertainment and tourism industries. Specifically, the government has been promoting the entertainment industry by spending more government budget on film studios. Moreover, the government provided funding for tourism development projects (Kim & Nam, 2016).

The remainder of this paper is organized as follows. The existing literature is discussed in Section II. Section III presents the datasets used and summary statistics. Section IV introduces the methodology and regression models used in this paper. This section also describes the seven heterogeneity tests conducted. Section V shows the regression results and the limitations of this study. In Section VI and Section VII, the discussion and conclusion are presented, respectively.

II. Literature Review

This section is divided into two parts. Part A presents the push and pull factors that influence international students' decisions on choosing a destination country. Part B discusses the existing body of literature that uses empirical methods to study the impact of Hallyu on consumer goods, tourism, and international students.

A. The Influence of Push and Pull Factors on International Students' Decisions

As the number of international students is increasing in Korea, a large body of literature has been studying the factors that influence these students' decisions to study in Korean universities. Bogue (1969) developed the push-pull model to explain the push factors that drive students out of their home countries and the pull factors that drive international students into their destination countries. Many studies have applied this model to explain the factors that influence international students' destination choices. For example, Mo, Won, and Kim (2005) constructed a survey to understand international students' decision-making process. By analyzing the results, this paper concludes that Hallyu is one of the factors that affected international students when they were choosing which university they wanted to attend. Moreover, Lee (2013) studies Chinese students at two universities (selective vs. non-selective) using a case study approach. The results show that Hallyu is one of the four factors that drove Chinese students to choose Korea as their destination country. Studies by Bae (2016) and Kang (2018) provide additional insight into the factors that influenced Chinese students' choice to study in Korea. They concluded that Halllyu impacts students to have a positive image of Korea, which leads them to choose Korea as their destination country.

Furthermore, many papers have studied other factors that influence the decision-making process of international students. Collins, Şimşek, and Takır (2022) collected surveys from 197 international students and concluded that safe culture, campus buildings, and library resources were the most influential factors. Wilkins and Huisman (2011) also investigated international students who decided to study in the U.K. Their findings show that pull factors had a stronger influence than push factors. Pull factors that had a significant impact on the students' decisions were summarized into three areas. The first factor was the students' desire to study in a host country, such as their passion to learn English. The second factor was the characteristics of the host country, such as the quality of education in the U.K. The third factor was the characteristics of the university, such as university rankings. Other factors from other studies include low institution selectivity (Lee, 2017); shared cultural values, financial cost, and proximity to home (Nachatar Singh, Schapper, and Jack, 2014); geography (Cullian & Duggan 2016); economic and educational factors (Wei, 2012); university ranking dimensions of student-professor ratio, number of clinic beds, and student satisfaction (Horstschräer, 2012); human capital theory (future employment opportunities) and global cultural capital (global citizen preparation) (Kim et al., 2018); and climate and time effects (Rodríguez González, Bustillo Mesanza, and Mariel, 2011).

B. Using Empirical Methods to Determine the Impact of Hallyu

As the popularity of Hallyu spread to countries across the world, a large body of literature has increasingly studied the impact of Hallyu. Currently, the existing literature on Hallyu presents the effect in three different areas: consumer goods, tourism, and international students. Most studies use one of these three proxy variables: cultural goods specified by UNESCO, Google and Youtube search volume, and TV broadcasting content export amounts.

i. Consumer Goods

A large body of literature studies the impact of Hallyu on consumer goods by using a group of cultural items as a proxy variable. Kim et al. (2021) study the impact of Hallyu on consumer goods using the gravity model from 2001 to 2017. In this study, the proxy variable of Hallyu is the cultural goods in the music, film, broadcasting, and publishing industries. The consumer goods include food, clothing, cosmetics, IT products, and automobiles. The paper finds that cultural products promote international trade in consumer goods with 102 countries. Kim and Ahn (2012) also study the impact of Hallyu on consumer goods by using a set of cultural goods as the proxy variable for the Korean Wave. This paper conducts heterogeneity tests in three different categories: East Asian and non-East Asian countries, high and low-income countries, and durable and non-durable consumer goods. The results show that there is a statistically significant impact of Hallyu on consumer goods. More specifically, this effect was larger in East Asian countries, higher-income countries, and non-durable consumer goods. Other authors who have used cultural goods to study the impact of Hallyu include Choi (2012), Choi (2011), and Kang (2009). Choi (2012) studied the effect by categorizing Hallyu into five categories depending on the popularity level of the Korean Wave in other countries. Choi (2011) and Kang (2009) analyzed the impact of Hallyu specifically in China, Vietnam, and South East Asian countries.

There are also numerous studies that use search volume as the proxy variable for Hallyu and investigate its influence on consumer goods. Leem (2022) studies the effect of Google and Youtube search volume for Hallyu keywords on Korea's exports. Specifically, the paper categorizes 'K-POP' as a high level of construal while 'BTS' is considered a low level of construal. Abstract and ideological words are placed into a high level of construal while concrete

and detailed words are categorized as a low level of construal. The paper shows that the Google and Youtube search volume of the word ‘K-POP’ had a statistically significant impact on exports. However, the Google search volume of the word ‘BTS’ did not have any effect on exports, and the Youtube search volume of ‘BTS’ has a negative relationship with exports. Furthermore, Lee and Lee (2017) study the effect of K-beauty Google and Youtube search volumes on exports and inbound tourism. The paper concludes that the Google search volume of K-beauty had a positive impact on exports as well as tourism. The volume of Youtube page views also had a positive relationship with exports. However, the paper failed to find a statistically significant impact of the Youtube search volume on the number of tourists.

ii. Tourism

Many papers study the impact of Hallyu on inbound tourism. Kim and Ju (2013) study the effect of Hallyu on tourists from 40 Asian countries using TV broadcasting content exports as the proxy variable for the Korean Wave from 1998 to 2011. The paper also analyzes the impact by restricting TV broadcasting content to just K-dramas as well as limiting the years to 2004 and beyond. The paper concludes that there is a positive relationship between Hallyu and inbound tourism at a statistically significant level. Even when the Hallyu content is restricted to K-dramas and the years are limited to 2004 to 2011, the study finds similar results. Moreover, Lim and Giouvris (2020), Huh and Wu (2017), and Bae et al. (2017) each study the impact of the Korean Wave on tourism by analyzing different groups of countries. They all find a statistically significant impact of Hallyu on inbound tourism.

iii. International Students

Lien, Tang, and Zuloaga (2022) study the impact of Hallyu and the King Sejong Institute (KSI) on international students, inbound tourists, exports, and imports. Using the PPML gravity model, the paper also conducts a heterogeneity test by analyzing the effect on gender. In 2007, the Korean government established the King Sejong Institute to provide online Korean language courses. The study finds that Hallyu had a statistically significant impact on international students, tourists, and exports to other countries. Female students and tourists are more likely to study and visit Korea than their male counterparts. Furthermore, the KSI had a positive impact on tourism, exports, and imports; however, the KSI had a negative relationship with international students.

Moreover, Kim, Kim, and Park (2020) study the impact of Hallyu and R&D expenditures on international students' decisions to study in Korea using the PPML gravity model. In this study, Hallyu was divided into five categories based on export amounts using dummy variables. The paper uses data from 21 countries that had the highest amounts of TV broadcasting content exports from Korea between 2001 and 2018. The study concludes that Hallyu had a positive relationship with international students, both at undergraduate and graduate levels. As the TV broadcasting content export amount increased, Hallyu had a larger impact on attracting international students to attend South Korean universities. R&D expenditures also had a statistically significant impact on international students.

Similar to the studies presented by Lien, Tang, and Zuloaga (2022) and Kim, Kim, and Park (2020), this thesis uses the PPML gravity model to analyze the impact of Hallyu on international students' decision to choose Korea as their destination country. While both of the existing papers use TV broadcasting content export amount as the proxy variable for Hallyu, this

study will use a group of 44 cultural goods as the proxy variable. This is because the data on TV broadcasting content exports is only available in 21 countries. This paper studies 195 countries by using cultural items instead of broadcasting content exports. Moreover, this thesis adds to the existing literature on the impact of Hallyu on international students by running six heterogeneity tests. These tests include top 5 universities vs. non-top 5 universities; universities located in Seoul vs. outside of Seoul; gender; five academic majors; degree vs. non-degree; and foreign international students vs. Korean international students.

III. Data

This paper studies 195 countries from 1999 to 2019. Table A.1 shows the list of countries. The impact of the Korean Wave was analyzed starting in 1999 because the term 'Hallyu' was first used by the media during this year. It does not include years beyond 2019 due to the COVID-19 pandemic. Moreover, the data is broken down into country and university levels. WTO, 'top 5', and 'in-Seoul' are dummy variables, and therefore, take the value of 0 or 1. Table 1 shows the summary statistics.

Table 1. Summary Statistics

Variable	Obs	Mean	Std. dev.	Min	Max
Year	113,192	2013	5.155161	1999	2019
Country	113,192	104	58.52992	1	195
University	111,951	1089	604.462	1	2167
Location	111,951	11	4.578319	1	23
International Students	113,192	13.02262	69.68048	0	3494
Hallyu (US$)	111,230	8763128	2.11E+07	0	1.79E+08
GDPPC (in current thousands of US$)	107,853	14.07832	18.28698	0.103	193.892
Population (in thousands)	108,339	256457.7	454624.6	9.374	1407745

WTO	108,599	0.8865643	0.3171261	0	1
Inflation	112,866	27.61777	1037.646	-72.7	65374.1
Top 5	113,192	0.1431108	0.3501874	0	1
In-Seoul	113,192	0.261909	0.4396753	0	1
Social Science	113,192	3.321957	31.72416	0	1980
Engineering	113,192	0.784172	5.497019	0	282
Natural Science	113,192	0.3609266	2.953927	0	165
Medicine	113,192	0.043572	0.5560452	0	46
Performing Arts	113,192	0.4849989	7.182842	0	682
Undergraduate	113,192	5.479124	45.93886	0	2360
PhD	113,192	2.105511	12.17778	0	478
Master's	113,192	0.7880681	4.982402	0	279
Language Training	113,192	1.812796	20.90283	0	2210
Exchange Programs	113,192	0.7047406	5.151514	0	290
Other Non-Degree Programs	113,192	0.0459573	1.455858	0	265

A. International Students

Two different datasets from the Korean Education Statistics Service were used to collect data on the number of international students studying in Korea. The first dataset divided the data into the following categories: location, university, major, and degree or non-degree status. Location was further broken down into seven metropolitan cities in Korea: Seoul, Busan, Incheon, Daegu, Daejeon, Gwangju, Ulsan, and Sejong. There were a total of 2,167 different undergraduate and graduate universities in Korea. If applicable, this dataset also divided universities into different campuses and departments, such as the school of engineering or economics. Majors were categorized into five subjects: social science, engineering, natural sciences, medicine, and performing arts. ‘Degree’ was divided into three categories: undergraduate, PhD, and master’s. ‘Non-degree’ was also split into three categories: language

training, exchange programs, and other non-degree programs. Lastly, this dataset distinguished international students into two categories: foreign international students and Korean international students. Korean international students refer to Koreans whose permanent country of residency is not Korea. For example, a Korean American student who lives in America would count as a Korean international student.

However, this dataset did not divide the number of international students into females and males. Therefore, a different dataset from the Korean Education Statistics Service was used to analyze the impact of Hallyu on different genders. Table A.2 shows the summary statistics on this dataset.

B. Hallyu

In this study, a group of 44 cultural goods was used as the proxy variable for Hallyu. UNESCO (2005) published a list of items that could be classified as cultural goods; 44 cultural goods were selected from this list. These items were divided into four industries: music, film, broadcasting, and publishing. 15 items from the music industry, two items from the film industry, 16 items from the broadcasting industry, and 11 items from the publishing industry were used. Table A.3 shows the list of HS codes used in this paper. The data was pulled from the Korean International Trade Association (KITA) and is measured in US dollars.

C. Gravity Model Variables

The gravity model variables were gathered from two sources: IMF and CEPII. The inflation variable was taken from the International Monetary Fund. This variable represents average consumer prices as annual percent change. The *Gravity* database has geographical, cultural, trade facilitation, and macroeconomic variables for the gravity equation (Conte,

Cotterlaz, and Mayer, 2022). From this database, three variables were pulled: GDP per capita, population, and WTO. CEPII collected data on the *Gravity* database from multiple sources. CEPII gathered the data on GDP per capita and population from the World Bank's Development Indicators. The data on WTO was gathered from the World Trade Organization by CEPII. GDP per capita and population were measured in current thousands of US$ and in thousands, respectively. A value of 1 indicates that the country is a member of WTO while a value of 0 means that the country is not a WTO member. In this study, distance was not included because it does not vary over time. All the time-invariant characteristics of the destination country, South Korea, are absorbed in fixed effects.

D. Top 5 (Dummy Variable)

In this paper, one of the heterogeneity tests was conducted by creating a dummy variable for the top 5 universities in Korea. In U.S. News & World Report, Korean universities were ranked by their global scores. In 2023, the top 5 Korean universities were as follows: Seoul National University (SNU), Sungkyunkwan University (SKKU), Korea Advanced Institute of Science & Technology (KAIST), Korea University, and Yonsei University. For the 'top 5' dummy variable, both undergraduate and graduate schools affiliated with these top 5 colleges were included.

According to *U.S. News & World Report*, the first step in creating these rankings include creating a pool of 2,011 universities. To create this pool, *U.S. News & World Report* used Clarivate's global reputation survey to select the top 250 universities. Then, universities that published at least 1,250 papers from 2016 to 2020 were included. Out of the 2,011 universities selected in this process, the top 2,000 universities were ranked in the overall ranking. The second step used 13 indicators and weights to measure the research qualifications of the top 2000

universities. The 13 indicators and weights include global research reputation (12.5%), regional research reputation (12.5%), number of publications that are among the 10% most cited (12.5%), percentage of total publications that are among the 10% most cited (10%), publications (10%), normalized citation impact (10%), total citation (7.5%), international collaboration – relative to country (5%), international collaboration (5%), number of highly cited papers that are among the top 1% most cited in their respective field(5%), percentage of total publications that are among the top 1% most highly cited papers (5%), books (2.5%), and conferences (2.5%).

IV. Methodology and Regression Analysis

In this paper, the gravity model of trade was used to study the impact of the Korean Wave on persuading international students to enroll in Korean universities. The gravity model predicts that bilateral trade flows between countries are proportional to GDP and inversely proportional to distance. Tinbergen (1962) first derived this model using Isaac Newton's Law of Universal Gravitation. This model showed that a larger mass or closer distance between objects has a stronger gravitational pull between them. The field of economics adopted this idea in international trade by developing a gravity equation that can predict trade flows using GDP and distance. Many studies have been adding cultural factors to the gravity model. Examples include linguistic distance (Lohmann, 2010; Isphording & Otten, 2013); cultural proximity using bilateral score data from the Eurovision song contest (Felbermayr & Toubal, 2016); the role of history (Eichengreen & Irwin, 1998); immigration in UK (Girma & Yu, 2002); immigration in Canada (Head & Ries, 1998); and common language, literacy, and linguistic diversity (Melitz, 2007). In this study, Hallyu is used as the cultural factor.

Typically, a log-linearizing equation is applied when using this model. However, using a log-linearizing gravity equation creates two problems. First, there are heteroskedasticity issues within the error terms. The problem of inconsistent estimates arises from this issue. Moreover, gravitational force will never be zero in the Newtonian model while trade flows between countries can be zero in the economic gravity model. Silva and Tenreyro (2006) developed the Poisson pseudo maximum likelihood (PPML) estimator to solve the heteroskedasticity and the zero-trade issues.

In this study, the PPML gravity model is used because the number of international students is often zero. This paper studies the impact of Hallyu, GDP per capita, population, WTO, and inflation on attracting international students to Korean universities. The natural logarithm of all independent variables is taken. Moreover, Hallyu is lagged by three years. Table A.4 shows the results on Hallyu with a lag of one to four years for robustness checks. The results are robust regardless of the number of lagged years; therefore, a three-year lag is used. In Figure A.1, the line of best fit between international students and Hallyu is shown. Figures A.2 - A.4 also show scatter plots with the best fitting line for GDP per capita, population, and inflation, respectively.

This paper will study seven regression models. The first regression model is a base gravity equation with lagged Hallyu.

Below is the first equation with lagged Hallyu and the gravity model variables:

$$InternationalStudents_{c,t} = \exp[\beta_0 + \beta_1 lnHallyu_{c,t-3} + \beta_2 lnGDPPC_{c,t} + \beta_3 lnPopulation_{c,t} + \beta_4 WTO_{c,t} + \beta_5 lnInflation_{c,t} + \mu_c + \varphi_t] * \varepsilon_{c,t}$$

where subscript ‘c’ indicates countries, ‘t’ indicates the year from 1999 to 2019, and ‘t-3’ indicates a lag of three years. $InternationalStudents_{c,t}$ is the number of international students coming to Korea from countries *c* in the year *t*. $LnHallyu_{c,t-3}$ represents the total export amount of 44 cultural goods between Korea and its trading countries c in the year t-3. $LnGDPPC_{c,t}$ indicates the gross domestic product per capita of countries *c* in the year *t*. $LnPopulation_{c,t}$, $WTO_{c,t}$, and $lnInflation_{c,t,}$ denote the population, WTO member status, and inflation rate of the countries *c* in the year *t,* respectively. μ_c is the country fixed effects for all countries *c* while φ_t is the year fixed effects from 1999 to 2019.

The rest of the models are heterogeneity tests. The second model adds a dummy variable of ‘top 5’ and an interaction term between ‘top 5’ and lagged Hallyu to the first model. ‘Top 5’ takes a value of 1 if the universities are one of the following colleges: SNU, SKKU, KAIST, Yonsei University, and Korea University. For all other universities, the value is 0. Additionally, the third model includes a dummy variable of ‘in-Seoul’ and an interaction term between ‘in-Seoul’ and lagged Hallyu to the base gravity equation. ‘In-Seoul’ takes a value of 1 if the universities are located in Seoul. If a university is located outside of Seoul, it has a value of 0. This study conducts the heterogeneity test of ‘in-Seoul’ because Seoul, the capital city of Korea, has the most diverse culture, including many more English speakers and different cuisines of food. Because of this, the impact of Hallyu could be different for universities in Seoul and outside of Seoul; therefore, a heterogeneity test is conducted based on the location of colleges. The fourth model studies the impact of Hallyu on female and male international students. The fifth model analyzes the effect of the Korean Wave on five different majors: social science, engineering, natural science, medicine, and performing arts. Students choose to major in ‘medicine’ if they are planning to be on the pre-medicine track. In the sixth model, the influence

of Hallyu is studied by analyzing whether international students are taking courses to complete a degree or a non-degree. 'Degree' is divided into three levels: Undergraduate, PhD, and master's degree. 'Non-degree' is divided into 'language training', 'exchange programs', and 'other non-degree programs'. 'Language training' refers to international students who attend a higher institution in Korea to study the Korean language, hangul. 'Exchange programs' are programs where universities have a formal agreement with each other to exchange students. 'Other non-degree programs' mean any other programs that do not count towards degree credits, such as study abroad programs. The seventh model studies the impact of Hallyu on foreign international students and Korean international students.

V. Regression Results

In this section, the results of seven regression models are presented. The statistical significance of the results is indicated by p<0.10=*, p<0.05=**, and p <0.01=***.

Table 2. The Impact of Hallyu on International Students Using Gravity Model

Variables	International Students
lnHallyu (lagged)	0.0172037***
	(0.0062983)
lnGDPPC	0.5099412***
	(0.0617238)
lnPopulation	1.891278***
	(0.3316423)
WTO	0.2755653***
	(0.0519008)
lnInflation	-0.0244199
	(0.0250489)
Constant	-22.20222***

	(4.282015)
Observations	96,037
Pseudo R-squared	0.3923

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.10

Table 2 shows the results for the standard gravity model with lagged Hallyu. Hallyu is statistically significant at 1%. This indicates that a 1% increase in the export amount of cultural goods three years ago increases the number of international students by .017% in the current year. Because Hallyu is lagged, the positive relationship between the Korean Wave and the number of international students is shown after three years have passed.

Moreover, GDP per capita, population, and WTO are all statistically significant at 1%. This shows that a 1% increase in GDP per capita will increase the number of international students by .51%. For population, the number of international students increases by 1.89% if population increases by 1%. If a country is a member of WTO, the number of international students increases by 0.28%. However, inflation is statistically insignificant and inversely related to Hallyu.

Table 3. The Impact of Hallyu on International Students, by Top 5 Universities

Variables	International Students
lnHallyu (lagged)	0.0123621**
	(0.0064245)
lnGDPPC	0.4890219***
	(0.0607525)
lnPopulation	1.982981***
	(0.3321216)
WTO	0.2860987***
	(0.0511781)

lnInflation	-0.0262575
	(0.024839)
Top 5	0.1844478*
	(0.133043)
Top5*lnHallyu (lagged)	0.0325132***
	(0.0105586)
Constant	-23.34527***
	(4.286945)
Observations	96,037
Pseudo R-squared	0.4021

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.10

Table 3 shows the results of adding a dummy variable of 'top 5' and the interaction term between the dummy variable and Hallyu. The Korean Wave variable is still statistically significant at 5%. Similar to the results from Table 2, GDP per capita, population, and WTO are all statistically significant at 1% while inflation is statistically insignificant. The dummy variable of 'top 5' means that the top 5 Korean universities have .18% more international students than the non-top 5 schools, on average. The result of the interaction term between the 'top 5' dummy variable and Hallyu shows that a 1% increase in Hallyu will increase the number of international students at non-top 5 universities by 0.012% while the number of international students at top 5 universities increases by 0.045%. The interaction term is statistically significant at 1%.

Table 4. The Impact of Hallyu on International Students, by In-Seoul Universities

Variables	International Students
lnHallyu (lagged)	0.011578**
	(0.0061429)
lnGDPPC	0.5442605***
	(0.0626583)

lnPopulation	2.315442***
	(0.3326781)
WTO	0.3145689***
	(0.050966)
lnInflation	-0.0291161
	(0.0248555)
In-Seoul	0.1878443*
	(0.1076267)
In-Seoul*lnHallyu (lagged)	0.0249297***
	(0.0082371)
Constant	-27.79232***
	(4.298291)
Observations	95,820
Pseudo R-squared	0.4031

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.10

Table 4 presents the results of adding a dummy variable of 'in-Seoul' and the interaction term between 'in-Seoul' and Hallyu. At a significance level of 5%, Hallyu still has a positive relationship with international students. GDP per capita, population, and WTO remain statistically significant at 1% while inflation is still insignificant. The dummy variable of 'in-Seoul' means that universities in Seoul have .19% more international students than universities located outside of Seoul, on average. The interaction term between the 'in-Seoul' dummy variable and Hallyu shows that a 1% increase in the exports of cultural goods increases the number of international students who attend universities located outside of Seoul by 0.012% while the number of international students increases who attend universities located in Seoul by 0.037%. The interaction term is significant at 1% level.

Table 5. The Impact of Hallyu on International Students, by Gender

Variables	Female	Male
lnHallyu (lagged)	0.0348911***	0.0033336
	(0.0119298)	(0.0122872)
lnGDPPC	1.063378***	0.4973283***
	(0.1782415)	(0.1648832)
lnPopulation	3.5673222***	5.582266***
	(0.6839246)	(0.9631897)
WTO	0.324818**	0.1053081
	(0.1390407)	(0.1285827)
lnInflation	-0.01953	0.0418247
	(0.0476837)	(0.0557601)
Constant	-35.63652***	-57.06422***
	(7.480347)	(10.57008)
Observations	1,763	1,766
Pseudo R-squared	0.9631	0.9436

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.10

Table 5 shows the impact of Hallyu on female and male international students. Hallyu is statistically significant at 1% for female students. This indicates that a 1% increase in the export amount of cultural goods increases the number of female students by 0.035%. However, Hallyu is statistically insignificant for male students. This means that there is no evidence to conclude that male international students are influenced by Hallyu when they are deciding on their destination country. GDP per capita and population are statistically significant for both genders. WTO is only statistically significant for female students. For both genders, inflation is statistically insignificant.

Table 6. The Impact of Hallyu on International Students, by Majors

Variables	Social Science	Engineering	Natural Science	Medicine	Performing Arts
lnHallyu (lagged)	0.021998**	0.0081482	-0.0010084	0.0123151	-0.0427206
	(0.0099413)	(0.0101711)	(0.0132938)	(0.0201734)	(0.0405041)
lnGDPPC	0.4475366***	-0.1857265	0.1221949	-0.1787502	0.4986296
	(0.1718007)	(0.14732)	(0.1715918)	(0.2994485)	(0.3831256)
lnPopulation	1.287441**	-0.2064993	0.8657985	1.043735	14.34317***
	(0.6559197)	(0.3871436)	(0.8725078)	(1.516335)	(4.573627)
WTO	0.2302521	0.7077786*	1.983062***	1.391003	0.6470566
	(0.2342265)	(0.3913844)	(0.4385773)	(1.081364)	(0.4824258)
lnInflation	-0.0177204	-0.0050206	-0.0555586	0.0780135	0.137648**
	(0.0416799)	(0.043226)	(0.0709808)	(0.0873266)	(0.0614521)
Constant	-15.22341*	3.115942	-12.71575	-15.70062	-192.6559***
	(8.610697)	(4.899052)	(11.07424)	(18.4058)	(61.08534)
Observations	58,715	58,346	57,418	48,124	55,612
Pseudo R-squared	0.4016	0.2535	0.2311	0.1044	0.4091

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.10

Table 6 presents the results of the impact of Hallyu by 5 academic majors. Hallyu was statistically significant for social science majors. However, the Korean Wave was statistically insignificant for all other majors. This indicates that only international students who are majoring in social science are influenced by Hallyu during their decision-making process. Moreover, GDP per capita is statistically significant at 1% for only social science majors. Population is statistically significant for social science and performing arts majors. For the WTO variable, the coefficients are statistically significant for engineering and natural science majors. Lastly, inflation was only statistically significant for the performing arts major.

Table 7. The Impact of Hallyu on International Students, by Degree and Non-Degree

	Degree		
Variables	Undergraduate	PhD	Master's
Hallyu	.0332173***	-0.0001686	-0.066011***
	(0.0094892)	(0.007401)	(0.008934)
GDP per capita	0.6558053***	0.5228895***	0.4032286***
	(0.0908122)	(0.0539046)	(0.0706609)
Population	3.511443***	0.4882048**	0.8564408**
	(0.6393741)	(0.23233)	(0.4031992)
WTO	0.6590873***	-0.1561096***	-0.3654707***
	(0.0999879)	(0.0601998)	(0.1094988)
Inflation	0.0389678	0.1218335***	0.1416379***
	(0.0440439)	(0.0241386)	(0.0354474)
Constant	-45.95926***	-5.487906*	-9.919714**
	(8.50432)	(2.918207)	(5.169464)
Observations	95,235	95,662	94,237
Pseudo R-squared	0.3785	0.2629	0.2379

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.10

Table 7. The Impact of Hallyu on International Students, by Degree and Non-Degree cont.

	Non-Degree		
Variables	Language Training	Exchange Programs	Other Non-Degree Programs
lnHallyu (lagged)	0.0519736***	0.0065157	-0.0191681
	(0.0175902)	(0.0103938)	(0.0350332)
lnGDPPC	1.327805***	0.2353457	0.284062
	(0.2616073)	(0.246019)	(0.8422013)
lnPopulation	8.171192***	-1.381074	-7.02761*
	(1.948412)	(1.277832)	(4.2573)
WTO	-0.1888472	-0.5021433***	-1.040166

	(0.2378274)	(0.1923748)	(0.9095602)
lnInflation	-0.1242357*	0.0247718	0.1919751
	(0.0683957)	(0.0423567)	(0.1279128)
Constant	-101.8565***	17.79087	91.72133
	(24.1648)	(15.69802)	(56.1098)
Observations	58,828	57,774	48,913
Pseudo R-squared	0.2797	0.2887	0.255

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.10

Table 7 shows the results on the impact of Hallyu on international students who are seeking a degree and taking non-degree courses. At a significance level of 1%, Hallyu was significant for undergraduate and master's degree students. There is a negative relationship between the Korean Wave and master's degree students, however. This indicates that a 1% increase in the export amount of cultural goods decreases the number of master's international students by 0.066%. For non-degree results, Hallyu was statistically significant at 1% for international students who were receiving language training. However, the coefficients of Hallyu for 'exchange programs' and 'other non-degree programs' were statistically insignificant. GDP per capita was statistically significant for undergraduate, PhD, master's, and 'language training' students. Moreover, the coefficients of the population variable were statistically significant for undergraduate, PhD, master's, 'language training', and 'other non-degree programs.' WTO was statistically significant for undergraduate, PhD, master's, and 'exchange programs.' Lastly, inflation was statistically insignificant for all variables except PhD and master's degrees.

Table 8. The Impact of Hallyu on International Students, by Foreign International Students and Korean International Students

Variables	Foreign	Korean
lnHallyu (lagged)	0.0104541	-0.0144768
	(0.0074023)	(0.0172607)
lnGDPPC	0.3853181***	0.1540178
	(0.064698)	(0.0991133)
lnPopulation	2.565267***	2.738829***
	(0.3803322)	(0.8358836)
WTO	0.4012678***	0.4269583***
	(0.0501893)	(0.164938)
lnInflation	-0.0325437	0.0111266
	(0.0251412)	(0.0482756)
Constant	-30.56252***	-35.00029***
	(4.876792)	(11.17596)
Observations	91,761	7,990
Pseudo R-squared	0.4015	0.1646

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.10

Table 8 shows the results for foreign international students and Korean international students. The coefficients of the Hallyu variable were statistically insignificant for both categories of international students. Furthermore, the relationship between Hallyu and Korean international students was negative. This indicates that a 1% increase in Hallyu decreases the number of Korean international students by 0.014%. Population and WTO are statistically significant for both international students. GDP per capita is only significant for foreign international students. Inflation was insignificant for both students.

One of this study's limitations is that the coefficients of GDP per capita are negative for engineering and medicine majors in Table 6. This indicates that students from poorer countries

are more likely to study at Korean universities if their majors are engineering or medicine. The negative coefficients for GDP per capita contradict the gravity model's prediction that the number of international students would be proportional to the size of the country. One possible explanation for this is that generous scholarships provided by Korean universities, such as KAIST, attract more students from less wealthy countries. Moreover, another explanation is that individuals from poorer countries, especially Vietnamese, are interested in visiting and studying in Korea to experience using technological developments as well as advanced medical tools (Yoon, Chung, and Lee, 2012). Therefore, they are more likely to choose engineering or medicine majors. This study only presents the findings and does not further explain the causes of the negative relationship. Future papers could investigate the explanation for this inverse relationship between GDP per capita and the number of international students who are studying engineering and medicine.

Another limitation is that intangible goods were not used in this study. A group of 44 cultural items used as the proxy variable for Hallyu does not include intangible goods. This exclusion of intangible goods is a limitation of this study because most individuals are exposed to Hallyu content through streaming services and social media platforms. Future research could supplement the findings of this paper by using both tangible and intangible goods as the proxy variable for Hallyu.

VI. Discussion

In Korea, the number of international and Korean students enrolled in Korean universities has been decreasing. There are two causes of this decline. First, the number of international students in Korea has been staggering since 2011. Second, Korea has been struggling with low birth rates. The rate was so low that the country has been ranking last in birth rates among all

countries since 2013. As a result of this, a smaller population of Korean students are enrolled in universities every year. The Korean government responded to this emergency by announcing a policy called "A Plan to Attract More International Students" in 2015 (Translated by the author). This policy hopes to reach 200,000 international students in Korea by 2023 (Ministry of Education). In 2015, approximately 2% of total students were international students; this plan would increase the number to 5%.

The issue of the declining number of university enrollees reinforces the importance of this paper's results, which show that international students are influenced by Hallyu during their decision-making processes. To solve this problem, the government and universities should advertise Hallyu more. For instance, universities could offer more Hallyu-related courses. The results of this paper show that Hallyu impacts international students who attend the top 5 universities and in-Seoul universities more than international students who attend non-top 5 schools and universities located outside of Seoul. Therefore, the top 5 Korean universities and in-Seoul schools should especially consider marketing Hallyu by offering courses that fulfill these international students' interests. Furthermore, the results show that a significant number of international students come to Korea to improve their Korean by receiving language training. The government should consider giving university course credits for completing the language training courses to encourage them to stay longer and earn a degree instead of temporarily staying in Korea. Lastly, studies indicate that a positive image of a country attracts more international students, and Hallyu has been shown to improve the image of Korea (Trolan, 2017). Therefore, the government should use Hallyu as a promotional tool to shape Korea's image and to reach the goal of attracting 200,000 international students by the end of 2023.

VII. Conclusion

In this paper, the impact of Hallyu on international students' decisions to attend South Korean universities was studied. The results show that Hallyu plays a big role in influencing international students' decisions to choose Korea as their destination country. In the base gravity model, Hallyu is statistically significant at 1% level. This shows that an increase in the export amount of cultural goods increases the number of international students arriving in Korea to attend higher institutions. Moreover, the interaction terms of 'top 5' and 'in-Seoul' indicate that the influence of the Korean Wave is larger for international students who attend top 5 and in-Seoul universities than their counterparts. Furthermore, the effect of Hallyu was studied for different genders. Hallyu is statistically significant for female international students. However, there is no evidence of statistical significance for male students. Additionally, the Korean Wave was statistically significant for social science, undergraduate, master's, and language training students. Lastly, the coefficients of the Hallyu variable were insignificant for both foreign and Korean international students.

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IX. Appendix

Table A.1. List of Countries

Afghanistan	Congo, Rep.	Indonesia	Morocco	Solomon Islands
Albania	Costa Rica	Iran	Mozambique	Somalia
Algeria	Côte d'Ivoire	Iraq	Myanmar	South Africa
Andorra	Croatia	Ireland	Namibia	South Sudan
Angola	Cuba	Israel	Nauru	Spain
Antigua and Barbuda	Cyprus	Italy	Nepal	Sri Lanka
Argentina	Czech Republic	Jamaica	Netherlands	St. Kitts and Nevis
Armenia	Denmark	Japan	New Zealand	St. Lucia
Australia	Djibouti	Jordan	Nicaragua	St. Vincent and the Grenadines
Austria	Dominica	Kazakhstan	Niger	Sudan
Azerbaijan	Dominican Republic	Kenya	Nigeria	Suriname
Bahamas	Ecuador	Kiribati	North Korea	Sweden
Bahrain	Egypt	Kuwait	North Macedonia	Switzerland
Bangladesh	El Salvador	Kyrgyzstan	Norway	Syria
Barbados	Equatorial Guinea	Laos	Oman	Taiwan
Belarus	Eritrea	Latvia	Pakistan	Tajikistan
Belgium	Estonia	Lebanon	Palau	Tanzania
Belize	Eswatini	Lesotho	Panama	Thailand
Benin	Ethiopia	Liberia	Papua New Guinea	Timor-Leste
Bhutan	Fiji	Libya	Paraguay	Togo
Bolivia	Finland	Liechtenstein	Peru	Tonga
Bosnia and Herzegovina	France	Lithuania	Philippines	Trinidad and Tobago
Botswana	Gabon	Luxembourg	Poland	Tunisia

Brazil	Gambia	Macau	Portugal	Turkey
Brunei Darussalam	Georgia	Madagascar	Qatar	Turkmenistan
Bulgaria	Germany	Malawi	Romania	Tuvalu
Burkina Faso	Ghana	Malaysia	Russia	Uganda
Burundi	Greece	Maldives	Rwanda	Ukraine
Cabo Verde	Grenada	Mali	Samoa	United Arab Emirates
Cambodia	Guatemala	Malta	San Marino	United Kingdom
Cameroon	Guinea	Marshall Islands	São Tomé and Príncipe	United States
Canada	Guinea-Bissau	Mauritania	Saudi Arabia	Uruguay
Central African Republic	Guyana	Mauritius	Senegal	Uzbekistan
Chad	Haiti	Mexico	Serbia	Vanuatu
Chile	Honduras	Micronesia	Seychelles	Venezuela
China	Hong Kong	Moldova	Sierra Leone	Vietnam
Colombia	Hungary	Monaco	Singapore	Yemen
Comoros	Iceland	Mongolia	Slovakia	Zambia
Congo, Dem. Rep.	India	Montenegro	Slovenia	Zimbabwe

Table A.2. Summary Statistic (Gender Dataset)

Variable	Obs	Mean	Std. dev.	Min	Max
Year	4,271	2009	6.052405	1999	2019
Country	4,271	99	56.90891	1	195
Female	2,947	171.4588	1622.996	0	34773
Male	2,947	154.0221	1246.11	0	22090
Hallyu (US$)	3,466	1023769	7384892	0	1.79E+08
GDP per capita (in current thousands of US$)	3,955	12.60358	20.8664	0.103	193.892
Population (in thousands)	4,068	34640.57	132514.2	9.374	1407745
WTO	4,101	0.7781029	0.415573	0	1
Inflation	4,089	27.4945	1068.665	-72.7	65374.1

Table A.3. List of Cultural Goods

Industry	HS Code
Music	852410 852432 852451 852452 852499 8523292119 8523292129 8523292139 8523292919 8523292992 8523292999 8523402119 8523402120 8523402992 8523402999 8523512190 8523512990
Film	3706 370590
Broadcasting	8523292211 8523291130 8523292219 8523292229 8523292231 8523292239 8523292991 8523402139

	8523402991 8523512910 8523802910 8524399000 8524539000 8524991000 8528690000 8524531000
Publishing	4901 4902 4903 4904 4905 4906 4907 4908 4909 4910 4911

Table A.4. Lag 1 - Lag 4

Variables	Lag 1	Lag 2	Lag 3	Lag 4
Hallyu (US$)	0.0155097**	0.0152742**	0.0172037***	0.016777***
	(0.0067567)	(0.0065444)	(0.0062983)	(0.0061872)
GDP per capita (in current thousands of US$)	0.5066755***	0.5074424***	0.5099412***	0.5110068***
	(0.0616358)	(0.0616911)	(0.0617238)	(0.0618025)
Population (in thousands)	1.932957***	1.922995***	1.891278***	1.898004***
	(0.3372502)	(0.3347404)	(0.3316423)	(0.332261)
WTO	0.2765272***	0.2752571***	0.2755653***	0.2716964***
	(0.05203)	(0.0520644)	(0.0519008)	(0.0518649)
Inflation	-0.0238048	-0.0250141	-0.0244199	-0.0235152
	(0.0250349)	(0.0250198)	(0.0250489)	(0.0250411)
Constant	-22.70776***	-22.57515***	-22.20222***	-22.28172***
	(4.35061)	(4.319531)	(4.282015)	(4.290768)
Observations	96,087	96,051	96,037	96,015
Pseudo R-squared	0.392	0.3921	0.3923	0.3924

Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.10

Figure A.1. The Line of Best Fit between International Students and Hallyu

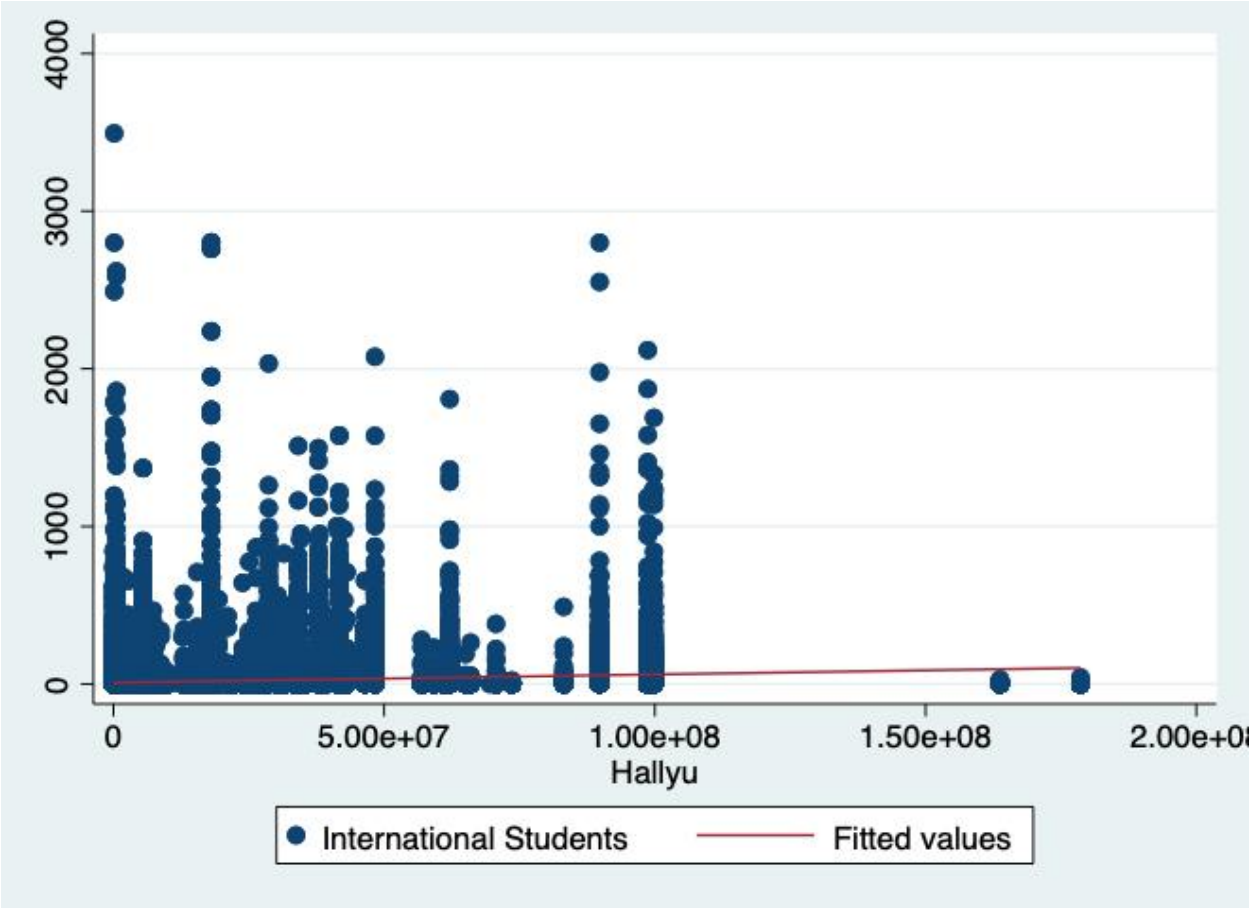

Figure A.2. The Line of Best Fit between International Students and GDP per capita

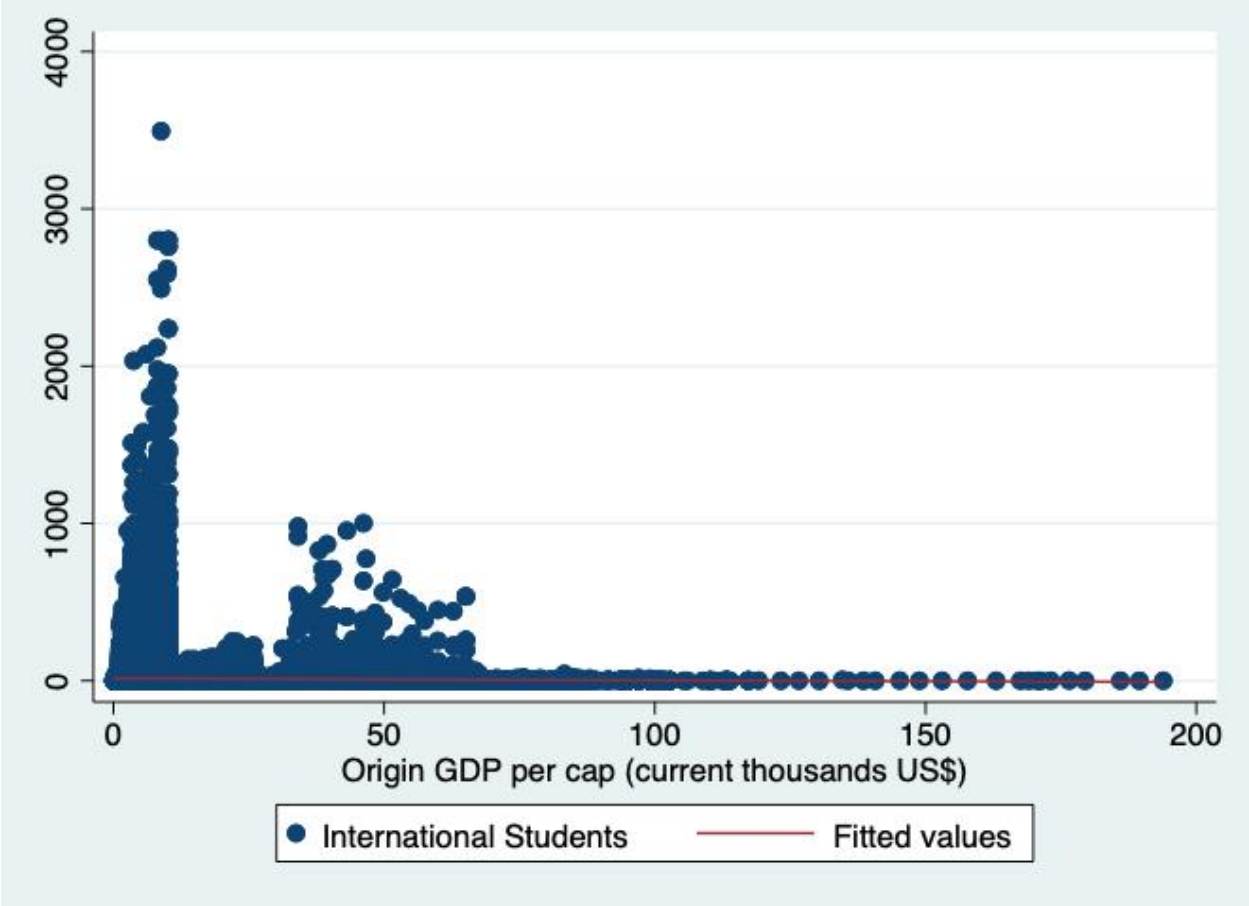

Figure A.3. The Line of Best Fit between International Students and Population

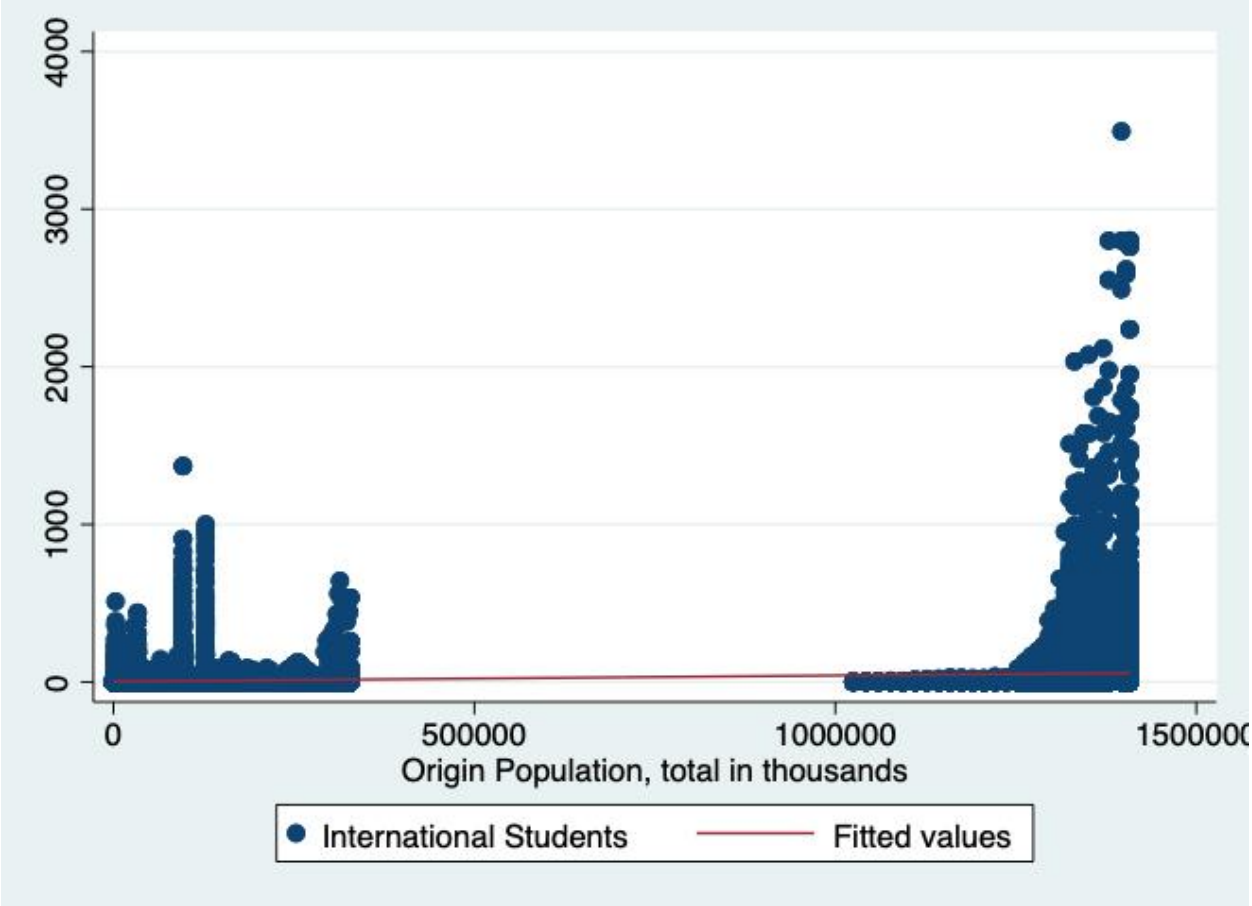

Figure A.4. The Line of Best Fit between International Students and Inflation