

Immigration, Value-Added Exports, and Global Value Chains in Korea

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This paper investigates the impact of immigration on Korea's value-added exports and participation in Global Value Chains (GVCs) using a country-level panel dataset. To address the endogeneity between immigration and trade, this study employs a fixed effects two-stage model and uses visa policy as an instrumental variable. The results reveal that immigration significantly enhances Korea's domestic value-added exports and GVC involvement, highlighting the crucial role of immigrants in the nation's trade dynamics. The impact of immigration on value-added exports varies with the economic status of immigrants' home countries, with significant effects observed primarily in low-income countries. This effect is mainly driven by the increase in Korea's domestic value-added embedded in exports from these low-income countries, demonstrating a forward linkage. Additionally, the study finds that the coefficient for the industry sector is larger, providing insights into sector-specific dynamics.

JEL Classification: F14, F16, F22

핵심 주제어: Value-Added Exports, Immigration, Gravity Model, Fixed Effects Two-Stage

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1. Introduction

Immigration can reduce natural barriers to trade and potentially lead to the expansion of trade.¹⁾ Concurrently, unlike the traditional focus on final goods in trade, the development of global value chains (GVCs) has led to increased specialization in production among countries. This shift underscores that in contemporary trade, the final origin of products is less significant than the contribution of value-added elements. From this perspective, this paper aims to empirically investigate the impact of immigration on Korea's exports in value-added, using a country-level panel dataset.

Since the implementation of the third Basic Plan on Low Birth Rate and Aging Society in 2016, the Korean government has structurally addressed the epochal issue of population decline by making the expansion of foreign manpower one of its four major goals (Byeon and Hwang, 2018). Consequently, while studies on immigration in Korea have primarily focused on labor market outcomes (Choi, 2013; Jung and Kim, 2020; Lee, 2020; Kim, 2023), there is a need for research across all economic sectors as immigration impacts various aspects of the economy. Nevertheless, the literature on the impact of international labor migration on Korea's trade is limited (Kang, 2017; Kim, 2023). Furthermore, these studies indicate that immigration boosts trade using customs-based trade data, yet examining its contribution in terms of value-added within the developing GVCs could provide a more comprehensive and accurate understanding of its effects.

From a macroeconomic view, the influx of foreigners can increase aggregate demand, boosting imports, or enhance the host country's export competitiveness through reduced production costs associated

1) While immigration can impact both exports and imports, this study focuses specifically on exports due to data limitations encountered during the construction of the panel data.

with labor inflow. From a microeconomic perspective, immigrants may increase imports in the host country due to their preference for products from their origin countries and demonstration effects.²⁾ Additionally, the linkage effect - trust-building through immigrant networks, understanding of laws and institutions, and easing language barriers - can lead to new market development. Various empirical studies have shown that immigration increases trade (Head and Ries, 1998; Rauch and Trindade, 2002; Genc et al., 2011; Aleksynska and Peri, 2014; Kang, 2017; Erhardt and Lassmann, 2023; Kim, 2023). However, with the advancement of GVCs, traditional trade data often double-count trade in intermediates, posing issues (Hummels et al., 2001; Johnson and Noguera, 2012; Koopman et al., 2014). Thus, trade effects are more accurately assessed when expressed in value-added terms since value-added trade inherently measures the value produced within a country and eliminates double counting, aligning well with the mechanisms through which immigration can increase trade.

One of the major challenges in studying immigration and trade is controlling for the endogeneity between them (Erhardt and Lassmann, 2023; Kim, 2023). Immigration might promote trade, but people might also prefer to move to countries where trade is more active. Therefore, controlling for endogeneity through quasi-natural experiments, matching, or instrumental variable approaches is necessary for causal inference (McKenzie, 2005; Tai, 2009; Javorcik et al., 2011; Hatzigeorgiou and Lodefalk, 2015; Kim, 2023).³⁾ This research uses visa policy as an instrumental variable, measured by the number of confirmations of visa issuance. This variable is theoretically and statistically exogenous to trade

2) This effect occurs when the host country's residents see immigrants using products from their home countries, thereby generating demand and leading to an increase in imports.

3) McKenzie (2005) and Javorcik et al. (2011) utilized the costs of passports and legal barriers to immigration as instrumental variables. Meanwhile, Tai (2009) and Hatzigeorgiou and Lodefalk (2015) used the number of immigrants from neighboring countries as instrumental variables. Kim (2023) used the number of immigrants from past periods as an instrumental variable.

but appears to significantly influence immigration.

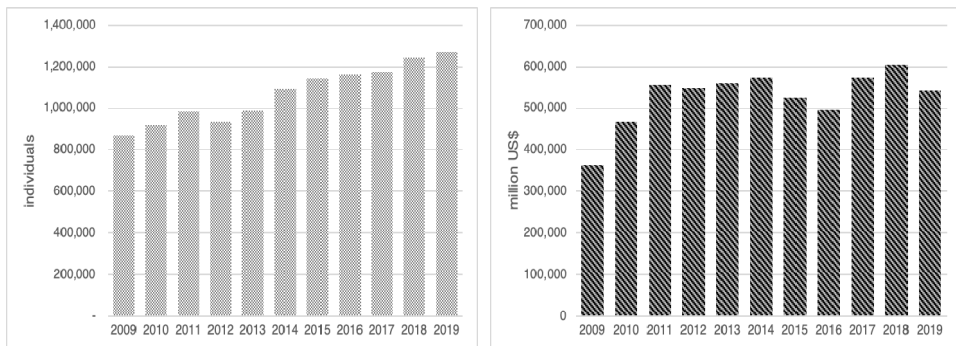
According to the empirical analysis results of this study, an increase in foreign residents has been shown to boost Korea's domestic value-added exports. Particularly, heterogeneity was discovered depending on the income level of partner countries. In other words, the influx of immigrants with different characteristics showed a relatively strong positive effect on Korea's value-added exports and forward GVC-related exports in low-income group. This suggests that the increase in value-added exports may be associated with the influx of heterogeneous workers with different levels of skills. Furthermore, the regression coefficient for the industry sector - where immigrants predominantly engage - exceeds that of the service sector within both the overall sample and the low-income group. Nevertheless, the relatively small difference between the two coefficients indicates that the impact of immigrants may be comparable across both sectors.

The structure of this paper is as follows: The next section provides an overview of the current status of immigration within Korea. The following section is a theoretical review and prior research on immigration and trade. The fourth section discusses the construction of panel data and the instrumental variable. The fifth section presents the results of the empirical analysis and robustness results, and the final section concludes.

2. Overview of Immigration within Korea

The influx of foreigners to Korea has been steadily increasing. According to data from the Ministry of Justice of Korea, the number of foreigner sojourns was only about 0.31 million in 1998, rose to 1.46 million by 2012, and reached 2.52 million in 2019. Moreover, as indicated in <Figure 1>, the number of registered foreign residents, used as an explanatory variable in this study, also increased consistently from about 0.87 million

〈Figure 1〉 Trends of Registered Foreign Residents and Exports in Korea



(a) Registered Foreign Residents

(b) Export Values

Sources: The Ministry of Justice of Korea (a), Korea International Trade Association (b).

in 2009 to 1.25 million in 2019. Although the export values of Korea fluctuate depending on external circumstances, they have generally shown an upward trend, growing from US\$364 billion in 2009 to US\$542 billion in 2019.

〈Table 1〉 organizes the number of registered foreign residents and export values for the top 10 countries with the most residents in 2012 and 2019. Of these, nine are Asian countries, suggesting that migration to Korea is often for employment or study, driven by relatively higher wages or educational opportunities compared to emerging countries. While these top 10 countries accounted for 90% of all foreign residents in 2012, their share dropped to 80% by 2019, indicating an extensive increase in inflows. China had the highest number due to its large ethnic Korean population and geographic proximity, closely linking it to Korea through GVCs, showing the highest export share. Conversely, the U.S. had only 23,244 residents (2% of the total) but accounted for 11% of the exports in 2012. Vietnam, gaining attention in new GVCs with Korea, has seen significant increases in both immigrant inflow and export values and shares. This study examines effects based on income levels, distinguishing between high, middle, and low-income panels, with the U.S., China, and Vietnam representing the high, middle, and low-income groups, respectively.

〈Table 1〉 Registered Foreign Residents and Export by Country in Korea

Unit: Individuals, million US\$, %

Country	2012				2019			
	Foreign Residents	Share	Export values	Share	Foreign Residents	Share	Export values	Share
China	515,301	55%	134,323	25%	540,606	43%	136,203	25%
Vietnam	114,123	12%	15,946	3%	187,334	15%	48,178	9%
Philippines	34,000	4%	8,211	1%	45,354	4%	8,365	2%
Indonesia	31,471	3%	13,955	3%	37,043	3%	7,650	1%
Uzbekistan	28,949	3%	1,767	0%	56,237	4%	2,338	0%
Thailand	24,036	3%	8,221	2%	32,633	3%	7,804	1%
U.S.	23,244	2%	58,525	11%	26,025	2%	73,344	14%
Japan	22,157	2%	38,796	7%	24,316	2%	28,420	5%
Cambodia	21,705	2%	523	0%	45,016	4%	697	0%
Mongolia	21,509	2%	433	0%	24,845	2%	291	0%
Others	96,488	10%	267,170	49%	252,398	20%	228,943	42%
Total	932,983	100%	547,870	100%	1,271,807	100%	542,233	100%

Sources: The Ministry of Justice of Korea, Korea International Trade Association. 〈Table 2〉 shows the economically active population and participation rates of foreigners in Korea by visa type for the years 2012 and 2019. According to Statistics Korea, the overall economic participation rates were 61.9% in 2012 and 53.5% in 2019, indicating that the participation rates of foreigners, which were 74.0% in 2012 and 69.1% in 2019, were higher than the national average. In terms of share, nearly half of all visas, including the H-2 visa⁴⁾ for ethnic Koreans and the E-9 non-professional employment visa, indicate that a significant number of foreigners are employed in low-wage jobs. In contrast, professional visas (E-1 to E-7) accounted for only 4% in 2019.

4) The H-2 visa is available to ethnic Koreans aged 18 and above from China, Uzbekistan, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Ukraine. Permitted employment sectors for H-2 visa holders include agriculture (crop cultivation, livestock), fisheries (coastal and aquaculture), mining, small-scale manufacturing, and certain construction industries. Most service industries are also eligible, including accommodation, food services, welfare services, and domestic care. However, sectors such as water supply, environmental sanitation, car sales, transportation, warehousing, IT, finance and insurance, real estate, scientific and technological services, facility management, landscaping, and educational services are excluded. Meat transport, freight handling, and loading activities are permitted.

〈Table 2〉 Economically Active Population and Participation Rate of Foreigners within Korea by Visa Type

Unit: Individuals, %

Visa Type	2012			2019			Change in EAP (B/A)-1
	EAP (A)	Share	Participation Rate	EAP (B)	Share	Participation Rate	
Non-professional Employment (E-9)	238	29%	99.9	261	29%	99.9	10%
Visit Employment (H-2)	254	31%	88.5	169	18%	84.2	-34%
Professional Personnel (E-1 to E-7)	47	6%	99.4	38	4%	99.5	-18%
Students (D-2, D-4-1)	17	2%	20.1	30	3%	20.9	76%
Overseas Koreans (F-4)	103	13%	64.5	211	23%	67.4	105%
Permanent Residents (F-5)	50	6%	68.9	82	9%	78.8	64%
Marriage Immigrants (F-2-1, F-6)	65	8%	50.8	59	7%	54.1	-9%
Others	49	6%	51.1	64	7%	41.6	30%
Total	823	100%	74.0	914	100%	69.1	11%

Sources: 2012, 2019 Survey on Immigrants' Living Conditions and Labour Force, Statistics Korea and Ministry of Justice of Korea.

Note: "EAP" is Economically Active Population.

According to 〈Table 3〉, in both 2012 and 2019, approximately half of the foreign workers were employed in the mining and manufacturing sectors. Following these, a significant number were employed in wholesale and retail, accommodation, and food service sectors.

About 80% of Korea's total exports are concentrated in the manufacturing sector, reflecting Korea's status as a traditional manufacturing powerhouse. Given this reality, it is conceivable that foreign workers, who often receive lower wages, may be contributing to enhancing the export competitiveness of Korea's manufacturing sector.

〈Table 3〉 Employed Foreigners and Exports by Industry

Unit: Thouand individuals, million US\$, %

Industry	2012				2019			
	Employed Foreigners	Share	Export values	Share	Employed Foreigners	Share	Export values	Share
Agriculture, Forestry, Fisheries	40	5%	775	0%	52	6%	997	0%
Mining, Manufacturing	368	47%	338,515	81%	399	46%	493,372	83%
Construction	85	11%	74	0%	95	11%	141	0%
Wholesale and retail, Accommodation, Food service	149	19%	45,172	11%	165	19%	45,289	8%
Utilities, Transport, IT, Finance	12	2%	31,303	7%	14	2%	51,277	9%
Business, Personal, Public Services	136	17%	2,553	1%	138	16%	2,275	0%
Total	790	100%	418,391	100%	863	100%	593,351	100%

Note: The export values used in this table have been adjusted by the OECD and differ from the data provided by Korea International Trade Association. However, since OECD Stat provides export values by sector, this data was utilized for this table.

Sources: The Ministry of Justics of Korea, OECD Stat.

3. Theoretical and Literature review

Immigration brings both new demand and labor into an economy. From a demand perspective, immigration can increase total demand and thereby boost imports. Immigrants often have a high preference⁵⁾ for goods from their origin countries, thereby increasing demand. This demand is further influenced by demonstration effects, which generate additional interest as host country nationals observe the use of these goods (Erhardt and Lassmann, 2023; Kim, 2023). From a labor perspective,⁶⁾ immigrants, bringing heterogeneous skills, can enhance productivity when working alongside host country workers. An increase in labor supply may reduce production costs, thereby enhancing price competitiveness in

5) Gould (1994) explained this using the immigrant preference hypothesis.

6) This is primarily based on the neo-classical model.

international markets.⁷⁾⁸⁾ Additionally, according to the immigrant link hypothesis (Gould, 1994), utilizing the human capital of immigrants can facilitate easier resolution of language communication issues between two countries that share the same language, and reduce transaction costs such as information costs for acquiring market information from the origin country, and costs involved in contracts and negotiations. By leveraging the human capital of immigrants to reduce transaction costs, trade (both imports and exports) can be expected to increase.

According to <Table 2>, the participation rate of the economically active foreign population in Korea's economy was 69.1% in 2019, while the overall participation rate in Korea was 53.5% according to Statistics Korea, indicating that the influx of foreigners to Korea is primarily a supply of labor. Additionally, as seen in <Table 3>, many of these immigrants are employed in the manufacturing sector, where Korea's exports are concentrated, suggesting that the influx of immigrants may primarily affect the supply side, particularly exports.

This paper primarily examines the impact of immigration on trade, focusing on value-added exports in Korea. Since Gould (1994) demonstrated a positive impact of immigration on trade using the gravity model with trade data from the U.S. and 47 partners, numerous studies have provided empirical evidence of a causal relationship between immigration and trade (Head and Ries, 1998; Rauch and Trindade, 2002; Genc et al., 2011; Aleksynska and Peri, 2014; Kang, 2017; Erhardt and Lassmann, 2023; Kim, 2023).⁹⁾

Genc et al. (2011) utilized 48 studies to perform a meta-analysis, concluding that a 10% increase in a country's immigrant population can lead to a 1-2% increase in international trade. They synthesized findings from various research to present theoretical justifications for this

7) It could also replace imports in the domestic market, or alternatively, an increase in exports could lead to a rise in national wealth, which might increase imports as well.

8) For a detailed theoretical background on immigration and trade, refer to Kang (2017).

9) All the mentioned empirical studies have provided evidence that immigration increases trade.

relationship. On a macroeconomic level, they argue that immigration boosts total demand by bringing more people into a country, which in turn increases the demand for imports. Additionally, they suggest that the host country's exports can expand due to enhanced competitiveness, which comes from the acquisition of price competitiveness through lowered average wage levels. On a microeconomic scale, they highlight the linkage effect, where trust is built through immigrant networks, along with a better understanding of laws and systems, and reduced language barriers. Moreover, they note an increase in demand for specific products, like food from the immigrants' origin countries, due to preferences and demonstration effects.

In an empirical study using Korean data, Kim (2023) showed that immigration also increased exports in Korea. However, the study assumed that the number of immigrants in a previous period does not directly affect the trade volume with target countries in the current period. This assumption is based on the notion that trade in a given period is primarily determined by the economic and political situations of that period, considering the advancements in information and communication technology. Thus, the number of immigrants from past periods was used as an instrumental variable. However, according to Choi et al. (2024), although based on the U.S. data, the immigration of ancestors was found to increase trade with origin countries in subsequent generations. Considering the theoretical background that immigration affects trade through network effects via links, the assumption that past immigration is exogenous to current trade can be challenging to accept.

Kang (2017) conducted an analysis using panel data and a gravity model to study the impact of immigration on trade in Korea. The results showed that both long-term residents and total entrants positively affected exports and imports. Such empirical studies using data from Korea or other countries consistently indicate a positive effect of immigration on trade.

This paper presents new approaches to analyzing the impact of immigration on value-added exports in Korea, using a country-level panel

dataset. This analysis is particularly timely given the increasing significance of viewing trade in value-added terms, spurred by the evolution of GVCs, and amidst the reality of Korea's demographic decline.

By leveraging visa policy as an instrumental variable, this study aims to robustly address the endogeneity between immigration and trade to accurately estimate causal effects. Furthermore, by demonstrating that the impacts vary by income level and industry, this research provides substantive policy implications for formulating immigration policies related to trade, thereby enriching the discourse on the nexus between immigration and economic output.

4. Data and methodology

4.1. Data

In this research, I have constructed a country-level panel dataset targeting 75 major trading partners¹⁰⁾ of Korea using data from the OECD's Trade in Value Added (TiVA) Indicators (OECD, 2023), the CEPII Gravity database (Conte et al., 2022),¹¹⁾ UNCTAD stat, and immigration statistics from the Ministry of Justice of Korea. These 75 countries accounted for 89.5% of Korea's gross domestic value-added in exports, with foreign residents representing 86.9% of the total in 2019, suggesting that this dataset adequately represents the overall value-added exports and foreign resident population in Korea. The sample period spans from 2009 to 2020, during which data on registered foreign residents is available.¹²⁾

10) The list of 75 countries has been presented in the appendix <Table A1>.

11) For missing data in the CEPII Gravity database (Conte et al., 2022), I supplemented the original data sources with the Maddison Project Database (Bolt et al., 2020) and the National Statistics, Taiwan (<https://nstatdb.dgbas.gov.tw/dgbasall/webMain.aspx?k=engmain>, Accessed on January 15, 2024) to construct a balanced panel.

12) Additionally, robustness checks were conducted by adjusting the sample period to account for specific external shocks during the given timeframe.

The OECD TiVA data, based on inter-country input-output tables,¹³⁾ provides information on trade in value-added terms for 76 economies from 1995 to 2020. According to the OECD TiVA indicator guide 2023,¹⁴⁾ a country's gross exports ($EXGR$)¹⁵⁾ are decomposed into gross domestic value-added contents of gross exports ($EXGR_DVA$) and foreign value-added contents of gross exports ($EXGR_FVA$), along with double-counted parts.¹⁶⁾ The $EXGR_DVA$ are further classified into direct domestic value-added contents of gross exports ($EXGR_DDC$), which represent the domestic value-added absorbed directly in the importing country, indirect domestic value-added contents of gross exports ($EXGR_IDC$), which are the domestic value-added processed in the importing country and then exported to a third country, and re-imported domestic value-added contents of gross exports ($EXGR_RIM$). <Figure 2> summarized the decomposition of gross exports in terms of value-added. From the perspective of GVCs, the $EXGR_FVA$, which is foreign value-added contents of gross exports, signify *backward GVC-related exports*. Conversely, domestic value-added in foreign exports measure *forward GVC-related exports*. Summing *forward* and *backward GVC-related exports* yields *GVC-related exports*.¹⁷⁾¹⁸⁾ This study utilizes

13) The databases that form the basis for trade in value-added analysis include the OECD, Institute of Developing Economies (IDE), Global Trade Analysis Project (GTAP), The World Input-Output Database (WIOD), and the Asian Development Bank (ADB). While there are differences between these databases, discrepancies are not considered significant (Uchida and Oyamada, 2017). One of advantages of the OECD's database is its provision of data in a ready-to-use format based on input-output tables for research purposes.

14) It assumes settlement within a single period; in other words, all products consumed within a year are produced in the same year, and vice versa.

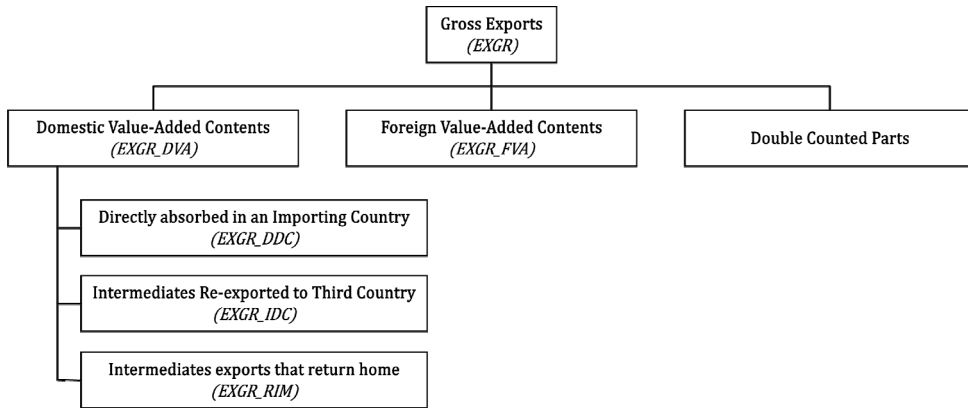
15) The abbreviations in parentheses are variable names from the OECD database.

16) The double-counted parts are removed by estimates of re-exports and re-imports, converting to a basic price valuation, and reconciling bilateral asymmetries through balancing under output constraints.

17) For more explanations of the decomposition of value-added exports, refer to Koopman et al. (2014) and Borin and Mancini (2019).

18) The OECD (2023) provides data on forward GVC participation ($FEXDAVpSH$) and backward GVC participation ($DEXFVApSH$), calculated by dividing each of these exports by Korea's total gross exports at year t . However, this study extracted only the numerator by multiplying Korea's total gross exports value for each year to exclude variations due to gross exports. Using the share variables directly did not significantly alter the empirical results, which are available upon request.

〈Figure 2〉 Decomposition of Gross Exports in Terms of Value-Added



Note: Gross Domestic Value-Added Exports: *EXGR_DVA*; *Backward* GVC-related exports: *EXGR_FVA*; *Forward* GVC-related exports: *EXGR_FVA* from perspective of a foreign country.

Sources: by the author, referencing OECD (2023), Borin and Mancini (2019), and Koopman et al. (2014).

gross domestic value-added contents of gross exports (*EXGR_DVA*) and *GVC-related exports*, including *forward* and *backward*, variables as dependent variables.

The Ministry of Justice in Korea provides immigration statistics including the number of entrants by visa type, registered foreign residents, confirmations of visa issuance, and permanent residents. However, in Korea, visa types do not always align with employment status, which can complicate interpretations based on visa classification (Chung and Lee, 2016). While data on permanent residents may be more suitable for studying the economic integration of immigrants and its trade impact, it may not represent the entire immigrant population and could be biased towards certain nationalities or economic conditions. Thus, this research uses the number of registered foreign residents staying over 90 days as a proxy for immigration, excluding short-term visitors and potentially reducing instability. Additionally, confirmations of visa issuance can serve as a variable reflecting Korea's visa policy.¹⁹⁾ And, UNCTAD stat provides

19) The Korean Minister of Justice issues these confirmations prior to visa issuance by heads of overseas missions when it is deemed particularly necessary. This is based on applications from foreigners looking to enter Korea or from sponsors residing within the country.

information on each country's Consumer Price Index (CPI) and exchange rates. Lastly, the CEPII Gravity database provides essential data for gravity model analysis, including information on GDP per capita.²⁰⁾ Descriptive statistics of the panel dataset are presented in <Table 4>.

<Table 4> Descriptive Statistics

Variables	Mean	Std. dev.	Min	Max	Obs.
Gross Domestic VA in Exports (logged)	6.77	2.06	0.99	11.60	900
Gross Domestic VA_Industry (logged)	5.96	2.36	-1.61	11.33	900
Gross Domestic VA_Service (logged)	5.84	1.89	0.74	10.51	900
GVC-related Exports (logged)	13.18	0.81	11.50	15.64	900
Forward GVC-related Exports (logged)	1.75	2.73	-5.74	7.86	900
Backward GVC-related Exports (logged)	12.05	1.20	0.00	15.27	900
Foreign Residents (logged)	6.35	2.42	0.00	13.25	900
Visa Policy (individual)	1064.49	3218.38	0.00	36160.00	900
GDP_pc_Origin (logged)	2.54	1.27	-0.38	4.78	900
CPI (logged)	4.76	0.24	4.48	6.91	900
Exchange Rate (logged)	2.17	2.77	-1.51	9.93	900

Note: The "Gross Domestic Value-Added (VA) Exports" represents the logarithmic value of domestic value-added in gross exports. The Industry sector includes Mining (B), Manufactures (C), and Utilities (D). The Service sector covers all service industries (F-T), including Construction (F). Parenthetical classifications conform to the International Standard Industrial Classification of All Economic Activities (ISIC) Revision 4. The "Forward Global Value Chain (GVC)-related Exports" represent the log value of the domestic value-added in foreign exports. The "Backward GVC-related Exports" represent the log value of the foreign value-added in domestic exports. The "GVC-related Export" is the log value of the sum of "Forward GVC-related Exports" and "Backward GVC-related Exports". The "Foreign Residents" variable captures the logarithmic value of the count of foreign individuals who have resided in Korea for over 90 days. The "Visa Policy" variable reflects the number of visa issuance confirmations approved by the Ministry of Justice in Korea. The "GDP pc Origin (logged)" pertains to the originating countries' GDP per capita expressed in current thousands of US dollars. The "CPI" variable represents the logarithmic value of annual consumer price indices (2015 = 100). The "Exchange Rate" represents the logarithmic value of the currency value relative to 1,000 Korean Won (KRW). The sample period spans from 2009 to 2020.

Sources: OECD TiVA Indicators (2023), CEPII Gravity database (2022), UNCTAD stat, and the Ministry of Justice of Korea.

20) While the CEPII Gravity database provides useful information such as distances between countries, origins of legal systems, and WTO membership status, this study did not report descriptive statistics for these variables due to its reliance on a fixed effects model, which cannot estimate time-invariant variables. These details are available upon request.

4.2. Methodology

4.2.1. Gravity model

In this study, the relationship between immigration and value-added exports was empirically examined based on the gravity model. The gravity model was first proposed by Tinbergen (1962) and Pöyhönen (1963) and has been widely used to explain patterns and determinants of international trade to this day (Genc et al., 2011; Erhardt and Lassmann, 2023; Kim, 2023). Drawing inspiration from Newton's law, which suggests that larger and closer objects exert greater gravitational pull, the gravity model assumes that trade between two countries is directly proportional to their economic sizes and inversely proportional to the distance between them. Hence:

$$X_{ij} = G \frac{E_i E_j}{D_{ij}} \quad (1)$$

Where i represents Korea and j refers to other countries; X_{ij} is the trade (exports, imports, or both) between countries i and j ; E_i and E_j represents the economic size, such as GDP or GDP per capita, of i and j ; D_{ij} is the distance between i and j ; and G is a gravitational constant.

Many previous studies have logarithmically linearized Equation (1) and conducted empirical analyses by including factors such as the similarity of languages, access to coasts, presence of trade agreements, adjacency to neighboring countries, and colonial relationships, in addition to the economic sizes and distances between countries. These studies have demonstrated that the gravity model possesses considerable explanatory power (Genc et al., 2011; Erhardt and Lassmann, 2023; Kim, 2023). In this study, a standard logarithmically linearized gravity model is employed, with value-added exports like *GR_DVA* and *GVC-related exports* as the dependent variables. The model is further controlled by

including explanatory variables such as the number of foreign residents, price level, exchange rate, GDP per capita, origin's time-invariant fixed effects,²¹⁾ and year dummy (Kang, 2017; Kim, 2023):

$$\ln VA_{jt} = \beta_0 + \beta_1 \ln M_{jt} + \beta_2 \ln E_{jt} + \beta_3 Z_{jt} + \sigma_j + \mu_t + e_{jt} \quad (2)$$

Where j refers to each origin country; VA_{jt} stands for each type of value-added exports to j from Korea at t ; M_{jt} is the number of foreign residents from j at t ; E_{jt} are the per capita GDP of j at t ; Z_{jt} indicate price level, exchange rate of j in year t ; σ_j represents the unobserved time-invariant unique country fixed effects; μ_j is the year dummy, and e_{jt} is the error term.

4.2.2. Instrumental variable

One of the main challenges in studying the causal relationship between immigration and trade is the endogeneity of immigration and trade. It is possible that immigration influences trade, but it is also likely that people migrate to countries with active trade (Erhardt and Lassmann, 2023; Kim, 2023). Thus, many empirical studies have attempted to address this endogeneity issue using the instrumental variable approach (McKenzie, 2005; Tai, 2009; Javorcik et al, 2011; Hatzigeorgiou and Lodefalk, 2015; Kim, 2023). This study employed the Fixed Effects Two-Stage Least Squares (FE2SLS) model to handle the potential endogeneity issue.

A good instrumental variable should explain an endogenous variable while being determined independently with the dependent variable of a main model. In this study, Korea's visa policy was utilized as an instrumental variable. The visa policy, influenced by the Korean government's decision to control social issues arising from

21) The distance between countries has been included in the fixed effects and is not displayed in the equation.

indiscriminate influx of foreigners, is not considered to directly impact trade volume. However, the visa policy is likely to have a direct effect on the number of foreign residents. The study measures the visa policy by the number of confirmations of visa issuance, a system where the Minister of Justice of Korea approves upon requests from Korean inviters for expedited visa processing. Since these confirmations are granted by the Ministry of Justice of Korea, they are expected to be exogenous to trade, while likely being highly correlated with the number of foreign residents.

To assess the appropriateness of the instrumental variable used in the research, the summary of the first-stage within regression results is presented in <Table A2> in the appendix. According to <Table A2>, foreign residents show a positive correlation with visa policy, indicating that visa policy effectively explains the endogenous variable, foreign residents, in the main model. The F-statistic of this estimation is 10.80, which suggests that the instrument is strong, as an F-statistic above 10 is generally considered robust (Stock et al., 2002), mitigating concerns about weak instrument bias. As previously mentioned, the visa policy incorporates governmental intent, rendering it theoretically likely that the instrumental variable is exogenous in relation to the main model's dependent variables which are gross domestic value-added exports and GVC-related exports. <Table A3> empirically shows that the correlation coefficient between gross domestic value-added exports and visa policy is relatively low at 0.3271, supporting this assumption. Lastly, I assume that only foreign residents have an endogenous relationship with trade, while the other variables are considered exogenous.²²⁾ In this case the only one endogenous variable and a corresponding single instrumental variable in the model reduces concerns about over-identification.

22) In the design phase of this study, the FTA dummy was considered as an explanatory variable, assuming exogeneity. However, following an anonymous reviewer's suggestion that FTAs could be endogenous since they are more likely to be established with countries engaging in active trade, the FTA dummy was excluded. After excluding this variable, the empirical results and analysis did not change significantly.

5. Results

5.1. Main results

The regression results displayed in <Table 5> indicate that an increase in foreign residents leads to an increase in value-added exports in Korea, although the effect size is relatively smaller compared to the regression using gross exports as the dependent variable presented in <Table A4>. ²³⁾ Specifically, a 1% increase in foreign residents results in a 0.316% increase in value-added exports. ²⁴⁾ This suggests that the influx of immigrants follows known pathways, and the effect appears smaller once double-counting is eliminated. When setting value-added exports as the dependent variable for different sectors, the regression coefficient representing the influx of immigrants is larger in the industry sector than in the service sector. While the coefficients show statistically significant effects across all sectors, the difference is not substantial, suggesting it is challenging to conclusively state that immigrants have a more significant impact on the industry sector.

By categorizing panels by income, ²⁵⁾ the analysis has identified heterogeneity in the impact of immigration on value-added exports: increases were observed only in low-income groups. Throughout the sample period, Korea effectively grew from a middle to a high-income status, suggesting differences in technology and other factors compared to the low-income group. In the case of the low-income

23) Previous research has shown that immigration in Korea increases gross exports (Kang, 2017; Kim, 2023).

24) In contrast, a 1% increase in foreign residents leads to a 0.374% increase in gross exports. See <Table A4>.

25) Based on the average per capita GDP from 2009 to 2020, countries have been categorized as follows: low income (including countries like Vietnam) with a per capita GDP of \$5,000 or less, middle income (including countries like China) with a per capita GDP exceeding \$5,000 but less than \$15,000, and high income (including countries like the U.S.) with a per capita GDP of \$15,000 or more.

(Table 5) Impacts of Foreign Residents on Domestic Value-Added Exports

Variables	Gross Domestic Value-Added Exports											
	Entire Sample			High Income			Middle Income			Low Income		
	(1) All	(2) Industry	(3) Service	(4) All	(5) Industry	(6) Service	(7) All	(8) Industry	(9) Service	(10) All	(11) Industry	(12) Service
Foreign Residents _{it} (logged)	0.316*** (0.111)	0.510* (0.280)	0.393*** (0.135)	0.063 (0.097)	0.084 (0.129)	0.102 (0.088)	0.770 (0.724)	1.922 (1.357)	0.679 (0.699)	0.682*** (0.228)	1.161* (0.605)	0.974*** (0.305)
GDP_pc_Origin _{it} (logged)	1.006*** (0.258)	0.815** (0.359)	0.725*** (0.206)	1.931*** (0.323)	1.269* (0.691)	1.562*** (0.269)	0.808 (0.790)	1.519 (1.424)	0.537 (0.686)	0.177 (0.404)	-0.141 (0.613)	-0.050 (0.366)
CPI _{it} (logged)	-1.221*** (0.445)	-1.473** (0.615)	-0.635 (0.410)	-1.806* (1.026)	-3.439 (2.125)	-1.477* (0.854)	0.097 (0.981)	0.644 (2.190)	0.433 (0.788)	0.711 (0.590)	1.265 (1.405)	1.899** (0.954)
Exchange Rate _{it} (logged)	0.842** (0.359)	0.764 (0.499)	0.322 (0.319)	1.894*** (0.574)	1.621 (0.989)	1.192*** (0.461)	-0.105 (0.868)	-0.553 (1.911)	-0.483 (0.691)	-1.499** (0.681)	-2.772* (1.533)	-2.279*** (0.782)
Constant	6.092*** (1.231)	5.761*** (2.351)	3.784*** (1.224)	7.388 (5.174)	16.148 (10.141)	6.454* (3.821)	-0.131 (-5.135)	-10.645 (-10.556)	-0.734 (-5.366)	4.268* (2.555)	3.546 (5.074)	-0.201 (3.164)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Origin FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
First-stage F stat	10.80	10.80	10.80	12.82	12.82	12.82	11.16	11.16	11.16	31.14	31.14	31.14
Observations	900	900	900	432	432	432	252	252	252	216	216	216

Note: *** p<0.01, ** p<0.05, * p<0.1. Numbers in parentheses represent country-clustered standard errors. The "Gross Domestic Value-Added (VA) Exports" represents the logarithmic value of domestic value-added in gross exports. The Industry sector includes Mining (B), Manufactures (C), and Utilities (D). The Service sector covers all service industries (F-T), including Construction (F). Parenthetical classifications conform to the International Standard Industrial Classification of All Economic Activities (ISIC) Revision 4. Based on the average per capita GDP from 2009 to 2020, countries have been categorized as follows: low income (including notable countries like Vietnam) with a per capita GDP of \$5,000 or less, middle income (including countries like China) with a per capita GDP exceeding \$5,000 but less than \$15,000, and high income (including countries like the U.S.) with a per capita GDP of \$15,000 or more. The "Foreign Residents" variable captures the logarithmic value of the count of foreign individuals who have resided in Korea for over 90 days. The "GDP pc Origin (logged)" pertains to the originating countries' GDP per capita expressed in current thousands of US dollars. The "CPI" variable represents the logarithmic value of annual consumer price indices (2015 = 100). The "Exchange Rate" represents the logarithmic value of the currency value relative to 1,000 Korean Won (KRW). All estimations were controlled for year dummies and origin country fixed effects. The "Visa Policy" variable, which represents the number of visa issuance confirmations approved by the Ministry of Justice in Korea, is utilized as an instrumental variable. The Fixed Effects Two-Stage Least Square model is applied in this estimation. The sample period spans from 2009 to 2020.

group, the increase in value-added is perceived to stem from improvements in labor productivity due to different skill sets compared to the Korean workforce and its lower wage level. Interestingly, no statistical significance was found in the high and middle-income group,²⁶⁾ which includes China. While the foreign

26) In the regression including the GDP variable, results for the high-income group were statistically significant, suggesting that value-added creation may result from spillover effects due to the influx of labor with higher technology levels. However, concerns about a weak instrument were raised, as the F-statistic from the first-stage regression was 9.88, which is below the threshold of 10. Consequently, these findings were not reported in the

residents variables of the OLS estimations²⁷⁾ was statistically significant, this is believed to be due to biases arising from the endogeneity between immigration and value-added exports. After adjusting for this, the impact of immigration on value-added exports was not observed. Unlike the low-income groups, it is speculated that the mechanisms capable of generating value-added are weaker in these groups. As discussed in section 3, heterogeneous labor can enhance productivity. These results may suggest that the technological level of Korean labor might not significantly differ from the skill levels of workers from high-income and middle-income countries.

Next, let's delve into the results from estimating each control variable. Across the entire sample, all control variables demonstrated statistical significance. Specifically, the GDP per capita of the origin country, and exchange rate exhibited positive correlations, whereas the CPI showed an inverse relationship. This pattern aligns with expectations to some extent. Dividing the dataset by income level reveals that the high-income group mirrors the aggregate findings, with every variable being statistically significant. Conversely, within other income brackets, the exchange rate measure displayed a significant negative association with gross domestic value-added exports among the low-income countries. This distinction hints at the variables related to the GDP per capita, price level, and exchange rate from the importer's perspective influencing the import price, suggesting that the high-income group might exhibit greater price elasticity of import demand, thereby impacting the value-added exports from Korea. However, this inference about price elasticity's impact across different income groups is nuanced, considering factors like the monopolistic strength of Korean goods and services or the cost and time associated with finding new suppliers due to

main results of the study, but they are available upon request.

27) The OLS estimation results presented in <Table A5> of the appendix.

integration into GVCs potentially reducing short-term price elasticity in low and middle-income groups.

Remarkably, in the low-income category, the coefficients of the exchange rate variable stand out negatively. Typically, a rising exchange rate of the exporter's currency would lower the import cost for the importing nation, expectedly increasing demand - a scenario observed within the high-income cohort. Nevertheless, this suggests that for the low-income group, despite a decrease in import prices due to a depreciating Korean Won, demand remains unchanged,

<Table 6> Impacts of Foreign Residents on GVC-related Exports

Variables	GVC-related Exports											
	Entire Sample			High Income			Middle Income			Low Income		
	(1) All	(2) Forward	(3) Backward	(4) All	(5) Forward	(6) Backward	(7) All	(8) Forward	(9) Backward	(10) All	(11) Forward	(12) Backward
Foreign Resident _{it} (logged)	-0.032 (0.054)	0.492 (0.300)	-0.195 (0.219)	-0.101* (0.058)	-0.007 (0.167)	-0.179** (0.078)	0.307 (0.359)	0.969 (1.084)	0.123 (0.394)	0.006 (0.125)	1.427** (0.626)	0.476 (0.697)
GDP_pc_Origin _{it} (logged)	0.168 (0.121)	1.097*** (0.344)	-0.730 (0.774)	0.236 (0.268)	2.066*** (0.487)	-0.028 (0.545)	0.593 (0.420)	0.943 (1.296)	0.870* (0.448)	-0.025 (0.183)	0.020 (0.618)	-2.296 (1.931)
CPI _{it} (logged)	-0.435* (0.250)	-1.576*** (0.681)	0.118 (0.992)	-0.360 (0.660)	-2.251 (1.542)	-1.236 (1.174)	-0.540 (0.456)	0.179 (1.465)	-2.337*** (0.573)	-0.339 (0.459)	2.040 (1.510)	2.213 (2.798)
Exchange Rate _{it} (logged)	0.438** (0.204)	1.097** (0.512)	0.068 (0.746)	0.302 (0.400)	2.143** (0.867)	0.564 (0.674)	0.666* (0.382)	-0.031 (1.272)	2.055*** (0.517)	0.047 (0.381)	-3.137** (1.515)	-2.167 (2.806)
Constant	13.700*** (0.814)	0.955 (2.591)	13.763*** (1.304)	13.969*** (2.988)	4.229 (7.688)	18.060*** (4.318)	10.753*** (2.896)	-7.239 (7.570)	15.267*** (3.056)	14.086*** (1.345)	-4.178 (5.782)	9.303* (4.835)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Origin FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
First-stage F stat	10.80	10.80	10.80	12.82	12.82	12.82	11.16	11.16	11.16	31.14	31.14	31.14
Observations	900	900	900	432	432	432	252	252	252	216	216	216

Note: *** p<0.01, ** p<0.05, * p<0.1. Numbers in parentheses represent country-clustered standard errors. The "Forward Global Value Chain (GVC)-related Exports" represent the log value of the domestic value-added in foreign exports. The "Backward GVC-related Exports" represent the log value of the foreign value-added in domestic exports. The "GVC-related Export" is the log value of the sum of "Forward GVC-related Exports" and "Backward GVC-related Exports". Based on the average per capita GDP from 2009 to 2020, countries have been categorized as follows: low income (including notable countries like Vietnam) with a per capita GDP of \$5,000 or less, middle income (including countries like China) with a per capita GDP exceeding \$5,000 but less than \$15,000, and high income (including countries like the U.S.) with a per capita GDP of \$15,000 or more. The "Foreign Residents" variable captures the logarithmic value of the count of foreign individuals who have resided in Korea for over 90 days. The "GDP pc Origin (logged)" pertains to the originating countries' GDP per capita expressed in current thousands of US dollars. The "CPI" variable represents the logarithmic value of annual consumer price indices (2015 = 100). The "Exchange Rate" represents the logarithmic value of the currency value relative to 1,000 Korean Won (KRW). All estimations were controlled for year dummies and origin country fixed effects. The "Visa Policy" variable, which represents the number of visa issuance confirmations approved by the Ministry of Justice in Korea, is utilized as an instrumental variable. The Fixed Effects Two-Stage Least Square model is applied in this estimation. The sample period spans from 2009 to 2020.

leading to a reduction in Korea's value-added exports. This phenomenon may indicate a lower price elasticity or the enduring impact of contractual obligations within GVCs, making it challenging to adjust demand promptly in response to price changes.

The estimation results for foreign residents and GVC-related exports²⁸⁾ are presented in <Table 6>. Across the entire sample, all sorts of GVC-related exports were not statistically significant. However, when divided by income group, the increase in forward GVC-related exports occurred in the low-income group. This suggests an expansion in the production of final goods or secondary intermediates in those countries through intermediate exports from Korea, implying that immigrants act as a bridge with secondary producers located in lower-wage countries. On the other hand, in the high-income group, all and backward GVC-related exports decreased. Considering that backward-GVC exports represents the foreign value-added in Korea's gross exports and that gross domestic value-added exports increased in the high-income group as shown in <Table 6>, it was inferred that there is a positive relationship with value creation within Korea rather than with their home countries. In other words, as the number of immigrants from high-income countries increases, the domestic value-added in Korea's exports to these high-income countries also increases.

5.2 Robustness check

I conducted two analyses to verify the robustness of the research, both of which support the main results: (1) transforming variables into difference variables to observe within-panel effects,²⁹⁾ (2) adjusting the

28) The discrepancy between value-added exports and gross exports is attributed to the export of intermediates, that is, participation in GVCs. The development of GVCs leads to the double counting issue in gross exports, which is also a reason for examining value-added exports.

29) To control for endogeneity in panel data, one can use fixed effects or the first difference (FD) method. If the error terms exhibit serial correlation, the FD model may be more efficient (Wooldridge, 2010).

(Table 7) Robustness Check: Difference Variables

Variables	Δ Gross Domestic Value-Added			Δ GVC-related Exports		
	(1) All	(2) Industry	(1) Service	(4) All	(5) Forward	(6) Backward
Δ Foreign Residents _{it} (logged)	1.805** (0.871)	2.304** (1.025)	0.768 (0.773)	0.500 (0.637)	2.879** (1.344)	-0.351 (1.159)
Δ GDP_pc_Origin _{it} (logged)	1.002*** (0.366)	1.435** (0.593)	0.435** (0.202)	0.284* (0.156)	1.416** (0.578)	0.198 (0.459)
Δ CPI _{it} (logged)	-0.520 (0.587)	-0.696 (1.103)	-0.182 (0.369)	-0.237 (0.390)	-0.837 (0.984)	-0.948 (0.684)
Δ Exchange Rate _{it} (logged)	0.236 (0.334)	0.594 (0.677)	-0.192 (0.169)	0.186 (0.174)	0.408 (0.591)	1.274** (0.497)
Constant	-0.193 (0.162)	-0.278 (0.200)	0.011 (0.139)	0.181 (0.112)	-0.443* (0.250)	0.273 (0.220)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes
Origin fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
First-stage F stat	10.96	10.96	10.96	10.96	10.96	10.96
Observations	825	825	825	825	825	825

Note: *** p<0.01, ** p<0.05, * p<0.1. Numbers in parentheses represent country-clustered standard errors. The "Gross Domestic Value-Added Exports" represents the logarithmic value of domestic value-added in gross exports. The Industry sector includes Mining (B), Manufactures (C), and Utilities (D). The Service sector covers all service industries (F-T), including Construction (F). Parenthetical classifications conform to the International Standard Industrial Classification of All Economic Activities (ISIC) Revision 4. The "Forward Global Value Chain (GVC)-related Exports" represent the log value of the domestic value-added in foreign exports. The "Backward GVC-related Exports" represent the log value of the foreign value-added in domestic exports. The "GVC-related Export" is the log value of the sum of "Forward GVC-related Exports" and "Backward GVC-related Exports". The "Foreign Residents" variable captures the logarithmic value of the count of foreign individuals who have resided in Korea for over 90 days. The "GDP pc Origin (logged)" pertains to the originating countries' GDP per capita expressed in current thousands of US dollars. The "CPI" variable represents the logarithmic value of annual consumer price indices (2015 = 100). The "Exchange Rate" represents the logarithmic value of the currency value relative to 1,000 Korean Won (KRW). All estimations were controlled for year dummies and origin country fixed effects. The "Visa Policy" variable, which represents the number of visa issuance confirmations approved by the Ministry of Justice in Korea. 1-year lagged visa policy variable is utilized as an instrumental variable. The Fixed Effects Two-Stage Least Square model is applied in this estimation. The sample period spans from 2009 to 2020.

sample period to exclude exogenous shocks, and (3) considering time-lagged effects. (Table 7) presents the results using difference variables. Similar to the main results, the relationship between foreign residents and value-added exports remained consistent when transformed into difference variables, but the CPI and exchange rate variables were not statistically significant. While the results by income

group are not reported due to space limitations,³⁰⁾ this trend is primarily driven by an increase in forward GVC-related exports from the low-income group, as indicated in <Table 6>.

<Table 8> Robustness Check: Sample Period (2009–2015, 2017–2019)

Variables	Gross Domestic Value-Added			GVC-related Exports		
	(1) All	(2) Industry	(1) Service	(4) All	(5) Forward	(6) Backward
Foreign Residents _{it} (logged)	0.354*** (0.119)	0.570* (0.298)	0.424*** (0.125)	-0.052 (0.065)	0.559* (0.309)	-0.245 (0.263)
GDP_pc_Origin _{it} (logged)	0.990*** (0.238)	0.801** (0.375)	0.706*** (0.205)	0.180 (0.117)	1.082*** (0.319)	-0.777 (0.833)
CPI _{it} (logged)	-1.162*** (0.448)	-1.434** (0.648)	-0.494 (0.438)	-0.414 (0.264)	-1.496** (0.706)	0.059 (0.913)
Exchange Rate _{it} (logged)	0.718** (0.357)	0.624 (0.523)	0.185 (0.341)	0.389* (0.219)	0.909* (0.533)	0.133 (0.676)
Constant	5.882*** (1.350)	5.538** (2.544)	3.265** (1.299)	13.787*** (0.903)	0.599 (2.806)	14.308*** (1.528)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes
Origin fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
First-stage F stat	10.89	10.89	10.89	10.89	10.89	10.89
Observations	750	750	750	750	750	750

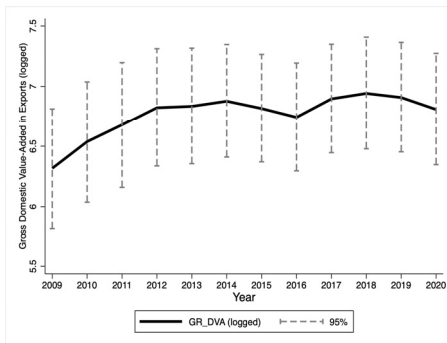
Note: *** p<0.01, ** p<0.05, * p<0.1. Numbers in parentheses represent country-clustered standard errors. The "Gross Domestic Value-Added Exports" represents the logarithmic value of domestic value-added in gross exports. The Industry sector includes Mining (B), Manufactures (C), and Utilities (D). The Service sector covers all service industries (F-T), including Construction (F). Parenthetical classifications conform to the International Standard Industrial Classification of All Economic Activities (ISIC) Revision 4. The "Forward Global Value Chain (GVC)-related Exports" represent the log value of the domestic value-added in foreign exports. The "Backward GVC-related Exports" represent the log value of the foreign value-added in domestic exports. The "GVC-related Export" is the log value of the sum of "Forward GVC-related Exports" and "Backward GVC-related Exports". The "Foreign Residents" variable captures the logarithmic value of the count of foreign individuals who have resided in Korea for over 90 days. The "GDP pc Origin (logged)" pertains to the originating countries' GDP per capita expressed in current thousands of US dollars. The "CPI" variable represents the logarithmic value of annual consumer price indices (2015 = 100). The "Exchange Rate" represents the logarithmic value of the currency value relative to 1,000 Korean Won (KRW). All estimations were controlled for year dummies and origin country fixed effects. The "Visa Policy" variable, which represents the number of visa issuance confirmations approved by the Ministry of Justice in Korea. 1-year lagged visa policy variable is utilized as an instrumental variable. The Fixed Effects Two-Stage Least Square model is applied in this estimation. The sample period spans from 2009 to 2020.

30) Results are available upon requests.

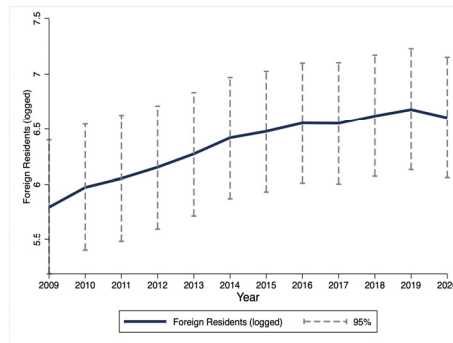
The results in <Table 8> were consistent with the main findings even in the sample period excluding 2016 and 2020. As shown in <Figure 3>, in 2016, the friction between Korea and China, known as the THAAD³¹⁾ dispute, led to a decrease in Korea's value-added exports due to China's informal sanctions. In 2020, both main variables decreased due to the impact of COVID-19. The analysis, excluding these influences, showed the same effect as the main results, with the coefficients slightly increasing. Especially, the decrease in Korea's value-added exports in 2016, due to friction with China, indirectly supports the empirical findings that foreign residents do not influence value-added exports in the middle-income group, which includes China.

Choi et al. (2024) used U.S. data to demonstrate that the descendants of immigrants trade more with their ancestors' countries. Limited by this study, I included one-year and two-year lag variables in the analysis, the results of which are presented in <Table 9>. However, excluding the service sector, the results were not statistically significant when lag variables were included. This suggests that the history of immigration in Korea might be too short to establish significant

<Figure 3> Averages of Dependent Variables over the Sample Period



(a) Gross Domestic Value-Added Exports



(b) Foreign Residents

31) Terminal High Altitude Area Defense: A high-altitude missile defense system deployed in Korea by the U.S. Forces Korea in 2016. China has raised issues with the radar range of this system, leading to intensified diplomatic and economic friction with Korea.

linkages among immigrants, and the nature of the inputs involved might be pronounced. However, the service sector might be more influenced by the linkage effect since it involves human interactions.

<Table 9> Robustness Check: Time Lags

Variables	One-year Lag						Two--year Lag					
	GR_DVA		GVC-related Exports				GR_DVA			GVC-related Exports		
	(1) All	(2) Industry	(1) Service	(4) All	(5) Forward	(6) Backward	(7) All	(8) Industry	(9) Service	(10) All	(11) Forward	(12) Backward
Foreign Resident _{t-1} (logged)	0.145 (0.136)	0.331 (0.284)	0.323*** (0.111)	-0.107 (0.075)	0.237 (0.294)	-0.147 (0.145)						
Foreign Resident _{t-2} (logged)							0.101 (0.159)	0.194 (0.264)	0.312*** (0.119)	-0.165* (0.095)	0.100 (0.289)	-0.269 (0.174)
GDP_pc_Origin _t (logged)	1.001*** (0.292)	0.846*** (0.374)	0.710*** (0.219)	0.163 (0.130)	1.102*** (0.377)	-0.708 (0.733)	1.074*** (0.336)	1.080*** (0.381)	0.748*** (0.240)	0.203 (0.132)	1.297*** (0.423)	-1.044 (1.030)
CPI (logged) _t	-1.181*** (0.438)	-1.377*** (0.627)	-0.695* (0.399)	-0.383 (0.249)	-1.516*** (0.656)	0.323 (1.222)	-1.226*** (0.457)	-1.543*** (0.629)	-0.711* (0.389)	-0.440* (0.234)	-1.704*** (0.650)	1.277 (2.037)
Exchange Rate _t (logged)	0.864*** (0.378)	0.752 (0.512)	0.393 (0.318)	0.390* (0.208)	1.120** (0.512)	-0.087 (0.860)	1.002** (0.412)	1.089** (0.512)	0.491 (0.323)	0.467** (0.204)	1.450*** (0.525)	-0.740 (1.444)
Constant	6.967*** (1.164)	6.508*** (2.296)	4.450*** (1.068)	14.267*** (0.776)	2.164 (2.403)	13.164*** (1.793)	7.045*** (1.160)	7.004*** (2.101)	4.261*** (0.972)	14.929*** (0.696)	2.902 (2.195)	11.995*** (3.494)
Year dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Origin fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
First-stage F stat	10.89	10.89	10.89	10.89	10.89	10.89	10.74	10.74	10.74	10.74	10.74	10.74
Observations	825	825	825	825	825	825	750	750	750	750	750	750

Note: *** p<0.01, ** p<0.05, * p<0.1. Numbers in parentheses represent country-clustered standard errors. The "GR_DVA (Gross Domestic Value-Added Exports)" represents the logarithmic value of domestic value-added in gross exports. The Industry sector includes Mining (B), Manufactures (C), and Utilities (D). The Service sector covers all service industries (F-T), including Construction (F). Parenthetical classifications conform to the International Standard Industrial Classification of All Economic Activities (ISIC) Revision 4. The "Forward Global Value Chain (GVC)-related Exports" represent the log value of the domestic value-added in foreign exports. The "Backward GVC-related Exports" represent the log value of the foreign value-added in domestic exports. The "GVC-related Export" is the log value of the sum of "Forward GVC-related Exports" and "Backward GVC-related Exports". The "Foreign Residents" variable captures the logarithmic value of the count of foreign individuals who have resided in Korea for over 90 days. The "GDP pc Origin (logged)" pertains to the originating countries' GDP per capita expressed in current thousands of US dollars. The "CPI" variable represents the logarithmic value of annual consumer price indices (2015 = 100). The "Exchange Rate" represents the logarithmic value of the currency value relative to 1,000 Korean Won (KRW). All estimations were controlled for year dummies and origin country fixed effects. The "Visa Policy" variable, which represents the number of visa issuance confirmations approved by the Ministry of Justice in Korea. 1-year lagged visa policy variable is utilized as an instrumental variable. The Fixed Effects Two-Stage Least Square model is applied in this estimation. The sample period spans from 2009 to 2020.

6. Conclusion

This study explores the impact of immigration on Korea's value-added exports and participation in GVCs, using a country-level panel dataset. Through empirical analysis with the fixed effects two-stage model and visa policy as the instrumental variable, the findings indicate that immigration significantly boosts Korea's domestic value-added exports. Particularly in the low-income group, there is an enhancement in forward GVC-related exports. These results highlight the pivotal role of immigrants in strengthening Korea's trade dynamics and economic resilience.

The findings of this research offer several policy implications. Firstly, facilitating immigration can serve as a strategic tool to boost Korea's export-driven economy, especially in sectors where value addition is critical. Secondly, heterogeneity and diversity may be more effective in creating value-added and participating in GVCs. Therefore, it is necessary to examine the influx of immigrants with a more proactive attitude and evaluate their effects.

A notable limitation of this study is the dataset's inability to account for the effects of Koreans residing abroad, which might influence the model's outcomes. This gap underscores the complex interplay between immigration and trade, highlighting areas for further exploration.

The mechanism through which immigration increases value-added exports warrants deeper analysis and empirical investigation. Understanding the specific ways in which immigrants contribute to the domestic economy's value addition - whether through innovation, bridging cultural and economic gaps, or enhancing labor market flexibility - is crucial.

It is reported that immigration also affects imports, which this study has not empirically examined, marking a limitation.

Additionally, while the study suggests that income group heterogeneity could play a crucial role in increasing value-added exports, it has not conducted a rigorous causal analysis, so interpretations should be made with caution. Furthermore, even though the variable for the number of immigrants was statistically significant in the empirical analysis of value-added exports, it is essential to distinguish whether it is economically significant for considering policy implications.

Future studies should adopt a more micro-level approach, examining firm-level or industry-specific impacts of immigration on trade. Such research could offer nuanced insights into optimizing immigration policies to bolster Korea's economic growth and its role in the global economy. Furthermore, as evidenced by the analysis, the impacts of immigration can differ based on the country of origin and sector. With the expected increase and evolving composition of immigrants in Korea, ongoing and more refined research will be essential.

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Appendix

〈Table A1〉

Panel Country List

No.	Economy	No.	Economy	No.	Economy
1	Australia	26	New Zealand	51	Hong Kong (China)
2	Austria	27	Norway	52	India
3	Belgium	28	Poland	53	Indonesia
4	Canada	29	Portugal	54	Jordan
5	Chile	30	Slovakia	55	Kazakhstan
6	Colombia	31	Slovenia	56	Lao
7	Costa Rica	32	Spain	57	Malaysia
8	Czechia	33	Sweden	58	Malta
9	Denmark	34	Switzerland	59	Morocco
10	Estonia	35	Türkiye	60	Myanmar
11	Finland	36	United Kingdom	61	Nigeria
12	France	37	United States	62	Pakistan
13	Germany	38	Argentina	63	Peru
14	Greece	39	Bangladesh	64	Philippines
15	Hungary	40	Belarus	65	Romania
16	Iceland	41	Brazil	66	Russia
17	Ireland	42	Brunei Darussalam	67	Saudi Arabia
18	Israel	43	Bulgaria	68	Senegal
19	Italy	44	Cambodia	69	Singapore
20	Japan	45	Cameroon	70	South Africa
21	Latvia	46	China	71	Taiwan
22	Lithuania	47	Côte d'Ivoire	72	Thailand
23	Luxembourg	48	Croatia	73	Tunisia
24	Mexico	49	Cyprus	74	Ukraine
25	Netherlands	50	Egypt	75	Vietnam

〈Table A2〉 First-stage Within Regression

Variables	Foreign Residents (logged)
Visa Policy _{it}	0.000*** (0.000)
GDP_pc_Origin _{it} (logged)	0.210 (0.282)
CPI _{it} (logged)	0.095 (0.540)
Exchange Rate _{it} (logged)	0.270 (0.452)
Constant	4.286*** (1.551)
Year dummy	Yes
Origin fixed effects	Yes
F Statistics	10.80
Prob > F	0.0000
Within R2	0.4618
Observations	900

Note: *** p<0.01, ** p<0.05, * p<0.1. Numbers in parentheses represent country-clustered standard errors. The "Foreign Residents" variable captures the logarithmic value of the count of foreign individuals who have resided in Korea for over 90 days. The "Visa Policy" variable represents the number of visa issuance confirmations approved by the Ministry of Justice in Korea. The "GDP pc Origin (logged)" pertains to the originating countries' GDP per capita expressed in current thousands of US dollars. The "CPI" variable represents the logarithmic value of annual consumer price indices (2015 = 100). The "Exchange Rate" represents the logarithmic value of the currency value relative to 1,000 Korean Won (KRW). All estimations were controlled for year dummies and origin country fixed effects. The sample period spans from 2009 to 2020.

〈Table A3〉

Correlation Matrix

Variables	GR_DVA (logged)	GVC (logged)	Foreign Resident (logged)	Visa Policy (individual)
GR_DVA	1.0000			
GVC	0.6236	1.0000		
Foreign Resident	0.6406	0.4896	1.0000	
Visa Policy	0.3271	0.3705	0.6236	1.0000

Note: The "GR DVA (Gross Domestic Value-Added Exports)" represents the logarithmic value of domestic value-added in gross exports. The "GVC (GVC-related Export)" is the log value of the sum of "Forward GVC-related Exports", which is domestic value-added contents in foreign exports, and the "Backward GVC-related Exports", which is foreign value-added contents in domestic exports. The "Foreign Residents" variable captures the logarithmic value of the count of foreign individuals who have resided in Korea for over 90 days. The "Visa Policy" variable represents the number of visa issuance confirmations approved by the Ministry of Justice in Korea. The sample period spans from 2009 to 2020.

〈Table A4〉 Impacts of Foreign Residents on Gross Exports

Variables	Gross Exports		
	(1) All	(2) Industry	(3) Service
Foreign Residents _{it} (logged)	0.374*** (0.138)	0.524* (0.309)	0.439*** (0.138)
GDP_pc_Origin _{it} (logged)	0.940*** (0.268)	0.683* (0.398)	0.726*** (0.221)
CPI _{it} (logged)	-1.269*** (0.469)	-1.417** (0.641)	-0.747* (0.443)
Exchange Rate _{it} (logged)	0.845** (0.376)	0.704 (0.530)	0.388 (0.342)
Constant	6.394*** (1.416)	6.225** (2.545)	4.086*** (1.287)
Year dummy	Yes	Yes	Yes
Origin fixed effects	Yes	Yes	Yes
First-stage F stat	10.80	10.80	10.80
Observations	900	900	900

Note: *** p<0.01, ** p<0.05, * p<0.1. Numbers in parentheses represent country-clustered standard errors. The Industry sector includes Mining (B), Manufactures (C), and Utilities (D). The Service sector covers all service industries (F-T), including Construction (F). Parenthetical classifications conform to the International Standard Industrial Classification of All Economic Activities (ISIC) Revision 4. The "Foreign Residents" variable captures the logarithmic value of the count of foreign individuals who have resided in Korea for over 90 days. The "GDP pc Origin (logged)" pertains to the originating countries' GDP per capita expressed in current thousands of US dollars. The "CPI" variable represents the logarithmic value of annual consumer price indices (2015 = 100). The "Exchange Rate" represents the logarithmic value of the currency value relative to 1,000 Korean Won (KRW). All estimations were controlled for year dummies and origin country fixed effects. The "Visa Policy" variable, which represents the number of visa issuance confirmations approved by the Ministry of Justice in Korea, is utilized as an instrumental variable. The Fixed Effects Two-Stage Least Square model is applied in this estimation. The sample period spans from 2009 to 2020.

<Table A5> OLS Estimation Results (Middle-Income group)

Variables	(1) GR_DVA	(2) GVC	(3) fGVC	(4) bGVC
Foreign Residents _{it} (logged)	0.680*** (0.090)	0.205*** (0.053)	0.865*** (0.143)	0.249*** (0.051)
GDP_pc_Origin _{it} (logged)	0.967 (0.838)	0.003 (0.551)	0.741 (1.496)	0.240 (0.437)
CPI _{it} (logged)	-0.092 (0.735)	-0.195 (0.288)	-0.114 (1.078)	-0.478* (0.250)
Exchange Rate _{it} (logged)	0.076 (0.108)	0.081 (0.065)	0.162 (0.178)	0.006 (0.055)
Constant	0.546 (4.490)	12.261*** (2.529)	-5.308 (7.380)	11.855*** (1.887)
Year dummy	Yes	Yes	Yes	Yes
Adj_R2	0.638	0.404	0.541	0.380
Observations	252	252	252	252

Note: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Numbers in parentheses represent country-clustered standard errors. The "GR_DVA (Gross Domestic Value-Added Exports)" represents the logarithmic value of domestic value-added in gross exports. The "fGVC (Forward Global Value Chain (GVC)-related Exports)" represent the log value of the domestic value-added in foreign exports. The "bGVC (Backward GVC-related Exports)" represent the log value of the foreign value-added in domestic exports. The "GVC (GVC-related Export)" is the log value of the sum of "Forward GVC-related Exports" and "Backward GVC-related Exports". The "Foreign Residents" variable captures the logarithmic value of the count of foreign individuals who have resided in Korea for over 90 days. The "GDP pc Origin (logged)" pertains to the originating countries' GDP per capita expressed in current thousands of US dollars. The "CPI" variable represents the logarithmic value of annual consumer price indices (2015 = 100). The "Exchange Rate" represents the logarithmic value of the currency value relative to 1,000 Korean Won (KRW). All estimations were controlled for year dummies. The Ordinary Least Square model is applied in this estimation. The sample period spans from 2009 to 2020.

한국의 부가가치 수출 및 글로벌 가치사슬 참여에 관한 이민의 영향

정용근*

본 연구는 국가 수준의 패널자료를 활용하여 한국의 부가가치 수출 및 글로벌 가치사슬(GVC) 참여에 관한 이민의 영향을 실증분석하였다. 이민과 무역 간의 내생성 문제를 해소하기 위해 2단계 고정효과 모형을 채택하였으며 비자정책을 도구 변수로 활용하였다. 실증분석 결과에 따르면 이민은 한국의 국내 부가가치 수출과 GVC 참여를 통계적으로 유의하게 증가시키는 것으로 나타났다. 이민의 부가가치 수출에 대한 영향은 이민자의 출신 국가의 소득 수준에 따라 상이하였으며, 저소득 국가군에서 주로 유의미한 효과가 확인되었다. 이러한 효과는 주로 저소득 국가에서 한국의 수출에 내재된 국내 부가가치 증가로 인해 발생하며, 이는 GVC의 전방연계를 보여준다고 볼 수 있다. 또한, 이러한 효과가 주로 제조업 분야에서 상대적으로 크게 나타남을 보였다.

JEL Classification Number: F14, F16, F22

핵심 주제어: 부가가치 수출, 이민, 중력모형, 2단계 고정효과 모형

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