The Role of International Migration and Restrictions on Their Entry in the Timing of COVID-19's Arrival: Evidence from County-level Data in the United States

Abstract

On April 22, President Trump signed a new executive order limiting all immigration to the United States for 60 days in the middle of the COVID-19 pandemic. This paper examines the role of international migration and restrictions on entry in the timing of COVID-19's arrival across 3,142 different counties in the United States. COVID-19 is still in the process of spreading throughout the United States, but it has already reached 84.6 percent of counties. Using the Cox proportional hazards regression, I find that counties with a higher proportion of international migration and foreign-born populations are more likely to experience earlier arrival of the COVID-19 infection, even after controlling for domestic cross-county migration and (short-term) travel spending. Although Presidential proclamations blocked entry of non-U.S. citizens from China, Iran, Schengen countries in Europe, the United Kingdom, and Ireland, no evidence has been found to suggest that these travel restrictions delayed the arrival of COVID-19 in counties with a higher proportion of people born in these countries. This paper implies a paradoxical conclusion that, while a high proportion of international in-migrants can potentially cause COVID-19 to arrive earlier, these restrictions were less likely to have delayed its arrival. Further research is needed to reconcile this paradox.

Introduction

The recent global pandemic of COVID-19 has hit the United States particularly hard, reaching 819,175 infections and 45,343 deaths (Dong et al., 2020). Further to earlier Presidential proclamations banning the entry of non-U.S. citizens from or having recently visited China, Iran, 26 Schengen countries in Europe, the United Kingdom, and Ireland in February and March, President Trump signed a new executive order (on April 22) temporarily suspending all immigration to the United States. However, the question remains over the role immigration has played on the introduction and spread of COVID-19 and the effectiveness of these early Presidential proclamations to prevent infections across the country.

According to the Centers for Disease Control and Prevention (CDC), nine out of the first eleven cases confirmed in the country were travel-related infections (Herman, 2020). However, confirmed cases are only a small fraction of the true number of people infected. Therefore, the true effect of international migration on the introduction of COVID-19 into the United States is still unknown.

There is also no scientific evidence that the effectiveness of travel restrictions on incoming travelers substantially delays the introduction or spread of pandemic influenzas, except in some island countries (Mateus et al., 2014).

This paper examines the association between international migration, foreign-born populations, and the timing of COVID-19's arrival across 3,142 counties in 50 U.S. states and the District of Columbia. Although COVID-19 is still in the process of spreading across the United States, it is already present in 84.6 percent of counties. This provides sufficient variation for examining the role that international migration has had on the timing of COVID-19's arrival in different parts of the country.

The rest of this paper is organized as follows. In Section 2, I describe the data and discuss the empirical specifications used. In Section 3, I present the results. I provide empirical evidence that counties with higher proportions of international migration and foreign-born populations are more likely to experience early arrival of the COVID-19 infection. However, I find no evidence that early Presidential proclamations actually delayed its arrival in counties where a higher proportion of people born in these countries reside. Finally, Section 5 discusses the limitations and implications of the paper.

Method

I employ the Cox proportional hazards regressions model to examine the association between the proportion of international migration, the foreign-born population, and the timing of COVID-19's arrival in 3,142 counties in 50 U.S. states and the District of Columbia (Cox, 1972).

The main variables of interest are the proportion of international in-migration and foreign-born population, with the outcome of the number of days from the first arrival of COVID-19 in the United States on January 21 until the day when COVID-19 arrived in each county.

Data on the number of days before the arrival of COVID-19 in each country were constructed from the daily number of confirmed cases available from the COVID-19 real-time dashboard by John Hopkins University's Center for Systems Science and Engineering (Dong et al., 2020). I am aware of the time lag between infection, onset of symptoms, hospitalization, and the official reporting of new cases. This means the actual arrival of an infected person is earlier than the first confirmed date. However, due to the availability of data, I construct the number of days before the arrival of COVID-19 based on the date of official reports of cases.

Data on international in-migration and foreign-born population come from the Census of Bureau's five-year American Community Survey (ACS) 2014-2018 (Manson et al., 2019). These two international migration variables are different in several ways. First, the international in-migration rate is the flow measure of migration, which is defined as the proportion of people whose residence one year ago was outside the United States, while foreign-born populations are a stock measure of the migration. Stock migrants can create a new spatial arrangement of social network, which may be translated into travel and tourism flows from their country of origin that are not easily captured by other county-level statistics. Migrants are more likely to travel to and return from their country of origin. They also attract friends and relatives to their residential location from their country of origin. In some places, ethnic enclaves can attract travelers and tourists from their counties of origin as well as migrants of the same nationality who are already present in other counties of the United States. All of these movements can potentially bring a virus to their residential county. Second, foreign-born are those who were not a U.S. citizen at birth, but international in-migration counts all people, including U.S. citizens, at birth who migrated from outside the border of a county. The latter variable accounts for non-U.S. citizens who can potentially bring the virus to their residential counties. Third, data on the foreign-born population allows us to break down into country of birth. This allows us to investigate the heterogeneous effect of migrants from countries restricted on entry and countries that are not. For these reasons, I include both international in-migration and the foreign-born population in the specification.

Not all in-migrants came from outside the U.S. Some people migrated from other counties within the territory of the United States. For this reason, I also include a variable of domestic cross-county migration rate, which is defined as the proportion of people whose residence one year ago was in another county within the United States. Another concern is that short-term visits to a county, including international and domestic travel and tourism, are more likely to take a role in the arrival of COVID-19. While it is difficult to track the exact number of visitors, I include a variable of domestic and international travel and tourism spending per resident at congressional district levels from the U.S. Travel Association. Other independent variables include median household income, the proportion of people aged 18-64, the total population of counties, and the land area in each country.

All independent variables are transformed into categorical variables (split into quartiles) in the analysis. All specifications include state fixed effects, which account for different policy responses and other characteristics among different states. Standard errors are clustered at state level.

Results

Table 1 provides the mean and standard deviation of all variables used in this study. COVID-19 has already arrived at 84.6 percent of counties. Another 15.4 percent is right-censored at the end of the study period. On average, COVID-19 arrived in counties 66 days after first being identified as arriving in the United States. Figure 1 shows the Kaplan-Meier curves of the introduction of COVID-19 into counties by quartiles for the proportion of international in-migration (left) and the foreign-born population (right). From the figure, it is evident that COVID-19 arrived much earlier in the counties with a higher proportion of international in-migration and foreign populations. Table 2 shows the result of the Cox hazards regression, explaining the number of days before COVID-19's arrival in each county as a function of pre-determined covariates. The first column shows that the earlier arrival of COVID-19 was associated with the top and second quartile of international in-migration at the one percent level, while it was not significantly associated with domestic cross-county in-migration. The second column added the foreign-born population to the specification, which is the stock measure of migration. While the top two quartiles for international in-migration are still significant, the top quartile for the foreign-born population is also significantly associated with the arrival of COVID-19. This suggests that not only the flow but also the stock of international migrants accelerated the arrival of COVID-19 in each county.

Column 3 splits the foreign-born population into people born to countries restricted and not restricted on entry by earlier Presidential proclamations. I tested the equality of the coefficients of the proportion of people born to countries restricted and not restricted in each quartile. The result shows no evidence that COVID-19 arrived in counties with a higher proportion of people born to these countries later than in counties with a higher proportion of those born to countries unaffected by entry restrictions. This indicates that such travel restrictions against in-migrants were not effective for the purpose of delaying the introduction of COVID-19.

I further divided the restricted countries into four different groups based on the effective date of Presidential proclamation. Restrictions on entry took effect on different dates: February 2 for China, March 2 for Iran, March 13 for 26 Schengen countries, and March 14 for the United Kingdom and Ireland. It is natural to think that earlier entry bans against China delayed COVID-19's arrival more than the recent ones. Figure 2 shows the coefficients of quartiles for the proportion of people born to the five groups of countries (four groups of restricted and one group of unrestricted countries). For all groups, the coefficient of the top quartiles is significantly positive, suggesting that a high proportion of the foreign-born population—regardless of their country of origin—speeded up COVID-19's arrival. I tested the equality of the coefficients of the proportion of people born to this

group of countries in the same manner as Column 3 in Table 2. The result shows no evidence that COVID-19 arrived at counties with a higher proportion of people born to countries where the U.S. entry ban was introduced earlier. I also implemented the pairwise tests, but no pair of countries is significantly different from each other.

The full list of regression coefficients is given in the Online Appendix. I also allowed different effects of migration variables before and after April 1st. I find that the effect of all migration variables diminished after April 1st, indicating that migration took a role in the early stages of pandemic, but not after the number of new confirmed cases stabilized in April.

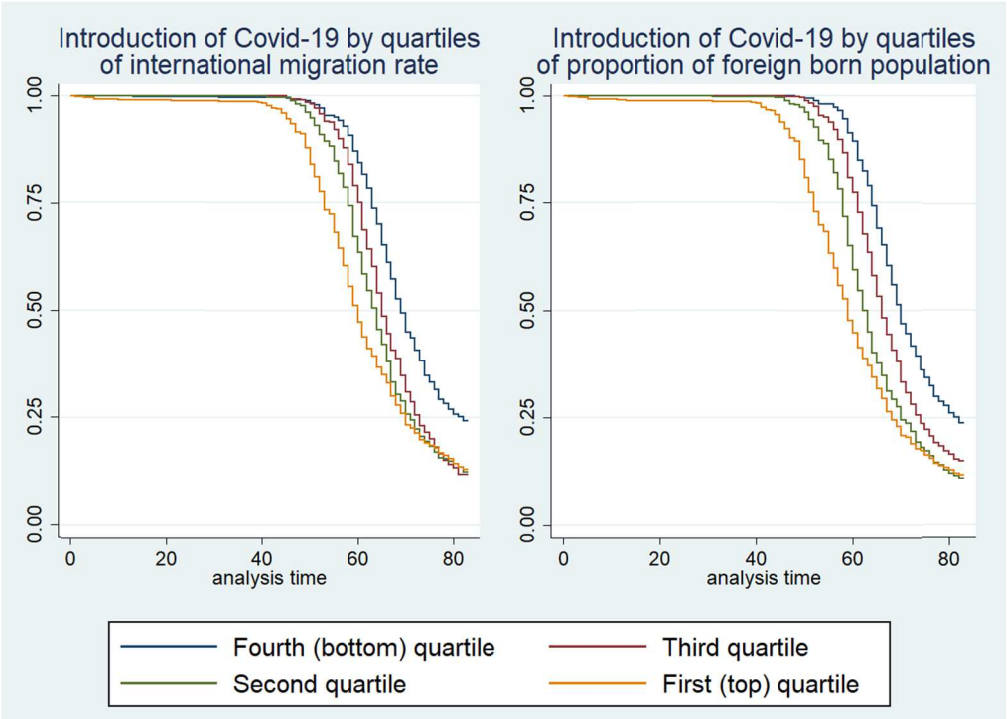
Discussion

The results of this paper show that higher international migration and the foreign-born population, not domestic cross-county migration, is associated with an earlier COVID-19 arrival at the county level. It also shows no evidence to support the suggestion that earlier Presidential proclamations successfully delayed the arrival of COVID-19 in counties with migrants born to these countries.

There are several limitations to this analysis. First, the country of origin variable is based on self-described places of birth in response to questions in the American Community Survey. It is not necessarily the same as the actual place of birth, nor is it indicative of immigrant or citizenship status. Second, the pandemic is still ongoing. Although our results are derived from 84.6 percent of all counties, another 15.4 percent may change the result of the analysis. Third, the analysis focused on the arrival of the COVID-19 infection, not the spread of the infection after the first case. It is likely that in-migration plays a major role in the introduction but not the spread of COVID-19. I leave this to future research after the pandemic is over. Fourth, our data of the arrival of COVID-19 was based on official reporting. It did not reflect the actual date that COVID-19 arrived in each county. Therefore, the gap between the actual date of arrival and the confirmed date can introduce biases to the analysis if this gap is associated with some of the pre-determined covariates in the specification.

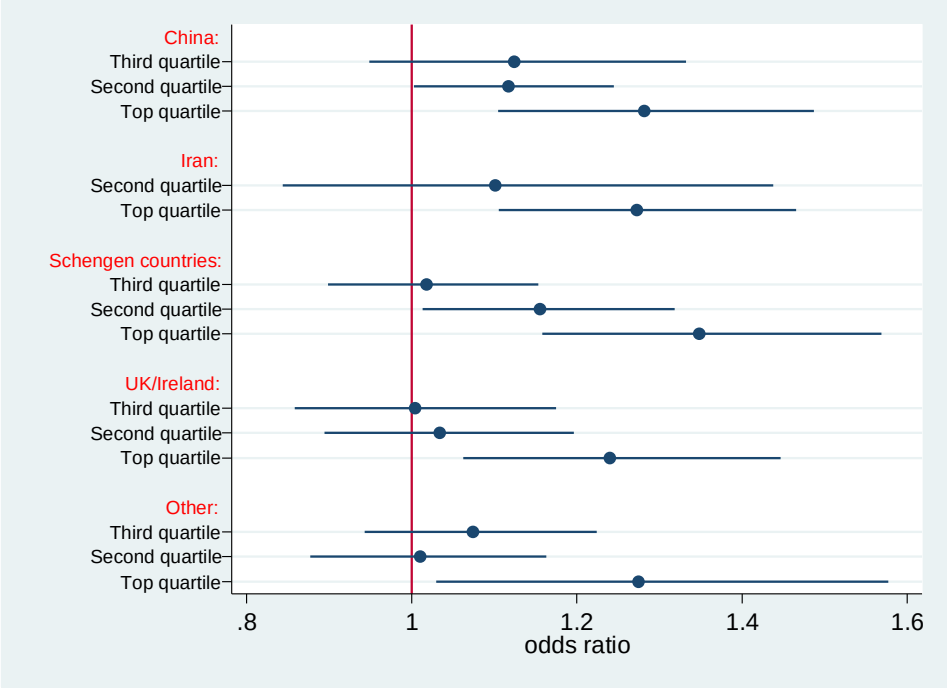
Despite these limitations, the results of this paper lead to the paradoxical conclusion that, while a high proportion of international in-migrants can potentially cause COVID-19 to arrive earlier, restrictions on entry are less likely to delay it. However, further research is needed to reconcile this paradox.

Figure 1. Arrival of COVID-19 by quartiles of International Migration Rate and Proportion of Foreign-born Population



Note: Data from the American Community Survey 2014-2018 and the COVID-19 real-time dashboard by John Hopkins University.

Figure 2: Coefficients for the proportion of people born to countries with restrictions of entry (by effective date).



Note: The specification includes a categorical variable for international migration rate, domestic cross-county migration rate, median household income, the proportion of people aged 18-64, the total number of population, land area, and state fixed effects. Chi-square tests for the equality of the coefficients across five groups are: third quartile 1.65, second quartile 3.17, top quartile 0.61; these are all non-significant at a 10% level.

Table 1. Mean and Standard Deviation of Variables

Variable	Mean	Std. Dev.
Number of days before the arrival of COVID-19	66.1	10.9
International migration rate	0.0034	0.0056
Domestic cross-country migration rate	0.0640	0.0287
Proportion of foreign-born population	0.0472	0.0571
Population born to countries with restrictions of entry	0.0059	0.0084
China-born population	0.0018	0.0049
Iran-born population	0.0002	0.0006
Schengen-country-born population	0.0028	0.0035
UK/Ireland-born population	0.0011	0.0016
Population born to other country	0.0413	0.0528
Median household income (thousands)	89.4	20.1
Proportion of people aged 18 to 64	0.5866	0.0386
Total population	104127.1	333486.3
Land area (sq. km)	1118.7	3601.8

Data from COVID-19 real-time dashboard by John Hopkins University and the American Community Survey 2014-2018.

Table 2. Results of the Analysis

VARIABLES	(1)	(2)	(3)
Domestic Migration Rate (Baseline: Bottom Quartile)			
Third Quartile	1.08	1.092	1.089
	(0.921 - 1.265)	(0.932 - 1.280)	(0.931 - 1.273)
Second Quartile	1.03	1.04	1.018
	(0.867 - 1.224)	(0.871 - 1.241)	(0.853 - 1.215)
Top Quartile	0.884	0.897	0.863
	(0.711 - 1.101)	(0.723 - 1.114)	(0.693 - 1.076)
International Migration Rate (Baseline: Bottom Quartile)			
Third Quartile	1.101*	1.101	1.109*
	(0.982 - 1.235)	(0.979 - 1.239)	(0.988 - 1.245)
Second Quartile	1.165***	1.143***	1.130**
	(1.049 - 1.294)	(1.033 - 1.264)	(1.021 - 1.252)
Top Quartile	1.484***	1.379***	1.326***
	(1.288 - 1.710)	(1.190 - 1.597)	(1.145 - 1.535)
Proportion of Foreign Population (Baseline: Bottom Quartile)			
Third Quartile		1.028	
		(0.889 - 1.189)	
Second Quartile		1.018	
		(0.842 - 1.232)	
Top Quartile		1.304**	
		(1.018 - 1.669)	
Proportion of people born to countries affected by earlier Presidential proclamations			
Third Quartile			1.034
			(0.921 - 1.161)
Second Quartile			1.017
			(0.875 - 1.182)
Top Quartile			1.361***
			(1.132 - 1.636)
Proportion of people born to countries not affected by earlier Presidential proclamations			
Third Quartile			1.056
			(0.911 - 1.225)
Second Quartile			0.987
			(0.834 - 1.168)
Top Quartile			1.265*
			(0.999 - 1.601)
Control Variables	YES	YES	YES
Observations	3,138	3,138	3,138
No. Clusters	51	51	51
Log-likelihood	-18431	-18422	-18410
Equivalence of coefficients between countries affected and not affected by earlier Presidential proclamations			
Third Quartile			0.05
Second Quartile			0.08
Top Quartile			0.24

Note: All specifications include median household income, the proportion of people aged 18-64, total population, land area in categorical variables, and state fixed effects. Standard errors are clustered at state level. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. 95% confidence intervals are reported in parentheses.

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Online Appendix

Table 1. The Full List of Regression Coefficients in Table 2 and Figure 2

	Table 2 (1)		Table 2 (2)		Table 2 (3)		Figure 2 (4)	
VARIABLES	**Coefficient**	**CI**	**Coefficient**	**CI**	**Coefficient**	**CI**	**Coefficient**	**CI**
Domestic Migration Rate (Baseline: Bottom Quartile)								
Third quartile	1.08	(0.921 - 1.265)	1.092	(0.932 - 1.280)	1.089	(0.931 - 1.273)	1.077	(0.915 - 1.268)
Second quartile	1.03	(0.867 - 1.224)	1.04	(0.871 - 1.241)	1.018	(0.853 - 1.215)	0.996	(0.826 - 1.200)
Top quartile	0.884	(0.711 - 1.101)	0.897	(0.723 - 1.114)	0.863	(0.693 - 1.076)	0.849	(0.679 - 1.063)
International Migration Rate (Baseline: Bottom Quartile)								
Third quartile	1.101*	(0.982 - 1.235)	1.101	(0.979 - 1.239)	1.109*	(0.988 - 1.245)	1.116*	(0.995 - 1.251)
Second quartile	1.165***	(1.049 - 1.294)	1.143***	(1.033 - 1.264)	1.130**	(1.021 - 1.252)	1.119**	(1.010 - 1.239)
Top quartile	1.484***	(1.288 - 1.710)	1.379***	(1.190 - 1.597)	1.326***	(1.145 - 1.535)	1.281***	(1.113 - 1.474)
Proportion of Foreign Population (Baseline: Bottom Quartile)								
Third quartile			1.028	(0.889 - 1.189)				
Second quartile			1.018	(0.842 - 1.232)				
Top quartile			1.304**	(1.018 - 1.669)				
Proportion of people born to countries affected and not affected by earlier Presidential proclamations								
Proportion of people born to countries affected by earlier Presidential proclamations								
Third quartile					1.034	(0.921 - 1.161)		
Second quartile					1.017	(0.875 - 1.182)		
Top quartile					1.361***	(1.132 - 1.636)		
Proportion of people born to countries not affected by earlier Presidential proclamations								
Third quartile					1.056	(0.911 - 1.225)		
Second quartile					0.987	(0.834 - 1.168)		
Top quartile					1.265*	(0.999 - 1.601)		
Proportion of people born to countries affected and not affected by earlier Presidential proclamations (by the effective date)								
Proportion of people born to China								
Third quartile							1.005	(0.850 - 1.189)
Second quartile							0.991	(0.874 - 1.125)
Top quartile							1.203***	(1.064 - 1.360)
Proportion of people born to Iran								
Third quartile								
Second quartile							1.021	(0.755 - 1.382)
Top quartile							1.094	(0.946 - 1.264)
Proportion of people born to Schengen countries								
Third quartile							1.019	(0.885 - 1.173)
Second quartile							1.126	(0.969 - 1.309)
Top quartile							1.332***	(1.134 - 1.564)
Proportion of people born to UK/Ireland								
Third quartile							0.889	(0.755 - 1.047)
Second quartile							0.914	(0.790 - 1.058)
Top quartile							1.114	(0.959 - 1.293)
Proportion of people born to countries not affected by earlier Presidential proclamations								
Third quartile							1.063	(0.919 - 1.230)
Second quartile							0.981	(0.832 - 1.156)
Top quartile							1.227*	(0.972 - 1.549)
Median Household Income								
Third quartile	1.113	(0.938 - 1.320)	1.109	(0.939 - 1.310)	1.101	(0.928 - 1.306)	1.089	(0.918 - 1.293)
Second quartile	1.373***	(1.139 - 1.656)	1.365***	(1.133 - 1.646)	1.351***	(1.123 - 1.625)	1.323***	(1.090 - 1.607)
Top quartile	1.870***	(1.606 - 2.178)	1.851***	(1.587 - 2.158)	1.777***	(1.510 - 2.092)	1.683***	(1.428 - 1.983)
Proportion of people aged 18-64								
Third quartile	1.245***	(1.084 - 1.430)	1.235***	(1.075 - 1.419)	1.271***	(1.099 - 1.470)	1.300***	(1.128 - 1.498)
Second quartile	1.181**	(1.006 - 1.386)	1.180**	(1.007 - 1.383)	1.224***	(1.051 - 1.426)	1.262***	(1.094 - 1.456)
Top quartile	1.541***	(1.316 - 1.806)	1.537***	(1.316 - 1.794)	1.547***	(1.328 - 1.803)	1.560***	(1.332 - 1.828)
Land area (sq. km)								
Third quartile	1.067	(0.884 - 1.289)	1.087	(0.899 - 1.314)	1.093	(0.901 - 1.327)	1.116	(0.919 - 1.354)
Second quartile	1.051	(0.798 - 1.385)	1.066	(0.805 - 1.413)	1.092	(0.826 - 1.444)	1.124	(0.850 - 1.487)
Top quartile	0.99	(0.705 - 1.390)	1.003	(0.711 - 1.414)	1.038	(0.735 - 1.467)	1.068	(0.756 - 1.508)
Total Population								
Third quartile	2.338***	(1.775 - 3.079)	2.308***	(1.754 - 3.038)	2.259***	(1.728 - 2.954)	2.296***	(1.799 - 2.931)
Second quartile	4.414***	(3.263 - 5.972)	4.338***	(3.186 - 5.907)	4.238***	(3.145 - 5.712)	4.308***	(3.323 - 5.585)
Top quartile	11.57***	(7.764 - 17.23)	11.13***	(7.342 - 16.87)	10.66***	(7.108 - 15.98)	10.34***	(7.024 - 15.22)
Observations	3,138		3,138		3,138		3,138	
No. Clusters	51		51		51		51	
Log-likelihood	-18431		-18422		-18410		-18392	
Equivalence of coefficients between countries affected and not affected by earlier Presidential proclamations								
Third quartile					0.05		1.65	
Second quartile					0.08		3.17	
Top quartile					0.24		0.61	

Note: All specifications include state fixed effects. Standard errors are clustered at state level. *** p < 0.01; ** p < 0.05; * p < 0.1. 95% confidence intervals are reported in parentheses.

Table 2. The Heterogeneous Effects of Migration Variables before and after April 1st, 2020

	1		2		3		4	
VARIABLES	**Coefficient for**		**Coefficient for**		**Coefficient for**		**Coefficient for**	
	Until March	**In April**	**Until March**	**In April**	**Until March**	**In April**	**Until March**	**In April**
International Migration Rate (Baseline: Bottom Quartile)								
Third quartile	1.108	1.148	1.107	1.104	1.118	1.087	1.134*	1.050
Second quartile	1.188**	1.159	1.139*	1.173	1.121*	1.217	1.117	1.120
Top quartile	1.589***	1.066	1.402***	1.220	1.326***	1.227	1.272***	0.709
Proportion of Foreign Population (Baseline: Bottom Quartile)								
Third quartile			1.018	1.173				
Second quartile			1.048	1.043				
Top quartile			1.460***	0.749				
Proportion of people born to countries affected and not affected by earlier Presidential proclamations								
Proportion of people born to countries affected by earlier Presidential proclamations								
Third quartile					0.980	1.255		
Second quartile					1.017	1.039		
Top quartile					1.424***	0.944		
Proportion of people born to countries not affected by earlier Presidential proclamations								
Third quartile					1.059	1.166		
Second quartile					0.990	1.101		
Top quartile					1.380***	0.850		
Proportion of people born to countries affected and not affected by earlier Presidential proclamations (by the effective date)								
Proportion of people born to China								
Third quartile							0.987	1.108
Second quartile							1.016	0.924
Top quartile							1.209***	1.042
Proportion of people born to Iran								
Third quartile								
Second quartile							1.054	1.058
Top quartile							1.160**	0.646
Proportion of people born to Schengen countries								
Third quartile							0.928	1.447
Second quartile							1.044	1.624
Top quartile							1.320***	1.162
Proportion of people born to UK/Ireland								
Third quartile							0.891	0.954
Second quartile							0.924	0.925
Top quartile							1.172*	0.836
Proportion of people born to countries not affected by earlier Presidential proclamations								
Third quartile							1.072	1.113
Second quartile							0.977	1.128
Top quartile							1.310**	0.945
Observations	3138		3138		3138		3138	
No. Clusters	51		51		51		51	
Log-likelihood	-18426		-18405		-18387		-18349	
Equivalence of coefficients between countries affected and not affected by earlier Presidential proclamations								
Third quartile					0.40	0.35	1.77	3.25
Second quartile					0.05	0.10	1.33	6.24
Top quartile					0.04	0.28	1.72	7.19

Note: The specification includes a categorical variable for domestic cross-county migration rate, median household income, the proportion of people aged 18-64, the total number of population, land area, and state fixed effects. *** p < 0.01; ** p < 0.05; * p < 0.1. Chi-square tests for the equality of the coefficients are all non-significant at a 10% level