Do Immigration Restrictions Affect Job Vacancies? Evidence from Online Job Postings

By Elior Cohen and Samantha Shampine

The U.S. workforce relies heavily on immigration, with one out of every six workers originating from outside the country's borders in 2021. However, the supply of new immigrant labor has varied widely over the past decade. Although an average of 1 million immigrants entered the country annually from 2000 to 2016, a series of policy changes and the COVID-19 pandemic led to a rare decline in immigrant arrivals from 2016 to 2021. This period of reduced immigration coincided with and exacerbated already severe labor shortages in the U.S. labor market, leading employers and firms to look for new sources of labor.

In recent years, online job postings have become more prevalent as a method of searching for labor. In addition to providing information on the overall demand for labor in the economy, online postings contain rich data on a job's characteristics, location, industry, offered wages, and skill requirements. These data could help reveal how different dimensions of labor demand change in response to declining immigration. However, little is known about the link between immigration and online job postings.

In this article, we examine how declining immigration flows influence online job vacancies in labor markets with different levels of reliance on immigrant labor. We find that the growth rate of online job postings

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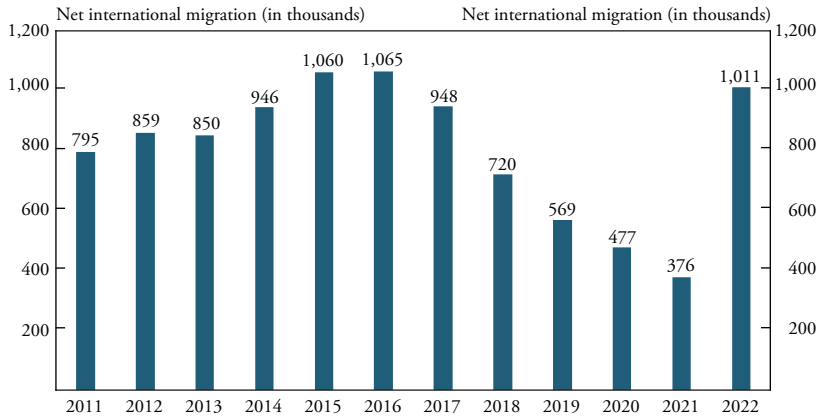
increased modestly in labor markets that historically relied more heavily on immigrant labor, but the content of those postings differed substantially: in more immigrant-reliant labor markets, starting wages increased and skill requirements grew more slowly as immigration declined. Our results highlight that as fewer immigrants arrive, firms in more immigrant-reliant labor markets increase their job search efforts (as measured by both the number and content of their online job postings).

Section I describes how and why the trend in U.S. immigration flows reversed from increasing to decreasing in 2016. Section II describes the uneven distribution of immigrant workers in the U.S. economy and shows how the 2016 trend reversal in immigration had differential labor supply effects based on a sector's degree of reliance on immigrant labor. Section III examines online job postings and shows that labor search intensity increased in more immigrant-reliant sectors in response to the 2016 trend reversal in immigration.

I.   Immigration and the U.S. Labor Market

Immigration to the United States shifted from an increasing trend from 2011 to 2016 to decreasing from 2017 to 2021, due to a series of immigration policy changes and travel restrictions related to the COVID-19 pandemic. Chart 1 shows annual net international migration to the United States—that is, the number of incoming immigrants minus the number of outgoing emigrants—from 2011 through 2022. From 2011 to 2016, net international migration was on an increasing trend, reaching more than 1 million immigrants per year in 2015 and 2016. From 2017 to 2021, this trend reversed: immigration gradually declined until reaching a low of 376,000 in 2021. In 2022, both immigration policy and pandemic-related travel restrictions eased. Accordingly, immigration has since rebounded close to its 2016 level and is expected to return to its pre-2016 trend. Thus, the 2016–21 period may provide a useful and rarely observed test case for the effect of declines in immigration on labor markets, particularly at times when labor markets are tight.

Immigration policy changes and the onset of the COVID-19 pandemic largely drove the observed shift in immigration flows. Starting in late 2016, hundreds of executive actions were passed to increase immigration enforcement, temporarily freeze refugee admissions, and restrict

Chart 1

Net International Immigration to the United States Declined from 2016 to 2021

Net international migration (in thousands)

795, 859, 850, 946, 1,060, 1,065, 948, 720, 569, 477, 376, 1,011

2011 2012 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022

Note: Chart shows net international migration to the United States (incoming immigrants minus individuals who left the United States) for each year from 2011 to 2022.
Source: U.S. Census Bureau.

family immigration through the Reforming American Immigration for Strong Employment (RAISE) Act, directly restricting immigration to the United States (U.S. Department of Homeland Security 2022). Immigration declined further with the onset of the COVID-19 pandemic as border closures used to mitigate the spread of COVID-19 reduced immigration flows to their lowest levels in decades. In particular, a new policy tool that limited international travel to the United States during the pandemic, Title 42, made it easier for border officers to prevent potential migrants from entering the United States (U.S. Customs and Border Protection 2023).

The post-2016 decline in immigration flows occurred at a time of increased demand for labor and widespread labor shortages, exacerbating the mismatch between labor supply and demand.[1] Unfilled job vacancies increased from an average of 5.8 million in 2016 to 7.2 million by 2019 and spiked to almost 10 million by the end of 2021. The job openings rate, measured as the number of new unfilled jobs as a percentage of employment and job openings, increased by more than 70 percent from 2016 to 2021. Over the same period, the number of unemployed individuals in the labor market reached historically low levels. As a result, the ratio of vacancies to unemployed individuals—a

standard measure of labor market tightness—reached over two unfilled vacancies for every unemployed individual in 2021 and has remained elevated, indicating a labor market in which jobs are plentiful and workers are scarce.

II.   Differential Reliance on Immigrant Workers across Labor Markets

The post-2016 decline in immigration did not have identical effects across the U.S. economy. Immigrant labor is unevenly distributed across geographies, industries, and occupations, suggesting certain labor markets would be hit more heavily than others. Table 1 summarizes the variation in foreign-born workers across states, industries, and occupations. Industries are defined using three-digit codes from the North American Industry Classification System (NAICS), while occupations are defined using three-digit codes from the Standard Occupational Classification (SOC) system. Specifically, Table 1 presents the mean percentage of foreign-born workers—along with the minimum, 25th percentile, 50th percentile (median), 75th percentile, and maximum percentage of foreign-born workers—across states, industries, and occupations in 2021. Although almost one out of three workers in California were foreign-born in 2021 (30.2 percent), only 1.3 percent of all workers in West Virginia were immigrants. Some industries, such as knitting fabric mills and clothing stores, have a high percentage of foreign-born workers, while others, such as utilities and health and personal care stores, have a lower percentage of foreign workers. Immigrants also sort into occupations, with one in three textile workers being foreign-born compared with only 3 percent of firefighters. Appendix A provides comprehensive lists of the foreign-born shares by state, industry, and occupation in 2010 and 2021.

The uneven distribution of immigrant labor makes measuring the effect of immigration on labor market outcomes challenging (Blau and Mackie 2016). Immigrants may target locations, industries, and occupations based on labor market conditions such as job opportunities and wages. A common approach that attempts to overcome these nonrandom choices of immigrants relies on the historical persistence of immigration (Card 2001). New immigrants tend to settle in areas and sort into industries and occupations that previous immigrants have

Table 1

Foreign-Born Employment Shares Vary across States, Industries, and Occupations

Category	Category size	Mean (percent)	Minimum (percent)	25th percentile (percent)	50th percentile (percent)	75th percentile (percent)	Maximum (percent)
State	51	10.3	1.3 West Virginia	5.2 Tennessee	8.0 North Carolina	15.3 Washington	30.2 California
Industry (three-digit NAICS)	97	14.3	0.2 Utilities	10.9 Communications	12.5 Health and personal care stores	16.4 Clothing stores	55.1 Knitting fabric mills
Occupation (three-digit SOC)	98	12.4	3.0 Firefighters	8.8 Entertainers and performers	11.3 Drafters, engineering technicians	14.8 Financial specialists	32.4 Textile workers

Note: Table demonstrates how immigrant labor is unevenly distributed across states, industries, and occupations by reporting the 2021 percentage of foreign-born workers out of all workers in each of the three categories.
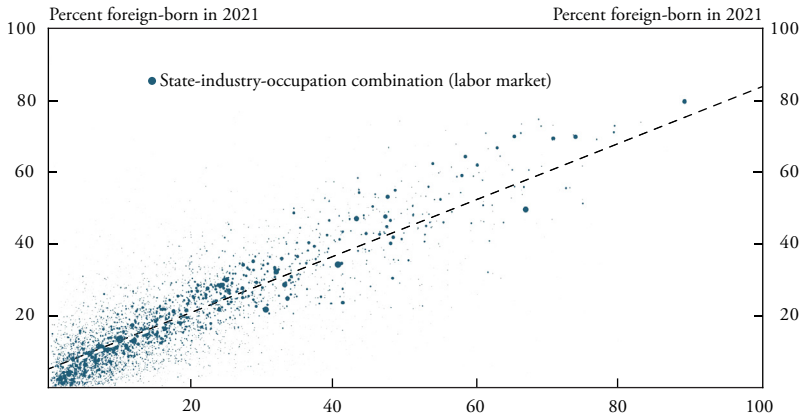Source: U.S. Census Bureau.

settled and sorted into. To demonstrate this, we use data from the American Community Survey (ACS), which includes a respondent's immigration status, state of residence, occupation, and industry. Then, we define each labor market as a state-occupation-industry combination.[2]

Chart 2 plots the percentage of foreign-born workers in each labor market as a share of its total labor force in 2021 on the vertical axis and its respective 2010 percentage on the horizontal axis. The black dashed line presents a linear fit of the two variables. The scatterplot and its fitted line show a clear and robust positive relationship between the past and current percentage of foreign-born workers in each labor market. The fact that foreign-born rates in labor markets remain similar over time, even as the population and economic conditions change, suggests that new immigrants sort into specific locations, industries, and occupations in a relatively stable and persistent way over time. (Appendix A further demonstrates this persistence by presenting comprehensive lists of the 2010 and 2021 foreign-born shares by state, industry, and occupation.)

The significant variation in immigrant labor and its persistence over time can be combined to create a measure of how reliant states, industries, and occupations are on immigrant labor that is more likely to be independent of current economic conditions. Therefore, we measure a labor market's reliance on immigration using its 2010

Chart 2

New Immigrants Sort into Labor Markets Based on Historical Trends

Percent foreign-born in 2021

Percent foreign-born in 2021

• State-industry-occupation combination (labor market)

Notes: Each blue dot in the chart represents one labor market (that is, one state-industry-occupation combination) out of 14,863 overall that appear in the ACS in each year from 2010 to 2021. Dot size is proportional to the number of observations in each combination. The horizontal axis shows the percentage of foreign-born workers in the state-industry-occupation combination in 2010, while the vertical axis shows the respective percentage in 2021. The dashed black line is the fitted linear regression line for the two variables.
Source: U.S. Census Bureau.

percentage of foreign-born workers.[3] We then divide labor markets into four groups based on their relative reliance on immigrant workers: very high, high, medium, and low. Using data from the ACS, we construct the distribution of the percentage of foreign-born workers for 14,863 labor markets in 2010. We then use the 90th, 75th, and 50th percentiles as cutoffs for being included in the very high, high, medium, and low reliance groups, respectively.

Table 2 shows each reliance group's cutoff and mean values and provides examples of a labor market in each. For example, agricultural workers in California are in the very high reliance group (90 percent), staff in nursing care facilities in Arizona are in the high group (21 percent), truck drivers in Colorado are in the medium group (13 percent), and public school teachers in Pennsylvania are in the low group (3 percent). We then follow the evolution of different outcomes for these groups over time.[4]

We begin our analysis by examining what happened to the foreign workforce in different labor markets as immigration flows started to decline post-2016. Chart 3 shows the evolution of the log of the immigrant workforce for each of the four reliance groups. We use the log

Table 2

Categories of Reliance on Immigrant Workers

Reliance category	Minimum (percent)	Maximum (percent)	Mean (percent)	Percent of labor force	Example
Very high	30	100	40	18	Agricultural workers (crops) in CA (90 percent)
High	18	30	23	21	Caretakers in nursing care facilities in AZ (21 percent)
Medium	9	18	13	26	Truck drivers in CO (13 percent)
Low	0	9	4	35	Public school teachers in PA (3 percent)

Notes: Table presents the cutoff values for inclusion and relative employment in each of four groups divided by their reliance on immigrant labor. Cutoffs are based on the 2010 percent of foreign-born workers in a state-industry-occupation combination.
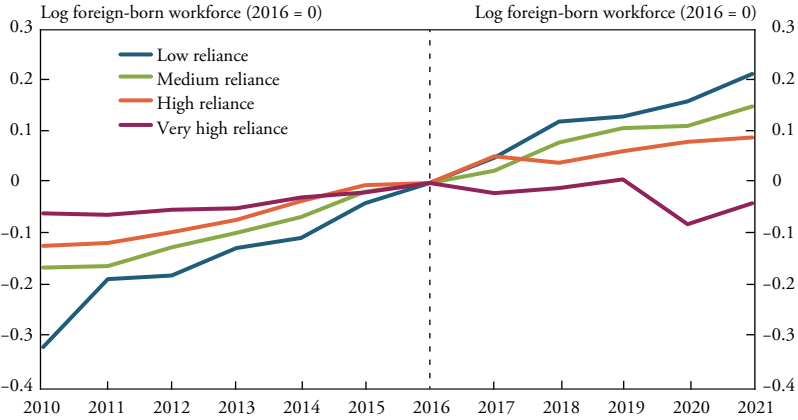Source: U.S. Census Bureau.

of the number of workers because it approximates percent changes, and we standardize all the series to equal 0 in 2016 for ease of interpretation. From 2010 to 2016, the foreign workforce grew across all four reliance groups due to increasing immigration flows. Post-2016, however, growth slowed more in groups with a higher reliance on immigration, especially for the very high reliance group. By the end of 2021, the size of the foreign-born workforce in the very high reliance group was about 5 percent lower than its 2016 level. The three other reliance groups still managed to increase their foreign workforce size post-2016 despite the reduction in immigration flows.[5] However, the increase was smallest for the high group (around 10 percent), followed by the medium group (15 percent) and the low group (more than 20 percent).

The slowdown in foreign workforce growth coincided with a slowdown in overall employment growth. Overall workforce growth slowed in labor markets with a very high reliance on immigrant labor and did not change in labor markets with a lower reliance. Chart 4 shows the evolution of the log of the overall workforce for each of the four reliance groups. Until 2016, overall workforce growth was similar across all four reliance groups.[6] Workforce size continued to grow at a similar pace for the low, medium, and high reliance groups, which had a 6 to 8 percent larger workforce size in 2021 relative to 2016. The same was not true for the very high reliance groups. First, the growth rate of the workforce dropped from an average of 1.6 percent per year in 2010–16 to 0.8 percent per year in 2017–19. The COVID-19 pandemic turned
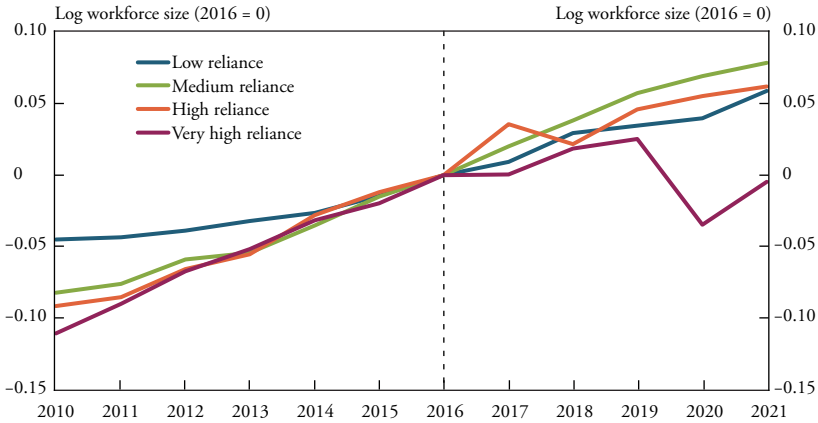
Chart 3

Immigrant Workforce Declines with Reliance Post-2016

Log foreign-born workforce (2016 = 0)   Log foreign-born workforce (2016 = 0)

Legend:
- Low reliance
- Medium reliance
- High reliance
- Very high reliance

Notes: Chart shows the evolution of the log average number of foreign-born workers in each of the four immigrant labor reliance groups in each year from 2010 to 2021. The values are standardized to equal 0 in 2016. Source: U.S. Census Bureau.

Chart 4

Overall Workforce Declines for the Very High Reliance Group

Log workforce size (2016 = 0)   Log workforce size (2016 = 0)

Legend:
- Low reliance
- Medium reliance
- High reliance
- Very high reliance

Notes: Chart shows the evolution of the log average number of foreign-born workers in each of the four immigrant labor reliance groups in each year from 2010 to 2021. The values are standardized to equal 0 in 2016. Source: U.S. Census Bureau.

the slowdown to a decline in workforce size in 2020, which, despite a recovery in 2021, remains about 1 percent lower than its 2016 level.

III. Measuring the Effect of the Post-2016 Decline in Immigration on Online Job Postings

Our findings from the previous section suggest that some labor markets experienced a slowdown in labor growth after the 2016–21 decline in immigration, while others did not. These findings are consistent with Borjas (2003), who shows that immigration has a direct short-term labor market effect on a narrow group of workers and industries based on skills and experience. To assess whether employers and firms in these labor markets adjusted their search efforts for workers in response to the decline in immigration, we analyze changes to both the volume and content of online job postings.

The prevalence and popularity of using online job postings as a hiring tool has skyrocketed in the past decade, with the number of online job postings increasing from 12 million in 2010 to more than 53 million in 2022. The share of online job postings out of overall job vacancies also increased from 35 percent to 40 percent during this time. Trends in online job postings are highly correlated with the traditional job openings rate from the Bureau of Labor Statistics' Job Openings and Labor Turnover Survey (JOLTS), suggesting they can proxy for trends in labor demand.

Analyzing labor demand responses using online job postings rather than traditional measures such as JOLTS has three main advantages. First, online job postings contain detailed information on location, industry, and occupation, allowing for a granular observation of labor demand trends. Second, online job postings often include information on a job's wage or salary range, which can reveal how labor input costs change across time, regions, industries, and occupations. Third, online job postings also include information on the experience, education, and skills required for a position, allowing the observation of additional dimensions of labor demand that are rarely observed in practice on a large scale.

Few studies have explored what happens to online job postings as immigration changes, though some researchers find more generally that increased immigration reduces labor search efforts. For example,
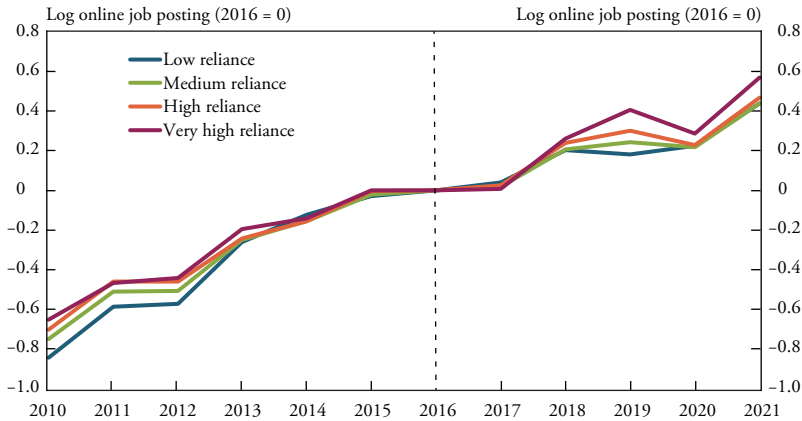
Anastasopoulos and others (2021) study the effect of the Mariel Boat-lift—a mass immigration event in the 1980s that led to an 8 percent increase in Miami's labor supply—on a job vacancies activity index based on newspaper ads. Their findings suggest a nearly 50 percent decrease in Miami's job vacancies index relative to comparable cities in the first few years after the Mariel shock, followed by a recovery. Another study by Pholphirul (2013) finds that immigration reduced short-term job vacancies in Thai manufacturing. Closer to our context, Duzhak (2023) finds that the slowdown in immigration to the United States after 2016 led to tighter labor markets as measured by the national vacancies-to-unemployment ratio. However, none of these studies presents evidence on changes to the quantity and content of online job postings specifically.

We use online job posting data collected and provided by Lightcast to examine how firms in different labor markets responded to the 2016–21 decline in immigration. These data aggregate job postings from more than 45,000 online job boards and company websites, resulting in a near complete coverage of all jobs posted online. We begin by count-ing the number of online job postings in each year from 2010 through 2021 for each of the 14,863 labor markets (state-industry-occupation combinations) analyzed in the previous section. We then aggregate the data further based on the four immigrant reliance groups. This exercise allows us to contrast the evolution of online job postings for labor mar-kets based on their dependence on immigrant labor.

We begin our exploration of job postings by showing that the quan-tity of online job postings evolved similarly across labor markets regard-less of their reliance on immigrant labor. Chart 5 contrasts the evolution of the log of online job postings for each of the four reliance groups (standardized to 0 in 2016). Growth in online job postings was relative-ly similar across all four reliance groups from 2010 to 2016. Although growth was relatively similar for these groups post-2016 as well, it ac-celerated slightly for labor markets with very high reliance on immigrant labor. For example, while online job postings for the high, medium, and low reliance groups increased by 20 percent on average from 2016 to 2019, they increased by 40 percent on average in the very high reliance group. In 2021, growth in online job postings accelerated across all reli-ance groups due to the COVID-19 pandemic and the labor shortages that accompanied it. In sum, we find a modest acceleration in online

Chart 5

Overall Online Job Postings Growth Increased with Reliance

Notes: Chart shows the evolution of the log average number of online job postings in each of the four immigrant labor reliance groups in each year from 2010 to 2021. The values are standardized to equal 0 in 2016.
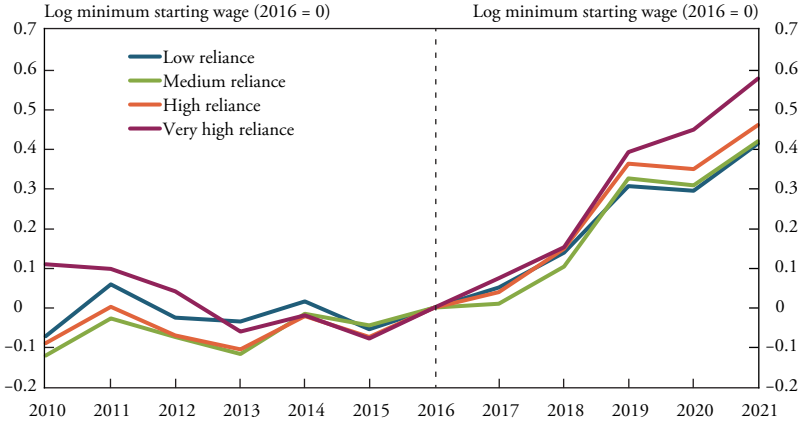Sources: Lightcast and U.S. Census Bureau.

job postings for the highest reliance group, but no meaningful change across the other three groups.

We next examine whether the *content* of online job postings—specifically, the wages and skill requirements—differed in labor markets more or less reliant on immigrant labor. Chart 6 shows the evolution of the log average minimum starting wage listed in an online job posting for each of the four reliance groups. Wage growth in online job postings was stable across the four groups before 2016 and then began to increase and diverge. In particular, the very high reliance group experienced considerably higher wage growth, especially after 2019. The chart suggests that posted wages increased by approximately 60 percent from 2016 to 2021 for the very high reliance group, by 45 percent for the high reliance group, and by around 40 percent in both the medium and low reliance groups.

Chart 7 shows the evolution of the log average number of skills listed in a job posting for each of the four reliance groups.[7] The skill requirements follow an increasing trend across all reliance categories, suggesting that, on average, the number of skill requirements in a job posting has increased over time. However, the growth rate slowed significantly after 2016, especially among labor markets more reliant on immigrant labor. From 2010 to 2016, the overall number of skills
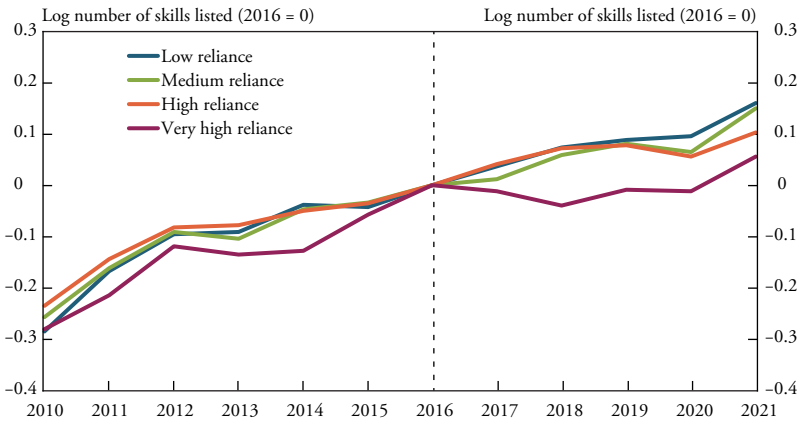
Chart 6

Starting Wages in Online Job Postings Increased with Reliance

Log minimum starting wage (2016 = 0)   Log minimum starting wage (2016 = 0)

- Low reliance
- Medium reliance
- High reliance
- Very high reliance

Notes: Chart shows the evolution of the log average minimum starting wages in online job postings in each of the four immigrant labor reliance groups in each year from 2010 to 2021. The values are standardized to equal 0 in 2016.
Sources: Lightcast and U.S. Census Bureau.

Chart 7

Growth in the Number of Skills in an Online Job Posting Slowed with Reliance

Log number of skills listed (2016 = 0)   Log number of skills listed (2016 = 0)

- Low reliance
- Medium reliance
- High reliance
- Very high reliance

Notes: Chart shows the evolution of the log average number of skills listed in online job postings in each of the four immigrant labor reliance groups in each year from 2010 to 2021. The values are standardized to equal 0 in 2016.
Sources: Lightcast and U.S. Census Bureau.

required in a job posting grew by about 23 percent. However, post-2016, the number of skills required increased by slightly more than 5 percent for the very high reliance group and by more than 10 percent for the other three reliance groups. In other words, even though the overall trend suggests an increase in skill requirements over time, the 2016–21 decline in immigration slowed this trend, especially for labor markets more reliant on immigrant workers.

In sum, our findings show that reduced immigration between 2016 and 2021 had modest effects on the growth rate of online job postings across labor markets. However, the content of those postings shifted more substantially: in labor markets that historically relied more heavily on foreign-born workers, starting wages increased and skill requirements growth slowed as immigration declined.

Conclusions

The decline in immigration from 2016 to 2021 provides a rare case study for understanding how firms react and adjust their online labor search in response to changes in immigration flows. We use the 2016–21 decline to study the relationship between immigration and online job postings, which contain detailed information on industry, location, and occupation. We find that the decline in immigration reduced labor supply growth in labor markets that historically have relied heavily on immigrant labor, while not significantly affecting labor markets with less historical reliance on immigrant labor. In addition, we find that employers in labor markets where labor supply growth slowed responded only modestly by increasing the quantity of job postings and more substantially by changing their content—specifically, by increasing starting wages and reducing skill requirements—to attract workers from different labor pools.

Although our analysis focuses on the decline in immigration from 2016 to 2021, it may also shed light on the rebound in immigration in 2022 and its evolution in the coming years. The historical sorting of immigrants to specific labor markets implies that the declines observed in workforce size in labor markets that rely heavily on immigrants will ease; indeed, these declines may even reverse, returning workforce size to or above pre-pandemic levels as new immigrants continue to flow to United States. As labor supply increases in more immigrant-reliant

labor markets, online job postings may decline. As a result, wage growth may be less substantial and persistent in more immigrant-reliant labor markets. However, posted wages are likely to remain stable: once wages increase, it is uncommon for them to go down. In other words, if the recent rebound in immigration continues, employers might react in the opposite way than they reacted in 2016–21—that is, they may reduce the number of job postings, increase the number of skill requirements in postings, and slow growth in starting wages.

Our findings contribute to understanding how labor markets operate in response to declines in immigration flows. Our findings suggest that changing immigration flows would have uneven effects on the U.S. economy, with some regions, industries, and occupations likely to have a more significant effect in terms of reduced labor supply and increased labor search costs that result from it. While we find an increase in posted wages as immigration declines, we do not see a similar increase in employment in labor markets that rely on immigrant labor. This finding suggests that some jobs filled by immigrants are not easy to fill using native-born workers or to substitute with technology.

Appendix A

State, Industry, and Occupation Foreign-Born Shares

The tables in this section provide detail on the variation in presence of foreign workers across states, industries, and occupations using data from the 2010 and 2021 American Community Survey (ACS). Each list shows the percentages of foreign-born workers in the state, industry, or occupation workforce in 2010 and 2021. We define industry as a three-digit NAICS code and occupation as a three-digit SOC code. The tables demonstrate the large variation and the persistence of immigrant labor.

Table A-1

State Foreign-Born Share in Labor Force

State	2010 (percent)	2021 (percent)
Alabama	4.2	3.7
Alaska	6.0	11.9
Arizona	15.2	14.9
Arkansas	3.9	4.7
California	34.3	32.0
Colorado	11.0	11.1
Connecticut	15.7	19.2
Delaware	9.5	14.5
District of Columbia	15.5	15.3
Florida	22.6	25.6
Georgia	11.8	12.8
Hawaii	22.9	22.1
Idaho	6.6	9.1
Illinois	17.6	18.0
Indiana	6.3	7.8
Iowa	5.8	6.7
Kansas	7.6	9.1
Kentucky	4.2	5.1
Louisiana	4.9	4.4
Maine	4.5	4.6
Maryland	18.1	20.0
Massachusetts	17.9	20.9
Michigan	7.5	8.9
Minnesota	8.8	12.7
Mississippi	2.4	2.4
Missouri	5.4	5.9

Table A-1 (continued)

State	2010 (percent)	2021 (percent)
Montana	2.1	3.2
Nebraska	7.0	8.6
Nevada	22.8	21.7
New Hampshire	6.7	8.3
New Jersey	26.0	28.4
New Mexico	9.6	12.2
New York	27.1	27.3
North Carolina	9.1	10.3
North Dakota	3.3	9.9
Ohio	5.3	7.0
Oklahoma	5.1	6.8
Oregon	13.1	12.5
Pennsylvania	7.4	9.5
Rhode Island	11.9	16.7
South Carolina	5.8	6.2
South Dakota	2.2	6.0
Tennessee	5.9	6.1
Texas	18.1	20.2
Utah	10.5	9.5
Vermont	4.5	7.2
Virginia	14.2	14.8
Washington	17.0	20.1
West Virginia	1.9	2.6
Wisconsin	5.8	7.1
Wyoming	4.0	2.2

Source: U.S. Census Bureau.

Table A-2

Foreign-Born Share in Occupation

Occupation (sorted by three-digit SOC code)	2010 (percent)	2021 (percent)
Top executives	12.3	15.2
Advertising, marketing, promotions, public relations, and sales managers	11.6	13.2
Operations specialties managers	14.1	16.4
Other management occupations	14.1	14.9
Business operations specialists	10.8	14.1
Financial specialists	14.9	15.9
Computer occupations	24.1	26.6
Mathematical science occupations	15.4	25.4
Architects, surveyors, and cartographers	17.0	18.5
Engineers	23.5	23.7
Drafters, engineering technicians, and mapping technicians	14.3	14.9
Life scientists	40.7	37.5
Physical scientists	34.5	33.5
Social scientists and related workers	14.4	13.8
Life, physical, and social science technicians	21.1	17.9
Counselors, social workers, and other community and social service specialists	9.4	10.8
Religious workers	11.3	13.8
Lawyers, judges, and related workers	6.7	9.0
Legal support workers	9.6	11.2
Postsecondary teachers	20.9	23.7
Preschool, elementary, middle, secondary, and special education teachers	6.7	8.5
Other teachers and instructors	13.2	14.3
Librarians, curators, and archivists	8.6	8.1
Other educational instruction and library occupations	11.1	14.8
Art and design workers	14.5	17.4
Entertainers and performers, sports, and related workers	11.0	13.2
Media and communication workers	15.6	15.1
Media and communication equipment workers	12.5	14.1
Healthcare diagnosing or treating practitioners	16.6	16.7
Health technologists and technicians	12.7	14.3
Other healthcare practitioners and technical occupations	8.3	19.0
Home health and personal care aides; and nursing assistants, orderlies, and psychiatric aides	23.5	30.3
Occupational therapy and physical therapist assistants and aides	16.2	13.6
Other healthcare support occupations	14.3	16.5
Supervisors of protective service workers	12.1	15.4

Table A-2 (continued)

Occupation (sorted by three-digit SOC code)	2010 (percent)	2021 (percent)
Firefighting and prevention workers	0.0	6.7
Law enforcement workers	7.4	7.9
Other protective service workers	12.7	13.7
Supervisors of food preparation and serving workers	25.3	26.6
Cooks and food preparation workers	32.3	26.9
Food and beverage serving workers	19.4	16.2
Other food preparation and serving related workers	32.1	21.9
Supervisors of building and grounds cleaning and maintenance workers	26.4	25.4
Building cleaning and pest control workers	36.0	36.9
Grounds maintenance workers	41.0	36.2
Supervisors of personal care and service workers	21.3	32.3
Animal care and service workers	7.8	8.3
Entertainment attendants and related workers	16.3	15.9
Personal appearance workers	33.1	34.2
Baggage porters, bellhops, and concierges	26.9	36.4
Tour and travel guides	0.0	2.2
Other personal care and service workers	20.1	16.9
Supervisors of sales workers	14.8	13.6
Retail sales workers	20.6	18.2
Sales representatives, services	10.0	11.1
Sales representatives, wholesale, and manufacturing	14.2	15.4
Other sales and related workers	13.7	15.5
Supervisors of office and administrative support workers	12.4	14.1
Communications equipment operators	11.4	17.1
Financial clerks	11.2	13.6
Information and record clerks	11.5	12.1
Material recording, scheduling, dispatching, and distributing workers	15.6	16.9
Secretaries and administrative assistants	8.2	10.2
Other office and administrative support workers	10.9	12.0
Agricultural workers	78.4	68.2
Supervisors of construction and extraction workers	3.7	3.4
Construction trades workers	16.7	16.5
Other construction and related workers	18.2	10.0
Supervisors of installation, maintenance, and repair workers	10.0	13.3
Electrical and electronic equipment mechanics, installers, and repairers	14.1	17.6
Vehicle and mobile equipment mechanics, installers, and repairers	18.8	18.7

Table A-2 (continued)

Occupation (sorted by three-digit SOC code)	2010 (percent)	2021 (percent)
Other installation, maintenance, and repair occupations	15.3	16.8
Supervisors of production workers	29.0	26.5
Assemblers and fabricators	24.0	19.8
Food processing workers	45.4	36.6
Metal workers and plastic workers	19.0	18.2
Printing workers	19.8	16.3
Textile, apparel, and furnishings workers	44.2	50.3
Plant and system operators	4.7	9.7
Other production occupations	26.5	25.1
Supervisors of transportation and material moving workers	9.2	11.5
Air transportation workers	10.2	13.2
Motor vehicle operators	20.3	26.2
Rail transportation workers	5.0	4.3
Water transportation workers	0.0	5.0
Other transportation workers	38.9	31.7
Material moving workers	24.4	20.5
Military officer special and tactical operations leaders	5.7	2.4
Military enlisted tactical operations and air/weapons specialists and crew members	6.0	6.8

Source: U.S. Census Bureau.

Table A-3
Foreign-Born Share in Industry

Industry (sorted by three-digit NAICS code)	2010 (percent)	2021 (percent)
Crop production	71.0	60.9
Animal production	10.2	15.4
Support activities for agriculture and forestry	19.4	17.1
Oil and gas extraction	14.6	17.7
Support activities for mining	23.9	23.7
Electric power generation, transmission, and distribution; natural gas distribution; sewage treatment facilities; water, steam, air-conditioning, and irrigation systems; electric and gas; and other combinations	10.5	11.3
Food manufacturing	32.4	30.8
Beverage and tobacco product manufacturing	25.6	18.2
Apparel manufacturing	52.4	43.1
Wood product manufacturing	28.8	25.6
Paper manufacturing	21.8	22.8
Printing and related support activities	23.1	21.6
Petroleum and coal products manufacturing	19.9	24.7
Chemical manufacturing	23.2	23.1
Plastics and rubber products manufacturing	19.4	17.4
Nonmetallic mineral product manufacturing	12.5	6.5
Primary metal manufacturing	13.5	13.4
Fabricated metal product manufacturing	20.5	19.4
Machinery manufacturing	15.4	14.6
Computer and electronic product manufacturing	35.5	36.5
Electrical equipment, appliance, and component manufacturing	2.9	11.4
Transportation equipment manufacturing	13.9	15.4
Furniture and related product manufacturing	12.5	16.0
Miscellaneous manufacturing	49.6	42.3
Merchant wholesalers, durable goods	15.2	13.9
Merchant wholesalers, nondurable goods	20.4	20.2
Motor vehicle and parts dealers	13.1	13.5
Furniture and home furnishings stores	13.8	14.6
Building material and garden equipment and supplies dealers	5.5	3.5
Food and beverage stores	19.3	17.8
Health and personal care stores	19.4	20.7
Gasoline stations	22.1	21.6
Clothing and clothing accessories stores	13.5	25.5
Sporting goods, hobby, book, and music stores	14.9	10.6
General merchandise stores	15.1	16.8
Miscellaneous store retailers	21.5	15.8
Non-store retailers	20.0	23.0

Table A-3 (continued)

Industry (sorted by three-digit NAICS code)	2010 (percent)	2021 (percent)
Air transportation	17.9	18.6
Rail transportation	6.2	8.4
Water transportation	46.0	34.6
Truck transportation	15.5	21.7
Transit and ground passenger transportation	32.1	39.7
Support activities for transportation	26.4	29.7
Postal service	10.4	10.4
Couriers and messengers	8.8	11.1
Warehousing and storage	27.7	23.6
Publishing industries (except internet)	15.3	20.3
Motion picture and sound recording industries	15.6	16.2
Broadcasting (except internet)	16.9	19.4
Telecommunications	17.5	20.3
Data processing, hosting, and related services	19.5	26.8
Other information services	15.8	25.9
Credit intermediation and related activities	13.2	14.7
Insurance carriers and related activities	9.2	11.4
Real estate	14.5	16.1
Rental and leasing services	20.7	21.4
Professional, scientific, and technical services	15.2	18.0
Administrative and support services	25.5	25.6
Waste management and remediation services	33.1	25.4
Education services	10.3	12.4
Ambulatory health care services	15.4	17.1
Hospitals	15.4	16.1
Nursing and residential care facilities	18.1	20.0
Social assistance	16.9	19.1
Performing arts, spectator sports, and related industries	14.0	15.7
Museums, historical sites, and similar institutions	9.6	12.6
Amusement, gambling, and recreation industries	15.1	14.3
Accommodation	30.0	27.3
Food services and drinking places	27.0	22.1
Repair and maintenance	22.0	20.8
Personal and laundry services	30.1	29.7
Religious, grantmaking, civic, professional, and similar organizations	10.6	12.1
Public finance activities; other general government and support; executive offices and legislative bodies	9.1	10.8
Administration of human resource programs	13.1	16.6
Armed forces	9.2	9.9

Source: U.S. Census Bureau.

Appendix B

Regression and Event-Study Analysis

This study documents the statistical analysis we conducted to estimate the effect of immigration flows on foreign-born workforce and online job postings. We define a state-industry-occupation combination as a labor market, where industry is defined as a three-digit NAICS code and occupation as a three-digit SOC code. We use the percent foreign-born workers in a labor market in 2010 as a generalization of our reliance on immigrant workers categories in the main text. This is a continuous measure of reliance on immigrant workers that allows us to model a labor market's incremental response to immigration. We estimate a difference-in-differences (DID) regression to estimate the effect of labor market outcomes on reliance on immigrant workers using the following model:

$$(1) \quad y_{oist} = \alpha_{ot} + \gamma_{it} + \delta_{st} + \beta\, fb_{ois} \times 1\{t > 2016\} + \varepsilon_{oist},$$

where y_{oist} measures outcome y in year t for a labor market that is defined by the occupation o, industry i, and state s combination. The coefficient of interest in the model, also known as the DID coefficient, is β, which captures the average effect of a 1 percentage point increase in a labor market's reliance on immigrant workers on outcome y post-2016. In addition to the DID coefficient, the model includes nonlinear occupation, industry, and state time trends, respectively. The goal of including these time trends is to make the "parallel trends" assumption in the DID plausible. In our context, the parallel trends assumption implies that if immigration trends did not shift from increasing to decreasing in 2016, outcome y would evolve similarly across labor markets regardless of their reliance on immigrant workers. Including nonlinear time trends relaxes this assumption by allowing for differential time trends across occupation, industries, and states, increasing the assumption's plausibility.

Table B-1 presents the estimated DID coefficients from equation (1) on the effect of immigration on workforce size. The outcome in column (1) measures the log of the number of foreign-born workers in

Table B-1

DID Estimates: Immigration and Labor Market Outcomes

Coefficient	Log foreign-born workers	Log total employment
	(1)	(2)
(2010 foreign-born rate) × (post-2016)	−0.0030*** (0.0008)	−0.0012*** (0.0003)
Percent foreign-born workers, 2010	12.84	12.84
Dependent mean, pre-2016	923	4,970
Implied effect (mean 2010 foreign-born percentage)	−3.8	−1.5
Number of state-industry-occupation combinations	14,863	14,863
Observations	178,356	178,356

* Significant at the 10 percent level
** Significant at the 5 percent level
*** Significant at the 1 percent level

Notes: Table presents regression results for the effect of immigration disruptions that began in 2017 on labor market outcomes. All outcomes are calculated at the annual level using the 2010–21 ACS. State-industry-occupation combinations are the unit of analysis. The outcomes in columns (1) and (2) measure the log of the foreign-born workforce and overall workforce in the unit of analysis, respectively. The 2010 foreign-born rate is interacted with the post-2016 indicator, the year in which immigration disruptions started. Robust standard errors, clustered at the labor market level, are in parentheses.

a labor market in each year from 2010 to 2021. The DID coefficient suggests that a 1 percentage increase in labor market's reliance on immigrant workers reduces the labor market's foreign-born workforce by 0.3 percent post-2016, or by 3.8 percent post-2016 for a labor market with a mean foreign-born rate of workers in 2010 (12.84 percent of workforce).

Column (2) of Table B-1 shows that labor markets with higher reliance on immigrant workers also experienced a decline in their overall workforce size. Specifically, our estimate suggests that a 1 percentage point increase in a labor market's reliance on immigrant workers reduces the labor market's workforce size by 0.12 percent post-2016, or by 1.5 percent post-2016 for a labor market with a mean reliance rate. Overall, the results in Table B-1 suggest that (i) firms with higher reliance on immigrant workers experienced more significant drops in their foreign-born workforce following the shift in immigration trends and (ii) these firms were not able to fully replace these missing immigrant workers and their overall workforce declined on average.

Table B-2 examines how firms' labor demand responded to the shift in immigration trends by examining their online job postings. The table presents the estimated DID coefficients from equation (1)

Table B-2

Relationship between Immigration and Online Job Postings

Coefficient	Log job postings	Log mean minimum posted wage	Log mean number of skills in postings
	(1)	(2)	(3)
(2010 foreign-born rate) × (post-2016)	0.0014*** (0.0004)	0.0034*** (0.0006)	–0.0004 (0.0003)
Percent foreign born workers, 2010	12.84	12.84	12.84
Dependent mean, pre-2016	489	19,384	12.59
Implied effect (mean 2010 foreign-born percentage)	2	4.4	–0.5
Number of state-industry-occupations	14,863	14,863	14,863
Observations	178,356	178,356	178,356

  * Significant at the 10 percent level
 ** Significant at the 5 percent level
*** Significant at the 1 percent level

Notes: Table presents regression results for the effect of immigration disruptions that began in 2017 on online job postings outcomes. All outcomes are calculated at the annual level using the 2010–21 Lightcast data. State-industry-occupation combinations are the unit of analysis. The outcome variable in column (1) is the log number of online job postings in the unit of analysis. The outcome in column (2) measures the log mean minimum wage posted at the unit of analysis. The outcome in column (3) is the log of the mean number of skills listed in a job posting at the unit of analysis. The 2010 foreign-born rates in the four different units of analysis are interacted with the post 2016 indicator, the year when immigration disruptions started. Robust standard errors, clustered at the labor market level, are in parentheses.

on the effect of immigration on various outcomes related to online job postings. The outcome in column (1) measures the log of the number of online job postings in a labor market in each year from 2010 to 2021. The DID coefficient suggests that a 1 percentage increase in labor market's reliance on immigrant workers reduces the labor market's foreign-born workforce by 0.14 percent post-2016, or by 2 percent post-2016 for a labor market with a mean foreign-born rate of workers in 2010. Columns (2) and (3) look at the posted starting wages and the log number of skills required in online job postings. The DID estimates show that firms in labor markets with higher reliance on immigrant workers increased the starting wages in their job postings by 4.4 percent on average and reduced the number of skills listed in their postings by 0.5 percent on average. Overall, the results Table B-2 suggest that firms with higher reliance on immigrant workers responded by increasing their search efforts as measured by increased online job postings, increased starting wages, and reduced skill requirements.

Next, we estimate event-study regressions to explore the dynamics of our findings and to test the validity of the parallel-trends assumption. We estimate the following regression models:
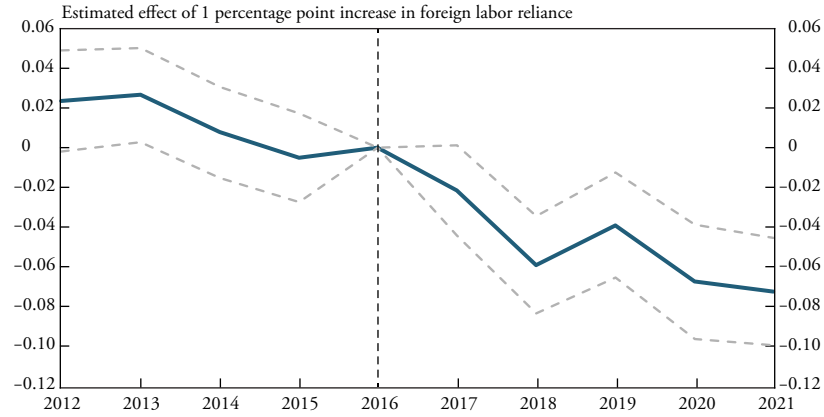
$$(2) \quad y_{oist} = \alpha_{ot} + \gamma_{it} + \delta_{st} + \sum_{k \neq 2016} \beta_k fb_{ois} \times 1\{t = k\} + \varepsilon_{oist}.$$

Equation (2) differs from equation (1) because it is estimating "annual" DID coefficients and allows us to examine the dynamics of the evolution of the different labor market outcomes we examine. Another benefit of using an event-study model is that it allows us to test the validity of the parallel trends assumption by considering the pre-2016 coefficients on reliance on immigrant workers and by examining whether labor markets with different reliance on immigrants were not on different trends prior to 2016.

Charts B-1 through B-3 show the event-study estimates for the foreign-born rate, the log number of online job postings, and the log mean starting wage, respectively, in online job postings for the labor markets in our study. The blue line represents the estimates for a 1 percentage point increase in a labor market's reliance on immigrant labor. The dashed gray lines represent the 95 percent confidence intervals for the estimated coefficients. As can be seen in Chart B-1, the pre-2016 coefficients on the effect of a labor market's reliance on immigrant workers are statistically insignificant and hover around 0, while becoming negative, significant, and increasing in magnitude over time, suggesting that the effect of decreasing flows of immigration grows larger over time. The estimates in Chart B-2 show that the effect of reliance on immigrant workers on online job postings becomes positive and significant in 2020 and 2021, suggesting that while firms with greater reliance on immigrants did increase the number of online job postings relative to firms with lower reliance on immigrant workers, this increase became much more evident in 2020 and 2021. However, Chart B-3 demonstrates that starting wages increased much faster and consistently in firms that rely more on immigrant workers. This suggests that firms responded first by increasing starting wages on already existing job postings; as labor shortages became more severe, firms added more job postings to fill positions.
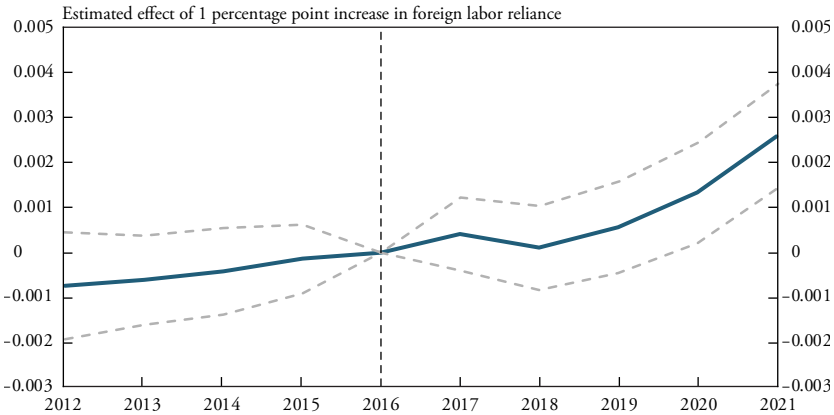
Chart B-1

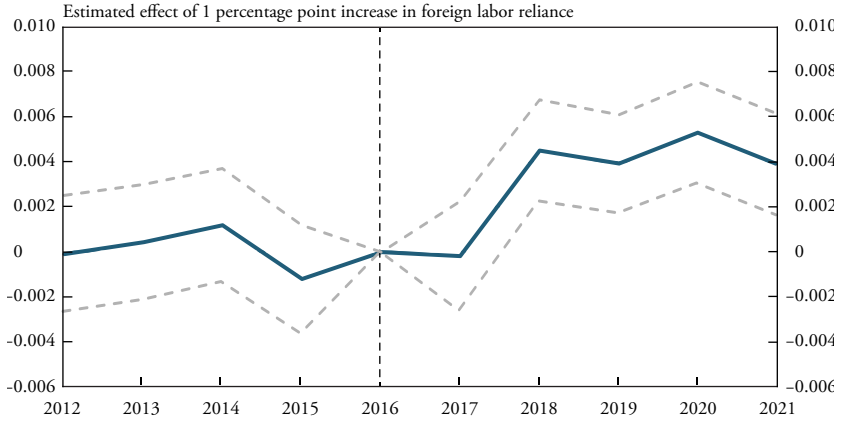## Event-Study Estimates: Foreign-Born Rate in Labor Market

Estimated effect of 1 percentage point increase in foreign labor reliance

Source: Authors' calculations.

Chart B-2

Event-Study Estimates: Log Number Online Job Postings in Labor Market

Estimated effect of 1 percentage point increase in foreign labor reliance

Source: Authors' calculations.

Chart B-3

Event Study Estimates: Log Starting Wage in Online Job Postings in Labor Market

Estimated effect of 1 percentage point increase in foreign labor reliance

Source: Authors' calculations.

Endnotes

[1]Immigration has always been a crucial source of labor supply to the United States. Two main factors that have contributed to the growing importance of immigration in the labor market in recent years are that immigrant employment growth has been outpacing that of natives and that immigrants are more likely to participate in the labor market compared with natives. From 2007 to 2021, foreign-born employment grew by 1.3 percent per year on average, more than twice the pace of native-born employment. Additionally, the labor force participation rate among the foreign-born working-age population was 67 percent during these years, compared with 63 percent among natives.

[2]The ACS contains a 1 percent representative sample of the U.S. population conducted by the U.S. Census Bureau. Each respondent to the ACS has an associated weight corresponding to how many people they represent, which we use to approximate the size of the foreign-born workforce.

[3]This measure assumes that immigrants' historical location and employment decisions are not correlated with current economic conditions (for example, employment and wage growth) but do influence the location and employment decisions of new immigrants through the chain migration or social network channel, as shown in Chart 2. The thought experiment behind this measure is that if two labor markets (that is, state-industry-occupation combinations) were experiencing similar economic conditions, a prospective immigrant would prefer the market (combination) that has historically attracted more immigrants from their country of origin.

[4]One concern with our approach is that the 2011–21 period was characterized by a strong economy and tight labor markets in addition to the globally disruptive COVID-19 pandemic. These factors affected the economy and labor markets in ways not directly related to immigration flows. Thus, comparing the time series of various outcomes across different reliance groups could inappropriately attribute changes in outcomes to the drop in immigration flows. To address this concern, Appendix B presents a complex econometric model that uses the 2010 percentage of foreign-born workers in a labor market as a continuous measure of reliance on immigrant labor and a regression analysis that controls for state, industry, and occupation time trends. The goal of this exercise is to account for as many factors that affect the evolution of the labor force and online job postings in addition to immigration across labor markets, such that we can convincingly net out the effect of reduced immigration flows on labor market outcomes. Reassuringly, the results we obtain are qualitatively similar to those presented in this article, suggesting that contrasting the evolution of labor market outcomes for different labor markets based on their reliance on immigrant labor is both simple and informative.

[5]One potential explanation is that would-be immigrants to high reliance labor markets are more likely to be barred from entering the United States relative to potential immigrants to low reliance labor markets. The mean annual wage for workers in the highest reliance groups is 10 percent lower on average, and their average years of education completed is considerably lower. This is consistent with the COVID-19 pandemic and the change in immigration policy that made it more difficult for refugees and asylum seekers, who are likely to have fewer years of education than the average immigrant, from entering the United States.

[6]The low reliance group experienced higher growth than other groups from 2010 to 2013 and similar growth after 2014.

[7]We also examine the share of job postings with no education or experience requirements and the percentage of postings with at least one skill requirement. The findings are consistent with a decline in requirements in state-industry-occupation combinations with higher reliance on immigrant labor across all listed measures.

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