



# Changes in international immigration and internal native mobility after COVID-19 in the USA

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## Abstract

The COVID-19 pandemic produced a significant decline in international immigration to the USA between 2020 and 2021. This paper documents the timing, characteristics, and heterogeneity of the change in immigration across states and economic sectors. Additionally, we describe the trends in internal native mobility in the USA prior to and after the pandemic, investigating whether natives responded to the decrease in immigration by relocating either geographically or across sectors. Despite the substantial drop in international migration, we do not observe any significant changes in native internal mobility. Employing a panel regression and a shift-share IV, we study the effect of foreign immigration, the emergence of remote-work, and changes in labor demand on cross-state native mobility. Our results indicate that the decline in immigration following COVID-19 and the differential availability of remote-work opportunities across sectors and states did not drive changes in natives' cross-state or cross-sector mobility.

**Keywords** COVID-19 pandemic · International immigration · Internal native mobility · Remote work · Vacancies

**JEL codes** F22 · J15 · J61

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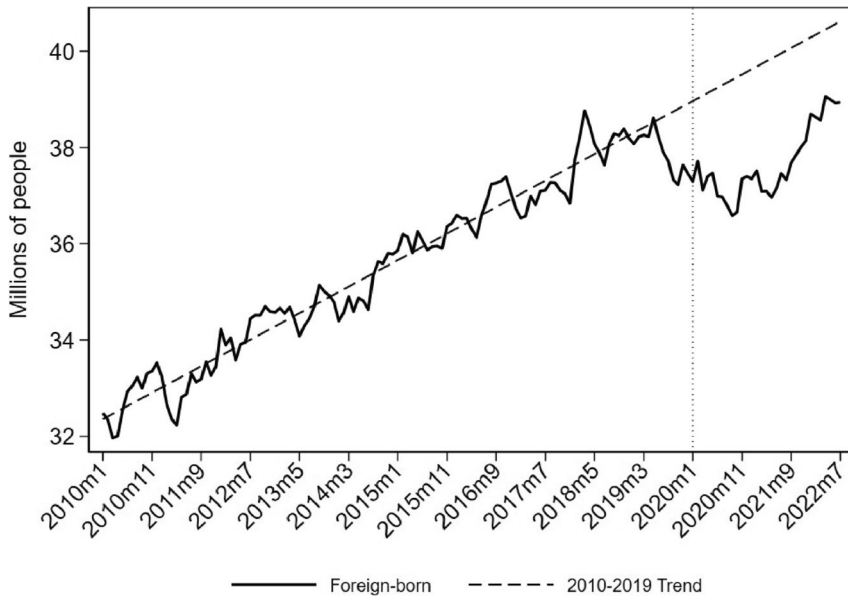
## 1 Introduction

Since the beginning of the COVID-19 pandemic in March 2020, the US economy and its labor markets have undergone numerous rapid changes. The employment rate experienced a dramatic decline in the few months following March 2020, especially affecting female participation (Albanesi and Kim 2021). A large number of older workers opted for retirement (Faria et al. 2021; Goda et al. 2023), and a substantial proportion of in-person work was replaced by remote work (see Barrero et al. 2020). In addition, the incidence of these shocks varied widely across sectors. Several of these changes and their consequences persisted well beyond the pandemic-driven recession and into 2022 (see Parker et al. 2022). As of July 2022, the total employment level had returned to its January 2020 level (around 158.5 million jobs). However, during the 10-year period prior to the pandemic, employment had been growing on average by 2 million jobs per year. Therefore, while the US economy has climbed out of its COVID-recession phase, the number of jobs remained, as of July 2022, 4–5 million lower than it would have been if it had continued on its pre-2020 growth trend. Similarly persistent were the prevalence of remote work (see Aksoy et al. 2022), which remained substantial as of July 2022, and the number of unfilled jobs (vacancies), which continued to be large and increasing in July 2022. These trends indicate a shift in work habits and a slow reallocation of labor across sectors, and potentially across space.

A less recognized factor that may have contributed to the stagnation of aggregate employment growth is the dramatic decrease in the inflow of foreign-born workers over a period of nearly 2 years. While immigration into the US had been slowing since 2017, it experienced a sharp decline in late 2019 and throughout 2020 until mid-2021. Executive orders, limiting visa issuance, and delaying the processing of green cards introduced during the Trump administration, combined with the usual sluggishness of the US immigration system, slowed down immigration in the years leading up to the pandemic, particularly affecting non-college educated immigrants.<sup>1</sup> Then, the COVID-19 pandemic almost entirely halted international travel and the processing of visas throughout most of 2020, resulting in a drastic reduction in the net growth of the foreign-born population during that year.

This fact is demonstrated in Fig. 1, where we plot the monthly time series, using data from the monthly Current Population Survey, of the foreign-born adult working-age population (18–65 years old) in the USA. The series spans from January 2010 to July 2022 and is represented by a solid line. Contrasted with this line is the linear trend (dashed line) for the population from January 2010 to May 2019, which represents the peak of the foreign-born population before the COVID-19 pandemic. For reference, we project this trend up to July 2022. During the nine years before May 2019, the working-age foreign-born population grew by an average of about 660,000 individuals per year. However, between May 2019 and June 2022, within a span of two and a half years, this population grew by a mere total of 300,000

<sup>1</sup> See Bolter et al. (2022) for a detailed description of all the executive orders related to immigration and enforcement introduced between 2017 and 2020.



**Fig. 1** US working-age foreign-born population, January 2010–July 2022. The solid line shows the total number of working-age (18–65) foreign-born individuals. The dashed line provides the linear fit of the data from January 2010 to May 2019. The slope of the dashed line is 55,106. By June 2022, the number of working-age foreign-born individuals was smaller by 1,638,680 relative to the level it would have achieved if the 2010–2019 trend had continued to July 2022. Data source: monthly CPS, January 2010–July 2022

individuals. This implies a gap of 1.65 million working-age foreign-born individuals, relative to what their population would have been if the pre-2019 growth rate had continued.<sup>2</sup>

In this paper, we focus on the slowdown in the inflow of foreign-born workers. We begin by describing how this decline varied across education groups, states, and sectors. As foreign-born workers tend to concentrate in specific sectors and jobs and in specific states, this large decline has had diverse effects on local labor markets in the USA. In this case, an important margin of response of local labor markets to the decline in immigrant workers' supply is native workers' internal mobility. This adjustment affects wages and local vacancies. Accordingly, we first examine the patterns of native mobility, comparing mobility during the years 2020–2022 to its

<sup>2</sup> As an alternative way to show the gap from the previous long-run trend, we show in Fig. A1 of the Appendix the evolution of the working-age foreign-born population from January 1994 to June 2022. This is the longest available period where we can identify foreign-born individuals in the monthly CPS. In this case, we observe a slowdown in the working-age immigrant population around 2002, followed by a flattening of the slow-down around 2010. We use a flexible polynomial specification (cubic) to approximate the trend from 1994 to 2019, and we calculate the gap in June 2022 based on this 25-year trend. Remarkably, the value of the gap is 1.4 million foreign-born, which closely aligns with the 1.65 million gap obtained using the more localized linear trend. This confirms the claim that there was a significant drop in foreign-born population in 2020 and 2021, even relative to a longer-term trend.

pre-2020 trend. Then, we analyze whether native mobility responded to the slow-down in immigration. In particular, we examine whether natives increasingly moved into areas and sectors that lost a large number of immigrants. This potential increase in native mobility could partially offset the aforementioned changes and contribute to stabilizing employment and population.

This paper contributes to two areas of existing literature. First, it adds to the literature that documents and seeks to explain the decline in internal mobility of individuals across US labor markets over the past few decades (Molloy et al. 2011; Kaplan and Schulhofer-Wohl 2017; Basso and Peri 2020). Second, this paper builds upon the long-standing literature that analyzes the mobility response of natives to inflows of immigrants across US cities or local labor markets. Card (2001) shows a very small response of native mobility to international immigration, a finding that is confirmed in Peri and Sparber (2011) in a broader context. A related literature suggests that local shocks are cushioned by the mobility of immigrants themselves, rather than natives (Cadena and Kovak 2016), since immigrants, particularly those with lower levels of education, tend to be more responsive to local employment opportunities than natives (Basso and Peri 2020). The drop in immigrant inflows during COVID-19 provides a new, sudden, and large negative shock to the inflow of immigrants, which is in contrast to the positive shocks observed in most previous studies. By assessing the impact of this decline on native mobility, this paper contributes new evidence to this literature.

Additionally, while we include it mainly as a control variable, we are among the first to analyze the association between the availability of remote work and the geographic mobility of natives. By utilizing data from the Current Population Survey (CPS), including the supplementary module introduced in May 2020 that focuses on remote work, we analyze variations in remote employment across skill groups, states, and sectors. The opportunity of working remotely may have created additional possibilities for native mobility by decoupling work and residence locations.

As the COVID-related changes affecting labor markets were quantitatively significant and geographically uneven, they could have stimulated stronger inter-state mobility of natives. To investigate this claim, we perform a panel regression, use shift-share style instruments to proxy for the changes in immigrant inflows, and analyze whether native inter-state mobility responded to these flows. We allow for different responses before and after 2020. We also incorporate a measure of remote work opportunities after COVID and control for changes in labor demand (using the so-called Bartik variable), as both are additional potential determinants of native mobility. Our findings reveal that there were no significant changes in the overall native mobility or its responsiveness to the drop in international immigration during and after the COVID-19 pandemic (post-2020).

In addition, we show that the decline in immigration had heterogeneous effects on employment across sectors due to the uneven sectoral distribution of foreign workers. Similarly, the availability of remote work opportunities varied across sectors. As a result of these two factors, there were instances where the same sector faced both a decrease in immigrant workers and a lack of remote work opportunities. A prominent example is the “Food and Hospitality” sector, which experienced the largest drop in foreign employment, while having the lowest remote work

options. Interestingly, this sector also had the largest number of unfilled job openings in 2022. We therefore complement the cross-state analysis with an analysis of whether the mobility of natives across sectors in each state was responsive to these combined shocks experienced post-2020. To do this, we divide workers in 17 major sectors, and we examine whether the mobility of native workers across these sectors responded to the large state-specific changes in immigration. We find only weak evidence of increased native cross-sector mobility being associated with the drop in immigration and the rise of remote work opportunities across states.

Finally, we analyze whether the drop in immigration, coupled with the unchanged mobility of natives, generated labor market shortages and imbalances, as captured by the unfilled jobs across US states. While our analysis reveals some evidence supporting this claim, the significance and magnitude of the association are small. With only 2 years of data since the onset of the COVID-19 pandemic in 2020, the cross-state and yearly analysis is rather under-powered to detect clear effects. Therefore, a future analysis using local labor market data over a longer period of time is warranted.

We conclude by discussing the main implications of our findings, emphasizing how the significant changes in foreign-born immigration and remote-work opportunities after 2020 did not seem to generate short-run effects on native internal mobility. Similarly, native workers' mobility across sectors did not respond quickly or significantly to the changes in the patterns of immigration and remote work. These results may speak to the presence of rigidity in labor markets and the costs of moving, such as housing costs and worker preferences, that need to be included more explicitly in the analysis to gain a more comprehensive understanding of the continued lack of native mobility.

The rest of this paper is organized as follows: We provide a brief overview of the data used in our analysis in Sect. 2. In Sect. 3, we describe the evolution of foreign-born immigration, remote work, and job vacancies in the USA. The discussion on the evolution of internal mobility of native workers is presented in Sect. 4. Section 5 presents the results of our panel 2SLS estimates, examining the native mobility response to pre- and post-COVID changes in immigration, while accounting for labor demand and remote work opportunities. Section 6 utilizes the same panel regression to analyze the correlation between these shocks and unfilled job vacancies. Finally, Sect. 7 provides concluding remarks.

## 2 Data

Our choice of data aims to strike a balance between extending our analysis to 2022 to identify post-COVID trends and performing analysis using a representative sample, at least at the state and sector level. To track the aggregate foreign-born population in the USA, we rely on data from the Current Population Survey (CPS), obtained through IPUMS (Flood et al. 2022). We construct the monthly time series using the monthly surveys of the CPS, from January 2010 to July 2022. In our analysis using the CPS monthly data, we restrict the samples to working-age (18–65), non-institutionalized individuals. We define foreign-born

individuals as those who were born outside the US and its outlying areas. College-educated individuals are those with a college degree or more. Individuals who are non-college educated are those with some college education but no degree, a high school degree, or less than a high school degree. We are also able to observe whether individuals were attending college (full time or part time) during the previous week.

We define an employed individual as someone who was either at work or had a job during the previous week. We follow the industry (sector) classification of the Bureau of Labor Statistics (BLS). That classification is based on the North American Industry Classification System (NAICS). The industries are aggregated to form super sectors and select sub-sectors. We map each individual's industry reported in the CPS to the aggregate sector groups using crosswalks publicly provided by the BLS.<sup>3</sup> We then only focus on the 17 mutually exclusive, broad sectors for our analysis.<sup>4</sup>

Starting in May 2020, the CPS added a module with specific questions related to the mode of work during the COVID-19 pandemic. We specifically consider the question of whether an individual did any telework or worked from home for pay in the last week. For each individual, we construct a dummy variable that takes the value 1 when the respondent answered that they have worked remotely for pay due to the pandemic. This variable captures the "extensive" margin of working from home, identifying individuals who have engaged in any work from home during the last week. We calculate the percentage of employees working remotely as the share of workers for whom the dummy variable is equal to one.

In order to look at native internal mobility patterns, we rely, instead, on the Annual Social and Economic Supplements (ASEC) of the CPS (March supplement) for the time period 2010-2022, also obtained through IPUMS (Flood et al. 2022). We again restrict the sample to working-age individuals. This data provides information on whether individuals changed their address since the reference date (March 1 of the preceding year). Individuals who did not change residence and still live in the same house are considered non-movers. Movers, on the other hand, are those who are not living in the same house as on March 1 of the previous year. This move is further classified as within county, within state, across states or from abroad. In addition, we are able to observe the state or foreign country where the movers resided a year ago. These variables allow us to calculate the in- and out-mobility across states for each year between 2010 and 2022. Finally, the dataset reports the reasons for moving. We group the reasons into two broad groups: "employment-related"<sup>5</sup> and "other" or "non-employment

<sup>3</sup> You can find the crosswalks at the following URL: <https://www.bls.gov/cps/cpsoccind.htm>.

<sup>4</sup> These are Mining and logging; Construction; Information; Professional and business services; Other services; Durable goods manufacturing; Non-durable goods manufacturing; Wholesale trade; Retail trade; Transportation, warehousing, and utilities; Finance and insurance; Real estate and rental and leasing; Educational services; Health care and social assistance; Arts, entertainment and recreation; Accommodation and food services.

<sup>5</sup> Employment reasons include new job or job transfer; looking for work; a lost job; moving closer to work/easier commute; retirement; other job-related.

related.”<sup>6</sup> We use this grouping to identify potentially distinctive patterns of labor-market related mobility.

In addition to geographic mobility, we analyze the mobility of employed natives across industrial sectors using the CPS ASEC (2010-2022). The March supplement of CPS asks individuals about the industry of employment one year ago, conditional on them having worked in that year. Thus, if the individual is currently employed, we are able to observe their current industry of employment and the industry of employment one year earlier. We construct a dummy that indicates whether an individual moved from one macro-sector to another, grouping industries into the 17 macro-sectors defined above. This dummy takes a value of 1 if the industry where the individual currently works (in year  $t$ ) is different from that of the previous year ( $t - 1$ ). This dummy indicates employment mobility across sectors.<sup>7</sup> Using this variable, we are able to construct sectoral mobility rates in each state by dividing the total number of individuals who moved during the previous year by the working-age population of the state in year  $t$ .

We then zoom in on the mobility of natives in and out of a particular group of macro-sectors.

This group constitutes five sectors that, as we will document, employed a large share of immigrant workers and provided limited possibility for remote work during COVID. These sectors are construction, accommodation and food services, other services, non-durable goods manufacturing, and transportation, warehousing, and utilities. In-mobility into these sectors is defined as an individual moving into one of these five high-immigrant, low-remote-work sectors from one of the 12 other sectors. Out-mobility from these sectors is defined as an individual moving from one of these five high-immigrant, low-remote-work sectors to one of the other 12 sectors. Using these dummy variables, we are able to construct mobility rates into and out of those five sectors by dividing the total number of individuals who moved between these two broad groups during the previous year by the state’s working-age population in year  $t$ .

Finally, we obtain data on vacancies from the Job Openings and Labor Turnover Survey (JOLTS) of the US Bureau of Labor Statistics.<sup>8</sup> The data covers all non-agriculture industries in public and private sectors for 50 states and the District of Columbia. Agriculture, forestry, fishing, and hunting are out of the scope of the JOLTS program. Industries are grouped to form super and sub-sectors. The industry classification used in JOLTS can be easily cross-walked to the Census classification used in the CPS. A job opening is defined as a position that is open and not filled on the last business day of the month. The position could either be full-time

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<sup>6</sup> Other reasons include family reasons (change in marital status; establish one’s own household; other family reasons; relationship with unmarried partner); housing reasons (wanting to own a home rather than rent; wanting newer/better/larger housing; wanting cheaper housing; foreclosure/eviction; and more); other (attend/leave college; change of climate; health reasons; other reasons; natural disaster).

<sup>7</sup> To construct all of these variables, we restrict the sample to employed working-age individuals who report an industry in both the current and previous year. This, therefore, represents only cross-sectoral mobility of people who are and were employed one year ago.

<sup>8</sup> You can find the data at the following URL: <https://www.bls.gov/jlt/>.

or part-time. At the sector level, the data provides seasonally adjusted monthly counts of job openings in the USA for establishments of all sizes from January 2010 to August 2022. At the state level, the data provides seasonally-adjusted monthly counts of total non-farm job openings for all establishment sizes from January 2010 to July 2022.

### **3 Falling immigration, increasing remote work, and rising vacancies: a timeline from March 2020 to July 2022**

The sudden spread of COVID-19 in various countries in early 2020 raised concerns in the USA as early as February. However, the policy responses, such as lockdowns, mandatory business closures, safety procedures, and worker protection policies were left to individual states and local administrations, resulting in non-uniform approaches across the USA. While most states enforced some form of lockdowns from March 2020 to May 2020, the severity and intensity of these closures varied significantly across states, with pronounced differences becoming evident after June 2020. During the period from March 2020 to June 2020, the Center for Disease control (CDC) issued several guidelines for social distancing and testing protocols, which several States followed upon re-opening their economies.<sup>9</sup> In February 2021, the first COVID-19 vaccines were introduced, and by then, most of the US states had either re-opened or fully opened. Similarly, the executive orders implemented to protect workers from COVID-19, such as guidelines for mask usage, social distancing, and vaccination requirements, varied widely across states and were most stringent during the period June 2020–June 2021, gradually easing thereafter. By 2022, all states had eliminated virtually all restrictions.

The first goal of this paper is to characterize the changes in immigration to the US during this timeline, starting from March 2020 with the onset of COVID-19, the subsequent brief economic recession driven by lock-downs (March to June 2020), and the economic recovery as the economy reopened (2021–2022). Second, as it was a very relevant labor market phenomenon in this period, we characterize the growth and geography of remote work, which expanded greatly during COVID and may have implications for native mobility. Certain states, such as California and New York, remote work for non-emergency workers was the only option during the summer and fall of 2020, and there were very strict regulations designed to protect workers.<sup>10</sup> On the other hand, other states, like Texas and Florida, did not enforce significant restrictions on work after Summer 2020. In 2021 and 2022, as mandatory work protection measures and remote work mandates receded, many employers continued to offer remote work on a discretionary basis, often due to workers signaling a strong preference for the flexibility and safety it provided. Access to remote

<sup>9</sup> See the timeline of the COVID-19 Pandemic at the CDC website: <https://www.cdc.gov/museum/timeline/covid19.html>.

<sup>10</sup> For example, refer to the COVID-19 prevention emergency measures implemented in California in 2020, available at: <https://www.dir.ca.gov/dosh/coronavirus/ETS.html>.



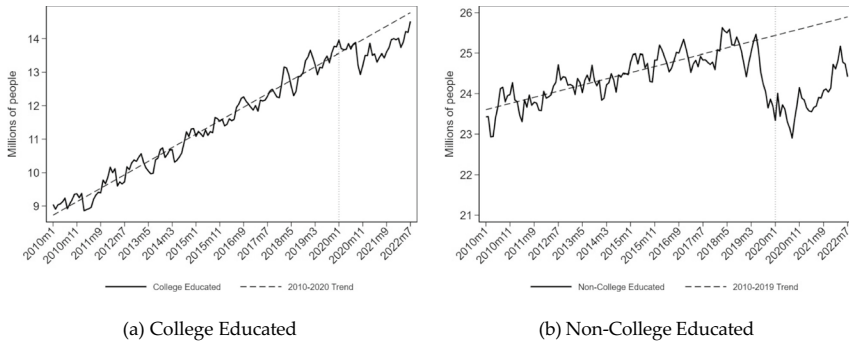
work opportunities, however, was unequally distributed across states, and we will consider its potential association with inter-state mobility. Since the decline in international mobility and slow mobility response of natives may generate labor market imbalances and sluggish adjustments, we additionally describe the evolution of job vacancies in the period 2020–2022.

### 3.1 The immigration slowdown: timing, skills, and geography

Figure 1 shows the significant slowdown in the growth of working-age foreign-born population since mid-2019. Figure 2 a and b show the same trends separately for the (a) college- and (b) non-college-educated working-age population. We notice two differences. First, the pre-2019 trend growth was steeper for the college-educated population, which was growing by almost 480,000 individuals each year. In contrast, the non-college-educated population was growing by only around 180,000 individuals each year. The second difference is that while college-educated immigration slowed in early 2020, almost perfectly coinciding with the onset of the pandemic, non-college-educated immigration had an earlier stagnation and decline beginning in mid-2019. The number of college-educated working-age immigrants barely increased between January 2020 and June 2022. Interruption of international travel and the slowdown in processing of student, scholar, and professional visas (F1, J1, and H1B) in 2020 were among the main causes of the decline in the inflow of college-educated immigrants.<sup>11</sup> The population of working-age immigrants without a college degree (Fig. 2b) was already growing at a rather slow rate over the last decade, but since 2017, it barely grew at all. Between May 2019 and July 2022, this group witnessed a decline in absolute numbers, with a substantial drop observed from 2019 to 2020, followed by a partial recovery in 2021. As of June 2022, this group was smaller by 1.1 million individuals than if it had maintained its pre-May 2019 population trend growth. While the slowdown in the inflow of non-college-educated immigrants has been previously noted in the literature (see Hanson and McIntosh 2016), this slowdown intensified during the Trump administration and even more so during the COVID-19 pandemic.

Overall, the slowdown in college-educated immigration was less pronounced than the slowdown for non-college educated, but one additional phenomenon that will continue to contribute to slower inflows of college-educated immigrants into the US labor force is the decline in foreign-born college students. Figure 3 shows the decline in the foreign-born college student population (aged between 18 and 24) from 2010 to 2022, smoothed by a 12-month moving average. The number started declining in 2017 and dropped significantly in 2020. Given that between one-fifth and one-fourth of those students will work in the US (see Beine et al. 2022) for at least several years, this decline in international student enrollment will contribute to the reduction in young, highly educated workers joining the US labor force for some years to come.

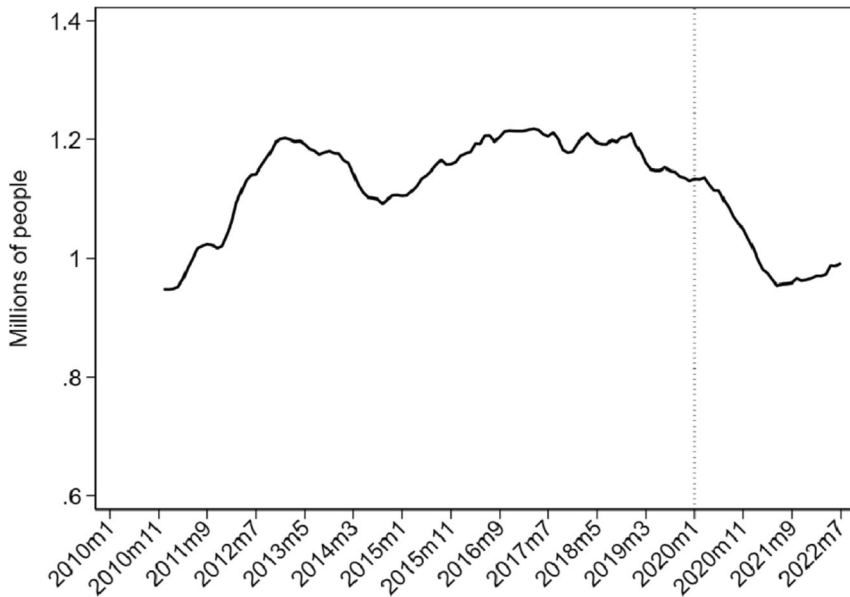
<sup>11</sup> Figure A2 in the Appendix shows the very large drop in F1 and J1 visas in 2020, as well as a pre-existing decline in student visas starting in 2015-16.



**Fig. 2** US working-age foreign-born population by college education. In **a**, the solid line shows the total number of working-age college educated foreign-born individuals, while the dashed line provides the linear fitting of the data from January 2010 to January 2020. The slope of the dashed line is 40,327. By June 2022, the number of working-age college-educated foreign-born individuals was smaller by 547,957 relative to the level it would have achieved if trend had continued. In **b**, the solid line shows the total number of working-age non-college educated foreign-born individuals, while the dashed line provides the linear fitting of the data from January 2010 to May 2019. The slope of the dashed line is 15,261. By June 2022, the number of working-age non-college educated foreign-born individuals was smaller by 1,143,683 relative to the level it would have achieved if trend had continued. Data source: monthly CPS, January 2010–July 2022

We also explore demographic heterogeneity in the slowdown of immigration. Figure A3 in the Appendix shows that immigration rates of both working-age men and women were similarly affected by the pandemic. Breaking down immigration by age groups shows clearly that the most affected group was that of prime-age workers between 25 and 44 years of age (Fig. 4). Their population declined significantly, and as of mid-2022, it was still lower than in mid-2019. On the other hand, the number of younger working-age immigrants (18–24), and the number of older, working-age immigrants (45–65) appear to have continued on their pre-2020 trends. This is an additional indication that the post-2020 change in immigration may have had a significant impact on the US labor force, by reducing the number of a group of immigrants who are very likely to work and whose employment rate was and remains high.

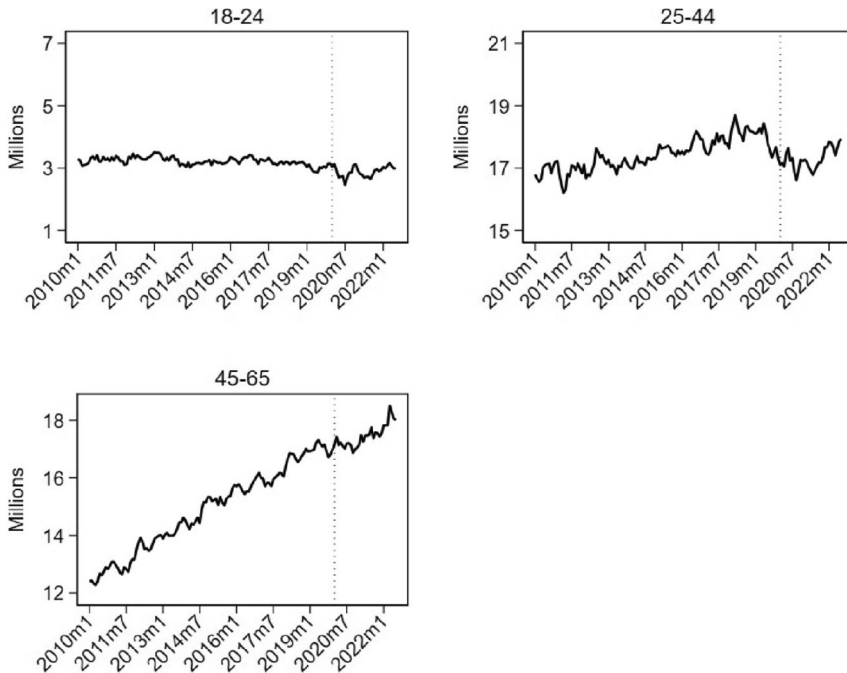
There was significant variation in the post-2020 change in immigration across US states as well. Figure 5 shows that, among the six states with largest immigrant populations in working age, California and Florida experienced the largest decline in their foreign-born population. New York, New Jersey, and Illinois, whose foreign-born population has remained fairly constant over the previous decade, did not experience a large change, while Texas, the state whose immigrant population had grown the most during the last decade, continued on that trend without much of a change. We will characterize the net immigration in each state and its relation to native population change, in Sect. 4.3. Here, we simply point out that the general slowdown in immigration during the pandemic varied significantly across US locations. Additionally, since the share of foreign-born in the total labor force varies significantly across states, we will be able to leverage these differences to capture the differential impact of the decline in immigration on the local population and labor force using a shift-share instrumental variable strategy.



**Fig. 3** US foreign-born population, ages 18–24, attending college. This figure shows the 12-month moving average of the number of foreign-born individuals who are between 18 and 24 years old and who are attending college. Data source: monthly CPS, January 2010–July 2022

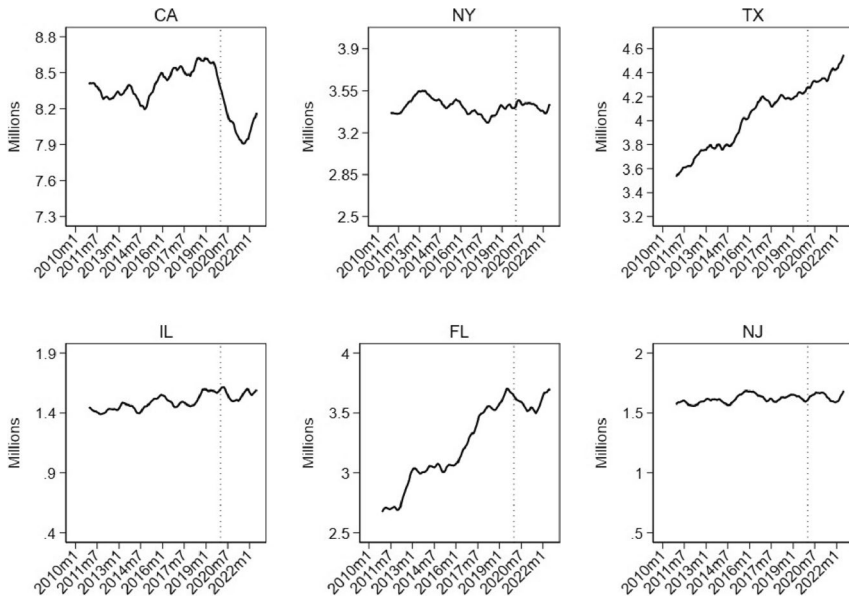
The changes in immigration were also quite different across countries of origin. Figure 6 shows the time series of the working-age foreign-born population for the largest three countries of origin (Mexico, China, and India) and for the remaining origin countries (denoted as “other”). The panels of Fig. 6 show a decline in the Mexican population after 2019, in contrast to its pre-2019 stability, as well as a clear slowdown in the growth of Indian-born population (which was on an upward trajectory before the pandemic) and a slowdown of the population from “other” origins. The population of immigrants from China remained on a relatively constant growth trajectory. Broadly, the behavior of the Mexican population mirrored that of non-college-educated immigrants (as seen in Fig. 2b). This makes sense, since a large fraction of immigrants from Mexico are not college-educated. On the other hand, Indian and “other” immigrants show a trend more similar to that of the college-educated foreign-born, since most of the inflow of these immigrants in the last decade was represented by college educated individuals. One way to characterize the impact of the post-COVID pandemic on immigrant flows is through the observed decline in the population of foreign-born individuals from Mexico and without a college degree, alongside a slowdown in the growth of the population of foreign-born individuals with a college degree from the rest of the world.

A final way to observe how the large slowdown in foreign-born population growth can have heterogeneous effects across the US economy is to characterize the foreign-born employment growth across sectors. As described in Sect. 2, we use the BLS classification system that divides the US economy in 17 mutually exclusive



**Fig. 4** US foreign-born population by age group. This figure shows the number of working-age foreign-born individuals separated into three age categories: 18–24, 25–44, 45–65. Data source: monthly CPS, January 2010–July 2022

broad sectors. Figure 7 shows the evolution of working-age, foreign-born employment overall (the dark line), and in the four broad sectors where immigrants represented a large share (more than 20%) of employment before COVID-19, namely “Accommodation and Food Services,” “Retail Trade,” “Non-durable Good Manufacturing,” and “Health Care and Social Assistance.” We standardize the value in January 2020 to 100, and we show the time series from January 2010 to July 2022. We highlight three facts. First, relative to the pre-2020 trend growth, foreign-born employment experienced a deep decline in 2020 and only a partial recovery in 2021, both overall and in each sector. In the four immigrant-heavy sectors, employment dropped by at least 10% during 2020. By July 2022, the employment of those sectors had barely recovered to its January 2020 level. Second, foreign employment in “Accommodation and food services” experienced a stunning drop in 2020 by more than 30%, with a sharp recovery in 2021. However, in mid-2022, the number of foreign-born workers employed in this sector was still 10% lower than it was in January 2020. As we will describe below, this is one of the sectors with the largest number of unfilled vacancies in the US economy and a very large share of foreign-born workers. Finally, foreign employment also notably fell in the “Health Care and Social Assistance” sector, a sector highly exposed to risk during the COVID-19 pandemic and where immigrants played a crucial role. We find that the number of immigrants



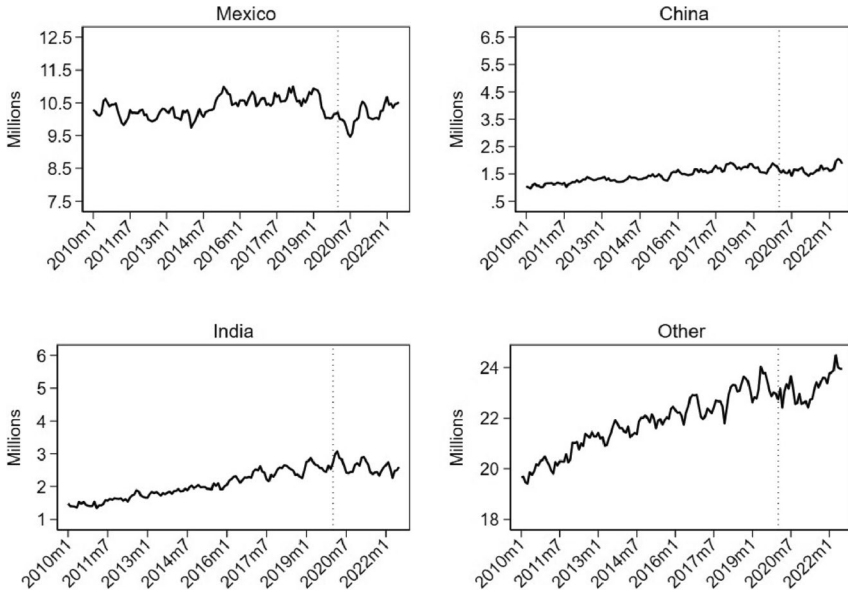
**Fig. 5** Working-age foreign-born population in top immigration states. This figure shows the 12-month moving average of the number of working-age foreign-born individuals in six main states. Data source: monthly CPS, January 2010–July 2022

employed in this sector was smaller in July 2022 than it was at the beginning of the pandemic.

### 3.2 The emergence of remote work

During the initial phase of the COVID-19 pandemic from March to May 2020, the possibility of working remotely became widespread in the USA and other countries. While already available for certain jobs, the possibility of telecommuting for part or all of the work week was expanded substantially (OECD 2021). In many cases, remote work was the only option during the national and regional lock-downs in the early months of the pandemic. The monthly Current Population Survey started collecting information on who was performing remote work in May 2020. The question introduced was: “At any time last week, did you telework or work at home for pay?” We will use a dummy variable that captures an affirmative answer to this question and measure the prevalence of remote work as the share of individuals who gave an affirmative answer across states and sectors. This is a measure of the extensive margin of remote work.

While remote work emerged early on in the pandemic and persisted afterwards (see Barrero et al. 2020), access to remote work varies substantially across sectors and occupations. This is illustrated in Fig. 8. The bar chart shows the percent of workers in each broad sector who did at least some remote work in the last week, on average from May through December 2020. In sectors such as Finance

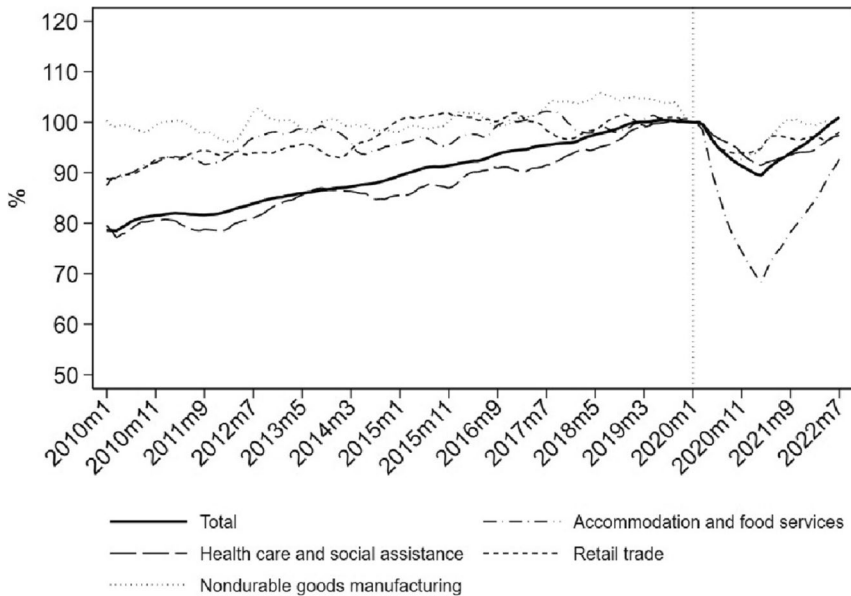


**Fig. 6** Working-age foreign-born population by origin. This figure shows the number of working-age foreign-born individuals from the main countries of origin. Data source: monthly CPS, January 2010–July 2022

and Insurance, Information, and Education Services, 50% or more of the employees performed some remote work in 2020. On the opposite end of the spectrum, in Construction and Accommodation and Food services, less than 10% performed any remote work. Sectors with a prevalence of in-person, manual, and physically-intensive jobs performed mainly by individuals without a college degree used remote work to a much smaller extent than sectors with cognitively-intensive and information-intensive jobs performed by college-educated workers.

It is important to emphasize that the variation in availability of remote jobs across sectors is not only due to differences in the share of college-educated workers who can more easily access remote work. Figure A4 in the Appendix shows in panels (a) and (b) the percentage of workers doing remote work at least sometimes, across sectors, but separately for those with college degree (panel a) and those without college degree (panel b). One sees very clearly that the range of variation is just as large across sectors within each education group. For instance, while 30% or more of non-college educated performed some remote work in the Information or Finance sectors, less than 6% did in Construction and Accommodation/Food. Similarly, while more than 60% of college-educated workers had access to remote work in the Finance and Information sectors, only 15% of them had access to it in the Accommodation/Food sector.

Additionally, the prevalence of remote work across sectors tended to be quite persistent after COVID. We know from the literature (e.g., Barrero et al. 2020) that many employees continued to work from home in some capacity, as they valued the flexibility and convenience of it. Figure A5 in the appendix shows that the

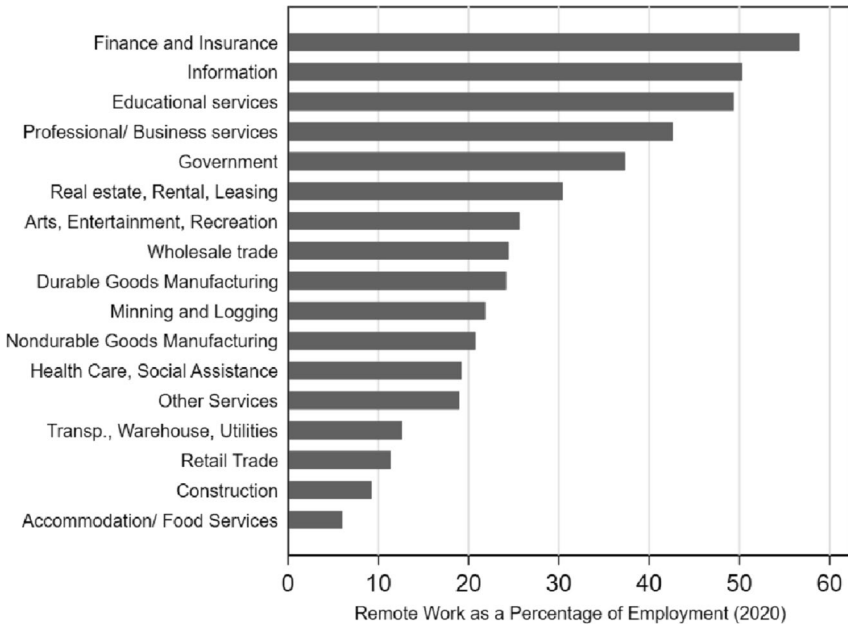


**Fig. 7** Working-age foreign-born employed population by industry and month. This figure shows the 12-month moving average of the total working-age foreign-born employed population standardized to 100 on January 2020 by industry group. The four sectors included are those with largest share of foreign workers in employment as of year 2019. Data source: monthly CPS, January 2010–July 2022

percentage of workers doing some remote work in May 2020 is highly correlated with that percentage in January 2022, across sectors. Except for the education sector, where many schools resumed in-person activities and remote work had dropped significantly by 2022, most sectors with high participation in remote work during the pandemic continued to such tendency into 2022.

The differences in participation in remote work was also very heterogeneous across US states. These differences were driven both by significant heterogeneity in sector composition and education across states, but probably due to different employer attitudes as well. Appendix Fig. A6 shows the bar chart distribution of percentage of remote workers across states in May 2020, from lowest to highest. Even ignoring DC, a very special city-economy, the percent of workers performing remote work varies from around 12% in Mississippi, Wyoming, and Alabama to around 40% in New Jersey, Massachusetts, and Maryland.

The option of working from home, even after COVID-19, has been increasingly valued by workers especially those with families, as it provides flexibility, lower exposure to risks, and sometimes productivity advantages (Barrero et al. 2021). Hence, the lower availability of this type of work in a sector or a location can generate lower willingness for US workers to supply labor (see Lufkin 2022). Additionally, Fig. 9 shows that several of the sectors providing fewer remote-work employment opportunities were also the sectors most reliant on foreign-born workers, as measured by the percentage of foreign-born in employment in 2019. The figure shows a clear and significant negative correlation. Sectors like Hospitality/Food services, Non-durable



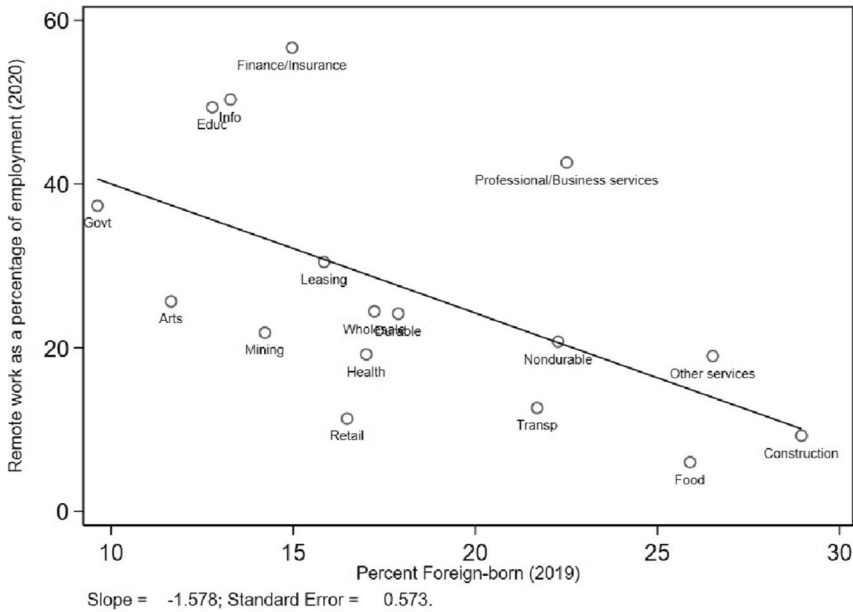
**Fig. 8** Percent of remote employment by sectors (2020). This figure shows the average percent of working-age remote employment relative to total working-age employment in 2020 for each sector. We exclude individuals who do not report an industry. Data source: monthly CPS, May 2020–December 2020

Goods Manufacturing, and Construction did not allow much remote work and had a very large dependence on immigrants before 2019. Therefore, those sectors potentially may have experienced declines in labor supply both from fewer immigrants and a lower willingness of natives to work in person during the COVID and post-COVID period. At the opposite end of the spectrum, sectors like Education and Information had a much larger share of remote work and a smaller dependence on foreign-born employees. The simultaneous increase in remote work and fall in immigration need not have affected labor supply in these sectors necessarily, if the movement of native workers across sectors partially offset the loss of immigrant workers. However, the preferences of natives for remote work may have reduced their willingness to provide this offsetting labor. We will analyze the impact of these two shocks on geographic and sector mobility of natives in the rest of the paper.

### 3.3 Vacancies

Before focusing on native internal mobility, we provide several facts about one indicator of the “mismatch” between demand and supply in the labor market: the number of unfilled jobs or “vacancies.” Mobility of native workers across states and sectors is a crucial mechanism to fill these unfilled jobs.

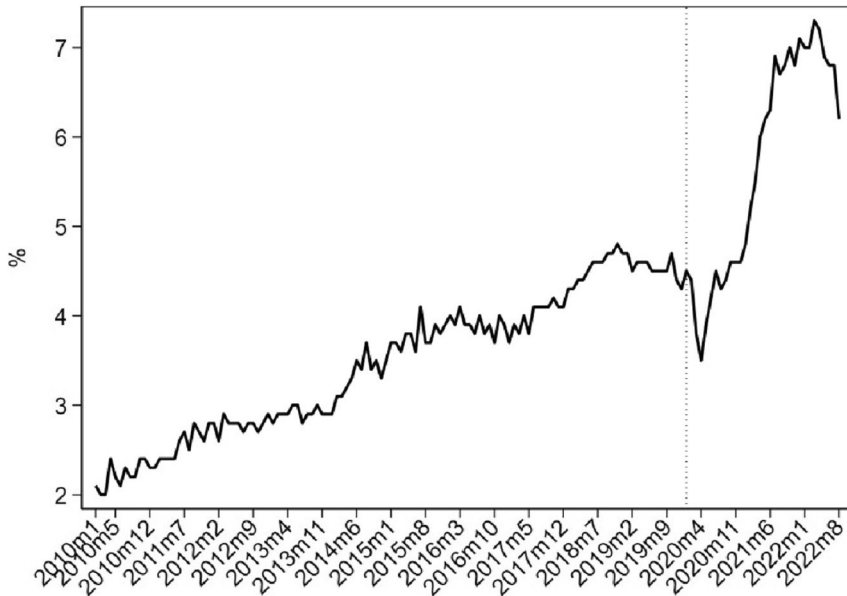




**Fig. 9** Percent remote employment vs percent foreign-born across sectors. This figure shows the correlation between the percentage of remote employment and the percentage of foreign-born across sectors. The *x*-axis pertains to the percent of working-age foreign-born employment relative to total working-age employment in 2019, calculated using the CPS ASEC (2019). The *y*-axis pertains to the average percentage of remote working-age employment in 2020, calculated using the monthly CPS (May 2020–December 2020). We exclude individuals who do not report an industry. The line represents the fitted values

Figure 10 shows the number of unfilled vacancies in the US economy as percent of the total number of jobs from January 2010 to August 2022. This is a common measure of how “tight” the labor market is. The value almost doubled in 2021, from 3.5 to 7%, and remained very high in early 2022, starting to decline only in March–April 2022. While the tightness of the labor market was increasing during the extended economic expansion starting after the Great Recession, and it dropped significantly in the early months of 2020 at the onset of COVID-19, the sudden increase in 2021 is unprecedented, suggesting a degree of excess labor demand and demand-supply mismatch not experienced for at least 15 years. The combination of the growth of labor demand during the post-2020 recovery, a decline in immigration, and a fall in labor supply driven by workers exiting the labor force due to challenging or hazardous workplace conditions during the pandemic can explain some of this increase.

Figure 11 shows the correlation between average unfilled jobs in January–August 2022, measured at the end of each month as a percent of 2019 employment and dependence on foreign-born workers, measured as percent of employment in 2019, across broad sectors (excluding the Government sector). We see a weak positive correlation, indicating that vacancies were higher in sectors where the decline in



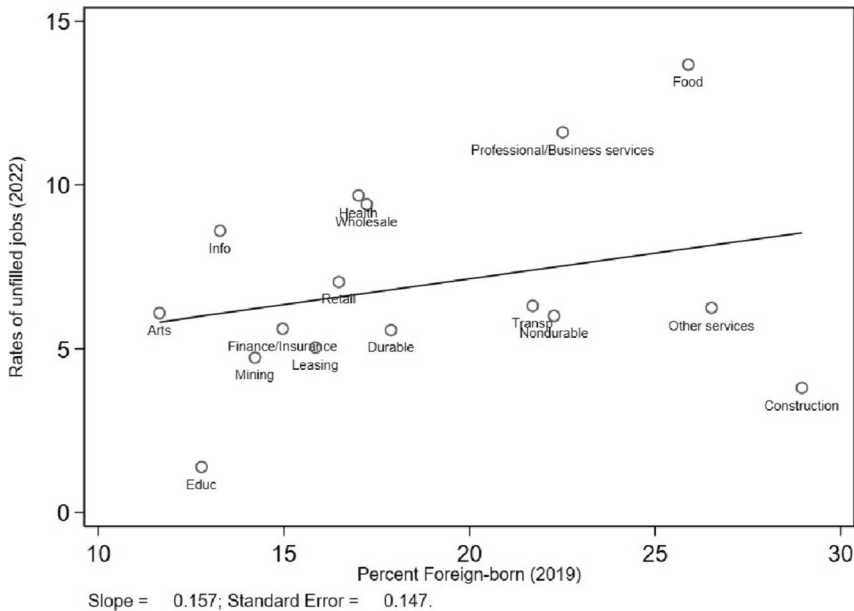
**Fig. 10** Total nonfarm job vacancy rate by month and year. The data shows total non-farm seasonally adjusted job vacancy rates for establishments of all size classes in the USA. The vacancy rate is the total number of vacancies divided by the sum of total employment and vacancies. Data source: BLS JOLTS, January 2010–August 2022

immigration was more important for labor supply.<sup>12</sup> Similarly, Fig. 12 shows a weak negative correlation between the prevalence of remote work measured in May 2020 and vacancy rate in January–August 2022 across broad sectors. Those two correlations and the correlation shown in Fig. 9 imply that many of the sectors who most suffered from the decline in immigration also were not compatible with remote work. This may have limited the degree to which native workers filled the openings in these jobs in response to this immigration shortage, and we have shown some evidence that these sectors had the highest vacancy rates after the pandemic. Did a lack of native workers' mobility contribute to imbalances and uneven excess demand across sectors? We will inquire into this, more systematically, in the rest of the paper.

#### 4 Native mobility

Several recent papers have shown that the internal mobility of US individuals across almost all geographic dimensions (between commuting zones, states and census regions) has been declining for the last three decades (see Jia et al. 2023) for an

<sup>12</sup> This correlation was even stronger using vacancies measured in 2021 as shown in our earlier analysis (Peri and Zaiour 2021).

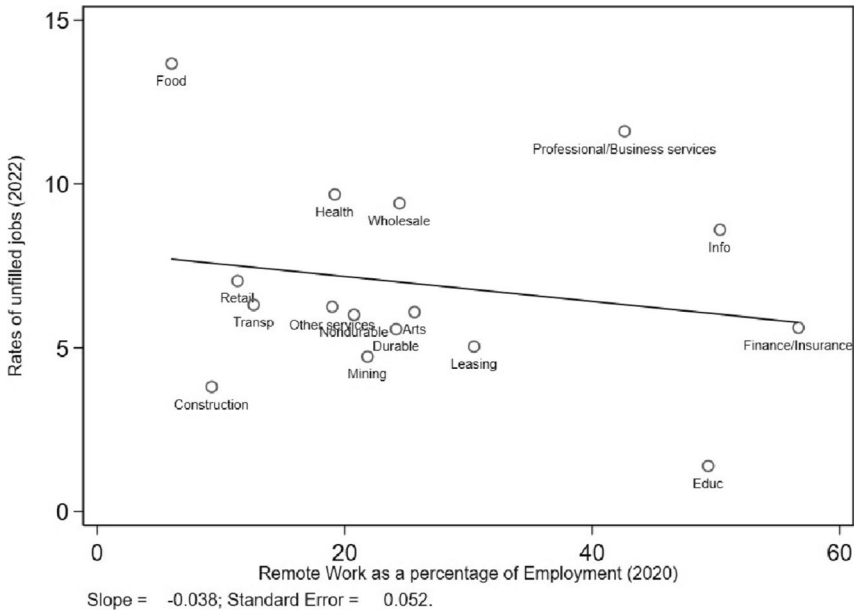


**Fig. 11** Rates of unfilled jobs vs percentage foreign-born across sectors. This figure shows the correlation between the rate of unfilled jobs and the percent foreign-born across sectors. The *x*-axis pertains to the percentage of working-age foreign-born employment relative to total working-age employment in 2019, calculated using the CPS ASEC (2019). The *y*-axis pertains to the rate of unfilled jobs by sector in 2022. That is, the average number of vacancies in 2022 (BLS JOLTS, January 2022–August 2022) relative to total working-age employment in 2019 by sector. We exclude the Government sector. The line represent the fitted values

overview, and Basso and Peri (2020) and Molloy et al. (2011) for additional details). However, the COVID-19 shock and the subsequent deep changes in labor markets documented above may have changed the incentives for moving. Native workers could have increased their willingness to move either potentially following opportunities from unfilled jobs, or to take advantage of work-from-home opportunities to move to more desirable locations (see for instance Althoff et al. 2022).

In this section, we update the data on native mobility within and across US states, beginning in 2010 and including the most recent years up to 2022 using the March CPS. We verify the existence of a downward trend, and focus on whether there is any evidence that the mobility patterns of natives changed significantly since the COVID pandemic. We use one-year mobility measures, considering people who moved within the last year in the March CPS (hence March- to-March) as a percent of the working-age population. As the data are collected yearly, we only have 2 observations (2021 and 2022) since COVID began.<sup>13</sup> Still, we will assess in a preliminary way whether there is any evidence of a change in the trend for all or some

<sup>13</sup> As COVID-19 was declared a pandemic in March 2020, the period covered by the data for 2020 includes only pre-COVID-19 mobility, from March 2019 to March 2020.

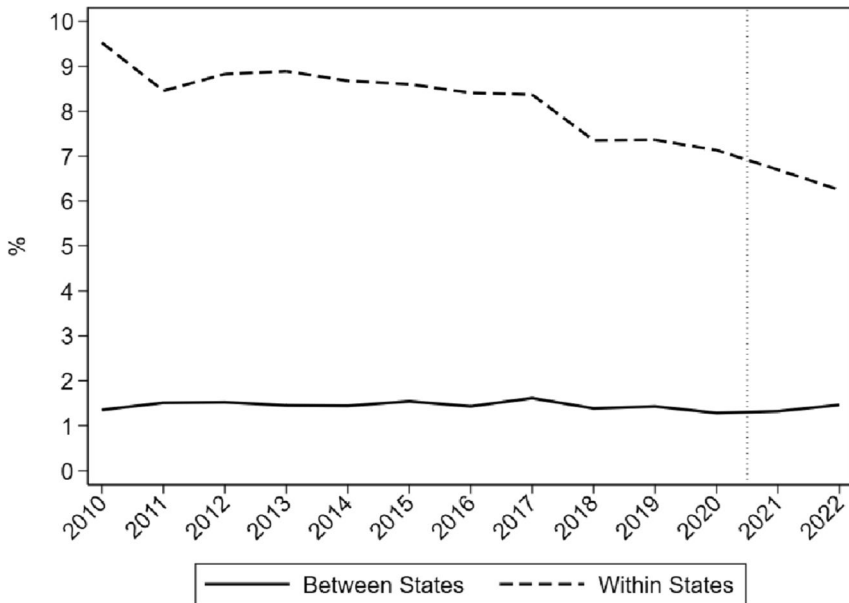


**Fig. 12** Rates of unfilled jobs vs percent of remote employment across sectors. This figure shows the correlation between the rate of unfilled jobs and the percentage of remote employment across sectors. The x-axis pertains to the average percent of remote working-age employment relative to total working-age employment by sector in 2020. The y-axis pertains to the rate of unfilled jobs by sector in 2022. That is, the average number of vacancies in 2022 (BLS JOLTS, January 2022–August 2022) relative to total working-age employment in 2019 by sector. We exclude the Government sector. The line represents the fitted values

groups of natives. We will first characterize overall migration patterns, then split them by education, age, and reason for moving. Finally, we will analyze the correlation between immigrant inflows and native mobility and between remote work availability and native internal mobility across US states.

### 4.1 The evolution of native internal mobility over time

Figure 13 updates a broadly used measure of internal mobility rates using March CPS data up to 2022. The values we report are the number of working-age natives who have moved between states (solid line) or within state (dashed line) in the previous year as a percent of the total working-age population in the US. We highlight three patterns in the chart. The first is that within-state mobility has steadily declined in the last 10 years. The second is that inter-state mobility, which is significantly lower, was steady in the early part of the decade and slightly decreasing since 2017. The third is that the observations for 2021 and 2022 do not signal any sharp break in trend relative to the previous years. The intra-state mobility continues the decline observed before 2020, although there was a small uptick in inter-state mobility. It is clearly too early to see the long-run effects of the dramatic changes that began

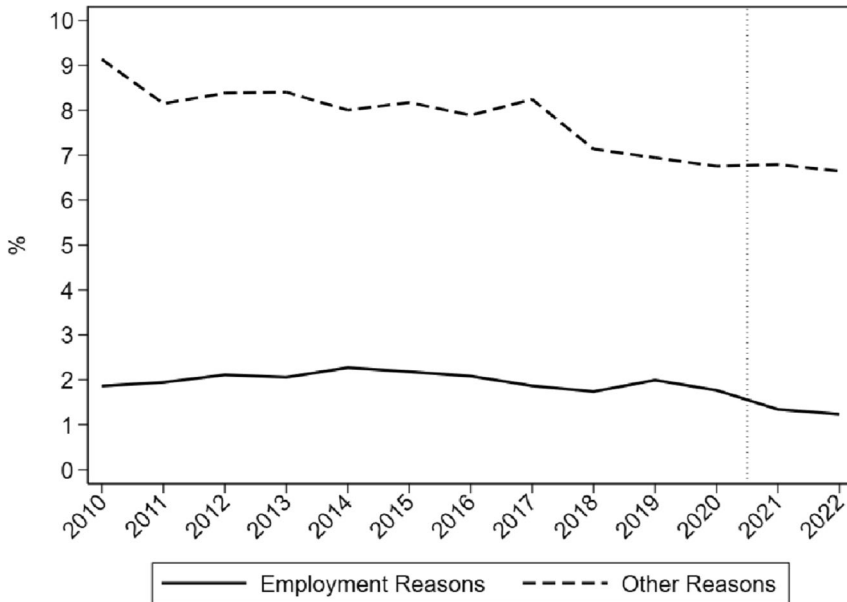


**Fig. 13** Working-age native-born mobility rates by distance of migration. This figure shows total working-age native-born migration (between and within states) relative to the total working-age population in each year. Data source: CPS ASEC, 2010–2022

during the COVID-19 pandemic on internal mobility of US citizens, but the chart does not show evidence of a sudden break in the existing trends.

Figures A7 and A8 in the Appendix show inter-state mobility rate by schooling levels (separating between college and non-college educated) and age groups. The main takeaway is that all groups experienced a decline in mobility since 2012 and the post-COVID years, 2021 and 2022, do not reveal a drastic change in trend. No group experienced substantial increases in their mobility level after 2020. Rather, the long-run decline seems to have continued during the COVID-19 years.

An interesting piece of information available in the March CPS data is the “main reason for the move.” We aggregate the moves by “reason” into two groups: “employment-related” moves and moves for any other reason. This gives an idea of what moves were directly related to job opportunities. Additionally, with the rise of the option for remote work, individuals may move more for other non-job-related reasons, keeping their job while moving to a more desirable living location. Figure 14 shows the total native internal mobility rate as percent of the population by their reason for moving. The downward trend is clear for the variable capturing mobility for “other reasons,” shown by the dashed line. Beginning in 2014, we also notice a downward trend in the mobility for employment-related reasons. No significant trend break is observable in the post-2020 observations for either line. Overall, the unusual conditions in US labor markets after 2020 did not disrupt the slow decline in mobility of US workers.

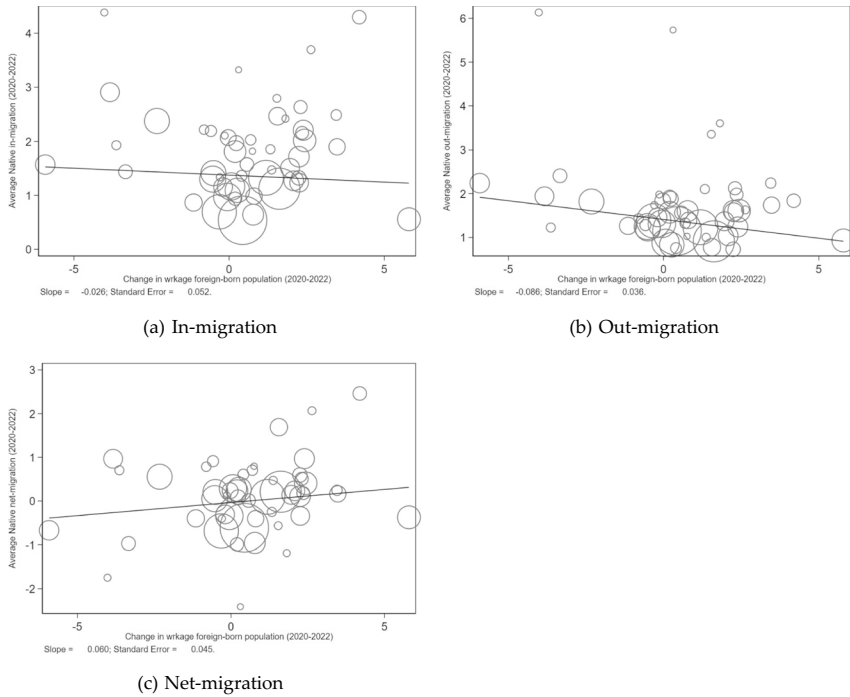


**Fig. 14** Working-age native-born mobility rates by reason for migration. This figure shows total working-age native-born migration (between and within states) by reason for move relative to the total working-age population in each year. Data source: CPS ASEC, 2010–2022

#### 4.2 Correlation between native inter-state mobility and changes in immigration and remote work

The data in the previous section document the evolution of gross native mobility in the decade before 2020 and in the 2 years since the beginning of the COVID-19 pandemic. Economists, however, are more focused on understanding net and “directed” mobility, namely the fact that individuals may respond to asymmetric shocks across labor markets by moving towards better wage and employment opportunities and away from places where labor market and earnings opportunities deteriorate. In this spirit, we consider the changes in the population of working-age immigrants and the rise in remote work opportunities as potential “shocks,” with heterogeneous impacts across the USA.

We begin by showing the correlation between the change in the foreign-born working-age population in the post-COVID period (2020–2022) and the in-, out-, and net mobility rates of working-age natives across US states during the same period. A negative (positive) correlation between in-mobility (out-mobility) of natives and change in foreign-born population would suggest that natives moved to fill jobs that were left vacant as a result of the decline in immigration. These correlations are displayed in Fig. 15a, b, and c. On the vertical axis, we show native in-migration (Fig. 15a), out-migration (Fig. 15b), or net migration—the difference of the two—(Fig. 15c) as a percent of the working-age population in the 2020–2022 period. On the horizontal axis, we show the change in

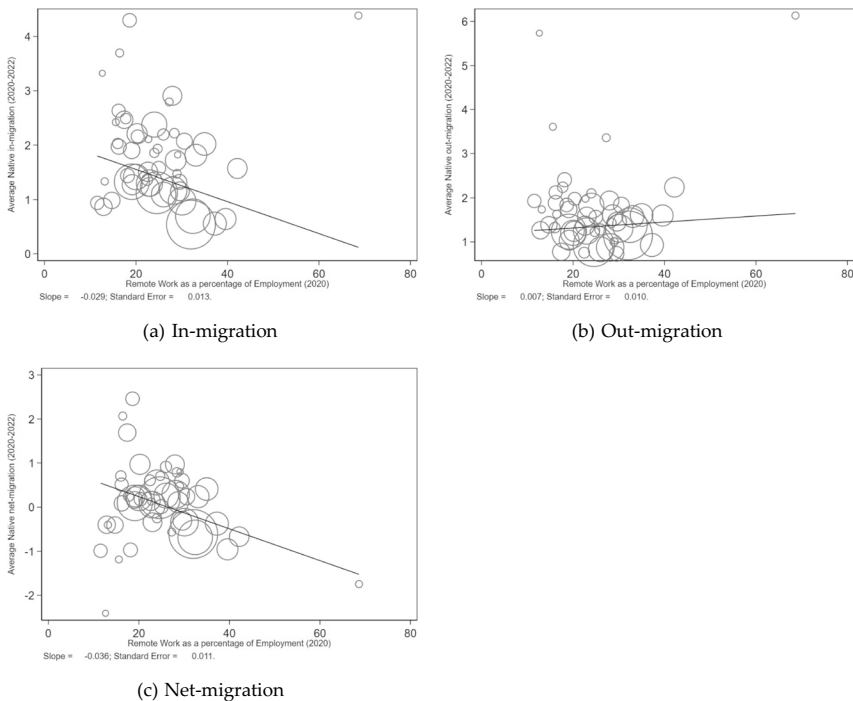


**Fig. 15** Working-age native-born migration patterns vs change in foreign-born population by state. In this figure, we look at the correlation between native migration patterns and the change in foreign-born population by state. The y-axis pertains to the average working-age native in-migration (a), out-migration (b), and net-migration (c) into states between 2020 and 2022. The x-axis pertains to the change in working-age foreign-born population between 2020 and 2022. All the variables are standardized to the state total working-age population in 2019 (in percent). The line represents the fitted values weighted by the state total working-age population in 2019. Data source: CPS ASEC, 2019–2022

the foreign-born population as percent of the total working-age population. Each bubble is a state, the size of which is proportional to the size of the state's population in 2019. Notice that, on average, the net change in foreign-born population was about 0 in this period (after a decade of positive values), and that several states experienced significant declines as large as 2–3% of their working age population. Two facts emerge from these correlations. First, all of the correlations are very small and not statistically significant, implying no association between the decline in immigration and the migration of natives. The OLS regression line in Fig. 15c, has a positive slope of 0.06 with a standard error of 0.045. Hence, the association implies that natives are actually more likely, on net, to leave (or to not to go to) a state where the immigrant population drops. The point estimate, however, is very small and not statistically significant at the 5% level. Second, from Fig. 15c, we see no evidence that even states experiencing the most significant drop in foreign-born population (shown in the left side of the panel) with drops as large as –5% of the population experienced a net inflow of natives. Rather, they have experienced net outflows of natives on average.

The finding that native mobility does not seem to respond much to the net inflow of immigrants is consistent with the consensus in the previous literature (e.g., Peri and Sparber 2011; Card 2001). We confirm in Fig. A9 of the Appendix that this small correlation between immigrant net inflows and native mobility held in the 2010–2019 pre-COVID period as well. Panels (a), (b), and (c) of the figure mirror those of Fig. 15, except that the period considered, both for foreign-born inflows and native inter-state migration rate, is 2010–2019. In this period, we find small regression coefficients which are insignificant for native in-mobility and out-mobility, but significant for net mobility. The sign of the correlation between native net mobility and immigrant inflows is positive, in contrast with the idea that the inflow of immigrants, which during this period was positive for almost every single state and sometimes quite large, would crowd out natives. Just as natives did not move out of states with large immigration before COVID-19, they did not move to replace them when their number declined during the post-COVID pandemic.

Next, we show the correlation between native in-, out-, and net mobility and the prevalence of remote work among workers in different states. Figure 16a, b, and c show these correlations, with the share of workers who did any remote working in



**Fig. 16** Working-age native-born migration patterns vs intensity of remote employment by state. In this figure, we look at the correlation between native migration patterns and percent of remote employment by state. The y-axis pertains to the average working-age native in-migration (a), out-migration (b), and net-migration (c) into states between 2020 and 2022. All the variables are standardized to the state total working-age population in 2019 (in percent). The x-axis pertains to the average percent of remote employment by state in 2020. The line represents the fitted values weighted by the state total working-age population in 2019. Data source: monthly CPS, May 2020–December 2020, and CPS ASEC, 2019–2022



the previous week in 2020 on the horizontal axis and the same measures of interstate in-, out-, and net mobility (as in Fig. 15) on the vertical axis. It appears that a larger incidence of remote work is associated with reduced inflows of natives to a state (and no change in outflows), producing a significant negative correlation between net migration and the incidence of remote work. The coefficient is large: States with one standard deviation higher remote work share are associated with one-third of a standard deviation lower net in-mobility. While these are only correlations, they may suggest that states providing more remote job opportunities, whether due to their sector composition or the willingness of their employers to give more location-flexibility to their workers, reduced the number of natives actually moving to these states, while possibly still allowing workers located elsewhere to work for companies in these states. This correlation is consistent with the recent findings that high-human capital service workers (e.g., business, IT, finance services), who have the largest remote work opportunities, may have moved out and not returned to large cities (Althoff et al. 2022). This phenomenon has depressed local urban economies with large human capital-intensive sectors as workers employed in those and in related sectors moved out. This association is large enough that we will want to control for remote work's potential impact on native mobility when we estimate the effects of immigration on native mobility in the next section.

## 5 Pre- and post-COVID19 responses of native mobility to immigration

In this section, we try to connect in a more systematic and causal way the post-COVID-19 changes in immigration across states (and sectors) with the internal gross and net mobility response of natives, controlling for remote work opportunities and changes in labor demand. To do this, we estimate a panel regression across states and over time. Smaller geographical units that capture labor markets more precisely, such as commuting zones, would be preferable to analyze the impact of immigrants, demand shifts, and remote work shocks on labor markets. However, due to the limitations of the sample size in the March CPS data used as to include post-COVID observations, we are restricted to conducting a state-level analysis. The dataset is too small to provide representative data at the county or commuting zone level. Since we are trying to evaluate short-run effects taking place within one or two years, we consider yearly observations in the panel.

We first estimate the panel using Least Squares to get a sense of the partial correlation between immigration and native mobility, allowing for a different response after the onset of COVID-19. To make progress on causally estimating the short-run impact of the changes in immigration on native mobility, we also construct a shift-share instrument, where we predict immigration flows into each state based on the shares of immigrants in that state, relative to total US immigrants by nationality as of 2010, well before the COVID-19 shock. By isolating the variation in immigration driven by the aggregate changes in migration into the US and the presence of different networks of immigrants by nationality in 2010, the IV should not be significantly correlated with contemporaneous local labor demand factors, but only with aggregate

supply shifts. For this to be the case, recent papers by Goldsmith-Pinkham et al. (2020) and Jaeger et al. (2018), point out that the instrument should not be correlated with pre-existing local trends across states, so we check for that. We also check that the IV constructed using only the most relevant shares for identification produce similar estimates to those using the full shift-share IV (Goldsmith-Pinkham et al. 2020). We provide the pre-trend tests and the Goldsmith-Pinkham et al. (2020) diagnostics, specifically focusing on the shift-share IV for the post 2020 period, in Appendix B.

### 5.1 Panel estimates: OLS and shift-share IV controlling for Bartik shocks and remote work

The regression we estimate in order to gain some insight on the possible impact of immigrants on native mobility before and after the COVID-19 pandemic follows the specification typically used in the literature studying the response of native migration (or employment) to an inflow of immigrants. The seminal work of Card (2001) and Card (2007) uses similar panel specifications.<sup>14</sup> We estimate the following equation:

$$\frac{Mig_{st}}{Pop_{s,2010}} = \phi_t + \phi_s + \beta_0 \frac{\Delta Immi_{st}}{Pop_{s,2010}} + \beta_1 \frac{\Delta BartikEmpl_{st}}{Pop_{s,2010}} + \gamma_0 (PostCov_t) \frac{\Delta Immi_{st}}{Pop_{s,2010}} + \gamma_1 (PostCov_t) \frac{Remote_{s,2020}}{Pop_{s,2020}} + \varepsilon_{st} \quad (1)$$

The variable  $\frac{Mig_{st}}{Pop_{s,2010}}$  measures alternatively native in-movers, out-movers, and net movers (the difference between the two) for state  $s$  during the period between year  $t - 1$  and year  $t$  as a share of the working-age population in the state at the beginning of the decade (2010),  $Pop_{s,2010}$ .

This is a measure of the mobility of individuals across states. Alternative dependent variables we use in further specifications are the net change in the working-age native population, the net change in employment, and measures of mobility across all sectors and mobility from sectors with high immigrant presence. All of these dependent variables are calculated during the same period and measured as a fraction of 2010 state population.

As the dependent variables measure flows of people, the state fixed effects  $\phi_s$  capture state-specific trends in mobility.  $\phi_t$  represents a set of year fixed effects. Together, these effects imply that we control for state-specific trends in the population evolution of immigrants and for common US changes over time.  $\frac{\Delta Immi_{st}}{Pop_{s,2010}}$  represents the change in immigrants (working-age foreign-born individuals) during the year, between  $t - 1$  and  $t$ , as a share of the working-age population in 2010.

The variable  $\frac{\Delta BartikEmpl_{st}}{Pop_{s,2010}}$  is a measure of sector-driven labor demand growth in the state and year, as a share of 2010 working-age population. This measure is broadly used in the regional and trade literatures, and we will define it below. The two variables capture changes in labor supply driven by immigration and changes driven by differential labor demand across sectors. Variation in these variables could produce a migratory response from natives if natives respond promptly to changes in labor market demand

<sup>14</sup> Peri and Sparber (2011) explains how this type of specification minimizes division bias.

or changes in competition from foreign workers. However, previous literature has not found that native mobility is very responsive to local labor demand or immigrant labor supply (e.g., Cadena and Kovak 2016; Basso and Peri 2020).

The last two terms of Eq. 1 are the interactions of a post-COVID19 dummy, ( $P_{ostCov_t}$ ), which is equal to one for years 2021 and 2022, with the change in immigrants and with the increase in participation to remote work. This second variable, as described in Sect. 3, is the fraction of the population in working age in 2020 (average May–December) that did some remote work in the previous week. The first interaction term captures whether natives responded differently to the sudden slowdown in immigration during and after the COVID-19 crisis, relative to how they responded to changes in immigration before the pandemic. This could be either because a drop in available workers may have encouraged natives to move into affected states and sectors to fill the gap, or because natives were more eager to take those opportunities during and after the COVID crisis in very tight labor markets. We emphasize, however, that due to the short time period after COVID-19 and the correlation of shocks over time, the power to separately identify the post-COVID response, especially using an IV, is rather low. The second interaction term captures whether the sudden increase of remote work opportunities across states, introduced during the COVID-19 lockdown and maintained by many firms afterwards, affected the mobility of natives in the 2020–2022 period.

### 5.1.1 Description of the shift-share IV and the Bartik control

In order to capture sector-driven shifts in labor demand that could affect states differently, we included a Bartik control in the panel regression. This variable uses the 2010 share of employment of each of the 17 broad BLS sectors in state  $s$  to construct the employment growth in the state that one would expect if each sector grew at its national rate, keeping its share in state  $s$  constant. Namely, the Bartik variable is constructed as follows:

$$\frac{\Delta BartikEmpl_{st}}{Pop_{s,2010}} = \frac{\sum_{n=1}^{17} S_{ns}^{2010} \cdot Empl_t^n - \sum_{n=1}^{17} S_{ns}^{2010} \cdot Empl_{t-1}^n}{Pop_{s,2010}} \quad (2)$$

In Eq. 2, the term  $S_{ns}^{2010}$  is the 2010 share of employment of sector  $n$  in state  $s$ , relative to the total 2010 employment of that sector nationally in the USA. Those shares sum to one if we fix a sector  $n$  and we sum across states  $s$ . They capture the sector composition of a state measured at the beginning of the period of analysis, 2010. The term  $Empl_t^n$  is the national US employment of sector  $n$  in year  $t$ . Hence,  $\Delta BartikEmpl$  captures the change in employment of a state, keeping constant the sector distribution across states (to its 2010 value) and using national employment growth to capture the growth in sector-specific labor demand. An alternative way of capturing the changing demand for labor across sectors is to use  $Vacancies_t^n$ , total vacancies in sector  $n$  and year  $t$ , instead of  $Empl_t^n$ , to proxy for demand in a sector and year. Using national vacancies instead of employment could be a better proxy for labor demand, especially during the COVID-19 period, when slow responses and mismatches prevented employment from adjusting rapidly. We use

the vacancy-based Bartik in robustness checks of the main specifications (results are shown in Appendix Tables A1–A5).<sup>15</sup> The value of these Bartik instruments is standardized by the working-age population of the state in 2010. These Bartik controls capture the change in labor demand in a state due to the growth/decline of sectors.

To construct the Shift-share instrument for the immigration variable, we use the distribution of immigrants from 51 different countries (or country-groups) of origin in 2010, and we apply to each country share the national growth of the foreign-born population from that country in the USA.<sup>16</sup> The shift-share is defined as follows:

$$\frac{\Delta F_{st}^{Foreign}}{Pop_{s,2010}} = \frac{\sum_{c=1}^{51} S_{sc}^{2010} \cdot F_t^c - \sum_{n=1}^{51} S_{sc}^{2010} \cdot F_{t-1}^c}{Pop_{s,2010}} \quad (3)$$

In Eq. 3, the term  $S_{sc}^{2010}$  is the share of foreign-born (age 18–65) from country of origin  $c$  in state  $s$  in the total foreign-born population aged 18–65 from country  $c$  in the whole USA in 2010. For each country of origin  $c$ , the sum of those shares across all US states ( $s$ ) is equal to one. The term  $F_t^c$  is the total foreign-born working-age population from country  $c$  residing in the USA in year  $t$ . This instrument captures the changes in each state's immigrant population driven by aggregate shifts in the migration patterns across origin countries, distributed proportionally based on the size of the country-specific networks (the pre-period shares) in each state in 2010.

The shift-share IV and its interaction with the post-2020 dummy will allow us to obtain an estimate closer to the causal impact of the immigrant inflows on native internal cross-state mobility. One issue is that, as we separate the response of native mobility between pre- and post-COVID by interacting with a post-COVID dummy, we need two instruments for those two variables. We therefore use the shift-share IV and the interaction of the IV with a post-2020 dummy as instruments for the corresponding changes in immigrants (across all years and post-COVID). The shift share variable is a strong IV for the immigrant inflow across years. However, when we jointly use the shift-share and its post-2020 interaction to instrument for the change in immigrants and its post-2020 interaction, respectively, the instruments are rather weak.<sup>17</sup> This is due to the fact that pre- and post-2020 variations of immigrants across states are correlated, and most of the shift-share variation captured by the IV is cross-sectional. Nevertheless, in Appendix B, we show, as a test of validity, that the shift-share variable post-2020 is only weakly correlated with pre-2020 trends of employment and population. Additionally, implementing the Goldsmith-Pinkham

<sup>15</sup> The coefficients of these regressions on the main variables of interest are virtually identical to those using the employment Bartik in Tables 1, 2, 3, 4, and 5. For the Bartik coefficient itself, we estimate a borderline significant, small positive effect on native in-migration using the vacancy-based Bartik, which may be an indicator that this measure captures local demand more effectively.

<sup>16</sup> For the country definition, we refine the classification of Card (2009) by including additional smaller countries and grouping the remaining ones into one group, yielding 51 origin groups.

<sup>17</sup> The Kleibergen-Paap Wald statistics is equal to 20 when using the shift-share IV for the change in immigrants but is only 4.4 when using the post-2020 interaction as an additional variable and the post-2020-interacted shift-share as an additional IV.

et al. (2020) tests, we show that the most relevant shares in terms of Rothemberg weights produce, when used individually, insignificant estimates of the response of native mobility. This is consistent with the estimates using the full shift-share IV. Those results reassure us of the validity of our IV. However, as weak instruments can be an issue, and the standard errors from our 2SLS estimates are large, we always show the OLS estimates as well.

## 5.2 Main results: cross-state mobility

Table 1 shows the results of estimating Eq. 1 using OLS (columns 1–3) or 2SLS with the shift-share IV (columns 4–6).<sup>18</sup> The standard errors are clustered at the state level to capture the correlation of residuals within states over time. The outcomes are mobility of natives into the state (columns 1 and 4), out of the state (columns 2 and 5), and net native mobility for the state (columns 3 and 6).

Confirming the correlations shown in the previous sections, most of the coefficients are not significant. Focusing on the response of native mobility to the inflow of foreign potential workers, the coefficients are very small and not significant using OLS and small, not significant, and not precisely estimated (because of the rather weak IV) using 2SLS. Even with the larger standard errors of the IV estimates, one can rule out significant net mobility of natives in response to the decline in immigrants. For each one immigrant lost, we can rule out that more than 0.12 natives moved into the state.<sup>19</sup> In fact, the coefficient on immigrant change is positive, and even after COVID, the net effect of a loss of immigrants in a state is net outflow of natives. Using the estimates in rows 2 and 3 of Table 1, we estimate that, after COVID, the states that lost more immigrants did not experience an inflow of natives, and in fact experienced a slight outflow of them. The 2SLS coefficient for net migration post COVID is 0.21 (= 0.38–0.17), implying that for one fewer immigrant, a state also lost 0.21 natives, though the coefficient is insignificant. At the state level, the Bartik demand shock and the increased remote work opportunities did not translate into short-run mobility responses of natives either. We estimate a positive correlation between the share of remote work and out-migration from states after COVID, weakly suggesting that workers tend to take advantage of remote work by moving out of the state. However, the significance of these estimates depends on the specification, and in general, the effect is not significant.

<sup>18</sup> Alternatively, we have estimated the regressions using least squares weighted by the state 2010 population. This accounts for the higher precision of measured variables in large states by weighting those observations more. The results (not reported) are very similar to those in Tables 1, 2, 3, and 4, with estimated standard errors that are 20–30% smaller. The coefficients on the immigrant change pre- and post-COVID are small and statistically insignificant, similar to the reported estimates.

<sup>19</sup> The coefficient of column 6 is 0.38 and the lower bound of a 1% confidence interval is – 0.12. Multiplying this lower bound by a – 1 change in immigrants, generates an inflow of 0.12% of natives.

**Table 1** Native inter-state mobility and local shocks

	OLS			2SLS		
	In (1)	Out (2)	Net (3)	In (4)	Out (5)	Net (6)
Bartik shock	- 0.062 (0.129)	0.233 (0.181)	- 0.296 (0.218)	- 0.090 (0.166)	0.273 (0.204)	- 0.363 (0.258)
Change immig	0.027 (0.018)	-0.009 (0.034)	0.035 (0.042)	0.114 (0.107)	- 0.270 (0.225)	0.384 (0.273)
Post × change immig	0.022 (0.060)	0.014 (0.045)	0.008 (0.069)	0.025 (0.231)	0.197 (0.361)	- 0.172 (0.418)
Post × remote	0.014 (0.017)	0.040** (0.015)	- 0.026 (0.025)	0.019 (0.020)	0.034 (0.021)	- 0.014 (0.034)
Observations	600	600	600	600	600	600
Mean Y	0.0190	0.0193	- 0.0003	0.0190	0.0193	- 0.0003
Within R-sq	0.0065	0.0112	0.0087			

Standard errors in parentheses. This table shows the OLS and 2SLS results where the outcomes are native working-age in, out, and net-migration to states as a share of the 2010 state total working-age population. Year and state fixed effects are added. Standard errors are clustered at the state-level. The Kleinbergen-Paap Wald statistics of the first-stage regression is 4.4. District of Columbia is excluded from the analysis. Data is taken from the 2011–2022 CPS ASEC

\* $p < 0.10$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

### 5.3 Mobility response by education group

While immigration changes did not seem to produce significant changes in aggregate native mobility, it may be useful to separately study the mobility responses of college- and non-college-educated natives. The first group has generally been more sensitive to responding to economic conditions in the long-run and has moved towards fast growing high employment locations (e.g., Moretti 2013). The second group, instead, has shown low and declining mobility. More specifically, it exhibited a much weaker tendency to move towards strong labor markets in the long run, generating a strong correlation between economic growth and presence of college-educated workers across US cities (e.g., Jia et al., 2023). Additionally, the decline in immigration after 2020 was larger for less-educated compared to more-educated immigrants, as we showed earlier, which may have generated different competition or complementarity effects for native workers with different levels of education.

Tables 2 and 3 show the native mobility response separately for college-educated and non-college-educated natives, respectively. The coefficients show weak evidence of mobility responses by college-educated natives in response to the decline in immigration after COVID (significant using OLS but not using 2SLS), implying that locations losing one additional immigrant were slightly more likely to also lose college-educated natives (0.08 of one person in OLS or 0.27 in 2SLS). This could be consistent with the loss of complementary, non-college educated immigrants who provide a large share of services that are in high demand by college-educated natives (such as in the food, restaurant, and hospitality industries). Additionally, this result

**Table 2** College educated native inter-state mobility and local shocks

	OLS			2SLS		
	In (1)	Out (2)	Net (3)	In (4)	Out (5)	Net (6)
Bartik shock	- 0.012 (0.070)	0.161 (0.204)	- 0.173 (0.206)	- 0.048 (0.090)	0.204 (0.190)	- 0.252 (0.192)
Change immig	0.009 (0.011)	0.017 (0.021)	- 0.007 (0.023)	0.027 (0.061)	- 0.089 (0.106)	0.115 (0.122)
Post × change immig	0.021 (0.031)	- 0.064 (0.045)	0.085* (0.045)	0.159 (0.147)	- 0.114 (0.219)	0.272 (0.334)
Post × remote	0.007 (0.008)	0.004 (0.009)	0.003 (0.015)	0.014 (0.013)	- 0.005 (0.018)	0.019 (0.028)
Observations	600	600	600	600	600	600
Mean <i>Y</i>	0.0073	0.0076	- 0.0003	0.0073	0.0076	- 0.0003
Within <i>R</i> -sq	0.0057	0.0083	0.0093			

Standard errors in parentheses. This table shows the OLS and 2SLS results where the outcomes are college educated native working-age in, out, and net-migration to states as a share of the 2010 state total working-age population. Year and state fixed effects are added. Standard errors are clustered at the state-level. The Kleinbergen-Paap Wald statistics of the first-stage regression is 4.4. District of Columbia is excluded from the analysis. Data is taken from the 2011–2022 CPS ASEC

\* $p < 0.10$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

emphasizes how the college-educated group co-moves with immigrants, as shown in previous research (e.g., Basso and Peri 2020).

This effect is not present for less-educated natives (see Table 3). These natives instead show a mild tendency to respond to remote work opportunities, leaving states where those opportunities are larger. The positive effect of post-COVID-19 remote work prevalence on net migration of non-college educated natives is, however, only borderline significant and quantitatively small. Overall, the group-specific regressions confirm the sluggishness of native cross-state mobility response, both to the change in immigration patterns, as well as to the remote work opportunities that appeared after COVID. Lacking these margins of adjustment, the supply shock and the resignation shock likely generated imbalances and unfilled vacancies.<sup>20</sup>

Aware that our panel regressions only capture the one-year responses, which are very short-term, we additionally estimate the regressions using 2-year intervals. This reduces the number of observations to only 300, and only includes one post-COVID observation per state. Table A7 in the Appendix shows the OLS estimates of the mobility panel regression for in-migration, out-migration, and net migration using 2-year intervals.<sup>21</sup>

<sup>20</sup> Additional 2SLS estimates from Table A6 in the Appendix show that the response of native aggregate population and employment to Bartik demand, immigration, and remote-work shocks, estimated in the same panel regression with Shift-share instruments as for Table 1, are also small and rarely significant. Employment of natives responds positively to Bartik (but not significantly), while negatively to immigration. However, the estimates are very imprecise and not significantly different after COVID.

<sup>21</sup> The shift-share instruments are even weaker in this case and do not generate reasonable 2SLS results when instrumenting both the inflow of immigrants and the interaction with the post-2020 dummy.

**Table 3** Non-college educated native inter-state mobility and local shocks

	OLS			2SLS		
	In (1)	Out (2)	Net (3)	In (4)	Out (5)	Net (6)
Bartik shock	- 0.050 (0.076)	0.073 (0.164)	- 0.123 (0.194)	- 0.042 (0.095)	0.069 (0.172)	- 0.111 (0.201)
Change immig	0.017 (0.015)	- 0.026 (0.027)	0.043 (0.029)	0.088 (0.076)	- 0.181 (0.174)	0.269 (0.200)
Post × change immig	0.001 (0.042)	0.078* (0.043)	- 0.078 (0.059)	- 0.133 (0.203)	0.311 (0.253)	- 0.444 (0.298)
Post × remote	0.007 (0.011)	0.037*** (0.012)	- 0.030* (0.017)	0.005 (0.013)	0.038** (0.016)	- 0.033 (0.024)
Observations	600	600	600	600	600	600
Mean <i>Y</i>	0.0117	0.0117	- 0.0000	0.0117	0.0117	- 0.0000
Within <i>R</i> -sq	0.0037	0.0155	0.0113			

Standard errors in parentheses. This table shows the OLS and 2SLS results where the outcomes are non-college educated native working-age in, out and net-migration to states as a share of the 2010 state total working-age population. Year and state fixed effects are added. Standard errors are clustered at the state-level. The Kleinbergen-Paap Wald statistics of the first-stage regression is 4.4. District of Columbia is excluded from the analysis. Data is taken from the 2011–2022 CPS ASEC

\* $p < 0.10$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

The slightly longer period generates slightly larger and more significant estimates of the positive native inflow response to immigration before COVID. Still, we do not estimate any significant change in mobility response of natives to immigration post-COVID. Additionally, the positive coefficient of remote work on out-migration, especially for non-college-educated, is slightly larger and more significant. The results confirm mostly those of Tables 1, 2, and 3, which suggest limited native mobility in response to immigrants.<sup>22</sup>

## 5.4 Cross-sector mobility

The results we have shown on native mobility across states suggest that at, least in the short-run, natives are unlikely to respond to changes in immigration, differential labor demand shocks, or remote work opportunities by moving across states, limiting their propensity to equilibrate labor markets. Even post-COVID, native mobility responses are weak, so that labor market imbalances generated by these shocks are likely to persist.

In Table 4, we explore the extent of native employment reallocation across sectors in response to the three shocks, in a specification as regression 1. The

<sup>22</sup> We also run a specification (available upon request) as in Tables 1, 2, and 3 using OLS, including lagged immigration changes. The estimates confirm a positive and marginally significant coefficient of contemporaneous and lagged inflow of immigrants pre-COVID on native in-mobility. The post-COVID coefficients are unchanged and not significant.



**Table 4** Native sector-mobility and local shocks

	OLS			2SLS		
	Mobility rate (1)	In-mobility (2)	Out-mobility (3)	Mobility rate (4)	In-mobility (5)	Out-mobility (6)
	Bartik shock	0.387 (0.275)	0.159** (0.065)	0.126 (0.077)	0.579* (0.300)	0.190** (0.078)
Change immig	0.031 (0.048)	0.003 (0.014)	0.025 (0.020)	0.418 (0.328)	0.028 (0.090)	0.151 (0.126)
Post x change immig	0.063 (0.141)	0.026 (0.045)	-0.025 (0.037)	-1.335* (0.674)	-0.148 (0.180)	-0.306 (0.185)
Post x remote	-0.063 (0.047)	-0.027** (0.013)	-0.025** (0.013)	-0.104* (0.062)	-0.034** (0.014)	-0.031** (0.014)
Observations	600	600	600	600	600	600
Mean Y	0.0924	0.0193	0.0210	0.0924	0.0193	0.0210
Within R-sq	0.0104	0.0174	0.0143			

Standard errors in parentheses. This table shows the OLS and 2SLS results where the outcomes are the total sector mobility rate of the native working-age employed population (1 and 4), the total in-mobility to high-immigrant low-remote work sectors from other sectors (2 and 5), and the out-mobility from high-immigrant low-remote work sectors to other sectors (3 and 6). High-immigrant low-remote work sectors include construction, accommodation and food services, other services, non-durable goods manufacturing, and transportation, warehousing and utilities. All outcomes are measured as a share of the 2010 state total working-age population. Year and state fixed effects are added. Standard errors are clustered at the state-level. The Kleinbergen-Paap Wald statistics of the first-stage regression is 4.4. District of Columbia is excluded from the analysis. Data is taken from the 2011–2022 CPS ASEC

\* $p < 0.10$ ; \*\* $p < 0.05$ ; \*\*\* $p < 0.01$

**Table 5** Job openings, local wages, and local shocks

	Job openings/ Pops2010 (1)	Job openings/ Pops2010 (2)	$\Delta$ Log hourly wage (3)	$\Delta$ Log hourly wage (4)
Bartik shock	0.097 (0.076)	0.109 (0.085)	0.465 (2.076)	0.202 (2.240)
Change immig	-0.012* (0.006)	-0.015 (0.039)	-0.337 (0.757)	0.300 (2.471)
Post $\times$ change immig	0.018 (0.023)	-0.030 (0.129)	1.026 (1.066)	1.188 (3.586)
Post $\times$ remote	-0.009 (0.011)	-0.011 (0.015)	-0.056 (0.155)	-0.010 (0.233)
Observations	600	600	550	550
Mean $Y$	0.0343	0.0343	0.0110	0.0110
Within $R$ -sq	0.0151		0.0014	

Standard errors in parentheses. This table shows the OLS (columns 1 and 3) and 2SLS results (columns 2 and 4) where the outcome is the annual average number of vacancies in a state relative to the 2010 state total working-age population (columns 1 and 2) or the change in log hourly wage (columns 3 and 4). Year and state fixed effects are added. Standard errors are clustered at the state-level. The Kleibergen-Paap Wald statistics of the first-stage regression is 4.4. District of Columbia is excluded from the analysis. Data is taken from the 2011–2022 CPS ASEC and BLS, JOLTS 2011–2022

\*  $p < 0.10$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$

dependent variables capture, in each case, the mobility of native workers, living in the state, in or out of sectors. These regressions, therefore, focus on sector-mobility as a potential alternative and complementary adjustment mechanism to spatial mobility. We note that out of all natives who change sectors in a year (about 10% of the employment), only 1 out of 50 of them change states. Therefore, the sector-mobility adjustment is a different (and largely independent) margin of adjustment relative to inter-state mobility, mainly operating within states in response to state-specific shocks.

In specifications of columns 1 and 4, the dependent variable, for each state and year, is the mobility rate of native workers across macro-sectors, measured as the number of workers who changed jobs across the 17 macro-sectors relative to the working-age population. Since cross-sector imbalances due to differential declines in immigration and remote job options have increased after COVID-19 across states, cross-sector mobility responses by natives could have adjusted those imbalances in terms of unfilled jobs during the post-COVID era. The second dependent variable is a measure of job mobility into (in-mobility) and out of (out-mobility) five large sectors that have a particularly large share of immigrant employment (since the beginning of the period analyzed) and had a low share of remote-work employment after COVID. These industries are construction, accommodation and food services, other services, non-durable goods manufacturing, and transportation, warehousing and utilities. These regressions estimate whether native mobility into (columns 2 and 5) or out of (columns 3 and 6) these industries was higher or lower in states with larger

declines in immigration, after controlling for remote work participation and Bartik in the state and year.

Focusing on the 2SLS estimates, several results stand out. First, increased local demand, as captured by the Bartik index, increased the mobility across sectors, as well as into and out of the five sectors with high reliance on immigration and low incidence of remote work. This is consistent with labor demand growth producing a reallocation of workers across sectors, as some sectors expand and other decline. Interestingly, the post-COVID drop in immigration induced some significant increase in cross-sector mobility of natives (negative coefficient in column 4). However, it did not generate increased inflow of natives into the five high-immigration, low-remote work sectors. In fact, outflows of natives from these industries increased in response to larger declines in immigration. Replacement of immigrants with natives in those sectors did not happen in states with large drops of immigrants. Higher incidence of remote work in some states mildly discouraged mobility across sectors, likely because people stayed in the sectors that allowed remote work and did not move in net into sectors with low remote opportunities.

The regression analyses presented in the previous sections need to be taken with caution. They only consider very short-term mobility responses of natives and are conducted using US states, which are more aggregated than local labor markets. Additionally, they rely on March CPS data, which includes a smaller sample than in the American Community Survey. Still, several results seem suggestive. First, the decline in immigration beginning during COVID, which differentially affected states and sectors, was not offset by geographical mobility of natives in the short run. We do not find significant evidence that natives moved to states that were losing more immigrants. On the other hand, mobility of native workers across sectors (within states) seems to have responded more to the drop in immigrants post-COVID, with natives moving towards sectors where the immigration drop was more significant and where limited remote work opportunities prevented demand from being filled by remote workers. Sectoral mobility of natives, rather than geographic mobility, could be a mechanism that responds more to change in labor demand and immigration. Still, natives did not seem to respond to the declines in immigration by moving into the immigrant-heavy sectors with limited remote work options. The availability of remote work in a state reduced the mobility of workers across sectors, suggesting that remote work could have been a substitute for sectoral mobility in labor market adjustment.

## 6 Potential effects of shocks on labor imbalances and local wages

We next test whether these immigration, demand, and remote-work shocks affected other labor market outcomes. As cross-state mobility of natives did not significantly adjust to the post-COVID fall in the population of immigrant workers, and cross-sector mobility responded only mildly, one might expect that this fall in labor supply could create imbalances in the labor market, such as a persistence of unfilled jobs. Additionally, while wage adjustment is usually more sluggish than employment response, we can analyze whether there is any evidence of local wage responses to these shocks.

An inspection of Figs. 11 and 12, showing the correlation of unfilled jobs and foreign born share, and of unfilled jobs with remote work participation, respectively, suggests that “Food and Accommodation,” and to a lower extent “Other services” and “Transportation,” are among the sectors with highest foreign shares, lowest remote work participation. These sectors also exhibit a relatively high vacancy rate. The overall correlation across these variables, however, is not strong, implying that other factors are contributing to the unfilled jobs phenomenon.

To make this analysis more systematic, we perform a panel regression analysis, similar to that in Eq. 1, to identify the correlates of the vacancy rate and hourly wage changes across states and over time, focusing on the Bartik shock, the change in immigrant inflows before and after COVID, and the incidence of remote work after COVID. Specifically, we estimate the following equation:

$$Y_{st} = \phi_t + \phi_s + \beta_0 \frac{\Delta Immi_{st}}{Pop_{s,2010}} + \beta_1 \frac{\Delta BartikEmpl_{st}}{Pop_{s,2010}} + \gamma_0 (PostCov_t) \frac{\Delta Immi_{st}}{Pop_{s,2010}} + \gamma_1 (PostCov_t) \frac{Remote_{s,2020}}{Pop_{s,2020}} + \varepsilon_{st} \quad (4)$$

In Eq. 4, the dependent variable,  $Y_{st}$ , is either  $\frac{Vacancies_{st}}{Pop_{s,2010}}$ , the number of unfilled vacancies as share of working-age population in state  $s$  at the beginning of the period, or  $\Delta \ln wage_{st}$ , the logarithmic change in average hourly wage of natives in state  $s$  and year  $t$ . To calculate average hourly wages for natives in a state, we divide the yearly wages by the total number of hours worked in the year, including employed individuals with non-negative earnings and adjusting the wage to 2010 constant dollars. The explanatory variables are defined as in Eq. 1. We continue to use variation of shocks across states (not across sectors) in order to be consistent with the previous analysis and IV.

Table 5 shows the estimates of the coefficients for vacancies in OLS (column 1) and 2SLS (column 2) and for natives’ log wage change in OLS (column 3) and 2SLS (column 4). While the estimates are usually not significant, and the standard errors of the IV estimates lead to imprecise inference, the 2SLS point estimates for vacancies suggest that a drop in immigrants and a lack of remote options, both, contribute positively (albeit not significantly) to vacancies in a US state. The estimates of the wage response are imprecise, which is plausible due to the short period and small sample size. However, the results confirm that both before and after the onset of COVID-19, there was no statistically significant impact of immigrants on native wages. Therefore, the decline in immigration during the post-COVID period did not lead to an increase in native wages.

The results of the 2SLS specification show that a drop of immigrant population by 5% of the working age population, as happened during COVID in the most negatively affected US states, are associated with an increase by two-tenths of a percentage point in vacancy rates (as percent of employment) ( $5 \times 0.045 = 0.22$ ). Similarly, a decrease in remote work options by 10% of employment, equal to one standard deviation in the remote work opportunities across states, only generates one-tenth of a percentage point higher vacancy rate ( $10 \times 0.011 = 0.1$ ). Taking these coefficients at face value would imply that even the strong drop in immigration rates explain a small part of the very steep increase in vacancies (equal to about 3.5% of employment) in the 2 years after COVID.

## 7 Discussion and conclusions

The first goal of this paper is to document, using data from monthly CPS, CPS ASEC, and JOLTS, the changes in foreign-born immigration to the USA after the onset of COVID-19. Additionally, we illustrate potential changes in internal cross-state mobility of natives in the US after COVID. Finally, we aim to capture using cross-states panel regressions whether the changes in immigrant flows were significantly associated with native mobility responses or with local labor market imbalances after controlling for demand shocks and the unequal access to remote work opportunities across states.

The main messages emerging from the analyses are three. First, the foreign-born population in the USA fell significantly starting in late 2019 up to 2021, though it has recovered significantly from late 2021 to 2022. This decline was largely driven by prime-age immigrants (25–45) and corresponded with a fall in the population of non-college-educated immigrants and a halt of the growth of college-educated immigrants. This decline in the immigrant population was heterogeneous across states. In some large immigration states, such as California and Florida, the number of immigrants dropped or its growth stopped; other states, such as Texas, did not experience a decline in immigration growth. There was also a heterogeneous decline in immigrant employment across sectors. Some sectors that heavily employed immigrants, such as “Food and accommodation services”, received the largest negative shock in foreign-born employment during COVID, with a sudden decline by 30 pp. in the first half of 2020, but experienced a strong rebound in 2021. Other sectors lost and partially recovered but to a less dramatic extent. In general, immigrant population and employment began to bounce back in the late months of 2021 and early months of 2022. Both seem to be heading back toward the pre-2020 trends.

The second lesson we can draw from our data analysis is that the cross-state mobility of natives, which has been on the decline for a while before COVID (see Basso and Peri 2020), seems to have continued on that trajectory. The presumption that labor market imbalances during COVID or the option of remote work could have inverted the trend or represented a large uneven shock that natives could absorb by increasing mobility has not materialized yet. Although we have a limited two-year period of observations after the onset of COVID, we still observe a stagnation in mobility of both college- and non-college-educated natives, particularly those of prime working-age, and especially in mobility for employment-related reasons. We also do not observe a correlation between the drop in immigrant flows in a state and mobility of natives into states or sectors within them that lost a large number of immigrant workers. We find some mild evidence that more remote work availability in a state may have reduced native inflows into that state for work-related reasons.

This may suggest that remote work has begun to decouple residential location choices from the location of employers, consistent with what has been found for large metropolitan areas in Althoff et al. (2022). More analysis would be needed on

the connection between remote work and native mobility and on the persistence of this connection over time.

Finally, in an effort to more systematically connect internal cross-state mobility of natives to the decline in immigration and to the increase in remote work availability, we use cross-state variation of those, controlling for a Bartik demand shock and for state and year fixed effects. We run panel regressions including pre- and post-COVID years, to test if there is evidence of native mobility responses to these shocks during the COVID period. We admittedly can only look at short-run (1-year) responses. While we use an IV estimation to capture immigrant changes not specifically driven by state-specific labor conditions, we are dealing with significant imprecision and rather weak instruments, albeit we do not find evidence of invalid instruments. The regressions reveal no significant partial correlation between internal native migratory response and the drop in immigrants, and hardly any change in such a correlation after COVID. We find only very weak evidence that, as a consequence, the drop in immigrants is correlated with more vacancies, a measure of labor market imbalances, and we do not find any correlation with native hourly wages.

We conclude with two considerations. First, while the decline in immigration may have played a role in generating vacancies in some specific sectors, such as the food and accommodation sector, as we argued in an early note (Peri and Zaiour 2021), our analysis does not support the idea that the decline in immigration explains a significant portion of vacancies across US sectors and US states. Large changes in job preferences, resignations, and a large shift of native workers' choices triggered by COVID must play a more prominent role.

Second, our findings of no migration response from natives and no significant wage impact on natives post-COVID adds to a large literature which finds small effects of immigration on labor demand for native workers (Card 2001). Since this decline in immigration seems to be only temporary (by late 2022, the immigrant population was fast rebounding), the potential long-run effects on local economies of this decline in immigration, such as lower growth and decline in economic activity (as in Lee et al. 2022), may not take place. However, the secular trends toward lower immigration in the US and slower internal mobility of natives (Basso and Peri 2020) seem to persist. These could be a continued reason for slow adjustment and challenges in filling job openings.

**Supplementary information** The online version contains supplementary material available at <https://doi.org/10.1007/s00148-023-00972-y>.

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**Data availability** The data used in our analyses is all publicly available. Specifically, we obtain Current Population Survey data through IPUMS, and data on job vacancies from the Bureau of Labor Statistics website, as discussed in the paper.

## Declarations

**Conflict of interest** The authors declare no competing interests.

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