The Postpandemic U.S. Immigration Surge: New Facts and Inflationary Implications*

Anton Cheremukhin
Federal Reserve Bank of Dallas
chertosha@gmail.com

Sewon Hur
Federal Reserve Bank of Dallas
sewonhur@gmail.com

Ronald Mau
Federal Reserve Bank of Dallas
ron.mau@dal.frb.org

Karel Mertens
Federal Reserve Bank of Dallas and CEPR
karel.mertens@dal.frb.org

Alexander W. Richter
Federal Reserve Bank of Dallas
alex.richter@dal.frb.org

Xiaoqing Zhou
Federal Reserve Bank of Dallas
xqzhou3@gmail.com

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Abstract

The U.S. experienced an extraordinary postpandemic surge in unauthorized immigration. A popular view is that an increase in immigration is a positive supply shock that reduces inflation. Using a standard model, we first demonstrate that the popular view does not account for important demand-side effects that dampen, and possibly overturn, the decline in inflation. We then examine the inflationary implications of the postpandemic immigration surge. To inform the strength of the demand-side effects, we examine the characteristics of postpandemic immigrants. We find that they tend to be hand-to-mouth consumers and low-skilled workers that complement the existing workforce. Building these features into a medium-scale model, we find robust evidence that the postpandemic immigration surge had little effect on inflation.

Keywords: Immigration, population growth, inflation, skill complementarity, hand-to-mouth
JEL Classifications: E21, E22, E31, F22, J11, J15

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1 INTRODUCTION

Before the COVID-19 pandemic, immigration to the U.S. was relatively stable, with roughly one million net immigrants added to the U.S. population annually from 2000 to 2019, according to Congressional Budget Office (CBO) estimates. The onset of the pandemic slowed U.S. immigration due to the halt in global mobility and a slowdown in application processing. Starting from late 2021, however, the U.S. experienced an unprecedented surge in immigration that far outpaced the prepandemic trend. The CBO estimated that total net immigration was 10 million from 2021 to 2024, causing year-over-year population growth to increase from about 0.5% before the pandemic to 1.2% at its peak in 2023.[1] This extraordinary shock triggered widespread discussions about its impact, particularly on inflation. Motivated by the policy relevance and historic nature of the shock, this paper examines the inflationary implications of the postpandemic immigration surge.

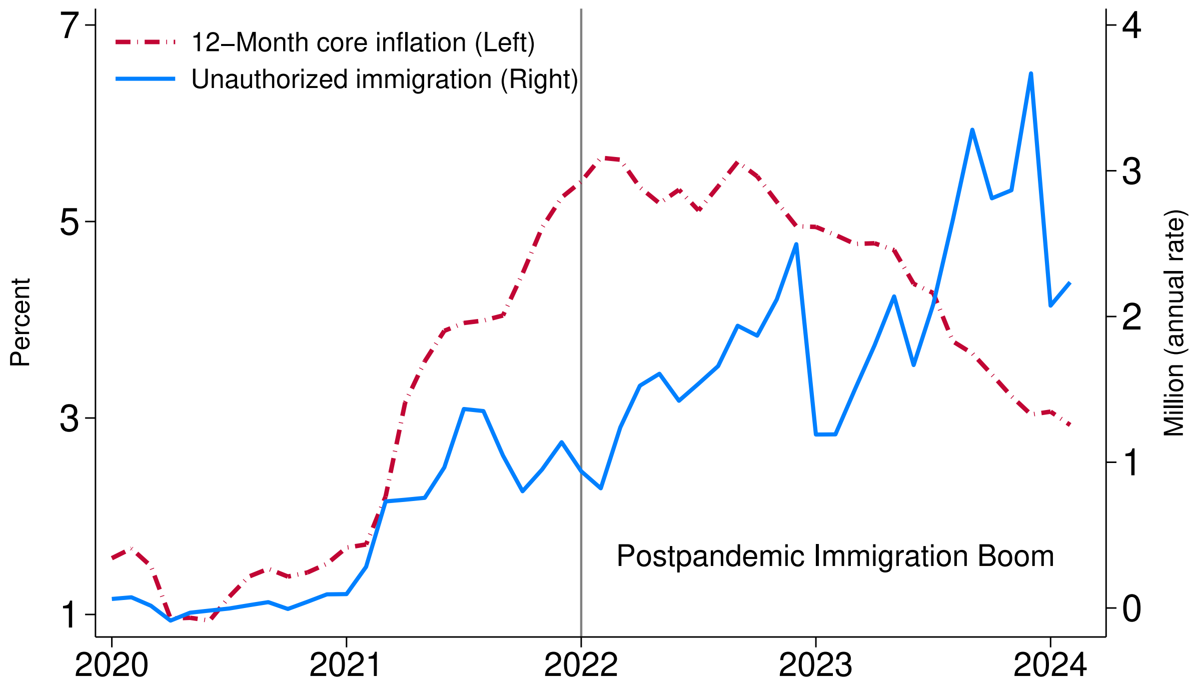
A popular view is that an increase in immigration is a positive supply shock that reduces inflation. As supporting evidence, some pointed to the fact that U.S. inflation steadily declined after the immigration boom began in late 2021.[2] We begin our analysis by evaluating this view using a standard representative agent New Keynesian (RANK) model. Our analytical solution suggests that a population growth shock acts as a natural rate shock with accompanying supply-side and demand-side effects. When investment growth is fixed, the supply-side effects dominate under weak conditions. This causes the output gap and inflation to decline, consistent with the popular view. However, when investment growth is optimally determined by households and firms, an increase in the return to capital causes the demand-side effects to dominate and the responses of the output gap and inflation to flip signs. This analytical example highlights that the strength of the demand-side effects are crucial for evaluating the impact of the postpandemic immigration surge.

To inform the strength of the demand-side effects, we examine the characteristics of postpandemic immigrants in the data. Our empirical analysis combines administrative data on border

[1] See *The Demographic Outlook: 2024 to 2054*, January 18, 2024, https://www.cbo.gov/publication/59697.

[2] See, for example, "How Immigrants Tame Inflation" (Wall Street Journal, May 1, 2023) and "One key reason inflation is cooling: Immigrant workers" (Yahoo Finance, January 15, 2024).

Figure 1: Postpandemic immigration boom and falling U.S. inflation



Notes: Core inflation is measured by the Personal Consumption Expenditures Price Index. The inflow of unauthorized immigration is measured by border encounters net of repatriations and expulsions.
Sources: Bureau of Economic Analysis; U.S. Department of Homeland Security.

encounters and immigration court records with household survey data—the Current Population Survey (CPS) and the Panel Study of Income Dynamics (PSID). The administrative data show that the postpandemic immigration surge was mainly driven by unauthorized immigrants from a few countries in Central and South America, but they do not reveal the economic characteristics of immigrants. On the other hand, household survey data allow us to understand the economic conditions of immigrants, but the legal status of an immigrant is unknown. Since unauthorized immigrants differ substantially from legal immigrants, and the former tend to be underrepresented in household surveys, the average immigrant in the survey would not represent the typical postpandemic immigrant. To address this concern, we use as a proxy survey respondents who were born in the same countries as the postpandemic unauthorized immigrants. This approach is motivated by a well-established finding in the literature that newly arriving immigrants tend to have similar characteristics as earlier immigrants from the same country of origin and tend to move to ethnic enclaves established by earlier immigrants (Bartel, 1989; Card, 2001, 2009).

Our empirical analysis establishes two key facts. First, postpandemic immigrants tend to have lower educational attainment and work in industries and occupations with lower skill requirements than the native population. This indicates that the skills of unauthorized immigrants are likely to complement those of the existing U.S. workforce. Second, postpandemic immigrants tend to consume a larger fraction of their income and have much lower wealth, particularly liquid wealth, than native households. A wide range of household finance measures indicate that unauthorized immigrants behave like hand-to-mouth consumers.

Motivated by our empirical results, we develop a medium-scale New Keynesian model with capital accumulation, population growth, and household heterogeneity. In particular, immigrants in the model are hand-to-mouth consumers whose labor is complementary to that of native-born, high-skilled workers. In addition, there is a higher degree of complementarity between high-skilled labor and capital than between low-skilled labor and capital, consistent with the evidence that Krusell et al. (2000) and Bilbiie et al. (2023) found using aggregate data.

With capital-skill complementarity, an abundance of low-skilled workers reduces the need to build up capital in response to the immigration surge, dampening the increase in investment. On the other hand, high-skilled households substitute from investment into consumption due to the lower return to capital, while low-skilled workers are hand-to-mouth and therefore interest rate insensitive. Both of these effects strengthen the demand-side effects. When combining all of these competing dynamics, we find little response of inflation, suggesting that the demand-side effects roughly cancel out the disinflationary, supply-side effects of the postpademic immigration surge.

We show that our finding is robust to the degree of price stickiness, alternative monetary policy rules, and the strength of the complementarity between the inputs in the production function. We also consider a counterfactual scenario in which the immigration surge was concentrated among high-skilled workers, given that these individuals made up the bulk of the immigration before the pandemic. In this case, firms respond by significantly increasing investment, which generates stronger demand-side effects and a material increase in inflation.

Related literature Our paper first contributes to the literature that employs general equilibrium models to explore the implications of immigration. Canova and Ravn (2000), for example, consider an influx of low-skilled workers as a consequence of the reunification of Germany. Storesletten (2000) utilizes an overlapping generations model to examine the fiscal repercussions of immigration. Ben-Gad (2004, 2008) applies a similar modeling approach with overlapping dynasties to investigate the effects of immigration on investment. While our analysis shares some of the modeling features of these studies, unlike their approach, we build nominal rigidity into our model, allowing us to assess the impact of immigration on inflation dynamics.

Several other studies have used dynamic stochastic general equilibriumn (DSGE) models to study net migration in alternative institutional contexts. Burriel et al. (2010), for example, develop and estimate a New Keynesian model for the Spanish economy, and Bentolila et al. (2008) show that immigration moderates the slope of the Phillips curve in Spain. Similar DSGE models with net migration are analyzed for Greece (Bandeira et al., 2018), Germany (Braun and Weber, 2021), and the U.S. (Hauser and Seneca, 2022). Some papers also examine the cross-country effects of immigration (Burstein et al., 2020; Mandelman and Zlate, 2012). Relative to these papers, we account for the unique elements of the postpandemic immigration wave in the U.S.

On the empirical front, vector auto regression (VAR) models have been used in the literature to assess the impact of migration on macroeconomic variables. Kiguchi and Mountford (2019), for example, estimate a VAR model with sign restrictions on U.S. data, observing muted impacts of immigration. Likewise, Furlanetto and Robstad (2019) apply a similar approach to Norwegian data, concluding that immigration shocks are a significant contributor to unemployment fluctuations but have negligible effects on inflation. Smith and Thoenissen (2019) use a VAR model to analyze New Zealand data, finding that migration shocks contribute to per capita GDP growth and its volatility with the size of the effects depending on the relative human capital levels of immigrants and natives. Weiske (2019) estimates a VAR model with long-run restrictions for the U.S., finding that immigration leads to a temporary decrease in the real wage, stimulates investment for up to five years, and has modest effects on per capita output, consumption, and hours. These results are broadly consistent with the predictions of our model.

Finally, our paper is related to a large empirical literature that uses cross-sectional data to examine the impact of immigration on the labor market (Borjas, 2003; Caiumi and Peri, 2024; Card, 2005, 2009; Ottaviano and Peri, 2012), prices and the composition of demand (Cortes, 2008; Frattini, 2024; Lach, 2007), and productivity (Peri, 2012). These studies highlight that the response of capital, such as the magnitude and speed with which it adjusts after an immigration surge, is crucial for assessing the effects of immigration. Our model, motivated by the postpandemic immigration surge, incorporates the dynamic effects of capital accumulation and corroborates the micro-level findings in these studies.

Outline The remainder of the paper is organized as follows. Section 2 highlights that changes in immigration generate important demand-side effects that can overturn the typical supply-side effects using an analytically tractable model. Section 3 presents our empirical analysis based on administrative data and household surveys. Section 4 describes our medium-scale model motivated by the empirical analysis. Section 5 discusses the macroeconomic effects of the postpandemic immigration surge using impulse responses that are calibrated to match the 2024 CBO projections for population growth. Section 6 conducts robustness checks and highlights the importance of the skill level of recent immigrants using counterfactual impulse responses. Section 7 concludes.

2 ASSESSING THE POPULAR VIEW

To develop intuition for how immigration affects inflation, we consider a standard RANK model, where a change in immigration is modeled as a shock to population growth. In order to allow for balanced growth while maintaining analytical tractability, we initially assume aggregate investment growth is fixed and there is no trend inflation. In all other aspects, the model is identical to textbook specifications such as Galí (2015) that feature monopolistically competitive firms, nominal price rigidity, and a monetary policy rule.

As shown in Appendix B, a log-linear approximation of the detrended model around the deterministic steady state simplifies to the usual investment-saving (IS) relation and Phillips curve (PC):

$$\widehat{gap}_t = \mathbb{E}_t\widehat{gap}_{t+1} - \bar{C}\left(\hat{R}_t - \mathbb{E}_t\hat{\Pi}_{t+1} - \hat{r}_t^*\right), \tag{IS}$$

$$\hat{\Pi}_t = \kappa\widehat{gap}_t + \beta\Gamma_N\mathbb{E}_t\hat{\Pi}_{t+1}, \tag{PC}$$

where $\widehat{gap}_t$ is the output gap, $\hat{R}_t$ is the nominal interest rate set by the central bank, $\hat{\Pi}_t$ is the inflation rate, $\bar{C}$ is the steady-state consumption share of aggregate expenditure that governs the interest rate semi-elasticity of the output gap, κ is the slope of the Phillips curve, β is the subjective discount factor, and Γ_N is the trend population growth rate. The natural rate, $\hat{r}_t^*$, is given by

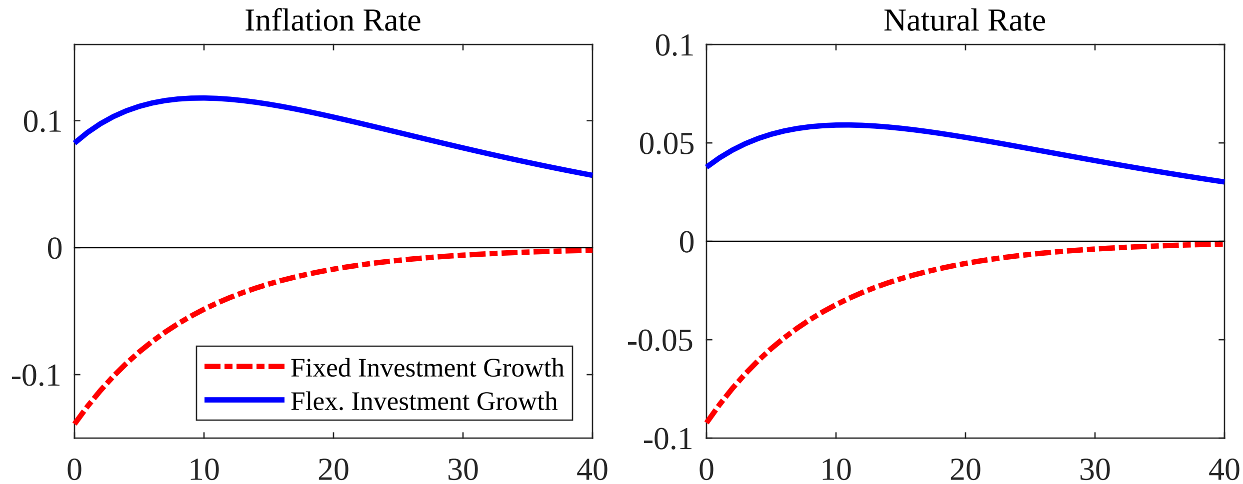
$$\hat{r}_t^* = \frac{1+\eta}{(1-\bar{C})(1-\alpha)+\bar{C}(1+\eta)}\mathbb{E}_t\Delta\hat{a}_{t+1} - \frac{(1-\bar{C})(\alpha+\eta)}{(1-\bar{C})(1-\alpha)+\bar{C}(1+\eta)}\mathbb{E}_t\Delta\hat{\imath}_{t+1},$$

where α is the capital share of income, η is the inverse Frisch elasticity, Δ is a first-difference operator, $\hat{\imath}_t$ is per capita investment, and $\hat{a}_t$ is a measure of productivity that depends on the initial capital stock and population growth. Given a change in the natural rate, the model dynamics are standard: An increase in the natural rate increases the output gap and inflation. The Phillips curve governs the relationship between current inflation and the expected future output gap. The IS curve implies that the output gap is a function of expected future real rate deviations from the natural rate.

What is new relative to the standard model is that population growth shocks shift the natural rate through a supply-side effect arising from changes in productivity growth (first term) and a demand-side effect due to changes in per capita investment growth (second term). To determine the inflationary implications of the shock, we must sign the natural rate response, which requires closed-form solutions for productivity growth and per capita investment growth. Since aggregate investment growth is fixed, $\mathbb{E}_t\Delta\hat{a}_{t+1}$ and $\mathbb{E}_t\Delta\hat{\imath}_{t+1}$ only depend on current population growth. We assume population growth follows a first-order autoregressive process (with persistence given by $\rho_N > 0$), so the natural rate collapses to

$$r_t^* = -\rho_N\frac{\bar{C}\alpha - \eta(1-\alpha-\bar{C})}{(1-\bar{C})(1-\alpha)+\bar{C}(1+\eta)}\hat{\Gamma}_{N,t}.$$

Figure 2: Impulse responses to an immigration shock in a simple RANK model



Notes: The responses are in annualized percentage point deviations from steady state.

An increase in population growth reduces the natural rate under weak conditions.[3] In this case, both the output gap and inflation decline when the shock occurs, consistent with the popular view.

Figure 2 plots the responses of the natural rate and inflation to an increase in population growth under standard parameter values. Consistent with our analytical results, the supply-side effects dominate in this environment, causing both variables to decline. This result, however, is sensitive to the assumption that investment growth is fixed. When we relax the assumption of fixed investment growth, the larger workforce from higher population growth raises the return to capital and hence investment. This causes the demand-side effects to strengthen and the output gap and inflation responses to flip signs. These results highlight that the popular view does not fully account for demand-side effects that dampen, and possibly overturn, the decline in inflation driven by the supply-side effects of an increase in population growth.

3 CHARACTERISTICS OF POSTPANDEMIC IMMIGRANTS

Our analytical results make clear that it is crucial to understand the characteristics of the postpandemic immigration surge in order to inform the strength of the demand-side effects. We first discuss

[3] It requires that $\frac{1}{\eta} > \frac{1-\alpha-\bar{C}}{\bar{C}\alpha}$, which is a weak restriction since $\alpha + \bar{C}$ tends to exceed unity.

the nature of the U.S. immigration surge, drawing on administrative data from various government agencies. The composition of immigrants during this surge differs systematically from that before the pandemic due to the influx of unauthorized immigrants. We then use household survey data to infer the labor market characteristics and consumption-saving patterns of these immigrants. Our analysis shows that they tend to be hand-to-mouth consumers and low-skilled workers that complement the existing U.S. workforce. These results motivate our model in Section 4.

3.1 THE POSTPANDEMIC IMMIGRATION SURGE

Before the pandemic, immigration to the U.S. was relatively stable (Figure 3a). The CBO estimated that about one million immigrants were added to the U.S. population annually from 2000 to 2019. Authorized immigrants, which include lawful permanent residents, individuals who are eligible to apply for lawful permanent residency, and nonimmigrants admitted under the Immigration and Nationality Act (such as students and temporary workers), accounted for the majority of annual net immigration (about 75%). Unauthorized immigrants, on the other hand, were not an important contributor to immigration during this period.[4]

In the first year of the pandemic, immigration inflows dropped sharply as travel restrictions and a slowdown in the processing of applications reduced the inflow of authorized immigrants. In addition, the issuance of a public health order under Title 42 allowed the rapid expulsion of unauthorized immigrants at the U.S. border.[5] As travel restrictions gradually unwound after the first year of the pandemic, the U.S. experienced a surge in unauthorized immigrants.

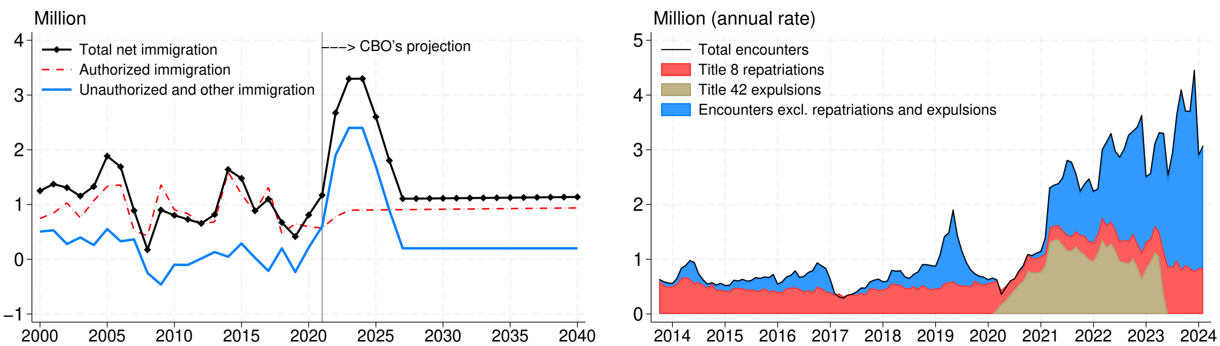
Starting in 2021, border protection officers working between or at ports of entry encountered an increasing number of foreign nationals who attempted to enter the U.S. without legal immigration status (Figure 3b). Meanwhile, a higher fraction of these individuals were released into the country through the use of parole or with a "notice to appear", which permits the individual to wait in the

[4]Unauthorized and other immigrants, referred to as "other foreign nationals" by the CBO, include people who entered the U.S. illegally, people who overstay their legal temporary status, and people who were permitted to enter through the use of parole and who may be awaiting proceedings in immigration court.

[5]In March 2020, the Center for Disease Control issued a public health order under a provision of a 1944 U.S. public health law (section 265 of Title 42), which allowed for the rapid expulsion of unauthorized border crossers and asylum seekers, citing COVID-19 concerns. The order was lifted on May 11, 2023.

Figure 3: Postpandemic immigration boom

(a) Immigration by type **(b)** Border encounters



Notes: Encounters are the sum of apprehensions (arrests of potentially removable noncitizens by the U.S. Border Patrol under Title 8 authority), inadmissibles (determined by the Office of Field Operations at ports of entry under Title 8 authority), and expulsions under Title 42 public health authority.

Sources: Congressional Budget Office; U.S. Department of Homeland Security.

U.S. while petitioning an immigration court for asylum. While in the U.S., these individuals can apply for work authorization subject to some delay, typically 0-6 months for parolees (depending on the country of origin) and 150 days for asylum seekers (Edelberg and Watson, 2024).[6]

The inflow of unauthorized immigrants, measured by border encounters net of repatriations and expulsions, surged from 17,000 in 2020 to 2.2 million in 2023 (Figure 4a). This increase coincided with a sharp rise in new deportation cases filed in U.S. immigration courts. Authorized immigration, in contrast, has been stable since 2022 and only slightly higher than the prepandemic level, based on visa-issuance data from the Department of State (Figure 4b). In January 2024, the CBO projected that the boom in unauthorized immigration would peak later in that year, before gradually returning to the prepandemic trend.[7]

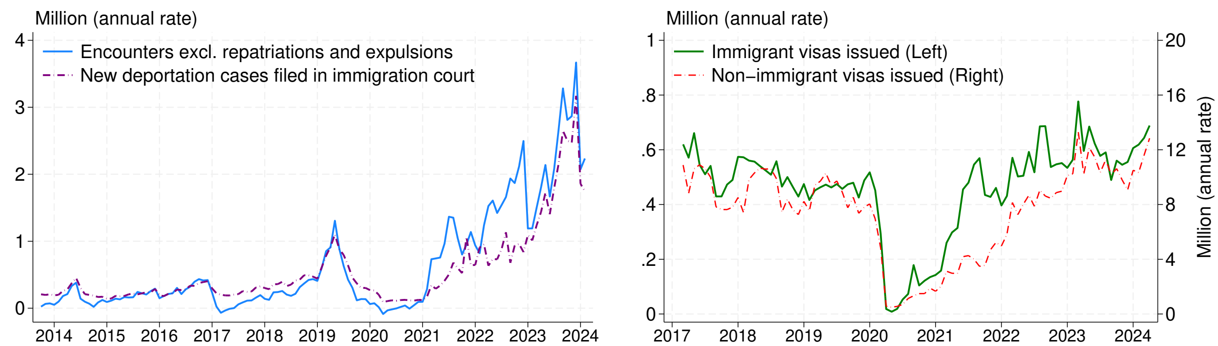
The surge of unauthorized immigrants in this episode raises the question of whether this is a na-

[6] Although the processing time of an immigration court case varies, it often takes several years, especially when the court faces a large influx of new cases. Immigration court data from TRAC, a research center at Syracuse University, show that the average time between the filling date and the date when the outcome is determined (e.g., removal, relief granted or termination) is 1,027 days for cases completed in fiscal years 2021-2023.

[7] The CBO projects net immigration for each immigration category using data from the Department of Homeland Security, the Census Bureau, various government reports and testimony, as well as the CBO's own judgments (on emigration rates, for example). The CBO projections for 2022-2024 are higher than those of other agencies such as the Social Security Administration and Census Bureau (which did not incorporate border encounters data), but they appear to be reasonable and consistent with administrative data (Edelberg and Watson, 2024).

Figure 4: Measures of immigration inflows

(a) Unauthorized immigration **(b)** Authorized immigration



Sources: U.S. Department of Homeland Security; Transactional Records Access Clearinghouse, Syracuse University; U.S. Department of State.

tional shock or a regional shock that mainly impacts border states. While most of these immigrants (about 80%) attempted to enter through the Southwest land border (Figure 5a), immigration court records, which track mailing addresses of individuals who received a notice to appear, suggest that their geographical footprint has been more widespread. New deportation cases filed after 2021 exceeded 0.5% of the population in 33 states (Figure 5b). One caveat about immigration-court data is that they only cover a subset of unauthorized immigrants (e.g., individuals paroled into the country without being placed into removal proceedings and individuals who entered illegally without being encountered are not covered).[8] Nevertheless, the spatial distribution of this subset of immigrants supports the view that the postpandemic immigration surge is a national, not a regional shock.

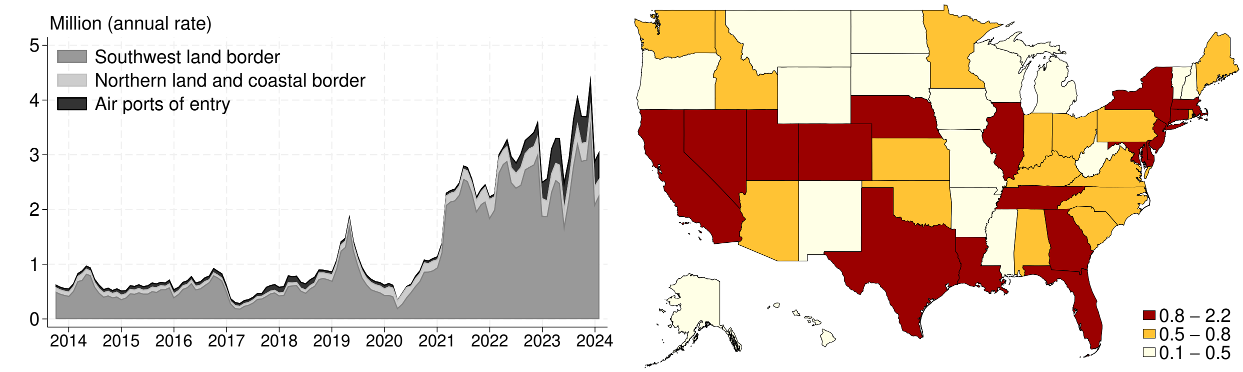
3.2 New Facts About Postpandemic Immigrants

Given the lack of information about immigrants' demographic and economic conditions in administrative data, we use household survey data to characterize their expected labor-market outcomes and consumption-saving patterns. We focus on two representative household surveys: (i) monthly CPS, which provides an up-to-date picture of labor market conditions, and (ii) PSID, which allows a more complete view of house-

[8] Individuals granted parole are allowed to enter the U.S., but they are not provided with an immigration status nor are they formally admitted into the country for purposes of immigration law. Individuals are typically expected to leave the country when the parole period expires. As of January 2023, major parole programs include those created for Afghans, Ukrainians, Cubans, Haitians, Nicaraguans, and Venezuelans.

Figure 5: Geographic distribution of encounters and immigration court cases

(a) Encounters by border region **(b)** New deportation cases by state



Notes: The left panel shows encounters in each border region. The right panel shows new deportation cases filed in immigration courts from 2022–2024 as a percent of the state's population in 2021.

Sources: U.S. Department of Homeland Security; Transactional Records Access Clearinghouse, Syracuse University.

holds' consumption, income, and wealth. Appendix A provides an overview of these surveys and details how we identify immigrants using these data.[9]

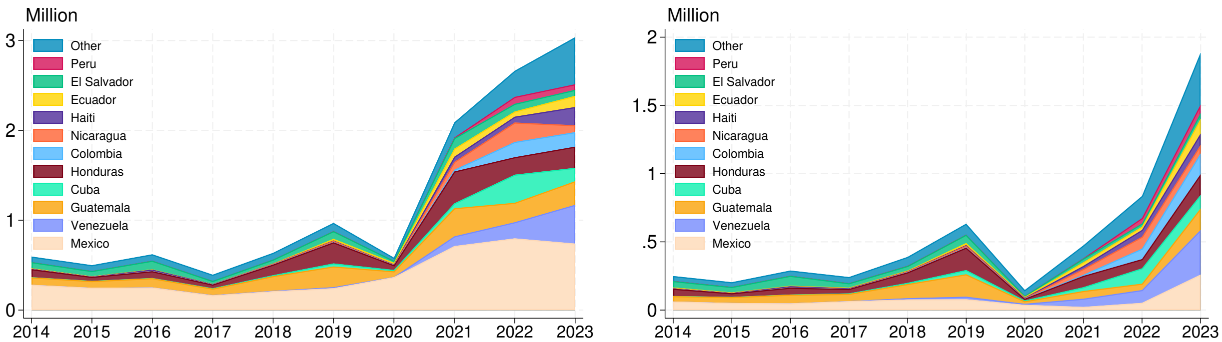
While survey data allow us to identify immigrants based on their citizenship status or birthplace, they do not reveal the legal status of an immigrant. To overcome this challenge, we use as a proxy survey respondents who were born in countries where the majority of unauthorized immigrants came from. This approach is motivated by the fact that newly arriving immigrants tend to have similar skills as earlier immigrants from the same country of origin and tend to move to enclaves established by these earlier immigrants (Bartel, 1989; Card, 2001, 2009). It also avoids using the average new immigrant in the survey as a proxy for the postpandemic unauthorized immigrants. Appendix A shows that household surveys are likely to undercount unauthorized immigrants in particular, rendering the average new immigrant in the survey not representative of the immigrants arriving after the pandemic.

To determine the nationality of unauthorized immigrants, we use administrative data on border

[9]We obtain very similar results to the CPS-based analysis when using the American Community Survey (ACS). The latest version of the ACS, however, reflects only the population through July 2023. On consumption and wealth, the PSID is the only household survey data that allow us to identify immigrants. The Consumer Expenditure Survey and the Survey of Consumer Finances, for example, do not provide information such as birthplace or citizenship status.

Figure 6: Nationality of unauthorized immigrants

(a) Encounters by country of origin **(b)** New deportation cases by country of origin



Notes: Encounters data underlying the left panel are the sum of the U.S. Border Patrol encounters, the Office of Field Operations enforcement encounters, and confirmed CHNV paroles.
Sources: U.S. Department of Homeland Security; Transactional Records Access Clearinghouse, Syracuse University.

encounters and new deportation cases filed in immigration courts. We find that a small number of countries in Central and South America have been associated with most (80%–90%) of these records since 2021 (Figure 6). These countries include Mexico, Guatemala, Honduras, and El Salvador—the main contributors before the pandemic—and new contributors after the pandemic (Venezuela, Colombia, Cuba, Ecuador, Nicaragua, Haiti, and Peru). We refer to these eleven countries as high-encounter (HE) countries, and we contrast immigrants born in these countries with those born in other countries and native-born individuals. Our analysis establishes two facts.

Fact 1. *The skills of unauthorized immigrants tend to complement those of native-born workers.*

We use the CPS from January 2017–April 2024 to document the expected labor market outcomes of individuals born in different country groups. In Table 1, the first three rows show that conditional on the working-age population, the labor force participation and employment rates do not differ much across groups. We then restrict the sample to individuals in the labor force and present three pieces of evidence to support the existence of skill complementarity between immigrants born in HE countries and other workers.

First, the educational attainment of HE immigrants is particularly low. Almost 70% of them

Table 1: Labor market characteristics

		Immigrants born in	
	Native-born	HE countries	Non-HE countries
% of working age (16–65)	62.1	84.6	77.3
Labor force participation rate, % (conditional on working age)	73.1	74.7	74.5
Employment rate, % (conditional on participation)	95.3	95.2	95.6
Education (conditional on participation)			
% of high school or below	32.2	68.8	25.6
% of master degree and above	13.3	4.5	26.5
Wage and salary, thous. 2019 dollars (conditional on employment)	54.0	34.3	64.6

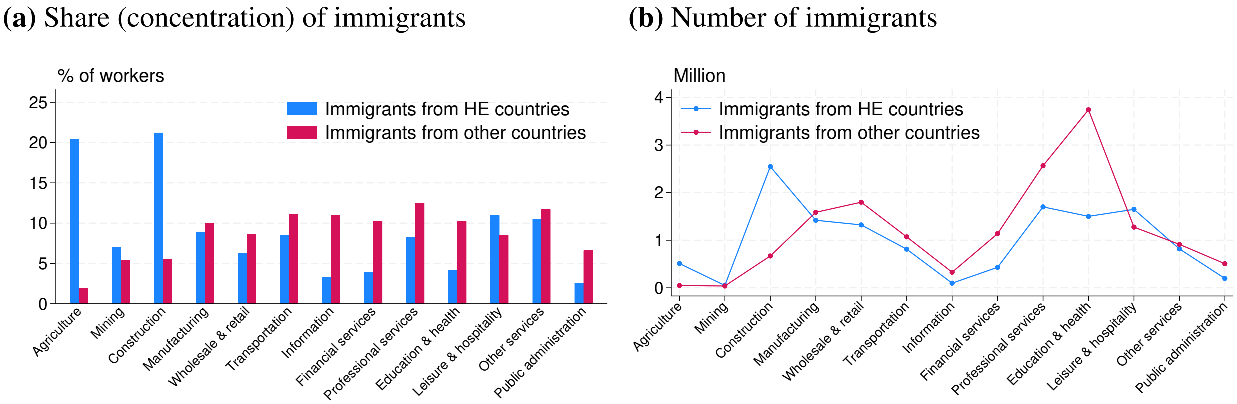
Notes: Mean values computed using the Current Population Survey, 2017–2024.

have a high-school degree or lower, compared to about 30% for the other two groups. Non-HE immigrants, in contrast, are more concentrated at the upper end of educational attainment: about 26% of them hold at least a master's degree, compared to 13% for native-born workers and only 4% for HE immigrants. The difference in education is reflected in their wage and salary. Compared to native-born workers, HE immigrants earn 38% less, while non-HE immigrants earn 20% more.

Second, immigrants born in HE countries are more likely to work in industries with lower skill requirements (measured by workers' average educational attainment), such as agriculture, construction, and leisure and hospitality. In contrast, non-HE immigrants are more concentrated in private sector jobs that require higher skills, such as information, financial services, and education (Figure 7). Native-born workers are the most likely of these groups to work in the public sector.

Third, within an industry, HE immigrants tend to work in occupations that require lower skills. Table 2 lists 10 industries (NAICS 3-digit) that have the highest concentration of HE immigrants. We then classify occupations into three broad categories: management occupations, computer and IT related occupations, and all other occupations. The table shows that within each industry, HE immigrants are more likely to work in non-management, non-IT occupations. These occupations

Figure 7: The presence of immigrants by industry



Notes: Current Population Survey, 2017–2024. Industry classification based on the NAICS 2-digit code.

Table 2: Share of high-encounter country immigrants by industry and occupation

Industry		Occupations		
Code	Description	Management	Computer & IT	Other
5617	Buildings, dwellings and landscaping services	10.9	2.0	32.6
814	Private households	11.7	0.0	30.8
315	Apparel, knitting and fabric manufacturing	7.4	1.4	28.5
23	Construction	7.8	2.3	24.2
311	Food manufacturing	6.3	1.2	19.5
721	Accommodation	3.8	9.0	19.1
493	Warehousing and storage	7.1	3.1	16.0
811	Repair and maintenance	7.3	4.1	14.5
327	Nonmetallic mineral products manufacturing	6.1	8.3	14.7
337	Furniture and related product manufacturing	6.3	0.0	14.6

Notes: Industry classification based on the NAICS 3-digit code; occupation classification based on the SOC code for major groups. The last three columns show the percent of HE country immigrants in a given industry-occupation cell, based on the monthly Current Population Survey, 2017–2024.

tend to require lower skills (based on workers' average education) and pay less than management and IT related occupations.

Fact 2. *Unauthorized immigrants tend to behave like "hand-to-mouth" consumers.*

Using the PSID family surveys from 2017–2021, Table 3 presents several key indicators of household financial conditions for each group on average (columns 1–3) and the subgroup of renters (columns 4–6).

Table 3: Measures of the prevalence of hand-to-mouth consumers

	All Households			Renters Only		
	Native-born (1)	HE (2)	Non-HE (3)	Native-born (4)	HE (5)	Non-HE (6)
Total expenditures (percent of income)	52	71	51	59	78	60
Basic expenditures (percent of income)	39	57	39	48	66	49
Total household wealth (thous. 2019 dollars)	277	97	365	35	17	53
Total liquid wealth (thous. 2019 dollars)	26	6	37	9	3	10
# of months liquid wealth support spending	8	2	9	4	1	3
KV hand-to-mouth prob. (percent)	35	55	29	51	63	39

Notes: Panel Study of Income Dynamics 2017–2021. Immigration status determined by the birthplace of the household head. Total expenditures include spending on nondurable goods, durable goods, and services. Basic expenditures refer to spending on food, housing, utility, and gasoline. Liquid savings include cash, checking and savings accounts, money market funds, CDs, Treasury bills and government bonds. Total wealth includes net liquid assets and net illiquid assets. KV hand-to-mouth probability is the share of households whose liquid savings are less than or equal to half of their income per pay period as in Kaplan and Violante (2014).

On the consumption side, the total consumption-to-income ratio is the highest for HE immigrants, with 71% compared to about 50% for the other two groups (row 1).[10] This difference is mainly explained by the much lower income earned by HE immigrants, suggesting that most of their income is likely to be spent, a necessary condition for being "hand-to-mouth" (Kaplan et al., 2014).[11] However, the consumption basket of earlier immigrants may differ from that of more recent immigrants. To conduct a more direct comparison, we isolate spending on necessities (food, housing, utilities, and gasoline). These expenditures take up 57% of HE immigrants' income, compared to only 39% for other households (row 2).

[10] We measure consumption, wealth, and income in the PSID as in Zhou (2022). See Appendix A for more details.

[11] Kaplan et al. (2014) and Kaplan and Violante (2014) distinguish between two types of hand-to-mouth households: the poor hand-to-mouth, who hold little or no wealth, and the wealthy hand-to-mouth, who hold a significant amount of illiquid wealth but have little or no liquid wealth. The balance sheets of HE immigrants, as shown in Table 3, suggest that they are closer to poor hand-to-mouth consumers.

On the wealth side, HE immigrants have the lowest household wealth, with $\$97$K compared to $\$277$K for native-born and $\$365$K for non-HE families (row 3). The liquid savings of HE immigrants, in particular, can support only two months of their expenditures, compared to 8–9 months for other households (rows 4 and 5).

A conservative approach to measuring the prevalence of hand-to-mouth consumers is to count the surveyed households whose average liquid savings are no more than half of their earnings per pay period. Using the PSID data, this probability is about one-third for native-born and non-HE households, consistent with the estimates in Kaplan and Violante (2014) and Kaplan et al. (2014), while it is 55% for HE immigrants (row 6). This result further supports the view that HE immigrants are more likely to be hand-to-mouth consumers.[12] Finally, when restricting the sample to renters to reflect the fact that new immigrants are less likely to be homeowners, we find that HE immigrants behave even more like hand-to-mouth consumers.[13]

4 MODEL OF POSTPANDEMIC IMMIGRATION

In this section, we present a medium-scale New Keynesian model with capital accumulation, population growth, and features consistent with the empirical facts established in Section 3. N_{ht} households are hand-to-mouth as in Gali et al. (2004) and Bilbiie (2008) and relatively low skilled. The remaining N_{st} households are savers and supply high-skilled labor. The production process includes capital-skill complementarity as in Krusell et al. (2000), where high-skilled labor is more complementary to capital than low-skilled labor.[14]

Both the saver and hand-to-mouth population grow exogenously. Saver population growth is deterministic at the constant gross growth rate Γ_N. Gross population growth of the hand-to-mouth

[12] Since the PSID does not have information on paycheck frequency, we apply the distribution-implied mean frequency from Kaplan and Violante (2014) to compute the per-pay-period income for every household.

[13] A fraction of immigrants' unspent income is likely to be remitted to their home country. Previous studies based on surveys of Mexican immigrants suggest that a quarter of their monthly income is remitted (see Amuedo-Dorantes et al., 2005). Using more recent data (2022-2024) from the Bank of Mexico on workers' remittances and the average income of Mexican immigrants in the CPS, we estimate that about 13% of immigrants' income is remitted. These estimates are small and unlikely to weaken the aggregate demand effects from the postpandemic immigration surge.

[14] Bilbiie et al. (2023) make the same assumption of perfect correlation between household financial market access and the labor skill type in the production process.

households, $\Gamma_{ht} = {}^{N_{ht}}/_{N_{h,t-1}}$, evolves according to

$$\ln \Gamma_{ht} = (1 - \rho_N) \ln \Gamma_N + \rho_N \ln \Gamma_{h,t-1} + \sigma_{hN} \epsilon_{ht}, \quad \epsilon_{ht} \sim N(0, 1), \tag{1}$$

where Γ_N, ρ_N, and σ_{hN} are the steady-state population growth rate, population growth persistence, and the standard deviation of the hand-to-mouth population growth shock, respectively. An ϵ_{ht} shock can be interpreted as a population growth shock due to the postpandemic immigration surge.

Define ν_t as the saver population share in period t, ${}^{N_{st}}/_{N_t}$, where $N_t = N_{st} + N_{ht}$. This population share can be written recursively as

$$\nu_t = \frac{\Gamma_N}{\Gamma_{Nt}} \nu_{t-1}, \tag{2}$$

where the gross population growth rate is given by

$$\Gamma_{Nt} = \Gamma_N \nu_{t-1} + \Gamma_{ht} (1 - \nu_{t-1}). \tag{3}$$

4.1 HOUSEHOLDS Households denoted by j maximize lifetime utility over consumption, $c_t(j)$, and hours worked, $h_t(j)$. Households are sorted such that the first N_{st} households are savers and households of a particular type are identical in every other way, so $c_t(j) \equiv c_{st}$ for all $j \in [0, N_{st}]$ and $c_t(j) \equiv c_{ht}$ for all $j \in (N_{st}, N_t]$. Thus, aggregate consumption is given by

$$C_t = \int_0^{N_t} c_t(j) dj = N_t (\nu_t c_{st} + (1 - \nu_t) c_{ht}) = N_t c_t,$$

where lower-case letters denote per capita variables.

Given that households of the same type are assumed to be identical in every other way, we consider the problems of the representative saver and hand-to-mouth households. Each household receives per period utility flows from consumption with disutility over hours worked. Household preferences are consistent with balanced growth as in King et al. (1988) and Jaimovich and Rebelo (2009). Households of type $i \in \{h, s\}$ supply labor to the production sector and receive a type-specific real wage w_{it} per hour worked.

The type s households save via a risk-free nominal bond, B_t, which returns gross nominal interest rate R_t in the subsequent period and is in zero net supply in equilibrium. Savers also own all firms in the economy with firm ownership distributed uniformly across these households. Firms maximize the present discounted value of aggregate profits, discounting future cash flows by the owners' stochastic discount factor, and remit profits to the owners via per capita dividends, d_t.

The representative saver's optimization problem is given by

$$\begin{aligned} \max_{c_{st},\, l_{st},\, b_t} \quad & \mathbb{E}_t \sum_{m=0}^{\infty} \beta^m \frac{\left(c_{s,t+m}\left(1-\psi l_{s,t+m}^{1+\theta}\right)\right)^{1-\sigma}}{1-\sigma} \\ \text{s.t.} \quad & c_{st} + b_t = w_{st} l_{st} + \frac{R_{t-1}}{\Pi_t} b_{t-1} + d_t, \end{aligned}$$

where $b_t = {}^{B_t}/_{P_t}$ is the real quantity of household bond holdings, P_t is the aggregate price of the consumption good, $\Pi_t = {}^{P_t}/_{P_{t-1}}$ is the gross inflation rate, β is the subjective discount factor, σ is the elasticity of intertemporal substitution, θ controls the Frisch elasticity of labor supply, and ψ determines the steady-state labor supply. Optimality implies

$$L_{st} = (1+\theta)\frac{\psi l_{st}^{1+\theta}}{1-\psi l_{st}^{1+\theta}}\frac{C_{st}}{w_{st}}, \tag{4}$$

$$1 = \mathbb{E}_t\left[\Lambda_{t,t+1}\frac{R_t}{\Pi_{t+1}}\right], \tag{5}$$

where the stochastic discount factor is given by

$$\Lambda_{t-1,t} = \beta\left(\frac{1-\psi l_{st}^{1+\theta}}{1-\psi l_{s,t-1}^{1+\theta}}\right)^{1-\sigma}\left(\frac{C_{s,t-1}}{C_{st}}\Gamma_N\right)^{\sigma}. \tag{6}$$

Utility maximization by the representative hand-to-mouth household,

$$\begin{aligned} \max_{c_{ht}, l_{ht}} \quad & \frac{\left(c_{ht}\left(1-\psi l_{ht}^{1+\theta}\right)\right)^{1-\sigma}}{1-\sigma} \\ \text{s.t.} \quad & c_{ht} = w_{ht} l_{ht} \end{aligned} \tag{7}$$

implies

$$1 = (1+\theta)\frac{\psi l_{ht}^{1+\theta}}{1-\psi l_{ht}^{1+\theta}}, \tag{8}$$

so labor supply of type-h households is effectively inelastic.

4.2 PRODUCTION SECTOR The production sector includes three levels, consistent with the setups in Sims and Wu (2021) and Mau (2023). The wholesaler produces a good for sale to a continuum of monopolistically competitive retailers. Retailers differentiate the wholesale good for sale to a final good bundler and exercise market power in pricing. The bundler operates in a perfectly competitive market, selling the final good to households.

We describe the production sector from the top down. The final good bundler purchases $Y_t(f)$ units of each retail good, $f \in [0,1]$. This firm bundles retail goods using a CES bundling technology to produce a finished good, $Y_t = \left(\int_0^1 Y_t(f)^{(\varepsilon-1)/\varepsilon} df\right)^{\varepsilon/(\varepsilon-1)}$, that is sold to households, where ε is the elasticity of substitution across goods. The final good bundler chooses retail good purchases to maximize its total profits, $P_t Y_t - \int_0^1 P_t(f) Y_t(f) df$. Profit maximization implies final good bundler demand for retail good f, $Y_t(f) = \left(P_t(f)/P_t\right)^{-\varepsilon} Y_t$, where$P_t = \left(\int_0^1 P_t(f)^{1-\varepsilon} df\right)^{1/(1-\varepsilon)}$.

Monopolistically competitive retailers each purchase $Y_{wt}(f)$ units of the wholesale good at the relative price p_{wt}. Retailers differentiate the wholesale good for sale to a final good bundler using a one-for-one production technology, $Y_t(f) = Y_{wt}(f)$. Each retailer maximizes profits subject to final good firm demand and optimally resets its price each period with probability $1-\zeta$. A retailer that can reset its price chooses $P_{\#t}$ to maximize the expected discounted present value of real future profits, or the value of the firm,

$$\mathbb{E}_t \sum_{m=0}^{\infty} \zeta^m \Lambda_{t,t+m} \left(\frac{P_{\#t}}{P_{t+m}} - p_{w,t+m}\right) \left(\frac{P_{\#t}}{P_{t+m}}\right)^{-\varepsilon} Y_{t+m},$$

where we have substituted the demand curve retailer f faces into the value of the firm. The optimal relative reset price, $p_{\#t} = P_{\#t}/P_t$, is given by

$$p_{\#t} = \frac{\varepsilon}{\varepsilon - 1} \frac{X_{1t}}{X_{2t}}, \tag{9}$$

where the auxilary variables, X_{1t} and X_{2t}, are written recursively as

$$X_{1t} = p_{wt} Y_t + \zeta \mathbb{E}_t[\Lambda_{t,t+1} \Pi_{t+1}^{\varepsilon} X_{1,t+1}], \tag{10}$$

$$X_{2t} = Y_t + \zeta \mathbb{E}_t[\Lambda_{t,t+1} \Pi_{t+1}^{\varepsilon-1} X_{2,t+1}]. \tag{11}$$

Aggregate inflation evolves according to

$$1 = (1-\zeta)p_{\#t}^{1-\varepsilon} + \zeta \Pi_t^{\varepsilon-1}. \tag{12}$$

The wholesaler produces the wholesale good using a nested CES production technology,

$$Y_{wt} = \left((1-\mu) L_{ht}^{\eta} + \mu \left((1-\chi) L_{st}^{\xi} + \chi K_{t-1}^{\xi} \right)^{\frac{\eta}{\xi}} \right)^{\frac{1}{\eta}}, \tag{13}$$

where η and ξ govern the elasticity of substitution between inputs. This nesting restricts the elasticity of substitution between hand-to-mouth and saver labor to be the same as that between hand-to-mouth labor and installed capital as in Krusell et al. (2000) and Bilbiie et al. (2023). To preserve strict quasiconcavity of the production function, $\eta, \xi \leq 1$. Saver labor is more complementary to capital than hand-to-mouth labor if $\xi < \eta$.

The wholesaler maximizes the expected present discounted value of real profits,

$$\max_{L_{ht}, L_{st}, K_t, I_t} \quad \mathbb{E}_t \sum_{m=0}^{\infty} \Lambda_{t,t+m} \left[p_{w,t+m} Y_{w,t+m} - w_{h,t+m} L_{h,t+m} - w_{s,t+m} L_{s,t+m} - I_{t+m} \right]$$

subject to the production function and the law of motion for capital,

$$K_t = I_t + (1-\delta) K_{t-1}, \tag{14}$$

where δ is the depreciation rate. Define R_t^k as the implicit capital rental rate. The optimality conditions imply

$$w_{ht} = p_{wt} \frac{Y_{wt}}{L_{ht}} \frac{(1-\mu) L_{ht}^{\eta}}{(1-\mu) L_{ht}^{\eta} + \mu \left((1-\chi) L_{st}^{\xi} + \chi K_{t-1}^{\xi} \right)^{\frac{\eta}{\xi}}}, \tag{15}$$

$$w_{st} = p_{wt} \frac{Y_{wt}}{L_{st}} \frac{\mu \left((1-\chi) L_{st}^{\xi} + \chi K_{t-1}^{\xi} \right)^{\frac{\eta}{\xi}}}{(1-\mu) L_{ht}^{\eta} + \mu \left((1-\chi) L_{st}^{\xi} + \chi K_{t-1}^{\xi} \right)^{\frac{\eta}{\xi}}} \frac{(1-\chi) L_{st}^{\xi}}{(1-\chi) L_{st}^{\xi} + \chi K_{t-1}^{\xi}}, \tag{16}$$

$$R_t^k = p_{wt} \frac{Y_{wt}}{K_{t-1}} \frac{\mu \left((1-\chi) L_{st}^{\xi} + \chi K_{t-1}^{\xi} \right)^{\frac{\eta}{\xi}}}{(1-\mu) L_{ht}^{\eta} + \mu \left((1-\chi) L_{st}^{\xi} + \chi K_{t-1}^{\xi} \right)^{\frac{\eta}{\xi}}} \frac{\chi K_{t-1}^{\xi}}{(1-\chi) L_{st}^{\xi} + \chi K_{t-1}^{\xi}}, \tag{17}$$

$$1 = \mathbb{E}_t [\Lambda_{t,t+1} (R_{t+1}^k + 1 - \delta)]. \tag{18}$$

4.3 MONETARY POLICY The central bank sets the gross nominal interest rate according to

$$R_t = R\left(\Pi_t/\Pi\right)^{\upsilon_\pi}, \tag{19}$$

where υ_π controls the response to the inflation gap.[15]

4.4 COMPETITIVE EQUILIBRIUM Aggregate supply is defined by equating wholesaler and total retailer output,

$$Y_{wt} = \int_0^1 Y_t(j)dj \equiv \Delta_t Y_t, \tag{20}$$

where price dispersion follows

$$\Delta_t = \int_0^1 \left(\frac{P_t(j)}{P_t}\right)^{-\varepsilon} dj = (1-\zeta)p_{\#t}^{-\varepsilon} + \zeta\Pi_t^{\varepsilon}\Delta_{t-1}. \tag{21}$$

The aggregate resource constraint is given by

$$Y_t = C_{st} + C_{ht} + I_t. \tag{22}$$

A competitive equilibrium is defined by sequences of quantities, $\{C_{st}, C_{ht}, l_{ht}, l_{st}, L_{ht}, L_{st}, N_{ht}, N_{st}, K_t, I_t, Y_t, Y_{wt}\ \nu_t\}$, prices, $\{\Lambda_{t-1,t}, R_t, \Pi_t, p_{\#t}, X_{1t}, X_{2t}, \Delta_t, w_{ht}, w_{st}, R_t^k, p_{wt}\}$, and exogenous variables, $\{\Gamma_{ht}, \Gamma_{Nt}\}$, such that equations (1) – (22) hold, given the definitions of the saver population share, $\nu_t = {}^{N_{st}}/_{(N_{st}+N_{ht})}$, gross population growth, $\Gamma_{it} = {}^{N_{it}}/_{N_{i,t-1}}$, and hours worked per household, $l_{it} = {}^{L_{it}}/_{N_{it}}$, $i \in \{h, s\}$.[16]

4.5 CALIBRATION Table 4 provides the model calibration at a quarterly frequency. The factor shares of production (μ and χ) are set to target a steady-state capital income share of $1/3$ and a wage skill premium of 85% following Carroll and Hur (2023). The elasticity of substitution between low-skilled labor and the capital/high-skilled labor bundle (η) and the elasticity of substitution between capital and high-skilled labor (ξ) are set to be consistent with empirical estimates from

[15] Section 6 shows that generalizing this rule to allow for interest rate inertia or a positive response to the output gap has very little effect on our results.

[16] Appendix C provides the definition of the stationary competitive equilibrium.

Table 4: Model calibration

Parameter	Description	Value
Production		
μ	Saver labor-capital production weight	0.198
χ	Capital production weight	0.992
η	Skill-type production elasticity, $1/(1-\eta) = 9$	0.889
ξ	Saver labor-capital production elasticity, $1/(1-\xi) = 0.4$	-1.5
ε	Goods elasticity of substitution	9
ζ	Price stickiness	0.8
δ	Depreciation rate	$1.1^{1/4} - 1$
Households		
β	Subjective discount factor	$1.01^{-1/4}$
σ	Elasticity of intertemporal substitution	1
ψ	Labor disutility preference shifter	3
θ	Labor preference elasticity	1.16
ν	Steady-state saver population share	0.8
Monetary Policy		
υ_Π	Interest rate policy inflation sensitivity	1.5
Π	Gross inflation target	$1.02^{1/4}$
Demographics		
Γ_N	Steady-state population growth rate	$1.005^{1/4}$
ρ_N	Persistence of the immigration shock	0.9

Bilbiie et al. (2023), who estimate a medium-scale New Keynesian model with features similar to our model, absent population growth. In line with estimates in the New Keynesian literature, the goods elasticity of substitution (ε) is set such that the steady-state markup is 12.5%, while the degree of price stickiness (ζ) implies that retailers reset prices every 5 quarters on average.[17] The annualized capital depreciation rate (δ) is set to 10% to match the depreciation rate on private fixed assets and durable goods in the data.

The discount factor (β) implies that the annualized steady-state real interest rate is 1%. The elasticity of intertemporal substitution is set to unity. The labor disutility preference shifter (ψ) and labor preference elasticity (θ) are set to target steady-state average labor equal to $1/3$ and a population weighted average Frisch elasticity of 0.5 in steady state following Chetty et al. (2012).

[17] We also considered smaller values for ζ, which increase the slope of the Phillips curve. As shown in Section 6, the degree of price stickiness has very little effect on our results.

The steady-state saver population share (ν) is set to 0.8 following Bilbiie et al. (2023) and is consistent with empirical estimates of the average marginal propensity to consume out of transitory income shocks (see Kaplan et al., 2014; Parker et al., 2013; Souleles et al., 2006). Monetary policy satisfies the Taylor principle ($\upsilon_{\Pi} = 1.5$) with an annual inflation target (Π) equal to 2%.

The steady-state population growth rate (Γ_N) is equal to the prepandemic average in the U.S. The persistence of the immigration shock (ρ_N) is set to 0.9 so that the average duration of the shock is 2.5 years, consistent with the 2024 CBO projection. When computing impulse responses, the immigration shock is calibrated such that aggregate population growth increases by 0.7 percentage points, consistent with the increase during the postpandemic immigration surge.

5 INFLATIONARY IMPLICATIONS OF THE IMMIGRATION SURGE

We now use the model in Section 4 to analyze the inflationary implications of the postpandemic immigration shock. Contrary to the popular view, we find that this shock has very little effect on inflation and show that this key result is robust to alternative specifications of the model.

Our baseline model is two steps removed from the standard representative agent New Keynesian (RANK) model with capital. First, we add hand-to-mouth agents who do not smooth consumption across time (i.e., the two-agent New Keynesian model, TANK). Second, we introduce capital-skill complementarity where skill is assumed to be perfectly correlated with whether or not the household is consumption smoothing or hand-to-mouth (i.e., TANK with capital-skill complementarity, TANK-CSC). Before we discuss the quantitative findings from our baseline TANK-CSC model, we first examine the implications of a surge in immigration in the RANK and TANK models, as these simplified settings provide useful intuition for the dynamics in our baseline model.

Responses in the RANK model In the RANK model, all households are identical, so an increase in immigration is simply a shock to the growth rate of the overall population (Figure 8, dash-dotted red lines).[18] A population surge leads to an increase in labor supply and aggregate output, but it

[18]In the RANK and TANK models, we assume production is Cobb-Douglas with a cost share of capital equal to $1/3$, consistent with the calibration target in the baseline model.

also increases aggregate investment as firms respond to the higher return to capital driven by the larger workforce. In equilibrium, the increase in demand exceeds the increase in supply because capital takes time to adjust, as can be seen from the decline and delayed recovery of the capital-labor ratio. Furthermore, while aggregate consumption initially contracts to accommodate higher investment, over time it increases with more people demanding consumption goods. Combining these supply-side and demand-side effects generates a small but positive inflation response, as we emphasized in Section 2.

Responses in the TANK model Next, consider the case in which immigrants are modeled as hand-to-mouth households whose labor is perfectly substitutable with the labor supplied by the rest of the population. In this case, the immigration shock is an increase in the growth rate of the hand-to-mouth population (Figure 8, dashed blue lines).

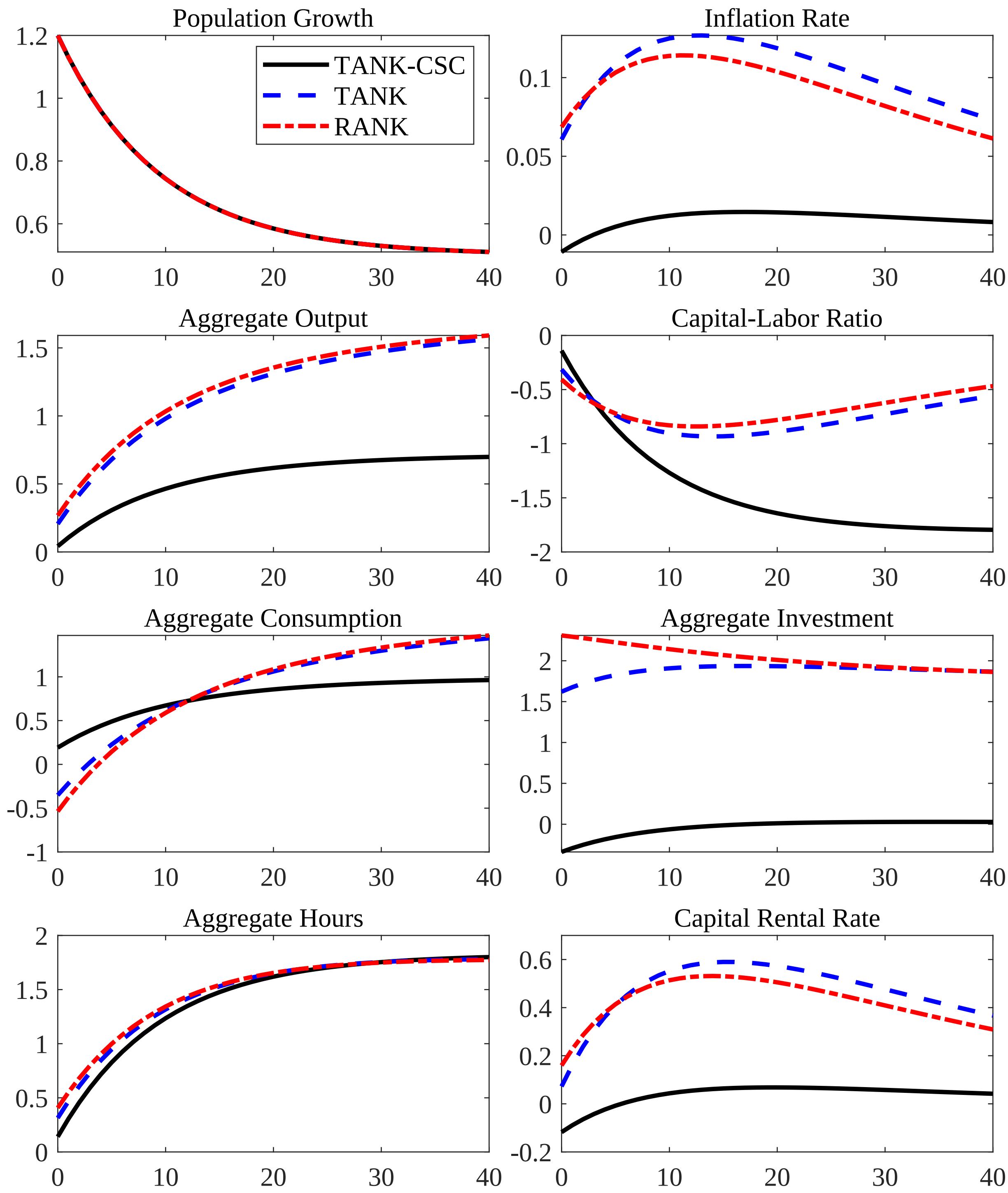
Qualitatively, the responses in the TANK model are similar to the RANK model. An increase in the hand-to-mouth population increases labor supply, reduces the capital-labor ratio, and boosts aggregate investment as the return to capital rises in response to the higher population growth. However, in this model, all of the increase in investment is financed by saver households.

Hand-to-mouth households are interest rate insensitive, so they do not adjust their consumption in response to the higher return to capital. For this share of the population, the consumption response is larger than in the RANK model. In contrast, the saver households take advantage of the higher return to capital by increasing investment, but they only represent a fraction of the population and are reluctant to sacrifice too much of their consumption. Thus, the investment response is somewhat dampened relative to the RANK model.

A larger consumption response in the TANK model raises inflationary pressures relative to the RANK model, but a smaller investment response has the opposite effect. Quantitatively, these effects essentially wash out in the short run, so the impact on inflation is similar in the two models.

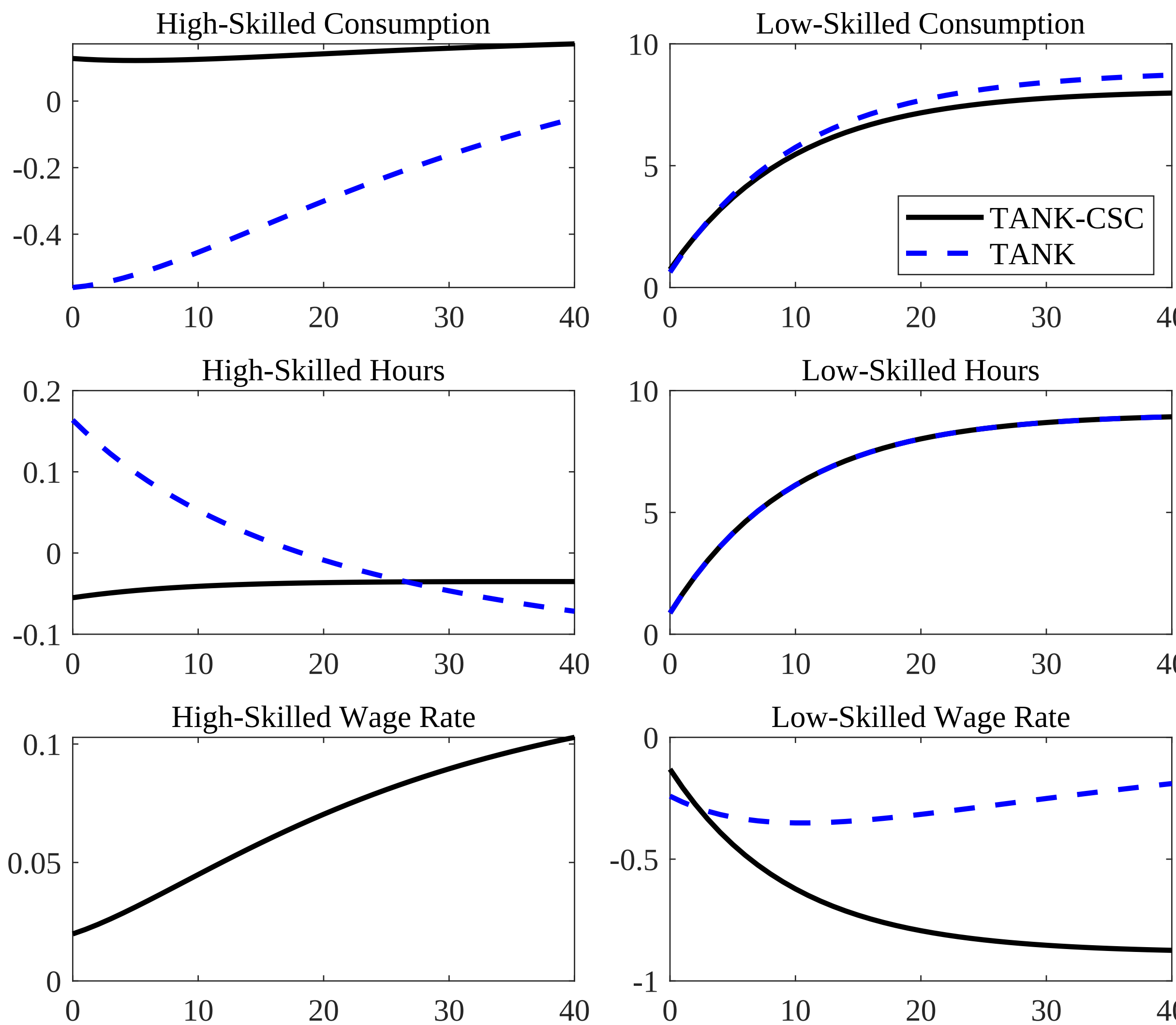
Responses in the baseline model Relative to the TANK model, low-skilled labor is less complementary to capital, so the immigration shock generates weaker investment demand in our baseline model (Figure 8, solid black lines). In addition, given the complementarity between high-skilled

Figure 8: Impulse responses to an immigration shock across models



Notes: The population growth response is the net annualized aggregate population growth rate. The inflation rate responses are annualized percentage point deviations from steady state. The capital-labor ratio and capital rental rate responses are percentage deviations from the detrended steady state. The remaining impulse responses are percentage deviations from the pre-shock trend.

Figure 9: Impulse responses of skill-specific variables to an immigration shock across models



Notes: The wage rate response is in percentage deviations from the detrended steady state. The remaining impulse responses are percentage deviations from the pre-shock trend. In the TANK model, the high-skilled and low-skilled wage rates are identical.

labor and capital, high-skilled households do not need to work as much or reduce consumption to support investment, in contrast with the TANK model where high-skilled households work more and lower their consumption (Figure 9). Thus, the limited investment demand occurs not only because immigration is concentrated among low-skilled workers but also because high-skilled workers cut their labor supply, reducing the marginal product of capital.

The low-skilled consumption and hours responses are nearly identical to the TANK model because these workers are hand-to-mouth and their labor supply is inelastic. Despite the fact that the low-skilled wage rate falls, the higher population causes low-skilled consumption to rise. Thus, the inflationary effects of additional consumption demand from low-skilled workers discussed in the TANK model still persist in our baseline model. While capital-skill complementarity completely unwinds the investment demand channel and its effects on inflation that occur in the RANK and TANK models, additional consumption demand from high-skilled workers limits the disinflationary nature of this channel. Although there are differences in the transmission mechanism, all three models show that there is little effect on inflation from the postpandemic immigration surge. The demand-side effects roughly offset the disinflationary supply-side effects of the postpandemic immigration surge.

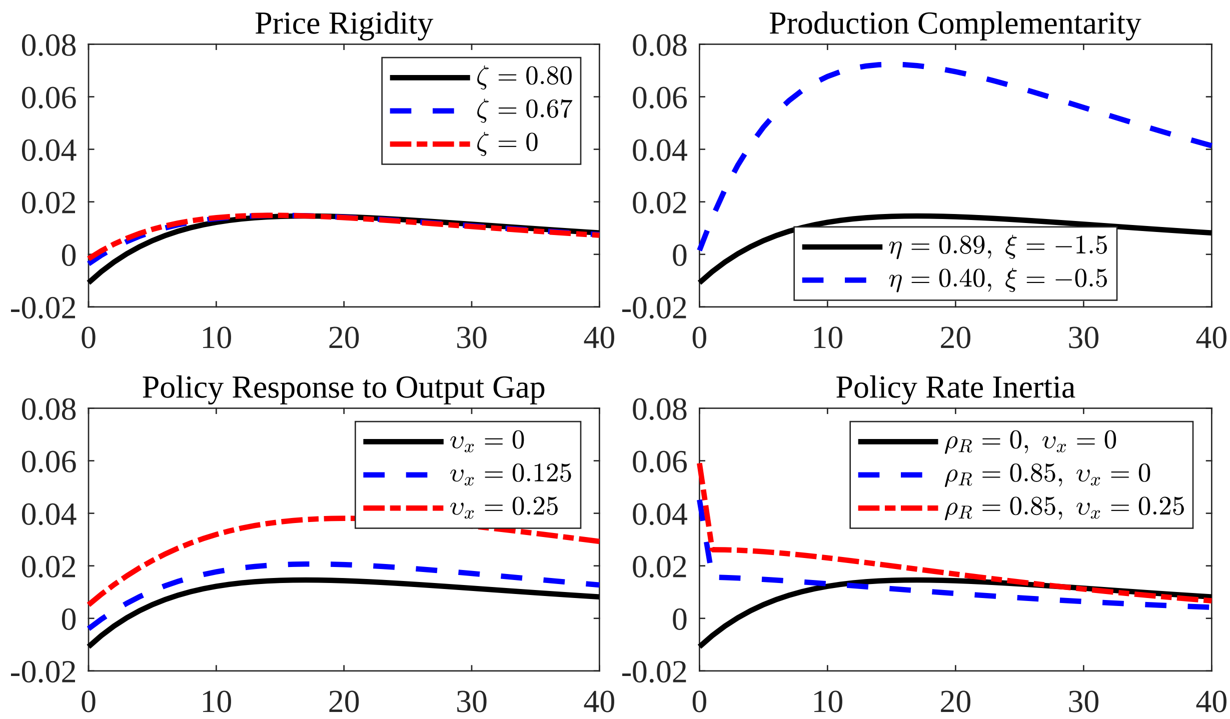
6 ROBUSTNESS

This section examines the robustness of our results. We first consider whether the response of inflation to an immigration shock is robust to alternative parameterizations of our baseline model. The results are shown in Figure 10. In the upper left panel, we consider smaller degrees of price stickiness (ζ) to allow for a steeper Philips curve. In the upper right panel, we consider alternative elasticities in the production function following Krusell et al. (2000) to vary the degree of complementarity between inputs. In the bottom panel, we consider alternative monetary policy rules. Specifically, we generalize the Taylor rule, $R_t = R_{t-1}^{\rho_R}(R\,(\Pi_t/\Pi)^{\upsilon_\pi}\,gap_t^{\upsilon_x})^{1-\rho_R}$, to allow for interest rate smoothing (ρ_R) and a response to the output gap (υ_x).[19] Despite the wide range of parameterizations we consider, there is very little effect on the inflation responses, and, in particular, no evidence of a material decline in inflation as suggested by the popular view. This highlights the robustness of our key result that the postpandemic immigration surge had little effect on inflation.

Surge in high-skilled immigration Our analysis thus far has focused on the influx of low-skilled workers driven by the postpandemic immigration surge. A related question is how high-skilled

[19]Since there is positive trend inflation, there is a gap between output in the sticky and flexible price economies. Thus, the output gap in the policy rule is multiplied by a scaling factor such that the steady-state output gap is unity.

Figure 10: Impulse responses of inflation to an immigration shock under alternative parameters



Notes: The responses are annualized percentage point deviations from steady state.

immigration impacts the economy, given that U.S. immigration inflows had been concentrated among highly educated individuals in the two decades prior to the pandemic (Caiumi and Peri, 2024), and that the U.S. public generally supports high-skilled immigration.[20] The literature on this question has mostly focused on the labor market effects, with little evidence on the inflationary effects. We use our model to shed light on this issue by introducing shocks to the high-skilled population. Analogous to low-skilled population growth, high-skilled population growth follows

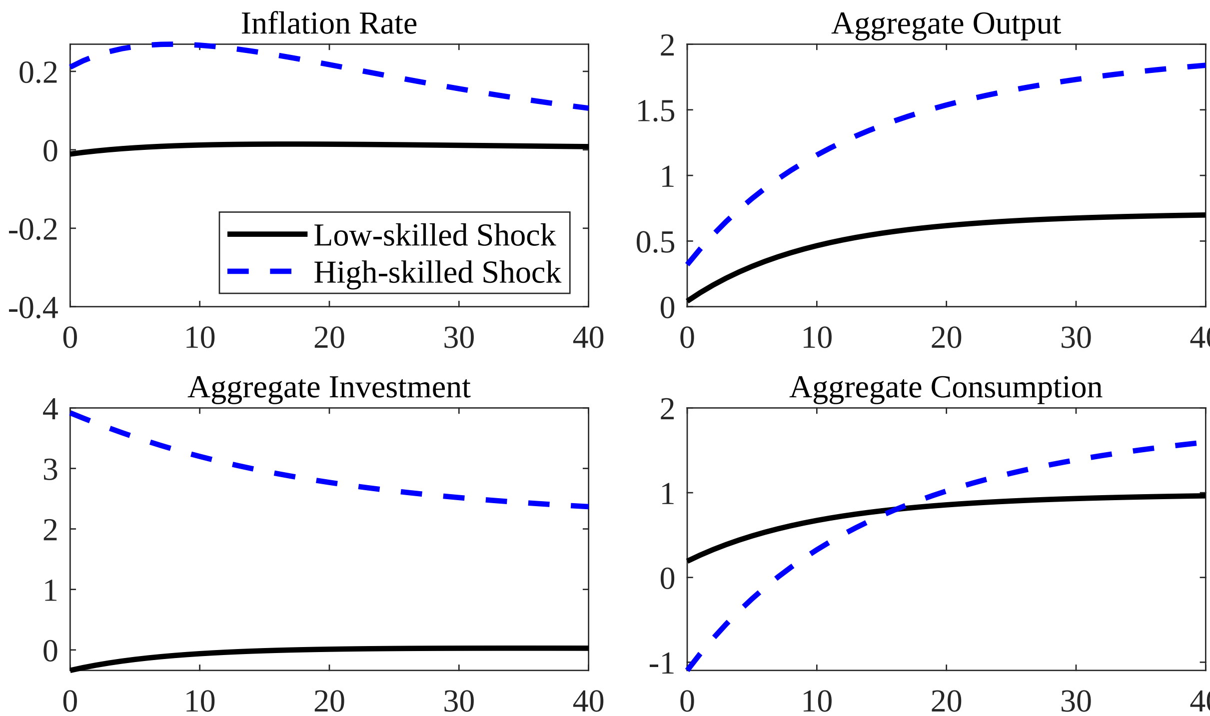
$$\ln \Gamma_{st} = (1-\rho_N)\ln \Gamma_N + \rho_N \ln \Gamma_{s,t-1} + \sigma_{sN}\epsilon_{st}, \quad \epsilon_{st} \sim N(0,1),$$

where the shock size is scaled by the relative population share (i.e., $\sigma_{sN} = (1-\nu)\sigma_{hN}/\nu$).

Figure 11 compares the responses to a high-skilled and low-skilled immigration shock in our baseline model. The high-skilled immigration shock generates a much larger increase in invest-

[20]See, for example, the results of a Pew Research survey from 2018 (https://www.pewresearch.org/global/2019/01/22/majority-of-u-s-public-supports-high-skilled-immigration/).

Figure 11: Impulse responses to a high and low-skilled immigration shock



Notes: The inflation rate responses are annualized percentage point deviations from steady state. The remaining impulse responses are percentage deviations from the pre-shock trend.

ment demand than the low-skilled immigration shock, which causes a larger increase in inflation. Contrary to the popular view, these results highlight that an immigration shock would generate a material increase in inflation if it was concentrated among high-skilled workers.

7 CONCLUSION

The surge in U.S. immigration that started in late 2021 triggered widespread discussion about its macroeconomic impacts. This surge happened when the labor market was transitioning from the pandemic-induced disruption and when the Fed was deliberating its policy in the postpandemic era. Existing studies, however, are not well-suited to addressing questions about the postpandemic immigration surge. For example, quantitative models with household heterogeneity often abstract from nominal frictions, and hence inflation dynamics, while VAR-based analysis for the

U.S. mainly captures the impact of authorized immigration, which differs from the current episode. These challenges require new facts and an empirically motivated general equilibrium model.

Our paper combines administrative records with household survey data to provide a more complete picture of unauthorized immigrants arriving in the U.S after the pandemic: They tend to be hand-to-mouth consumers and low-skilled workers that complement the existing workforce. We build these features into a New Keynesian model, allowing us to assess their inflationary effects.

While some have argued that the postpandemic immigration surge was disinflationary on the basis that it boosts labor supply, our analysis reveals that the effects of the shock are more complex. Not only does it increase labor supply, it also drives up aggregate demand through interactions between capital and labor. Accounting for both supply and demand channels in our empirically motivated model, we find that the postpandemic immigration surge had little effect on inflation.

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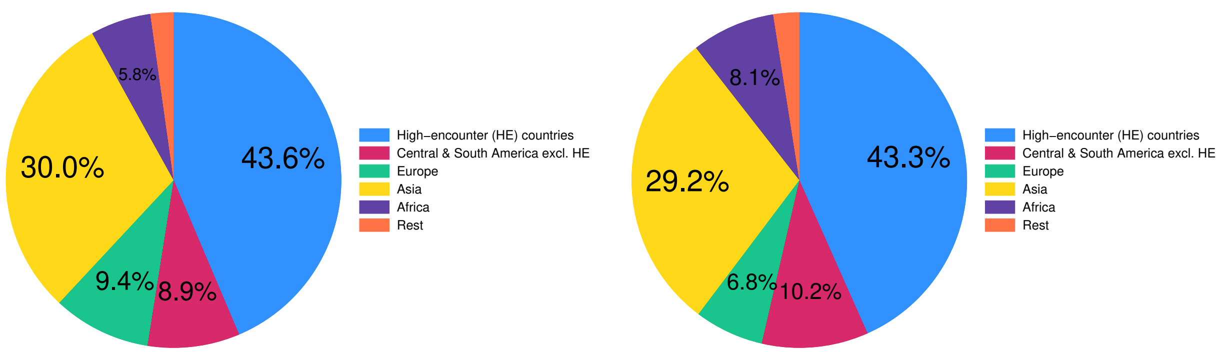
A EMPIRICAL METHODOLOGY

The Current Population Survey (CPS) is a monthly household survey conducted by the U.S. Census Bureau and the Bureau of Labor Statistics. It is the primary source of labor force statistics in the U.S., containing information about the labor force, employment, unemployment, hours, earnings, and other demographic characteristics. We use two survey questions to determine immigrants and their country of origin. First, the survey asks about the citizenship status of the respondent (i.e., born in U.S., born in U.S. outlying, born abroad of American parents, naturalized citizen, or not a citizen). We identify immigrants as those reporting themselves as a naturalized citizen or not a citizen. Second, we identify immigrants' country of origin based on their reported birth country.

Figure A.1: Composition of CPS immigrants

(a) All immigrants ($N = 1,133,105$)

(b) Immigrants arriving after 2020 ($N = 73,912$)



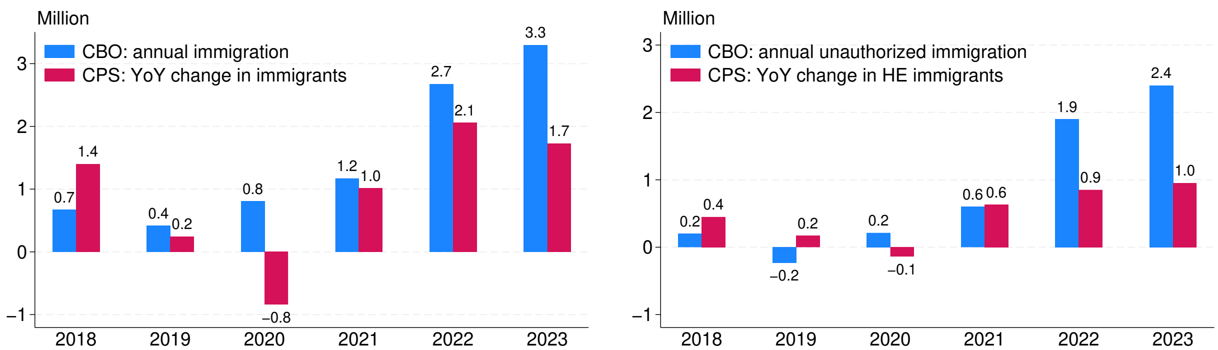
Notes: The composition of immigrants' country of origin using the monthly Current Population Survey, 2017-2024. High-encounter (HE) countries refer to the eleven countries listed by name in Figure 6.

Using data from January 2017–April 2024, Figure A.1 shows that immigrants from HE countries account for 44% of all immigrants. When we restrict the sample to immigrants arriving in the U.S. after 2020, the composition of their country of origin remains similar. This suggests that the CPS is likely to undercount unauthorized immigrants arriving in the U.S. after the pandemic, as administrative data on border encounters, visa issuance, and immigration court cases suggest that this surge was mainly driven by unauthorized immigrants born in HE countries.

This undercounting problem can also be seen by comparing the CBO's estimates of net immigration and unauthorized immigration to those implied by the CPS (Figure A.2). For example, the CPS implies 1.6 million (or 48%) less total immigration and 1.4 million (or 58%) less unauthorized immigration in 2023 than those estimated by the CBO. Since the labor market characteristics differ substantially between HE immigrants and non-HE immigrants (see Section 3.2), focusing on the average new immigrant in the CPS is likely to provide a biased picture of unauthorized immigrants.

Figure A.2: Immigration estimates using CBO and CPS data

(a) Total immigration **(b)** Unauthorized immigration



Notes: Comparison of CBO estimates of annual net immigration, and the unauthorized immigration component, to those implied by the CPS.

Our approach of focusing on HE immigrants mitigates this concern.

The Panel Study of Income Dynamics (PSID) is a biennial household survey conducted by the University of Michigan. It contains detailed information on wealth, income, and expenditures. We use two survey questions to determine immigrants and their country of origin. First, the survey asks whether or not the respondent (head of the household) was born in a U.S. state. We identify those reporting "no" as immigrants. Second, the survey asks what country or part of the world the respondent's ancestors came from. We use immigrants' answers to this question to determine their country of origin. Similar to the pattern in the CPS, the share of immigrants born in HE countries is 47% using the PSID family surveys from 2017–2021.

We measure consumption, wealth, and income in the PSID as in Zhou (2022). Total expenditures consist of (i) nondurable goods, which include food, gasoline, and clothing, (ii) durable goods, which include furniture, auto consumption, and recreation, and (iii) services, which include housing, utility, telephone and internet, education, health, childcare, transportation, and home repairs. We do not include investment expenditures such as vehicle and home purchases or home improvements in the consumption measurement. Household wealth includes: (i) net liquid assets, which are the sum of liquid savings (cash, checking and savings accounts, money market funds, CDs, Treasury bills, and government bonds) and risky assets, net of non-mortgage debt, and (ii) net illiquid assets, which include home equity, IRAs and private annuities, and net values of real estate, farms, business, and other assets. Income refers to total annual family income.

Data sources The data is available from the following sources:

1. Congressional Budget Office population projection,
   https://www.cbo.gov/publication/59697#data
2. Current Population Survey microdata,
   https://cps.ipums.org/cps/
3. Panel Study of Income Dynamics,
   https://simba.isr.umich.edu/data/data.aspx
4. Immigration enforcement and legal processes monthly tables,
   https://ohss.dhs.gov/topics/immigration/immigration-enforcement/immigration-enforcement-and-legal-processes-monthly
5. New proceedings filed in immigration court,
   https://trac.syr.edu/phptools/immigration/ntanew/
6. Monthly immigrant and nonimmigrant visa issuances,
   https://travel.state.gov/content/travel/en/legal/visa-law0/visa-statistics.html

B RANK MODEL WITH FIXED INVESTMENT GROWTH

This section considers a standard RANK model that facilitates an analytical solution. Capital follows a standard law of motion,

$$K_t = I_t + (1-\delta) K_{t-1}. \tag{B.1}$$

but investment growth is fixed,

$$I_t = \Gamma_N I_{t-1}. \tag{B.2}$$

Gross population growth, $\Gamma_{Nt} = N_t/N_{t-1}$, evolves according to

$$\ln \Gamma_{Nt} = (1-\rho_N)\ln \Gamma_N + \rho_N \ln \Gamma_{N,t-1} + \sigma_N \epsilon_t, \quad \epsilon_t \sim N(0,1), \tag{B.3}$$

where ϵ_t can be interpreted as a population growth shock due to an immigration surge.

B.1 HOUSEHOLDS

The representative household's optimization problem is given by

$$\begin{aligned} \max_{c_t,\, l_t,\, b_t} \quad & \mathbb{E}_t \sum_{m=0}^{\infty} \beta^m \ln\left(c_{t+m}\left(1-\psi l_{t+m}^{1+\theta}\right)\right) \\ \text{s.t.} \quad & c_t + b_t = w_t l_t + \frac{R_{t-1}}{\Pi_t} b_{t-1} + d_t. \end{aligned}$$

The optimality conditions imply

$$L_t = (1+\theta)\frac{\psi l_t^{1+\theta}}{1-\psi l_t^{1+\theta}}\frac{C_t}{w_t}, \tag{B.4}$$

$$1 = \mathbb{E}_t\left[\Lambda_{t,t+1}\frac{R_t}{\Pi_{t+1}}\right], \tag{B.5}$$

where the stochastic discount factor is given by

$$\Lambda_{t-1,t} = \beta\frac{C_{t-1}}{C_t}\Gamma_{Nt}. \tag{B.6}$$

B.2 PRODUCTION SECTOR

Consistent with the baseline model, the production sector includes three levels. The wholesaler produces a good for sale to a continuum of monopolistically competitive retailers. Retailers differentiate the wholesale good for sale to a final good bundler and exercise market power in pricing. The perfectly competitive bundler sells the final good to households.

The bundler's and retailers' problems are unchanged from Section 4. The equilibrium conditions, reproduced here for convenience, are given by

$$p_{\#,t} = \frac{\varepsilon}{\varepsilon - 1} \frac{X_{1,t}}{X_{2,t}}, \tag{B.7}$$

$$X_{1,t} = p_{wt} Y_t + \zeta \mathbb{E}_t [\Lambda_{t,t+1} \Pi_{t+1}^{\varepsilon} X_{1,t+1}], \tag{B.8}$$

$$X_{2,t} = Y_t + \zeta \mathbb{E}_t [\Lambda_{t,t+1} \Pi_{t+1}^{\varepsilon-1} X_{2,t+1}], \tag{B.9}$$

$$1 = (1 - \zeta) p_{\#,t}^{1-\varepsilon} + \zeta \Pi_t^{\varepsilon-1}. \tag{B.10}$$

The wholesaler produces the wholesale good using a Cobb-Douglas production technology,

$$Y_{wt} = K_{t-1}^{\alpha} L_t^{1-\alpha}, \tag{B.11}$$

and maximizes the expected present discounted value of real profits,

$$\max_{L_t} \quad \mathbb{E}_t \sum_{m=0}^{\infty} \Lambda_{t,t+m} \left[p_{w,t+m} Y_{w,t+m} - w_{t+m} L_{t+m} - I_{t+m} \right]$$

subject to the production function. Wholesale optimization defines the labor demand curve,

$$w_t = p_{wt} (1 - \alpha) \frac{Y_{wt}}{L_t}. \tag{B.12}$$

B.3 MONETARY POLICY The central bank sets the gross nominal interest rate according to

$$R_t = R \left(\Pi_t / \Pi \right)^{\upsilon_\pi}. \tag{B.13}$$

B.4 COMPETITIVE EQUILIBRIUM Aggregate supply is given by

$$Y_{wt} = \Delta_t Y_t, \tag{B.14}$$

where

$$\Delta_t = (1 - \zeta) p_{\#,t}^{-\varepsilon} + \zeta \Pi_t^{\varepsilon} \Delta_{t-1}. \tag{B.15}$$

Goods market clearing implies

$$Y_t = C_t + I_t. \tag{B.16}$$

A competitive equilibrium is defined by sequences of quantities, $\{C_t, l_t, L_t, N_t, K_t, I_t, Y_t, Y_{wt}\}$, prices, $\{\Lambda_{t-1,t}, R_t, \Pi_t, p_{\#,t}, X_{1,t}, X_{2,t}, \Delta_t, w_t, p_{wt}\}$, and exogenous population growth, Γ_{Nt}, such that equations (B.1)–(B.16) hold, given the definitions of gross population growth, $\Gamma_{Nt} = {}^{N_t}/_{N_{t-1}}$, and hours worked per household, $l_t = {}^{L_t}/_{N_t}$.

B.5 STATIONARY EQUILIBRIUM Let lowercase quantities denote per capita variables, $c_t = {}^{C_t}/_{N_t}$. A stationary competitive equilibrium is defined by sequences of quantities, $\{c_t, l_t, k_t, i_t, y_t\}$, prices, $\{\Lambda_{t-1,t}, R_t, \Pi_t, p_{\#,t}, x_{1,t}, x_{2,t}, \Delta_t, w_t, p_{wt}\}$, and exogenous population growth, Γ_{Nt}, so that the following hold:

$$\Gamma_{Nt} i_t = \Gamma_N i_{t-1}$$
$$k_t = i_t + (1-\delta)\, k_{t-1}/\Gamma_{Nt}$$
$$l_t = (1+\theta)\frac{\psi l_t^{1+\theta}}{1-\psi l_t^{1+\theta}}\frac{c_t}{w_t},$$
$$1 = \mathbb{E}_t\left[\Lambda_{t,t+1}\frac{R_t}{\Pi_{t+1}}\right]$$
$$\Lambda_{t-1,t} = \beta\frac{c_{t-1}}{c_t}$$
$$p_{\#,t} = \frac{\varepsilon}{\varepsilon-1}\frac{x_{1,t}}{x_{2,t}}$$
$$x_{1,t} = p_{wt} y_t + \zeta\mathbb{E}_t[\Lambda_{t,t+1}\Gamma_{N,t+1}\Pi_{t+1}^{\varepsilon} x_{1,t+1}]$$
$$x_{2,t} = y_t + \zeta\mathbb{E}_t[\Lambda_{t,t+1}\Gamma_{N,t+1}\Pi_{t+1}^{\varepsilon-1} x_{2,t+1}]$$
$$1 = (1-\zeta)p_{\#,t}^{1-\varepsilon} + \zeta\Pi_t^{\varepsilon-1}$$
$$w_t = p_{wt}(1-\alpha)\frac{\Delta_t y_t}{l_t}$$
$$R_t = R\,(\Pi_t/\Pi)^{\upsilon_\pi}$$
$$\Delta_t y_t = (k_{t-1}/\Gamma_{Nt})^{\alpha}\, l_t^{1-\alpha}$$
$$\Delta_t = (1-\zeta)p_{\#,t}^{-\varepsilon} + \zeta\Pi_t^{\varepsilon}\Delta_{t-1}$$
$$y_t = c_t + i_t$$
$$\ln\Gamma_{Nt} = (1-\rho_N)\ln\Gamma_N + \rho_N\ln\Gamma_{N,t-1} + \sigma_N\epsilon_t$$

B.6 LOG-LINEAR EQUILIBRIUM A log-linear approximation of the stationary equilibrium where $\hat{x}_t = \ln x_t - \ln x$ and $\bar{C} = C/Y$ is given by:

$$\hat{\imath}_t = \hat{\imath}_{t-1} - \hat{\Gamma}_{N,t}$$

$$\hat{k}_t = \frac{\Gamma_N - (1-\delta)}{\Gamma_N}\hat{\imath}_t + \frac{1-\delta}{\Gamma_N}\left(\hat{k}_{t-1} - \hat{\Gamma}_{N,t}\right)$$

$$\hat{w}_t - \hat{c}_t = \left[\frac{1+\theta}{1-\psi l^{1+\theta}} - 1\right]\hat{l}_t,$$

$$\mathbb{E}_t\hat{\Lambda}_{t,t+1} + \hat{R}_t - \mathbb{E}_t\hat{\Pi}_{t+1} = 0$$

$$\hat{\Lambda}_{t-1,t} = \hat{c}_{t-1} - \hat{c}_t$$

$$\hat{p}_{\#,t} = \hat{x}_{1,t} - \hat{x}_{2,t}$$

$$\hat{x}_{1,t} = (1-\zeta\beta\Gamma_N)\left(\hat{p}_{w,t} + \hat{y}_t\right) + \zeta\beta\Gamma_N\left(\mathbb{E}_t\hat{\Lambda}_{t,t+1} + \mathbb{E}_t\hat{\Gamma}_{N,t+1} + \varepsilon\mathbb{E}_t\hat{\Pi}_{t+1} + \mathbb{E}_t\hat{x}_{1,t+1}\right)$$

$$\hat{x}_{2,t} = (1-\zeta\beta\Gamma_N)\hat{y}_t + \zeta\beta\Gamma_N\left(\mathbb{E}_t\hat{\Lambda}_{t,t+1} + \mathbb{E}_t\hat{\Gamma}_{N,t+1} + (\varepsilon-1)\mathbb{E}_t\hat{\Pi}_{t+1} + \mathbb{E}_t\hat{x}_{2,t+1}\right)$$

$$0 = (1-\zeta)\hat{p}_{\#,t} - \zeta\hat{\Pi}_t$$

$$\hat{w}_t = \hat{p}_{w,t} + \hat{\Delta}_t + \hat{y}_t - \hat{l}_t$$

$$\hat{R}_t = \upsilon_\pi\hat{\Pi}_t$$

$$\hat{\Delta}_t + \hat{y}_t = \alpha\left(\hat{k}_{t-1} - \hat{\Gamma}_{N,t}\right) + (1-\alpha)\hat{l}_t$$

$$\hat{\Delta}_t = -\varepsilon(1-\zeta)\hat{p}_{\#,t} + \zeta\left(\varepsilon\hat{\Pi}_t + \hat{\Delta}_{t-1}\right)$$

$$\hat{y}_t = \bar{C}\hat{c}_t + \left(1-\bar{C}\right)\hat{\imath}_t$$

$$\hat{\Gamma}_{N,t} = \rho_N\hat{\Gamma}_{N,t-1} + \sigma_N\epsilon_t$$

B.7 DERIVATION OF THE IS AND PHILLIPS CURVES First simplify the log-linear equilibrium system by substituting out $\hat{w}_t$, $\hat{\Lambda}_{t-1,t}$, $\hat{p}_{\#,t}$, $\hat{x}_{1,t}$, $\hat{x}_{2,t}$, and $\hat{\Delta}_t$:

$$\hat{\imath}_t = \hat{\imath}_{t-1} - \hat{\Gamma}_{N,t} \tag{B.17}$$

$$\hat{k}_t = \frac{\Gamma_N - (1-\delta)}{\Gamma_N}\hat{\imath}_t + \frac{1-\delta}{\Gamma_N}\left(\hat{k}_{t-1} - \hat{\Gamma}_{N,t}\right) \tag{B.18}$$

$$\hat{p}_{w,t} + \hat{y}_t - \hat{c}_t = \frac{1+\theta}{1-\psi l^{1+\theta}}\hat{l}_t, \tag{B.19}$$

$$\hat{c}_t = \mathbb{E}_t\hat{c}_{t+1} - \left(\hat{R}_t - \mathbb{E}_t\hat{\Pi}_{t+1}\right) \tag{B.20}$$

$$\zeta\hat{\Pi}_t = (1-\zeta)(1-\zeta\beta\Gamma_N)\hat{p}_{w,t} + \zeta\beta\Gamma_N\mathbb{E}_t\hat{\Pi}_{t+1} \tag{B.21}$$

$$\hat{R}_t = \upsilon_\pi\hat{\Pi}_t \tag{B.22}$$

$$\hat{y}_t = \alpha\left(\hat{k}_{t-1} - \hat{\Gamma}_{N,t}\right) + (1-\alpha)\hat{l}_t \tag{B.23}$$

$$\hat{y}_t = \bar{C}\hat{c}_t + \left(1-\bar{C}\right)\hat{\imath}_t \tag{B.24}$$

$$\hat{\Gamma}_{N,t} = \rho_N\hat{\Gamma}_{N,t-1} + \sigma_N\epsilon_t \tag{B.25}$$

Next, use (B.24) to substitute out consumption from (B.19) and (B.20) to obtain

$$\hat{p}_{w,t} = (1+\eta)\hat{l}_t + \frac{1-\bar{C}}{\bar{C}}\left(\hat{y}_t - \hat{\imath}_t\right), \tag{B.26}$$

$$\hat{y}_t = \mathbb{E}_t\hat{y}_{t+1} - \left(1-\bar{C}\right)\mathbb{E}_t\Delta\hat{\imath}_{t+1} - \bar{C}\left(\hat{R}_t - \mathbb{E}_t\hat{\Pi}_{t+1}\right), \tag{B.27}$$

where $\eta = {}^{(1+\theta)}/_{(1-\psi l^{1+\theta})} - 1$ is the inverse Frisch elasticity and Δ is a first-difference operator. Finally, rewrite (B.23) as $\hat{y}_t = \hat{a}_t + (1-\alpha)\hat{l}_t$, where $a_t \equiv \alpha(\hat{k}_{t-1} - \hat{\Gamma}_{N,t})$ captures productivity, and substitute out $\hat{l}_t$ from (B.26) to obtain

$$\hat{p}_{w,t} = \frac{1+\eta}{1-\alpha}\left(\hat{y}_t - \hat{a}_t\right) + \frac{1-\bar{C}}{\bar{C}}\left(\hat{y}_t - \hat{\imath}_t\right). \tag{B.28}$$

From (B.21), the markup is fixed when prices are flexible ($\zeta = 0$). Let asterisks denote the flexible price economy. The flexible price level of output is given by

$$\hat{y}_t^* = \frac{\bar{C}(1+\eta)}{(1-\bar{C})(1-\alpha) + \bar{C}(1+\eta)}\hat{a}_t + \frac{(1-\bar{C})(1-\alpha)}{(1-\bar{C})(1-\alpha) + \bar{C}(1+\eta)}\hat{\imath}_t,$$

where $\hat{\imath}_t = \hat{\imath}_t^*$ since investment only depends on current and past population growth. Therefore,

$$\hat{p}_{w,t} = \frac{\left(1-\bar{C}\right)(1-\alpha) + \bar{C}(1+\eta)}{\bar{C}(1-\alpha)}\widehat{gap}_t,$$

where $\widehat{gap}_t = \hat{y}_t - \hat{y}_t^*$ is the output gap.

We can now write the Phillips curve as

$$\hat{\Pi}_t = \kappa\widehat{gap}_t + \beta\Gamma_N\mathbb{E}_t\hat{\Pi}_{t+1}, \tag{PC}$$

where $\kappa = \frac{(1-\zeta)(1-\zeta\beta\Gamma_N)}{\zeta}\frac{(1-\bar{C})(1-\alpha)+(1+\eta)\bar{C}}{\bar{C}(1-\alpha)}$. Higher trend population growth flattens the Phillips curve but increases the sensitivity to expected inflation. For $\bar{C} = \Gamma_N = 1$ and $\alpha = 0$, the Phillips curve reduces to the textbook equation in Galí (2015).

To derive the investment-saving curve, first note that the natural rate is given by

$$r_t^* = \frac{1+\eta}{(1-\bar{C})(1-\alpha)+\bar{C}(1+\eta)}\mathbb{E}_t\Delta\hat{a}_{t+1} - \frac{(1-\bar{C})(\alpha+\eta)}{(1-\bar{C})(1-\alpha)+\bar{C}(1+\eta)}\mathbb{E}_t\Delta\hat{\imath}_{t+1}.$$

Therefore, writing (B.27) in terms of the output gap implies

$$\widehat{gap}_t = \mathbb{E}_t\widehat{gap}_{t+1} - \bar{C}\left(\hat{R}_t - \mathbb{E}_t\hat{\Pi}_{t+1} - \hat{r}_t^*\right). \tag{IS}$$

A population growth shock acts as a natural rate shock with accompanying supply-side, $\hat{a}_t$, and demand-side, $\hat{\imath}_t$, effects. To determine the macroeconomic response to a population growth shock, we must sign the natural rate response, which requires solutions for productivity growth and investment growth. Investment at time t and $t+1$ is easy to define

$$\hat{\imath}_t = -\hat{\Gamma}_{N,t}, \quad \mathbb{E}_t\hat{\imath}_{t+1} = -(1+\rho_N)\hat{\Gamma}_{N,t} \quad \Rightarrow \quad \mathbb{E}_t\Delta\hat{\imath}_{t+1} = -\rho_N\hat{\Gamma}_{N,t}.$$

To define productivity, we must first define the per capita level of capital in the current period,

$$\hat{k}_t = \frac{\Gamma_N-(1-\delta)}{\Gamma_N}\hat{\imath}_t - \frac{1-\delta}{\Gamma_N}\hat{\Gamma}_{N,t} = -\frac{\Gamma_N-(1-\delta)}{\Gamma_N}\hat{\Gamma}_{N,t} - \frac{1-\delta}{\Gamma_N}\hat{\Gamma}_{N,t} = -\hat{\Gamma}_{N,t},$$

which implies that

$$\hat{a}_t = -\alpha\hat{\Gamma}_{N,t}, \quad \mathbb{E}_t\hat{a}_{t+1} = -\alpha\left(1+\rho_N\right)\hat{\Gamma}_{N,t} \quad \Rightarrow \quad \mathbb{E}_t\Delta\hat{a}_{t+1} = -\alpha\rho_N\hat{\Gamma}_{N,t}.$$

Therefore, the natural rate is given by

$$r_t^* = -\rho_N\frac{\bar{C}\alpha - \eta(1-\alpha-\bar{C})}{(1-\bar{C})(1-\alpha)+\bar{C}(1+\eta)}\hat{\Gamma}_{N,t}.$$

An increase in population growth reduces the natural rate as long as $\rho_N > 0$ and $\frac{1}{\eta} > \frac{1-\alpha-\bar{C}}{\bar{C}\alpha}$.

C Baseline Model Stationary Equilibrium

Let lowercase quantities denote per capita variables, $c_{it} = {}^{C_{it}}/_{N_{it}}$. A stationary competitive equilibrium is defined by sequences of quantities $\{c_{st}, c_{ht}, l_{ht}, l_{st}, k_t, i_t, y_t, \nu_t\}$, prices $\{\Lambda_{t-1,t}, R_t, \Pi_t, p_{\#t}, x_{1t}, x_{2t}, \Delta_t, w_{ht}, w_{st}, R_t^k, p_{wt}\}$, and exogenous variables $\{\Gamma_{ht}, \Gamma_{Nt}\}$, so the following hold:

$$\ln \Gamma_{ht} = (1-\rho_N)\ln \Gamma_N + \rho_N \ln \Gamma_{h,t-1} + \sigma_{hN}\epsilon_{ht}$$

$$\nu_t = (\Gamma_N/\Gamma_{Nt})\nu_{t-1}$$

$$\Gamma_{Nt} = \Gamma_N \nu_{t-1} + \Gamma_{ht}\,(1-\nu_{t-1})$$

$$l_{st} = (1+\theta)\frac{\psi l_{st}^{1+\theta}}{1-\psi l_{st}^{1+\theta}}\frac{c_{st}}{w_{st}},$$

$$1 = \mathbb{E}_t\left[\Lambda_{t,t+1}\frac{R_t}{\Pi_{t+1}}\right]$$

$$\Lambda_{t-1,t} = \beta\left(\frac{1-\psi l_{st}^{1+\theta}}{1-\psi l_{s,t-1}^{1+\theta}}\right)^{1-\sigma}\left(\frac{c_{s,t-1}}{c_{st}}\right)^{\sigma}$$

$$c_{ht} = w_{ht} l_{ht}$$

$$1 = (1+\theta)\frac{\psi l_{ht}^{1+\theta}}{1-\psi l_{ht}^{1+\theta}}$$

$$p_{\#t} = \frac{\varepsilon}{\varepsilon-1}\frac{x_{1t}}{x_{2t}}$$

$$x_{1t} = p_{wt} y_t + \zeta \mathbb{E}_t[\Lambda_{t,t+1}\Gamma_{N,t+1}\Pi_{t+1}^{\varepsilon} x_{1,t+1}]$$

$$x_{2t} = y_t + \zeta \mathbb{E}_t[\Lambda_{t,t+1}\Gamma_{N,t+1}\Pi_{t+1}^{\varepsilon-1} x_{2,t+1}]$$

$$1 = (1-\zeta)p_{\#t}^{1-\varepsilon} + \zeta \Pi_t^{\varepsilon-1}$$

$$k_t = i_t + (1-\delta)\,k_{t-1}/\Gamma_{Nt}$$

$$w_{ht} = p_{wt}\frac{\Delta_t y_t}{(1-\nu_t)l_{ht}}\frac{(1-\mu)\left((1-\nu_t)l_{ht}\right)^{\eta}}{(1-\mu)\left((1-\nu_t)l_{ht}\right)^{\eta} + \mu\left((1-\chi)\left(\nu_t l_{st}\right)^{\xi} + \chi\left(\frac{k_{t-1}}{\Gamma_{Nt}}\right)^{\xi}\right)^{\frac{\eta}{\xi}}}$$

$$w_{st} = p_{wt}\frac{\Delta_t y_t}{\nu_t l_{s,t}}\frac{\mu\left((1-\chi)\left(\nu_t l_{st}\right)^{\xi} + \chi\left(\frac{k_{t-1}}{\Gamma_{Nt}}\right)^{\xi}\right)^{\frac{\eta}{\xi}}}{(1-\mu)\left((1-\nu_t)l_{ht}\right)^{\eta} + \mu\left((1-\chi)\left(\nu_t l_{st}\right)^{\xi} + \chi\left(\frac{k_{t-1}}{\Gamma_{Nt}}\right)^{\xi}\right)^{\frac{\eta}{\xi}}}\frac{(1-\chi)\left(\nu_t l_{st}\right)^{\xi}}{(1-\chi)\left(\nu_t l_{st}\right)^{\xi} + \chi\left(\frac{k_{t-1}}{\Gamma_{Nt}}\right)^{\xi}}$$

$$R_t^k = p_{wt}\frac{\Delta_t y_t}{k_{t-1}}\Gamma_{Nt}\frac{\mu\left((1-\chi)\left(\nu_t l_{st}\right)^{\xi} + \chi\left(\frac{k_{t-1}}{\Gamma_{Nt}}\right)^{\xi}\right)^{\frac{\eta}{\xi}}}{(1-\mu)\left((1-\nu_t)l_{ht}\right)^{\eta} + \mu\left((1-\chi)\left(\nu_t l_{st}\right)^{\xi} + \chi\left(\frac{k_{t-1}}{\Gamma_{Nt}}\right)^{\xi}\right)^{\frac{\eta}{\xi}}}\frac{\chi\left(\frac{k_{t-1}}{\Gamma_{Nt}}\right)^{\xi}}{(1-\chi)\left(\nu_t l_{st}\right)^{\xi} + \chi\left(\frac{k_{t-1}}{\Gamma_{Nt}}\right)^{\xi}}$$

$$1 = \mathbb{E}_t(\Lambda_{t,t+1}(R_{t+1}^k + 1 - \delta))$$

$$R_t = R\,(\Pi_t/\Pi)^{\upsilon_\pi}$$

$$\Delta_t y_t = \left((1-\mu)\left((1-\nu_t)l_{ht}\right)^{\eta} + \mu\left((1-\chi)\left(\nu_t l_{st}\right)^{\xi} + \chi\left(k_{t-1}/\Gamma_{Nt}\right)^{\xi}\right)^{\frac{\eta}{\xi}}\right)^{\frac{1}{\eta}}$$

$$\Delta_t = (1-\zeta)p_{\#t}^{-\varepsilon} + \zeta \Pi_t^{\varepsilon}\Delta_{t-1}$$

$$y_t = \nu_t c_{st} + (1-\nu_t)c_{ht} + i_t$$

Frisch Elasticity Type-i households receive utility flows from consumption, c_{it}, and disutility from labor, l_{it}, with nonseparable preferences,

$$u\left(c_{it}, l_{it}\right) = \frac{\left(c_{it}\left(1 - \psi l_{it}^{1+\theta}\right)\right)^{1-\sigma}}{1-\sigma},$$

where hours worked provide total labor income $w_{it} l_{it}$. Equating the marginal cost and benefit of working yields the type-i household's labor supply curve,

$$w_{it}\lambda_{it} = c_{it}^{1-\sigma}\left(1 - \psi l_{it}^{1+\theta}\right)^{-\sigma}(1+\theta)\psi l_{it}^{\theta},$$

where λ_{it} is the household's marginal utility of wealth,

$$\lambda_{it} = c_{it}^{-\sigma}\left(1 - \psi l_{it}^{1+\theta}\right)^{1-\sigma}.$$

To derive the Frisch elasticity, log-linearize the labor supply curve and marginal utility of wealth,

$$\hat{w}_{it} + \hat{\lambda}_{it} - (1-\sigma)\hat{c}_{it} = \left[\theta + \frac{\sigma\psi(1+\theta)l_i^{1+\theta}}{1-\psi l_i^{1+\theta}}\right]\hat{l}_{it},$$

$$\hat{\lambda}_{it} = -\sigma\hat{c}_{it} - (1-\sigma)\frac{(1+\theta)\psi l_i^{1+\theta}}{1-\psi l_i^{1+\theta}}\hat{l}_{it}.$$

The Frisch elasticity is the wage elasticity of labor supply conditional on the marginal utility of wealth being held fixed. Setting $\hat{\lambda}_{it} = 0$ and combining the two log-linear equations implies

$$\sigma\hat{w}_{it} = \left[\theta\sigma + (2\sigma-1)\frac{\psi(1+\theta)l_i^{1+\theta}}{1-\psi l_i^{1+\theta}}\right]\hat{l}_{it},$$

so the Frisch elasticity is given by

$$\eta_i = \frac{\sigma\left(1-\psi l_i^{1+\theta}\right)}{\theta\sigma\left(1-\psi l_i^{1+\theta}\right) + (2\sigma-1)(1+\theta)\psi l_i^{1+\theta}}.$$

In the special case where $\sigma = 1$, the Frisch elasticity simplifies to

$$\eta_i = \frac{1-\psi l_i^{1+\theta}}{\theta + \psi l_i^{1+\theta}}.$$

The population-weighted Frisch elasticity, which is used to calibrate the model, is given by

$$\eta = \nu\eta_s + (1-\nu)\eta_h.$$