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Immigration Level and its Impact on the United States Labor Market Tightness

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IMMIGRATION LEVEL AND ITS IMPACT ON THE UNITED STATES LABOR MARKET TIGHTNESS

by

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Honors Thesis

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INTRODUCTION:

The United States has always been the heaven for immigration with the promise of prosperity and social mobility. Over the last 50 years, millions of immigrants have landed on the U.S soil despite stricter immigration regulations from the government. This large influx of immigrants has spurred many debates in the world of scholars and politicians regarding their effect on the economy as well as their motivation to move across the globe. A popular theory among scholars is that immigrants react correspondingly to job opportunities, meaning that they are more likely to migrate if they see an improvement in earnings potential as well as labor market conditions. However, the reality may be more nuanced, as immigrants also exert diverse influences on the U.S. labor market, especially on job openings. Immigrants have historically contributed to the U.S economy through the supply of labor as well as entrepreneurship (Borjas, 1994; Azoulay et al., 2022). Even though immigrants can take up vacant jobs, they can also create additional labor demands by starting new firms or businesses. These characteristics are even embedded in immigration policies such as the investment program EB-5, which requires foreigners to create or preserve 10 permanent full-time jobs for qualified U.S. workers in order to be eligible for employment-based green card [1]. With the varied impact of immigrants on job vacancies in mind, this paper seeks to explore the dynamic relationship between immigration and the equilibrium of the labor market.

My thesis concentrates on the correlation between immigrants and labor market tightness during the recent time period of 2000-2019. I believe my simple model can offer further insights into how immigrants can influence the U.S. labor market. This model is inspired by the

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[1] USCIS: EB-5

economic framework developed by Duzhak (2023) with the extension on the long-term effect of immigration on the future job market. To be specific, I examined the relationship between the net international migration, which reflects migration to the U.S from abroad, and unemployment-to-vacancies ratio (U/V), a metric that gauges the balance between unemployment rate and job vacancies, on a state level. This ratio is extremely useful when it comes to measuring the labor market tightness. A high unemployment-to-vacancy ratio suggests a loosening labor market while a low UV ratio emphasizes a tight market. Generally, a tight labor market is associated with low unemployment rate and high vacancies, benefiting most job seekers in the U.S. On the other hand, a loosening labor market means either low job vacancies or high unemployment rate. This situation might be unfavorable to many workers who are actively looking for jobs. In addition, changes in the U/V ratio can provide insights into the health of the economy. A decreasing U/V ratio over time suggests improving economic conditions, as it indicates a decreasing number of unemployed individuals relative to job vacancies or an increase of job openings relative to unemployment, both of which can imply economic growth. Conversely, an increasing U/V ratio may indicate worsening economic conditions, as it suggests a growing number of unemployed individuals relative to job vacancies or a contraction of job openings relative to unemployment, both of which can potentially signal economic downturns. Policymakers also utilize the U/V ratio to inform labor market policies and monetary or fiscal interventions. The reason is because the U/V ratio can influence wage dynamics in the labor market. In a tight labor market with a low U/V ratio, employers may need to offer higher wages and better benefits to attract and retain workers, creating inflationary pressure on the market. On the other hand, in a loose labor market with a high U/V ratio, wage

growth may be limited as employers have more bargaining power and can afford to offer lower wages, generating a deflationary pressure.

From many economic literatures as well as common notions, I pieced together my hypothesis about the relationship between Net International Immigration and the annual state average unemployment-to-vacancy. I assume that a low U/V ratio, which implies a tight labor market, will lead to an increase in immigration, meaning a surge in Rate of Net International Migration (RNIM).

The result reaffirms the strong relationship between the unemployment-to-vacancy ratio and the rate of net international migration. Lagged values of both U/V ratio and RNIM show significant explanatory power, reinforcing the hypothesis. A decrease in the U/V ratio leads to an increase in immigration in the following year. This dynamic relationship is demonstrated through the negative correlation observed between U_{t-1}/V_{t-1} and $RNIM_t$, implying that when the labor market in a state tightens, immigration inflow to that state tends to increase in the subsequent year. More precisely, a decrease of 1 percent in U_{t-1}/V_{t-1} corresponds to a rise of 0.18 percent in $RNIM_t$. In addition, the analysis also displays a statistically significant positive correlation between lagged RNIM and $RNIM_t$. Their coefficients indicate that the present immigration rate is influenced by past immigration patterns as well. Specifically, a 1 percent increase in the rate of net international migration leads to a 0.46% increase in RNIM in the following period. Other regressions reflect the reverse impact of lagged RNIM on current U/V ratio. Linear regression reveals that as $RNIM_{t-1}$ increases by 1 percent, U_t/V_t experiences a modest increase of 0.023 percent, signaling a loosening labor market. This phenomenon suggests the potentiality to

forecast the long-term interplay between immigration rate and labor market tightness in different states.

My paper is structured as follows: the first section is Literature Review, which is followed by Data and Methodology. Then, the paper progresses onto Analysis and Result. The thesis ends with Future Implication and Conclusions.

LITERATURE REVIEW:

Researchers have established complex models to estimate the long-term and short-term impact of immigrants influx on different areas of the U.S labor market such as jobs creation, degree of workforce substitutability, real wage growth, GDP per capita, employment cost as well as net fiscal cost. However, some of their population estimates were based in the period of 1990-2009 when immigration was increasing at a faster rate than today (Abascal et al., 2021). In addition, the demographics of immigrants back then were also different compared with the decade of 2010s, leading to potentially out-of-date results. For example, between 2000 and 2014, the U.S witnessed a decent drop in illegal immigrants while simultaneously receiving a spike in highly-skilled foreign-born STEM workers (Krogstad & Passel, 2023). Nevertheless, many of these papers showed that immigrants, despite their heterogeneous characteristics and groups, normally produce a positive effect, both long-term and short-term, on the U.S economy.

In terms of job displacement, Gunadi (2019) finds that STEM workers, one of the main components of recent immigrants, cannot fully replace their similarly skilled U.S-born workers. His research also suggests that the 2000 - 2015 foreign STEM labor supply shock increased the wages of preexisting U.S.-born STEM workers by 4.67 percent. In addition, a cost-benefit

analysis finds that this labor supply shock accrued to approximately 103 billion USD or 1.03 percent of U.S. GDP in 1999. Islam and Khan (2015) study supports the positive long-run causality from immigration to real GDP. Their results reinforce the claim that immigrants respond to higher wages and opportunity for better living standards. Authors also point out that even in the short-run, increase in the immigrant rate does not depress the average weekly earnings or real GDP. Peri (2016) simulated the wage effect of immigrants using a labor market equilibrium model and found that immigration has a poverty-reduction effect on the state and national level, in both the 1990s and 2000s. Furthermore, for all scenarios during the 2000-2009, the author found immigrants to have a poverty-reduction effect between 0 and 0.51 percent. Considering the enormous immigration wave in the 2000s, these effects are actually positive for wages of less educated individuals and, in general, tremendously reduce poverty across large immigration states and metropolitan areas.

Immigrants also help stabilize the labor demand and supply curve through their likelihood to engage in entrepreneurship of all sizes. Azoulay et al. (2022) analyzed administrative data pertaining to the US economy to examine the level at which immigrants initiate new businesses of different sizes and investigate the employment within these newly established firms. Intuitively, if immigrants primarily establish small businesses, their impact on labor demand may remain modest. However, if immigrant-founded businesses turn out to be large enterprises (SP 500), immigration could significantly boost labor demand, resulting in positive changes for both native and foreign-born workers. The data points out that there tend to be more immigrant-founded firms, per immigrant in the population, at each employment size compared to that of native-born. This result implies that immigrants tend to have a stronger

effect on increasing labor demand relative to labor supply, compared to their native-born counterparts.

Immigrants also contribute to the equilibrium of the labor market through their mobility across states. Cadena and Kovak (2016) used data from the Great Recession of 2008-2009 to investigate the responses to geographic variability of the labor market among Mexican-born workers. Their analysis uncovers a significant and noteworthy discovery: unlike their native-born counterparts, low-skilled workers born in Mexico demonstrated a propensity to relocate based on earnings incentives. These groups notably shifted away from the most severely affected metropolitan areas toward more favorable markets. Furthermore, this mobility was observed not only among newly arrived immigrants but also among those who had been residing in the United States prior to the recession. Migration driven by labor demand among Mexican-born immigrants, therefore, led to a substantial reduction in the geographical variation of labor market conditions, neutralizing the wage differences between states for native workers.

This paper builds upon prior economic research that explored the impact of immigrant influx on the labor market. Specifically, it focuses on examining the reciprocal relationship between immigrant rates and labor market tightness, as measured by the unemployment-to-vacancy ratio. This theoretical framework, initially proposed by Duzhak (2023), in which the author used the elevated vacancy-to-unemployment rate instead, is extended further into the future to provide a more granular understanding of this dynamic relationship. By utilizing population data spanning from 2000 to 2019, I was able to design a comprehensive analysis of demographic changes. My regression analysis incorporates dummy variables to capture variations in policy and cultural structures across different years and states. Furthermore,

this study investigates the potential long-term implications of sudden changes in immigration and labor market tightness, holding all other exogenous variables constant.

DATA:

The data collection process for this research encompassed several key steps. Firstly, Net International Migration data for each U.S. state spanning the years 2000 to 2019 was acquired. This data was sourced from the United States Census Bureau's (USCB) Annual Resident Population Change Estimates[2;3]. These estimates are derived from comprehensive measures of population change, including births, deaths, and both domestic and international migration. Specifically, net international migration is the sum of immigration of foreign-born (entry into the U.S from abroad), emigration of the foreign-born (moving out of the U.S), net migration between the United States and Puerto Rico, net migration of native-born to and from the United States, and net movements of the Armed Forces population to and from the United States. However, the moving of the Armed Forces should not have any influence on my data analysis as they contribute only a tiny fraction of the total annual net international migration and I have also conducted a robustness check below to verify this claim. In addition, these datasets from USCB cannot fully capture the amount of undocumented immigrants crossing into the U.S each year as this group tends not to disclose their immigration status. However, Pew Research Center was able to roughly estimate the growth of this population. Their analysis indicates that since 2003, unauthorized immigrants have made up from 4.4% to 5.4% of all U.S. workers, a relatively

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[2] USCB 2010 - 2020
[3] USCB 2000 - 2010

narrow range, showing no significant deviations (Krogstad & Passel, 2023). This suggests that there are likely no outliers within this demographic that could potentially distort my analysis.

In addition to Net International Migration data, relative Rates of Net International Migration for each state were collected. These rates were extracted from the USCB's Rates of the Components of States Resident Population Change. To calculate these rates, the Net International Migration for each estimated year, between July 1 and June 30, was divided by the average of the resident total populations within that state for the same year, and then multiplied by 1,000[4;5].

State-level unemployment-to-vacancy ratios for the years 2000 to 2019 were obtained from the U.S. Bureau of Labor Statistics' (USBLS) Job Openings and Labor Turnover Survey (JOLTS) section[6]. Job openings or vacancies include all positions that are open on the last business day of the reference month. A job is considered open if there's available work for a specific position, whether full-time or part-time, permanent, short-term, or seasonal. It must be ready to start within 30 days, and the employer actively recruits outside candidates for the position. The JOLTS survey employs various models to estimate this data at the state level. These estimates are crucial for understanding labor market dynamics. Regarding unemployment rate, the JOLTS program also uses the same definition as the Current Population Survey (CPS)[7]. People are classified as unemployed if they do not have a job, have actively looked for work in the prior four weeks, and are currently available for work.

Once the data was collected, it was meticulously organized and analyzed using Microsoft Excel and R Studio. However, to ensure the accuracy of the analysis, data from the years 2020 to

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[4] USCB 2010 - 2020
[5] USCB 2000 - 2010
[6] JOLTS
[7] CPS

2023 was excluded. This decision was made to prevent potential distortions in regression model residuals caused by disruptions in immigration trends resulting from international travel restrictions implemented during the COVID-19 pandemic.

Overall, the data collection process involved gathering comprehensive and reliable datasets spanning multiple years and employing robust methodologies to ensure the validity of the findings.

METHODOLOGY:
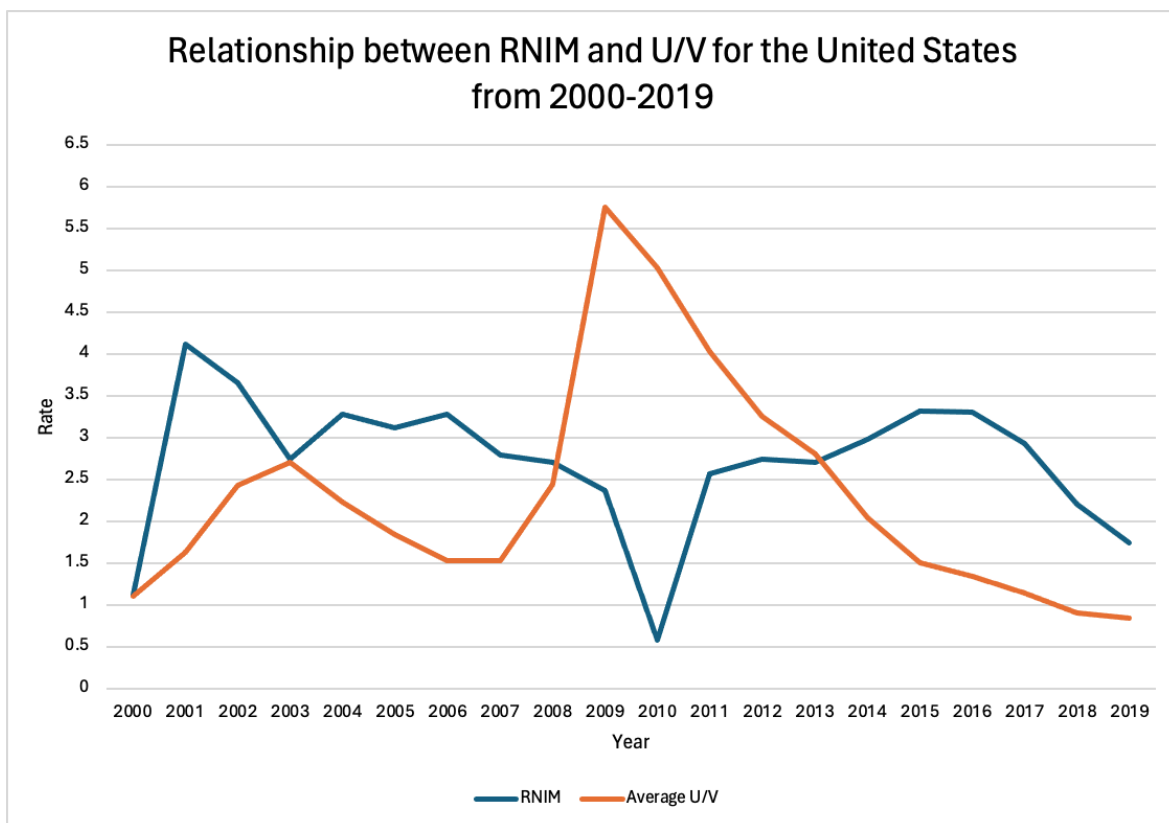
Graph 1

Graph 1 is the graphical representation of the relationship between the Rate of Net International Migration (RNIM) and average Unemployment-to-Vacancy in the U.S from 2000 to 2019. We can see the contradict movement of these two lines, suggesting that as average U/V dips, which signals a tightening labor market, RNIM increases. In contrast, as average U/V soars, signaling a loosening labor market, RNIM decreases. Each individual state also demonstrates a similar pattern, prompting me to hypothesize that these two variables have an inverse causal relationship. To further investigate the theory, I also graph the annual growth rate of the two variables in order to prepare for a regression model.
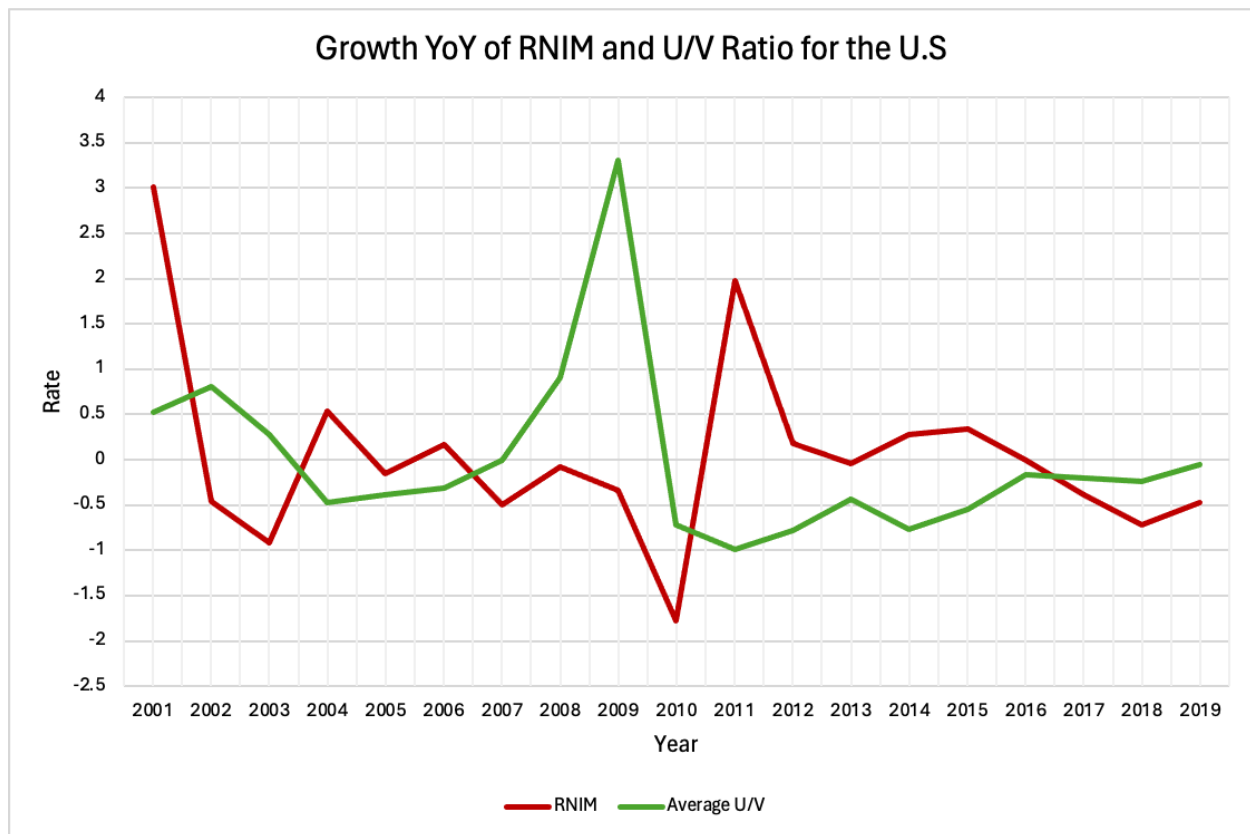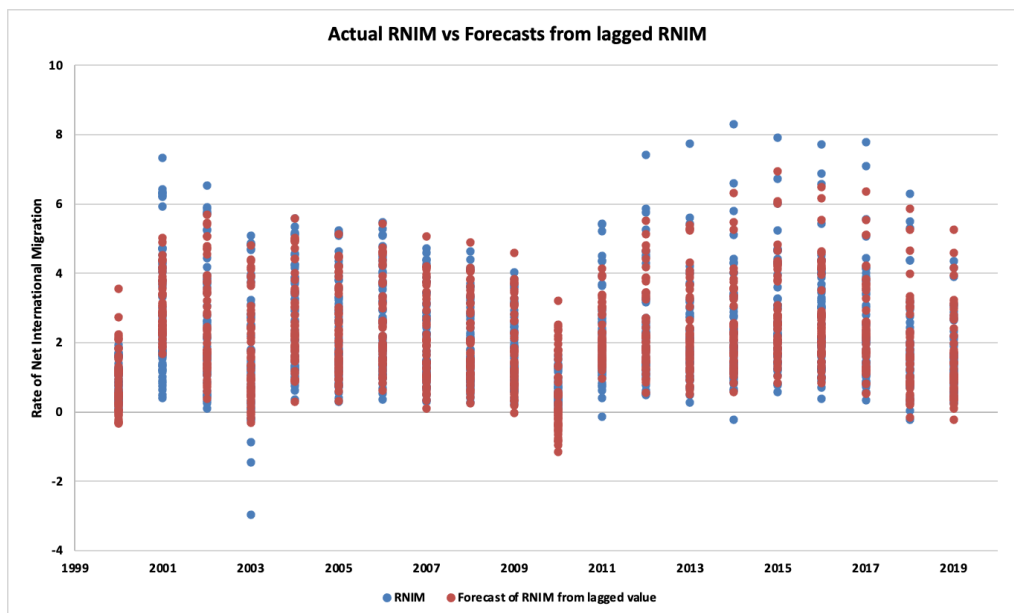

Graph 2

The year-over-year growth of RNIM and average U/V provides more context to my proposed hypothesis. From the graph 2, we can see that there is a lag factor in the inverse

relationship between RNIM and average U/V. As I proposed above, I believe that as the labor market tightens up (U/V ratio dips), immigration will increase (RNIM rises). However, looking into this graph, I realize that these effects do not occur simultaneously in the same time period. Instead, if we look into the period of 2009-2011, average U/V in the U.S dropped tremendously from 2009 to 2010, yet, RNIM experienced a huge spike in 2010-2011. Similar pattern also occurs in the period of 2002-2004; 2005-2007; 2008-2010; 2011-2013; 2014-2018. These situations indicate that immigration's responses to change in the tightness of the U.S labor market might be slower by 1 period. In a simpler interpretation, it might take immigrants at least one year to adjust to any shift in U.S labor market tightness. In real life, this lag in responsiveness is understandable as migrating to a new country is not something that can be done abruptly. It is rather a massive decision that requires time, capitals, and effort to execute. Therefore, upon learning about new job opportunities emerging from a tightening labor market, immigrants are likely to take at least a year to make a decision and relocate into a state in the U.S. This process can be further extended by the substantial legal paperwork and requirements mandated by the U.S. Citizenship and Immigration Service.

Regarding this lag factor, I also believe that the one-period lag RNIM (RNIM at time t-1) in each state can also be an explanatory variable influencing the contemporary RNIM (RNIM at time t). I predict that a lot of migration decisions might be based on some previous patterns. Speculatively, as we see people from our cultural identity group, including our relatives and neighbors, moving into a state, we might be compelled to do the same. Thus, it is logical to infer that immigrants tend to follow the migration behaviors of others when deciding on their settling locations. However, as previously discussed, it may take them several months to several years to

actually leave their home country and move to the U.S, emphasizing the need to use lagged RNIM. Furthermore, RNIM lag proves to be a relatively good predictor of RNIM. The correlation between lagged values and current values of RNIM, which is displayed with the partial autocorrelation in graph 4, suggests that the movement of RNIM can be explained by its past values. Its first period lagged value breached the significant boundaries by a far margin, indicating that $RNIM_{t-1}$ are correlated with $RNIM_t$. Thus, I ran and forecast the linear regression: $\mathbf{RNIM_t = \alpha + \theta RNIM_{t-1} + \Theta state + \Theta year + \varepsilon_{it}}$ in order to isolate the impact of one-period lagged RNIM on its current value. Subsequently, I compared the forecasted values obtained from this linear regression to the actual contemporary RNIM in graph 3. I categorized the findings by year and then plotted the predicted and actual RNIM of all 51 states for each of those years. The data shows that the forecasted value of $RNIM_t$ based on $RNIM_{t-1}$ aligns neatly with the actual value of $RNIM_t$ across 51 states from 2000 to 2019. Hence, this fitted analysis suggests that lagged RNIM can serve as an explanatory factor for current RNIM, particularly considering its low error measure (RMSE = 0.69). To put it in context, a simple trend model utilizing only dummy states and years yielded a worse RMSE of 0.78 when forecasting $RNIM_t$, suggesting that $RNIM_{t-1}$ is more suitable to predict $RNIM_t$ than its own trend model. From these analyses, I decided to include lagged values of RNIM into my main linear regression model.

Actual RNIM vs Forecasts from lagged RNIM

Graph 3

Series data.ts$RINM
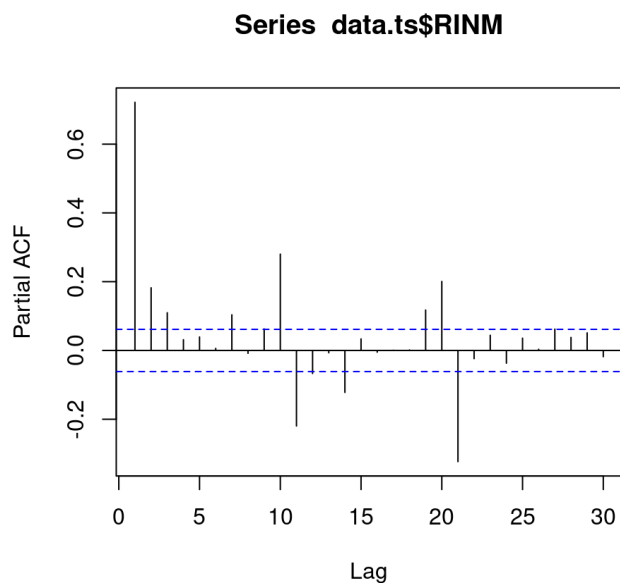
Graph 4

Next, I control for the states and years factors by creating dummy variables. These variables are categorized as 0 and 1 so as to reference a particular group. I believe that each state is different from each other in terms of demographics, job opportunities, earnings, taxes,

immigration policy, and so on, which affect the immigration level. Years also play an important role in the decision of an immigrant to move to the U.S. The economy, business cycle as well as policy structure change over time, influencing people's incentives to migrate. Thus, the state and year dummy variables should capture most of these differences in labor market conditions between states as well as time-varying factors from 2000-2019. Nonetheless, there are some particular factors that these dummy variables might not be able to fully encompass such as complex cultural aspects of states or other specific policy variations.

ANALYSIS:

From these analysis, I have my main linear regression model: With i = state; t = time; ε = errors in i and t; $\mathbf{RNIM_t = \alpha + \beta U_{t\text{-}1}/V_{t\text{-}1} + \theta RNIM_{t\text{-}1} + \Theta state + \Theta year + \varepsilon_{it}}$. I uploaded all the raw databases into R studio. Then, I stacked them on top of each other and created the dummy variables for states and years.

Not only did I run the main linear regression, I also ran several other similar hypothetical regressions in order to examine in detail the potential causal relationship between unemployment-to-vacancy ratio and rate of net international migration. These include variations of the linear relationship between $RNIM_t$, contemporary U/V ratio, lagged RNIM, and lagged U/V ratio. The first linear regression (regression 1) has this form: $\mathbf{RNIM_t = \alpha + \beta_1 U_t/V_t + \theta RNIM_{t\text{-}1} + \Theta state + \Theta year + \varepsilon_{it}}$ I also ran a regression on the relationship between RNIM at time t and lagged U/V ratio only. The second linear regression (regression 2) is: $\mathbf{RNIM_t = \alpha + \beta U_{t\text{-}1}/V_{t\text{-}1} + \Theta state + \Theta year + \varepsilon_{it}}$

I also tried to investigate the reverse relationship with U/V ratio being the dependable variable and RNIM as well as lagged U/V ratio acting as explanatory ones. I think that as RINM at time t-1 increases, the U/V ratio at time t might be affected. Presumptively, as immigrants move into a state, they might occupy many job vacancies, pushing the denominator in the U/V equation down, which leads to a higher U/V ratio. On the other hand, immigration would normally increase the total state population, which can result in a higher share of unemployed workers. Furthermore, the U/V ratio from one-period before can also exert its influence on U/V at time t, evidence of which is demonstrated in graph 5. The unemployment-to-vacancy ratio seems to have a trend component in it. The three-year moving average of U/V ratio aligns closely with its actual value, indicating an underlying consistent trend. Hence, I created this reverse linear regression model using $RNIM_{t-1}$ and U_{t-1}/V_{t-1} (regression 3) with dummy variables of states and years: $U_t/V_t = \alpha + \theta RNIM_{t-1} + \beta U_{t-1}/V_{t-1} + \Theta state + \Theta year + \varepsilon_{it}$
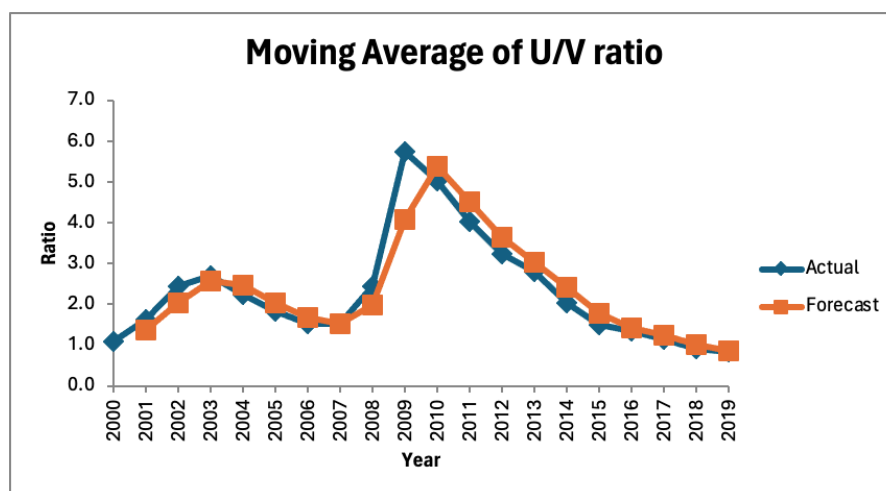
Graph 5

RESULT:

	Main Regression		Regression 1		Regression 2		Regression 3	
	Result	Standard Error	Result	Standard Error	Result	Standard Error	Result	Standard Error
Intercept	-0.079	0.19	-0.081	0.19	0.082	0.22	-0.065	0.10
U_{t-1}/V_{t-1} (β)	-0.184*	0.04	NA	NA	-0.219*	0.05	0.710*	0.02
U_t/V_t (β_1)	NA	NA	-0.067	0.04	NA	NA	NA	NA
$RNIM_{t-1}$ (θ)	0.464*	0.03	0.470*	0.03	NA	NA	0.023	0.02
State Dummy	Y	Y	Y	Y	Y	Y	Y	Y
Year Dummy	Y	Y	Y	Y	Y	Y	Y	Y
Adjusted R-square	0.784	NA	0.780	NA	0.724	NA	0.922	NA
Number of Observations	969	NA	969	NA	969	NA	969	NA
Notes: Statistically significant coefficients (p-value < 0.05) are represented with a "*" next to them								

The result demonstrates the presumed relationship. The lagged values of both U/V ratio and RNIM seem to carry more explanatory power as their coefficients are statistically significant. The result from the main regression agrees with what I hypothesized above. The inverse relationship between U_{t-1}/V_{t-1} and $RNIM_t$ indicates that as a state labor market tightens up (U/V ratio goes down), immigration flow into that state will increase in the following year. Specifically, as U_{t-1}/V_{t-1} drops by 1 percent, the $RNIM_t$ will rise by 0.18 percent. The positive

correlation between $RNIM_{t-1}$ and $RNIM_t$ also aligns with what I have predicted regarding immigration behaviors. If $RNIM_{t-1}$ rises by 1 percent, the next-year $RNIM_t$ will follow by ticking up 0.46 percent. Other regression also displays a similar relationship between unemployment-to-vacancy ratio and rate of net international migration in 51 states in the U.S. Regression 1 reaffirms the connection between lagged values of RNIM and its current data with θ equals 0.47, which is within the standard errors of θ of the main regression. It also shows a negative correlation between contemporary U/V ratio and RNIM. A 1 percent increase in U_t/V_t will be associated with a decline of 0.07 percent in rate of net international migration. However, it is worth noting that this β_1 is not statistically significant, meaning that it may not be an accurate predictor of change in RNIM at time t. Both of these linear regressions imply that when it comes to immigrations and labor market conditions, lagged values are more suitable in forecasting contemporary values. Therefore, the last two linear regressions focus solely on the lagged values of both RNIM and U/V ratio. Regression 2 separates the impact of past U/V ratio on $RNIM_t$. Its regression summary demonstrates a slightly different influence of U_{t-1}/V_{t-1} on $RNIM_t$ than what I have seen in the main regression. In regression 2, β equals -0.22 instead of -0.18, which indicates a steeper slope. One of the factors that leads to this difference of β of U_{t-1}/V_{t-1} in two models is lagged RNIM. Thus, I have a slight doubt that there might be a multicollinearity between $RNIM_{t-1}$ and U_{t-1}/V_{t-1}. However, since standard error of β is 0.04 in the main regression and 0.05 in regression 2, this difference might be justified as the fluctuation of the coefficients within its error bound. The last regression examines the reversed relationship of labor market tightness and immigration. The result suggests that lagged U/V has a positive correlation with current U/V. As lagged U/V moves up by 1 percent, U_t/V_t will also rise by 0.71

percent. This coefficient is also statistically significant, which strengthens its explanatory power. The second independent variable, $RNIM_{t-1}$ has an insignificant $\boldsymbol{\theta}$, which equals 0.02. This coefficient complies with the nature of all the previous assumptions. It implies that as $RNIM_{t-1}$ increases by 1 percent, U_t/V_t would follow with a hike of 0.02 percent, which means the labor market starts loosening up. The phenomena opens up a potential to forecast the long-term effect of a shock to labor market conditions such as a tremendous drop in U/V ratio. However, despite this probability, $\boldsymbol{\theta}$ is statistically insignificant.

Besides as I mentioned in the data part, the rate of net international migration does account for the movement in and out of the country of the U.S Armed Forces. Therefore, to ensure that these deployments did not influence the U/V ratio, I ran a robustness check using alternate versions of the regressions above. In the alternatives, I removed the states with the largest military bases in the U.S, which include Georgia, Texas, Washington, North Carolina, and Kentucky, from the panel data and then re-ran the four regressions using the same parameters. The resulting coefficients, standard errors, and p-values are virtually identical with those listed in the result table. This sensitivity analysis provides numerical evidence that international military relocation has no effect on job vacancies or immigration rate in 51 U.S states.

Overall, I think my regressions are fairly accurate and helpful in estimating relationships between U/V ratio and immigration. I have used 969 real observations in total with categorical dummy variables for states and years, which makes my data robust and comprehensive enough for conducting statistical analysis and drawing meaningful conclusions. Furthermore, adjusted R-square in all four of my regressions are above 0.7 and regression 3 stands out with a value of 0.92. While R-squared measures the proportion of variance in the dependent variable explained

by the independent variables, adjusted R-squared modifies this value to account for the number of predictors and the sample size. Thus, adjusted R-square can avoid overfitting in models, making this value a more reliable and reflective metric for the fitness of linear regressions. With such a relatively high adjusted R-square value, I believe that my models are well-suited for their forecasting purposes.

FUTURE IMPLICATION:

From these regressions above, I have a presumption regarding the effect of average U_{t-1}/V_{t-1} on $RNIM_t$ and its subsequent impact on U_{t+1}/V_{t+1} (in the next period): $U_{t-1}/V_{t-1} \rightarrow RNIM_t \rightarrow U_{t+1}/V_{t+1}$. According to the four linear regressions, I hypothesize that a drop in U/V ratio at time t-1 will lead to an increase in immigrant rate at time t, which can be rationalized by the incentives of immigrants to migrate in seeking for better job opportunities. This process is going to take at least a year because of the current employment law for immigrants, which requires a long waiting time for paperworks. Then, as immigration goes up at time t (one period after the initial drop in unemployment-to-vacancy), the labor market in the next period (time t+1) will loosen up in response, which can be partially attributed to either the increase of unemployed workers or decline in opening positions. This reaction has been illustrated in my main linear regression as well as regression 2. Therefore, it is plausible that this trend will continue into the long future. Finally, when the U/V ratio hikes, immigrants may not choose the U.S as their destination for settlement anymore, consequently halting and potentially decreasing the RNIM at time t+2.

To test this hypothesis, I employed the two-stage least squares model to assess the influence of both lagged RNIM and U/V ratio on their present values. To begin, I established my main linear regression as the first-stage model to evaluate the influence of lagged U/V ratio on current immigration rate. I then forecasted the current RNIM utilizing this model. Next, I constructed the second-stage linear model by incorporating this predicted RNIM into my regression 2 and recorded its statistical summary, which is illustrated in the data table below. These two models complete my two-stage least squares. The positive coefficient of the predicted $RNIM_t$ supports the claim proposed by regression 2 by indicating that a 1 percent increase in immigration rate will lead to the labor market loosening by 0.014 percent. I then used this θ along with the β from my main regression to estimate the change in future U/V ratio and RNIM given a 1 percent decrease in U_{t-1}/V_{t-1}.

Second-stage regression	θ	β
$U_{t+1}/V_{t+1} = \alpha + \theta RNIM_t\text{-hat} + \beta U_t/V_t + \text{control}$	0.014	0.710*
Notes: Statistically significant coefficients (p-value < 0.05) are represented with a "" next to them*		

Graph 6 demonstrates the predicted movement of U/V ratio and RNIM given that there is a sudden drop in U/V ratio. With a 1% decrease in the U/V ratio (t-1), indicating a tighter labor market, immigration in the subsequent period (t) rises as immigrants enter the U.S states in response to better job opportunities. This surge in immigration leads to an increase in the U/V ratio in the next period (t+1). This could be attributed to immigrants filling job vacancies or unintentionally elevating the unemployment rate due to a growing population. As the graph suggested, over the ten year time span, both the U/V ratio and RNIM gradually return to the

baseline zero. This movement aligns with my hypothesis that as average unemployment-to-vacancy drops, the increase in inflow of immigrants will eventually pull the ratio back to its equilibrium. In addition, fluctuations in labor market tightness can prompt immigrants to reconsider their choices about settling destinations. Because immigrants view the loosening of the U.S labor market at time t+1 as less favorably than at time t or t-1, they might change their plan and move to other countries with tighter markets instead, exerting downward pressure on the net international migration at time t+2. Gradually, over the long-run, the rate of net international migration would halt and then start retracting back to its equilibrium level. Nonetheless, this is merely a theory with the only purpose of offering some explanations for the movement of RNIM over time. Further research and evidence gathering would need to be conducted in order to validate this theory.
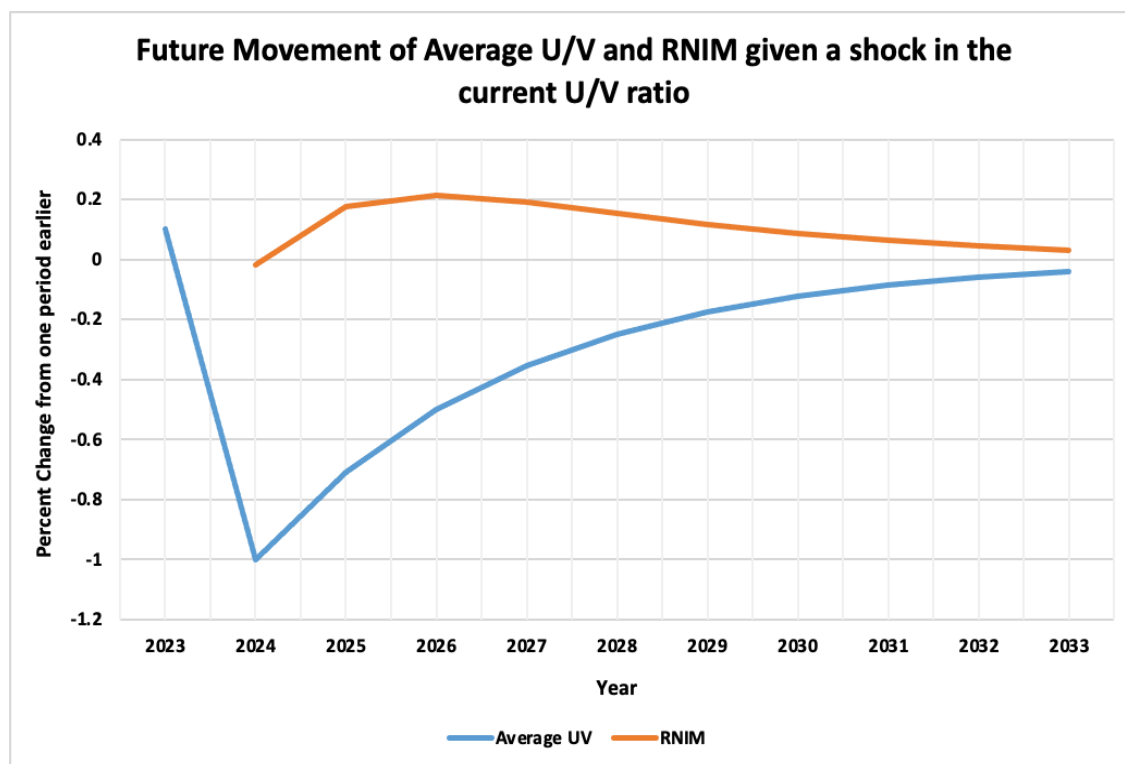
Graph 6

Besides, it is worth noting that my two-stage least squares model has some shortcomings and assumptions that deviate from real-life setting. The model presumes uncorrelated errors between the two regressions. However, this is not entirely true as both the White's and Durbin-Watson test reveal strong evidence of autocorrelation present at lag 1 in the residuals of these two linear regressions. In addition, as mentioned above, there is a possibility that the two variables, $RNIM_{t-1}$ and U_{t-1}/V_{t-1}, might share a certain degree of multicollinearity. These conditions make it unlikely that serial correlation is absent from the model. Furthermore, in order for the two-stage least squares to work, my hypothesis posits that $RNIM_t$ is solely influenced by U_{t-1}/V_{t-1} and U_{t+1}/V_{t+1} is only affected by $RNIM_t$, while keeping all control parameters unchanged. Therefore, the model ignores many uncontrollable outside factors such as economic cycles, geopolitical dynamics between the U.S and home countries of immigrants, skill level of immigrants, and so on. Another worth-noting detail is that a small portion of the annual net international migration is fixedly determined by the H-1B lottery cap. Every year, the USCIS grants a maximum of 85,000 H-1B[8] visas for undergraduate, graduates, and other skillful workers, which represents approximately 10% of the average annual net international migration from 2000-2019 (830,000 people). Therefore, any adjustment to this limit can also affect the immigration level in the long run. These negligences might reduce the accuracy and reliability of the prediction. However, the two-stage least square model can still create a simple framework for future study on the long term implication of immigration on unemployment-to-vacancies ratio and vice versa. Another method to explore this dynamic relationship could involve utilizing a

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[8] USCIS: H-1B

Vector Autoregression (VAR) model with Impulse Response Function analysis on a more granular panel data. Yet, this approach should be the focus of future research.

CONCLUSION:

This research delves into the intricate relationship between immigration and the equilibrium of the labor market in the United States. Despite debates and policies surrounding immigration, its impact on job vacancies and labor market dynamics remains a focal point. The study focuses on the period from 2000 to 2019 and examines the correlation between rate of net international migration and the unemployment-to-vacancy ratio (U/V) of 51 states.

The analysis reveals a significant relationship between the U/V ratio and the rate of net international migration, supporting the hypothesis that a 1 percent decrease in the U/V ratio leads to a 0.18 percent increase in immigration in the subsequent year. In other words, the negative correlation observed indicates that when the labor market tightens, immigration tends to rise in response to better job opportunities and earnings potential. Additionally, lagged values of net international migration also influence present immigration rates, emphasizing the importance of past immigration patterns. These results confirm the popular notion that immigrants come to the U.S. in search of improved employment prospects.

The delayed response can be attributed to the extensive processing times for immigration and employment paperwork by the U.S. Citizenship and Immigration Services (USCIS), along with time needed for immigrants to plan and prepare before relocating to the U.S.

Based on the regression analysis, I have inferred an autoregressive relationship between the average U_{t-1}/V_{t-1} and $RNIM_t$, which subsequently impacts U_{t+1}/V_{t+1}. The findings suggest that

a decline in the U/V ratio at time t-1 leads to an uptick in immigrant rates at time t, driven by immigrants seeking better job opportunities. This change in immigration demographics can result in a subsequent loosening of the labor market at time t+1, which can be caused by decrease of job openings or rising of unemployed workers. When the U/V ratio increases in time t+1, implying a disadvantageous labor market, immigrants may choose to migrate to other countries with better job prospects, potentially decreasing the RNIM at time t+2.

To test this hypothesis, I employed a two-stage least squares model. The first stage assessed the influence of lagged U/V ratio on current immigration conditions, with the subsequent prediction of contemporary RNIM. The second stage incorporated this predicted RNIM into a reverse regression that forecast the change of U/V ratio in the next period. Graph 6 illustrates the predicted movement of U/V ratio and RNIM following a sudden decrease in the U/V ratio. Over a ten-year period, both ratios gradually return to baseline, supporting the hypothesis that as the U/V ratio decreases, increased immigrant inflow eventually restores the ratio to equilibrium. Additionally, volatility in labor market tightness propels adjustments in migration behaviors. As the labor market loosens up with fewer job openings and higher unemployment rate, incoming immigration would reduce, sending the RNIM down to its stable level.

Despite this seemingly insightful discovery, I have to acknowledge some shortcomings associated with the two-stage model. Their residuals are not perfectly uncorrelated, which can impair the reliability of the predictions. Furthermore, in a real-world setting, there are multiple exogenous factors that can drive immigration to the U.S besides job availability such as median household income or education attainment and so on. There are also numerous barricades that

prevent immigrants from arriving on the U.S soil such as targeted travel restrictions or xenophobic sentiments and so on. These factors are not entirely captured by my dummy variables as they are not pertaining to any state or years. In future studies, it will be crucial to thoroughly investigate and implement these factors to comprehend their impact on immigration levels.

Overall, this research provides valuable insights into the dynamic interplay between immigration and the labor market tightness, contributing to our understanding of immigrants's impact on the U.S economy and informing future labor policy.

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