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Joe Jiuyi Long

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Abstract

In this dissertation, I explore topics related to migration studies, with a focus on Chinese migration, as China has a long history of both domestic and international migration, with China having the third largest diaspora in the world.

In the first chapter, I discuss how a lack of stable domestic investment opportunities spurs wealthy Chinese individuals to look abroad for investment opportunities, and show in their preferred investment tool, real estate, that their high demand pushes up local house prices. I go on to show that while prices are pushed up, most groups benefit, including home renters, due to a decrease in rental prices as a result of wealthy Chinese people renting out the houses they purchase. I argue that because only one group, renters seeking to become first-time home owners, are hurt by wealthy Chinese activity, that rents can be extracted from wealthy Chinese by local governments and be used to target assistance to these first-time home buyers.

In the second chapter, I explore how precarious farmland soil conditions in rural China have left agricultural workers sensitive to the effects of land degradation and desertification, and how land degradation can have persistent effects on livelihood decisions such as the rural-urban migration decision. Using exogeneous variation from wind speeds, I show that desertification has persistent effects not only on soil arability but on labor decisions of rural households. In particular, I find that affected households are more likely to shift out of agriculture and into off-farm labor such as manufacturing or services. I find no evidence of an

effect on total migration, although I note a small shift away from wage labor within-township towards out-of-township labor.

In the third chapter, I look at migration from China to the US in the late 19th century during a period of heavy turmoil in the later Qing dynasty, and the subsequent nativist backlash to migrants that ultimately resulted in the Chinese Exclusion Act, the first national immigration ban on the basis of nationality. Using the Act as a natural experiment affecting the migration decisions of Chinese immigrants, I demonstrate that the Act was effective not only in keeping new Chinese immigrants from entering the US but also in incentivizing incumbent Chinese immigrants to return to China. However, this out-migration does not seem to have any beneficial effects on the labor outcomes of natives; rather, it seems that the outflow of Chinese immigrants hurt productivity. I do find that staying Chinese immigrants were more likely to be assimilated, suggesting that while economically unsuccessful, the Act did succeed in lessening cultural differences between Chinese immigrants and natives.

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Chapter 1

Chinese Capital Flight to the US Real Estate Market

Abstract

Wealthy foreign real estate buyers have increased rapidly over the past few decades. Of particular note are those from China; in 2016 alone, Chinese buyers were the source of over 100 billion USD of outflows to real estate markets worldwide. In this paper, I investigate the effect that these wealthy Chinese buyers have on local US housing markets. Using a novel instrument, I demonstrate that an increase in the share of wealthy Chinese buyers in a locality causes an increase in house price growth. As a result of this increased growth, local governments benefit from increased property tax revenues, but do not see a drop in sales tax revenues, suggesting that the vacancy rate for wealthy Chinese is not actually different from counterfactual buyers, while a drop in rental prices suggests that wealthy Chinese are more likely to rent out their houses and less likely to move into them.

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1.1 Introduction

Over the past two decades the United States has experienced a real estate boom and bust that became a core factor in the Great Recession. Furthermore, many major cities in the United States are finding themselves facing housing unaffordability crises, as a limited housing supply continues to fall short of persistently high demand from people wanting to live in a small set of large cities (Hsieh and Moretti, 2019). At the same time, there has been a rapid increase in wealthy home buyers in international markets. In the past decade, billions of dollars have flowed from countries such as China (McMullen 2016) and Russia (Lawford 2018) into foreign residential real estate. China, in particular, has become the largest source of international buyers, with 101 billion USD spent on foreign real estate by Chinese home buyers in 2016 alone. The largest flow has been from China to the US; although previously Canadians were the dominant group among foreign buyers in the US, as of 2013 that distinction now belongs to China. Due to Chinese investors' large presence in the US housing market, shocks to economic and/or political stability in China can have substantial direct impacts on American consumers through the channel of housing prices. As a result of this increase in international home-buying activity, various governments (although not the US) have begun imposing taxes on home purchases by foreigners (including New Zealand and Ontario, Canada), suggesting that there is a strong perception that foreign influence on local housing markets is a serious concern. However, there has been little rigorous empirical evidence to support the scope of this phenomenon.

In this paper I study how wealthy Chinese buyers impact local US housing markets, and how economic conditions in China influence their demand for homes. While economic conditions may affect investors from other countries, China is particularly worth highlighting. As Glaeser et al. (2017) notes, the unusually high savings rate in China means that Chinese people typically have ample cash on hand, domestic investment opportunities other than

housing have low and/or volatile returns in China, and Chinese people frequently purchase houses in China as investment properties without actually living in them. This combination of factors suggests that the Chinese have strong potential to influence foreign housing markets such as those in the United States, especially as the number of wealthy people in China has grown rapidly in the past decades.

Anecdotally, Chinese investors in the American real estate market tend to be well-off and aggressive in their bidding,[1] so there is the potential for them to be crowding out American home buyers while simultaneously inflating housing markets that already have relatively inelastic housing supply. Because their home targets tend to be more expensive homes, any direct effects would be borne on more affluent Americans, but excessive Chinese home buying has the potential to affect households across the wealth distribution by forcing wealthier American home buyers to settle for cheaper homes and pushing up prices in the process. In addition, pushing up average prices can signal strong demand in the market and cause home sellers throughout the market to raise their prices in response.

Using an OLS panel fixed-effects regression, I find that Chinese real estate purchases are positively correlated with local-level US home price growth. However, this alone does not tell us whether home price growth is caused by Chinese real estate purchases or if Chinese investors simply target homes in areas or times with high growth potential, nor does it explain by what mechanism Chinese real estate purchases have an effect on US home price growth. In addition, because I am interested in *wealthy* Chinese purchases, proxying with general Chinese purchases will introduce significant measurement error if the activity of wealthy and non-wealthy Chinese buyers substantially differs. To account for these and other potential endogeneity issues, I construct an instrument for real estate purchases using fluctuations

[1]Poon (2017) and Levin (2018) both note that Chinese investors (as well as foreign investors in general) are significantly more likely to offer all-cash bids, which are typically more appealing to home sellers than mortgage-backed ones, as all-cash means a quicker and more straightforward transaction process. Poon (2017) also notes that wealthier Chinese investors often pay significantly above asking price, sometimes reaching a 60 percent markup.

in Chinese GDP growth interacted with travel times from China to tracts to predict the share of wealthy Chinese purchases in a tract-year, where low growth and low travel times each predict more Chinese purchases. The idea behind using growth is that wealthy Chinese people are more likely to divest their money abroad following a drop in economic performance in China. This rationale comes from the fact that wealthy individuals' income tends to be highly sensitive to business cycles relative to the average person, and so growth shocks act as a proxy for income uncertainty. Travel times provide spatial variation, in that demand in places with lower travel costs in terms of time are going to be more sensitive to these temporal shocks, especially since use as a vacation home is a commonly cited reason among Chinese home buyers.

In a 2SLS regression, I find that there is a positive causal effect of wealthy Chinese real estate purchases on local US home price growth, and show that this effect is robust to various alternative explanations. Moreover, I find that the magnitude of the instrumented coefficient is much larger than that of the OLS regression. This finding suggests that the behavior of wealthy Chinese does significantly differ from the average Chinese buyer; specifically, it suggests that tracts with more ordinary Chinese buyers do not have significantly higher growth than those with fewer. I conduct a series of robustness checks to rule out potential concerns about spurious correlations driving the effect or issues involving exclusion restriction violations. Using a heterogeneous treatment regression looking at county income, I also show that while wealthy Chinese buyers tend to purchase in wealthier areas, their effect on price growth is actually decreasing in the wealth of an area, which I argue suggests that part of the reason Chinese buyers are willing to pay high prices is to push out competitors, a strategy which works better in less wealthy neighborhoods where competitors are more liquidity constrained.

In order to better understand what wealthy Chinese buyers do with their houses after they purchase and how locals are affected by Chinese activity in the US housing market, I look

both at direct indicators of their activity as well as a number of outcomes that proxy for their behavior. As expected, I find that as a result of home price growth, local governments benefit from wealthy Chinese buying through an increase in property tax revenues. Interestingly, I also find a drop in the price of studio rentals as a result of wealthy Chinese purchases, implying that Chinese buyers tend to not move into their houses and instead are more likely than their local competitors to rent them out. Using a small sample of the largest MSAs, I show that vacancy rates do not change as a result of increased Chinese purchases, which is further supported by sales tax evidence at the county level that suggests that the occupancy rate of houses with increased wealthy Chinese is not significantly different.

An additional aspect to consider is how localities may be incentivized to enact policies that draw in more foreign buyers if they believe that they will lead to more tax revenues. Looking at pull factors, I also find no evidence that aspects such as lower income taxes or higher school quality, which one might think would be alluring to people moving into their houses, are driving the location choice of investors, and also find that Chinese buyers actually purchase houses in counties with *higher* average property tax rates, suggesting that the preferences of Chinese buyers weigh heavily towards travel convenience, and little on factors that locals may be interested in.

1.1.1 Related literature

This paper contributes to a number of strands of literature. Firstly, this paper is related to the literature on globalization and China's international economic influence, particularly with respect to the effect that Chinese exports have had on US manufacturing employment and the general US economy (e.g., Autor et al. 2013, Acemoglu et al. 2016, Pierce and Schott 2016). This paper extends this analysis to examine the effect that individuals can have across borders; while other work has examined the effect of immigrant inflows (e.g., Card 2009a,

Ottaviano and Peri 2012, Foged and Peri 2016) or remittances (e.g., Yang 2008, Ambler et al. 2015), this paper specifically looks at the flow of personal money away from one's home country towards international consumption/assets.

This paper is also related to a behavioral finance literature on the theory of price formation and noise traders, which studies how the existence of irrational, misinformed, or capital constrained traders can lead to asset pricing puzzles such as prices deviating from fundamentals (Shleifer and Vishny 1997, Scheinkman and Xiong 2003). This paper adds to the empirical evidence related to this theory that studies the effects of out-of-town buyers on house prices (Chinco and Mayer 2014, Bayer et al. 2015), with findings in line with these studies by showing that wealthy Chinese buyers drive prices up when purchasing houses in the US.

Finally, this paper is related to literature discussing household finance, specifically focusing on international investment decisions and outcomes. The international finance literature discusses the gains to diversification by investing in assets uncorrelated with domestic risk (see Coeurdacier and Rey 2013 for a discussion on diversification). One strand of this literature discusses the economic response to uncertainty, both in terms of economic and political risk. Alfaro et al. (2008) discuss the direction of capital flows in the context of the Lucas Paradox, suggesting that poor institutional quality is the main cause of capital movement from poor countries to rich ones. Gourio et al. (2016) show that uncertainty causes capital outflows, and construct a model in which economic or political risk shocks domestic assets, leading to capital flight. Few papers examine the impact on real estate, although some papers do discuss international determinants of real estate prices, finding that especially between developed countries, house prices tend to comove (Hirata et al. 2012).

A key aspect that sets this paper apart is that I discuss these capital flows and financial at the individual/household level. Scholarship in the field of household finance has burgeoned over the past decade; however, behavior with respect to domestic investments is the focus of study (see Agarwal et al. 2017 for a review of these papers). In addition, the household

finance literature mostly examines households in developed countries; differences in availability and riskiness of domestic investment opportunities as well as differences in overall political and economic risk, may affect how households in developing countries react to uncertainty shocks. Those papers which do examine households in developing countries typically focus on expanding financial access to the poorest of the poor (see Badarinza et al. 2018 for a review) rather than explore the financial decisions of those who are already financially included.

Whether households diversify portfolios and how they do so is poorly understood due to the lack of detailed or representative data.[2] On the other hand, a number of papers do address the household response to income uncertainty. Both Chamon et al. (2010) and Choi et al. (2014) calibrate structural models to show that the unusually high savings rate among households in China is a precautionary savings response to high income uncertainty over the past few decades. Giavazzi and McMahon (2008) use an uncertainty shock to Italian pensions to show a similar precautionary savings result. Brown et al. (2016) show that background risk leads to household portfolio reallocation such that there is a so-called "flight from risk"; i.e., that households divert money towards assets with less volatile returns.

Empirical work concerning international investment by households is scarce, unsurprising given that real estate purchase data does not typically provide detailed information on the buyer. The work mostly closely related to this paper is Badarinza and Ramadorai (2018), who examine the London housing market, demonstrating a reduced-form causal relationship between political and economic risk in a country and house price increases in neighborhoods with high concentration of immigrants from that country. My paper improves on their work in two ways. Firstly, with my instrument I am able to leverage transactions-level data on home transactions in order to isolate variation in wealthy Chinese home purchases by wealthy Chinese people at a very granular level, which allows me to explicitly demonstrate that house

[2]One exception in a developed country is Calvet et al. (2006), who are able to make use of detailed Swedish data to show that Swedish households diversify risk using mutual funds, with better diversification occurring with wealthier, more educated households.

purchases and overbidding by wealthy Chinese are the cause of home growth increase, as well as showing what wealthy Chinese do with their properties and how areas with wealthy Chinese purchases are affected. Secondly, because of the richness of the data that I use, I am able to expand the scope of study by making use of real estate data from across the United States rather than focusing on variation within a single city.

The rest of the paper is organized as follows: Section 1.2 provides some background information about home investment and the housing boom in China as well as some information about China's activity in the US real estate market. Section 1.3 describes the identification strategy, econometric specification, and data sources. Section 1.4 presents the main empirical results concerning the impact of Chinese activity on house prices, while Sections 1.4.4 and 1.4.5 discuss the local impacts and the pull factors. Section 1.5 provides concluding remarks.

1.2 Background

1.2.1 Financial investment constraints in China

Despite China being the fastest growing and largest economy in the world by PPP, China's modern financial system is relatively young and underdeveloped compared to other East Asian and Western countries. While the financial system is moving towards liberalization, the state still plays a relatively large role in financial markets. Although the state's presence helps maintain stability by shielding failing state-owned enterprises from disaster, its presence also distorts incentives of these enterprises by reducing their burden of failure, which in turn encourages enterprises to pursue business plans that are less prudent and riskier than they might otherwise (Allen et al., 2017).

While China does have two stock markets, both among the top ten largest stock markets in the world, its stock markets are still underdeveloped in many ways. For one, the majority

of listed firms are former state-owned enterprises. This owes in part from bureaucratic red tape that hinders other successful private enterprises from listing, which results in a lower level of quality among listed enterprises. Furthermore, there are strong limits on the extent to which shareholders have influence on management, especially for state-owned enterprises, because the government often determines the actions of firms rather than shareholders; as a result, shareholders have been shown to place less emphasis on actual firm value or long-run performance and instead focus on short-run fluctuations in stock prices. In addition, the variety in financial products available to Chinese investors is relatively limited; for instance, index futures, short selling, and margin trading were only introduced in 2010 and have had slow take-up since then. Finally, participants of the stock market are primarily individual investors rather than more well-informed, well-endowed institutional investors that populate stock markets of other countries, partially due to activity restrictions that institutional investors such as insurance companies and pension funds face. The result is that China's stock market is driven primarily by speculation and not by fundamentals, as evidenced by the consistent comovement of stocks, as well as unusually high stock turnover rates (Elliott and Yan, 2013). It is suggested that poor investor protection and poor regulation contribute to the inefficiencies of the Chinese stock market.

Bond markets are also relatively underdeveloped, as there are few quality bond-rating agencies and auditing systems, and legal protections for creditors are scarce during defaults; thus, the level of investment in the bond markets is relatively low. In addition, the bank bond market (established in 1996) and corporate bond market (established in 2007) are segmented, each regulated by separate entities, reducing the efficiency of bond issuance. Prior to the Great Recession the corporate bond market was relatively small, although since then it has grown significantly[3]. Most bonds, however, are held by banks rather than individual

[3]In 2007 corporate bonds made up only about nine percent of total issued bond value, not far from the 11 percent they made up in 1995. However, by 2011 corporate bonds had risen up to 27 percent of total bond value. (Allen et al., 2017)

investors.

One of the only available investment opportunities that has high returns in China is real estate. During the Cultural Revolution and up through the first decades of the "Reform and Opening Up" period, real estate was controlled and distributed entirely by the state through employers. Market liberalization reforms in 1998 alongside the development in individual mortgages and rising household income led to dramatic expansion in the private real estate market, with annual growth averaging 12.1 percent between 2003 and 2013. The fact that "traditional" investment opportunities such as stocks have poor returns and high volatility has positioned home ownership as one of the most reliable (and popular) forms of investment for the Chinese. These market forces align with traditional values that place high emphasis on home ownership; as is the case in many other countries, in China, owning a home is commonly regarded as a prerequisite for marriage, family-building, and a stable domestic life more generally (Glaeser et al., 2017). Thus, home buying and real estate investment are generally held in high regards by Chinese people.

Housing supply in major Chinese cities has not been able to keep up with the extremely high levels of demand, resulting in high, potentially bubble-like real estate prices. One suggestion that the high prices may represent a growing bubble is that house prices have grown faster than income in many large cities; while per capita income in China in top-tier cities is much lower than that of US counterparts, price per square foot is comparable between large metropolitan areas in the two nations. Further evidence of a bubble lies in the high per capita vacant owned land, estimated to be more than triple that of the US, suggesting that the demand for housing is not driven necessarily by desire to live in those houses, but instead by investment motives (Glaeser et al., 2017).

As a result of this bubble risk, the national government has attempted to control property speculation. In the spring of 2017 Beijing announced an increase in the required down payment for second houses to 60 percent, and 80 percent for third houses, which was then followed

by similar announcements in second-tier cities (Zheng, 2017). In addition, the government is planning on implementing local property taxes in order to disincentivize speculative investment. Nevertheless, the real estate market maintains strong growth, reflecting strong Chinese demand for investment opportunities.

1.2.2 The wealthy in China

In 2008, about 1.6 million, or 1 percent of Chinese households were considered wealthy, as defined by earning over US PPP $100,000; moreover, in 2006, about 180,000 Chinese people were considered to be high net-worth individuals (HNWI), holding wealth of upwards from 10 million RMB (appx. 1.47 million USD). By 2017, this number had increased over ten-fold to 1.87 million people. While the majority of HNWI are enterprise owners, their share in HNWI has been falling as the number of "gold-collar" professionals has risen quickly over the past decade.[4] Wealthy Chinese are increasingly eager to diversify their wealth allocation by moving their money abroad. According to a recent survey (Zeng and Ott 2017), over 80 percent of Chinese HNWI sought to diversify their investments, and over half of HNWI were looking to do so abroad. Another survey (Xu 2017) found that 85 percent of them in China were concerned about the devaluation of the yuan, and over half were concerned with issues including the USD exchange rate, foreign exchange controls[5], and the precariousness of domestic property bubbles.

As previously mentioned, property is the preferred investment for wealthy Chinese, as

[4]Gold collar professionals include executives, managers, engineers, accountants, and other well-paid professionals. In 2017, gold-collar professionals made up almost 30 percent of HNWI, up from just 12 percent in 2009. (Zeng and Ott 2017)

[5]Although Chinese nationals are limited in how much cash they can transfer out of the country ($50,000 USD annually), there are a number of ways that Chinese investors circumvent these limitations. One method is to split up a large transfer into multiple parts using friends and family, with each portion of the money eventually being deposited into a single overseas bank account. Another tactic lies involves transfer of money Hong Kong, which, while technically part of China, maintains its own separate regulations that allow for larger overseas outflows (Hepp 2017). Finally, individual investors can invest via investment firms, which are not subject to the same restrictions (Feng and Stevenson 2016).

well as for middle and upper-middle class Chinese. With increasing government restrictions and increasingly prohibitive prices in China, as well as fears of a bubble, investors are turning abroad. While international stocks and bonds are also viable opportunities, real estate is considered more appealing because on top of investment returns, it provides investors with more access to opportunities abroad such as travel, medical care, or retirement, and is a tangible durable asset that can be passed down through generations that also has the potential to help their children study abroad (Juwai 2017d). Around a third of wealthy Chinese individuals surveyed in the 2018 Hurun Report (an annual survey of HNWI in China) said that they were considering moving abroad.[6]

According to reports (Juwai 2017a), almost 75% of Chinese buyers spent fewer than 6 months researching overseas properties prior to purchase in 2016, and almost 85% of Chinese buyers bought within a year of research. Although overseas investment was initially dominated by the ultra-wealthy, over time, middle and upper-middle class households have increasingly entered this overseas market.

Recent media coverage on the proclivity of the Chinese to invest in overseas real estate markets (Pacurar 2017; Poon 2017; Levin 2018), as well as recent restrictions on overseas property purchases[7] suggests that China's level of investment is at least perceived to be significant. Although the United States is not the only country that Chinese home buyers target, it has many attributes that make it particularly amenable to Chinese nationals. For one, the United States boasts one of the largest overseas Chinese populations in the world, increasing the likelihood that investors will find Chinese communities as well as services

[6]It should be noted that purchasing a house in the United States is not a guarantee for gaining residency, nor does the United States require that you be a resident to purchase a house. An EB-5 visa can be acquired if one makes an investment of one million dollars that results in at least ten employment opportunities (the dollar amount is lowered to 500,000 if the area of investment is a low employment area or a neighborhood center), making this a potential route to permanent residency for the upper echelon of wealthy Chinese individuals who seek to emigrate from China.

[7]For example, as of April 2017, Ontario (Canada) levies a "Non-Resident Speculation Tax" amounting to 15 percent of the closing price of a property for foreign nationals. New Zealand imposed a similar tax in the fall of 2017.

that cater to the Chinese (e.g., restaurants, groceries, etc.). Another is that the United States has some of the highest ranked and most famous universities in the world, which make purchasing a home in the US appealing for parents who wish to send their children to school in America[8], a popular option among affluent Chinese families. Indeed, Chang et al. (2016) show that foreign house price indices are negatively associated with China's GDP and that the association is larger in countries with superior rankings in higher education.

A 2017 survey by the US National Association of Realtors showed that Chinese clients[9] accounted for 14 percent of international buyers, edging out buyers from neighboring Canada (12 percent) and Mexico (10 percent). However, around 40 percent of these Chinese buyers were non-residents. The most popular destination state for Chinese buyers was California (37 percent), followed by Texas (11 percent) and Florida (8 percent). In terms of cities, Los Angeles is the most popular, followed by Seattle, San Francisco, and New York City. 65 percent of Chinese buyers financed their purchases entirely with cash. For intended use, 42 percent responded that their house was intended to be either a vacation home or a residential investment, 39 percent said they intended it to be their primary residence, and 8 percent said the property would be used by a student.

1.3 Empirical Framework

1.3.1 Data sources

In Table 3.5, I show summary statistics for the main variables in the analysis. My main outcome variable, house price index growth, comes from data generated by the Federal

[8]Owning a home in America means that a family (or at least, a member of the family) can live in America while the child goes to American high school, which can help ease the transition to college.

[9]This survey lumped in buyers from Hong Kong and Taiwan into "Chinese clients", although given the sheer population difference, the vast majority of their Chinese clients are likely to be from the Mainland. (National Association of Realtors 2017)

Housing Finance Agency (Bogin et al. 2016). The house price index is calculated using repeat-sale single-family home sale price data, at the tract level. The fact that the index is calculated using sale prices from repeat-sale houses and not new houses should alleviate concerns that an effect could be driven by differences in quality of new and old houses, or endogeneity coming from new houses being built to attract Chinese buyers. From this house price index data, I have a total of 485,349 observations. Because the index is calculated using repeat-sale price data, for localities in which there is low turnover, the index is not calculated, which is why there are fewer tracts in the data than there are total tracts in the US. Thus, to avoid the possibility of the results being skewed by tracts with low turnover, I only include tracts for which I have observations for all years between 2005 and 2015, giving me a balanced panel with a total of 469,780 observations for 41,918 tracts. The average year-to-year growth rate was 12.3%. In Figure 4, I display the growth rates across census tracts in the base year 2005, showing that there is considerable variation in growth rates even within state.

For my instrument, I use Chinese GDP growth data reported by the World Bank from 2005 to 2015. In Figure 3, I also display the travel times for all tracts. Interestingly, medium airports on the West Coast (such as Portland or Seattle) have similar travel times as hub airports elsewhere in the US (such as Chicago or New York).

For my measure of Chinese house purchases, I utilize house-level real estate tax and deed data from CoreLogic, a real estate analytics company that aggregates county deed records, whose data is commonly used in the urban economics literature to study US housing dynamics. While the deed data do not specify country of origin of buyers, they do give names of buyers, with which I utilize the following method to proxy for Chinese purchases: First I take the *Pinyin* romanized version of the 100 most common surnames as reported by the Chinese Ministry of Public Security in the 2007 household registration data; this allows me to identify buyers of Chinese descent. Then, in all regressions I use census demographic data to control for both American-born Chinese and Chinese immigrant home ownership levels at

the PUMA level; this allows me to isolate identifying variation from foreign non-immigrant buyers. This way, the effect measured will be identified just off of activity by Chinese buyers who are not recorded by the census; i.e., Chinese buyers who do not live in the United States. For covariates, I also control for demographic shifts using annual county population totals from census data, as well as local labor market characteristics (unemployment rate, average annual wage, manufacturing share of wages) from the Bureau of Labor Statistics, which are also aggregated at the county level.

1.3.2 Empirical motivation

The aim of this paper is to understand the buying behavior of Chinese investors in the US real estate market and to enumerate the consequences their behavior has on local residents. Although the coefficient from a straightforward fixed-effects panel OLS regression of house price growth $HomeGrowth_{it}$ in locality i in year t on a measure of Chinese purchase share $CNShare_{it}$ (e.g., (1.1)) will capture this effect, there is a fundamental measurement issue, which is that the effect I wish to estimate is not simply the effect of Chinese home purchases, but specifically the effect of home purchases by Chinese investors, and so because my independent variable includes Chinese immigrants as well as Chinese-Americans, the effect from the investors may be washed out due to attenuation bias if wealthy Chinese buyers' behavior differs from non-wealthy Chinese buyers.

In addition to measurement bias, a simple OLS regression will also pick up any selection effects that reflect Chinese investors' skill (or lack thereof) at selecting houses with high growth potential relative to native buyers. In addition, this regression will capture any spurious correlations, perhaps from Chinese investment timing coinciding with US real estate growth periods but not actually having an effect on real estate growth or having anything to do with investors' ability to determine areas with high growth potential. Furthermore,

Chinese purchases may be related to prices growth through other mechanisms other than aggressive bidding, such as by tightening the market, or by neighborhood effects of having Chinese purchaser neighbors (Saiz 2003; Sivakumar 2007, Saiz and Wachter 2011, Accetturo et al. 2014).

$$HomeGrowth_{it} = \beta CNShare_{it} + \delta_i + \zeta_t + \varepsilon_{it} \tag{1.1}$$

In order to understand the relationship between Chinese investor home purchases and US home prices, it will be essential to deal with all these potential sources of endogeneity. To address these potential concerns, I construct an instrument for Chinese home purchases by exploiting exogenous variation that influences the timing of Chinese home purchases that is independent of US home price dynamics. For this, I use lagged Chinese GDP growth interacted with travel times from China to each tract for this exogenous variation. The use of this interaction between one variable that gives exogenous time variation and another with spatial variation gives me an instrument that varies across time and space and allows me to include tract- and year- fixed effects to control for any tract- or year-specific potential confounders.

Two main reasons motivate the choice of lagged Chinese growth as my time variation. Firstly, wage income is typically highly cyclical for wealthy individuals relative to the average person (Parker and Vissing-Jorgensen 2009; Parker and Vissing-Jorgensen 2010; Liebersohn 2016; Foellmi and Martínez 2017). The reason given for this cyclicality is that high-income individuals tend to be employed in large-scale firms whose performance is closely tied to the state of the aggregate economy, and that these wealthy individuals tend to be at the top of the employment hierarchy means that individuals' pay is often tied to the performance of the firm through bonuses. In addition, a large portion of wealthy individuals in China are company executives, who tend to invest in their own companies and receive dividends. A large empirical literature discusses the effects of income uncertainty, showing that a common

reaction to an uncertainty shock among individuals/households is precautionary saving and a "flight from risk" (Giavazzi and McMahon 2008; Chamon et al. 2010; Choi et al. 2014; Brown et al. 2016) as predicted by theory. A number of papers (e.g., Alexopoulos and Cohen 2009, Bloom 2014, Jurado et al. 2015) find that common measures of economic uncertainty are countercyclical,[10] and others (e.g., Neve et al. 2018, Luechinger et al. 2010) show that there is a psychological component to the positive relationship between a country's growth and individuals' subjective well-being stemming from perceived economic uncertainty that extends beyond simple changes in consumption. The ICRG political risk index, an index used in the literature on economic and political risk (e.g., Erb et al. 1996, Glaeser et al. 2004, Badarinza and Ramadorai 2018), includes GDP growth as one of the factors, and the other factors in the index such as inflation rate and government budget share of GDP are typically procyclical. Given that wealthy Chinese people are increasingly interested in having options to live/travel abroad, and that there are few investment opportunities with stable returns in China, it makes sense that domestic income risk will drive wealthy Chinese individuals to move their money to countries like the United States where there are more investment opportunities with less risk. In particular, this income risk should push these individuals to invest in the perennially-favored asset of real estate. This also has parallels to literature on migration (e.g., Ortega and Peri 2009); there, because migrants' income is primarily driven by labor, differences in the return to labor drive migration abroad, whereas here, as returns to investments make up a larger proportion of income for wealthy people, differences in the return to investment drives the movement of money abroad.

Secondly, an empirical fact is that Chinese GDP growth is perceived by the Chinese to be a rough proxy of Chinese economic stability and productivity, and is related to the yuan-dollar exchange rate, which mentioned before is an key concern among wealthy Chinese.

[10]There is no standard measure of uncertainty, but some frequently used include volatility in the stock market, bond markets, exchange rate, GDP growth, and usage frequency of the word "uncertainty" in newspapers.

In Figure 1, I plot both lagged Chinese growth and percent change in the dollar value of the Chinese yuan from 1996 to 2015. Prior to 2005 the yuan was pegged to the dollar and so there is no relationship between the two, but following the exchange rate liberalization, Chinese GDP growth is indeed highly predictive of future fluctuations in the exchange rate. I also plot lagged Chinese growth against exchange rate growth from 2005 to 2015 in Figure 2 (c), showing that there is a strong statistical association between the two variables ($R^2 = 0.869$).

Thus, when growth is low, investors may forecast that the returns to holding yuan may drop, and respond by shifting towards assets which will retain their value irrespective of the performance of the yuan. Another consistent mechanism would be that because wealthy Chinese already seek to move/divest out of China, their timing is based on when they fear their purchasing power abroad is going to decrease. This is particularly relevant given that individual investors are prone to suffering from confirmation bias which results in them believing that present negative fluctuations predict future downward trends (Barber and Odean 2013). Both fears of economic instability and yuan weakening are reported to be large drivers of Chinese households moving money abroad (Li 2017). Importantly for identification, lagged Chinese GDP growth should have no effect on local US housing markets except through influencing Chinese investors' home investment decisions.

Although there is no available micro-level data across time on Chinese household financial decisions, I am able to show some aggregate-level time-series data that are consistent with the idea that Chinese households respond to changes in domestic growth. In Figure 2 (a) I plot lagged Chinese growth against the number of US visas issued to Chinese citizens from 2002 to 2018, and find a weak negative relationship ($R^2 = 0.009$), suggesting that Chinese immigration timing does not seem to be immediately related to Chinese growth. In (b) though, I use the number of employment preference visas issued to Chinese citizens; while total visas include visas for relatives as well as diversity visas, wealthy Chinese make up a large portion

of employment visa applications such as an immigrant investor visa, where immigrants are eligible simply by making a large capital investment in a commercial enterprise. I find a negative relationship between lagged Chinese growth and employment visas ($R^2 = 0.679$). While not a perfect measure of investor activity, that these employment visas move against GDP growth does suggest that people who are more likely to be investors obtain more US visas following periods of low domestic growth. In Figure 2 (d), I plot lagged Chinese growth against the total value of Chinese household foreign currency savings deposits[11] from 2002 to 2018, and find a negative association ($R^2 = 0.726$). This relationship is consistent with Chinese households shifting their investments towards foreign currency following periods of low growth rather than holding it as cash. However, these numbers do not take into account the possibility of, say, RMB being moved abroad and then being exchanged outside of China, and so are likely to be a lower bound.

While Chinese investors are likely to be swayed by domestic growth, domestic growth is unlikely to play a significant role in the migration timing decision for Chinese immigrants or the house purchase decisions of Chinese-Americans (and Americans in general), and so the use of domestic growth should alleviate concerns about measurement error bias. In addition, because the instrument is not based on internal aspects of the housing market, this should also rule out issues related to reverse causality where growth or potential growth in the housing market would be pulling in Chinese investment. Although there is no reason to expect any direct effect from Chinese growth on the housing market except through Chinese investment, the possibility remains that Chinese growth may have indirect effects on the US economy that could trickle into the housing market and violate the exclusion restriction. I address those concerns in Section 1.4.3.

While I could instrument for Chinese home purchases just with Chinese growth, I would

[11] Financial institutions in this table include the People's Bank of China and banking depository financial institutions. Banking depository financial institutions include banks, credit cooperatives and finance companies.

be unable to include year-fixed effects to control for any confounding time-varying real estate market characteristics, such as increases in the housing supply or the Great Recession, because my instrument would not have any spatial variation, and so I interact it with approximated travel times between China and US census tracts. Because the US does not have an "open skies" policy with China, the number of routes between the two countries is strictly limited, and in fact in 2005 there were only 5 airports that flew direct to China.[12] These destinations are thus much more convenient for investors (Juwai 2017b, Juwai 2017c), who often take the opportunity to search for real estate while on holiday abroad (Juwai 2015). In addition, investors are more likely to know about large metropolitan areas, which are more likely to have these direct routes. Finally, airlines deliberately advertise their direct international routes, making these destinations more salient to travelers. Given that many investors do not purchase homes with (immediate) residential intentions, spatial preferences are more likely to be determined by salience and convenience. Indeed, Campante and Yanagizawa-Drott (2017) show that flight networks cause an increase in business linkages across countries.

That the gateways between China and the US are limited is not only going to make areas near direct-flight airports attractive to Chinese buyers, but also areas well-connected by plane to China via those direct-flight airports. To make use of this additional variation, the way I construct travel time is as follows:

1. Because direct flights tend to depart from either Beijing or Shanghai, I calculate the flight distance[13] between both Beijing and Shanghai to each of the cities with a direct flight, calculate the approximate flight time[14], and average the Beijing and Shanghai flight times to get a "China" flight time to each airport with a direct flight (henceforth,

[12]These airports were Los Angeles (LAX), San Francisco (SFO), Chicago O'Hare (ORD), Newark (EWR), and New York John F. Kennedy (JFK).

[13]For all flight distance calculations I use the haversine, or great-cirle, distance formula.

[14]For these calculations I use the flight calculator https://www.airmilescalculator.com/, which uses a commonly used flight time approximation of flight time F (minutes) as $F = 30 + 0.1136D$, where D is the flight distance in miles. The coefficient 0.1136 corresponds to the average flight speed of 528.116 mph, or 850 kph.

hub airport).

2. I then calculate the flight distance between each hub airport to the nearest medium airport in the US, [15] and calculate the approximate flight time for each pair.

3. I calculate the straight-line ground distance between each medium airport and the nearest census tract, and convert this to driving time by assuming an average drive speed of 60 mph.

4. For each tract, I calculate two times:

    a. China flight time to nearest hub + 1 hour layover + hub to nearest medium airport flight time + drive time [16]

    b. China flight time to nearest hub + drive time

5. I then take the minimum of 4a and 4b to take into account the fact that some airports are so close to the hub airports that it is not worth flying to them (e.g., San Francisco to Oakland)

To mitigate a potential reverse causality concern that US air routes might be influenced by real estate growth (e.g., a route opens between a house price growth hot spot in an effort to capitalize on Chinese investors), I keep travel time fixed at the base year level rather than use a contemporaneous measure. I display these distances in Figure 3. The instrument that I then construct is the interaction between lagged Chinese growth and base-year travel time. An advantage of using this interaction in combination with individual- and year-fixed effects is that any potential exclusion restriction violation would have to be related to both factors;

[15] I use the FAA definition of a medium airport, which must carry at least 0.25% of total annual passenger boardings.

[16] Using 1 hour as the layover time is an assumption based on the frequency and availability of domestic flights within the US; the results are robust to adjusting the layover time. Tables can be made available upon request.

for example, while we might expect travel time to China to be related to travel time to other countries, there is little reason to expect that the timing of home purchases in the US by people from other countries should vary with domestic growth in China, and so any potential confounding factor like this will be differenced out by fixed effects.

There are some possible concerns about my choice of instrument. One is that although I might wish to include state-by-year fixed effects to flexibly control for state-specific trends, given that most states have only one medium airport, including state-by-year fixed effects would eliminate a great deal of inter-state identifying variation; for the vast majority of states, the spatial variation would consist solely of the distance to the largest city, and the variation in flight time costs would be absorbed entirely by the fixed effects. I instead include census region-by-year fixed effects, which still allow for differential trends across regions (e.g., increasing preference for houses on the West Coast) without differencing out important flight time variation. The second concern of the instrument lies not in the validity but with data limitations; the time frame that I have data for is only for an eleven-year period, in which Chinese GDP growth only reverses direction three times. This could raise concern that Chinese GDP growth is spuriously correlated with house price growth or some other third variable that is related to house price growth. Along with the other robustness checks I address these spurious correlation concerns in Section 1.4.3.

1.3.3 Econometric specification

As mentioned previously, I instrument for Chinese home purchases using lagged Chinese GDP growth interacted with US base year travel time from China. Conceptually, using this interaction variable as an instrument follows the same intuition as a difference-in-difference estimation, where house prices in high Chinese purchase propensity areas are compared in years with high and low Chinese demand, with a reference group of low Chinese purchase

propensity areas. In Table 3.5, I run the following simplified reduced-form regression to verify that the data reflect the intuition of the instrument:

$$CNShare_{it} = \beta_1(D_{t-1} \times CN_i) + \beta_2 D_{t-1} + \beta_3 CN_i + \mathbf{X}_{it}\Gamma + \varepsilon_{it} \tag{1.2}$$

where $CNShare_{it}$ is the share of purchases in census tract i within census region r in year t that are Chinese, D_{t-1} is lagged Chinese GDP growth, CN_i is travel time, $\mathbf{X}_{it}$ is a vector of the relevant covariates, and ε_{it} is the error term. The logic of the instrument suggests that I should expect both β_2 and β_3 to be negative while β_1 should be positive. As a concrete example of how to think about this, we might expect that following a year of decreased growth in China, Chinese investors are keen to move their money abroad and purchase houses in the US, and also prefer for simplicity to stay close to direct-connection cities like Chicago, and so decide to invest either in Chicago itself or a relatively close city such as Milwaukee. On the other hand, after a boom year they might be calmer and have more patience, and both are less pressed to purchase immediately and are willing to look further to, say, Nashville or Tulsa. So, while we expect Chinese purchase share to be negatively related to both lagged growth ($\beta_2 < 0$) and travel time ($\beta_3 < 0$), a decrease in growth will increase Chinese purchase share more for somewhere with shorter travel time versus somewhere with longer travel time (or equivalently, an increase in growth will increase Chinese purchase share more for somewhere with longer travel times relative to short-travel areas), and so we expect $\beta_1 > 0$.[17] I find in all specifications that this is indeed the case; $t-1$ Chinese GDP growth and distance to direct-flight airport each negatively and significantly predict Chinese home purchases, while their interaction positively and significantly predicts Chinese home purchases.

[17] Another way to see this is that Chinese share is more sensitive to Chinese growth for places with short travel time, and less sensitive for places with long travel time. For somewhere like Chicago, an increase in growth should elicit a large drop in Chinese purchases, while for somewhere like, say, Fargo, an increase in Chinese growth should produce a smaller drop in Chinese purchases. This means that the drop in purchases is less negative (or increasing) as travel time increases, and so we expect $\beta_1 > 0$.

Moving on to the main regression, the identification strategy can be represented in a two-stage regression:

$$CNShare_{irt} = \pi(D_{t-1} \times CN_{ir}) + \mathbf{X}_{irt}\Theta + \eta_{ir} + \xi_{rt} + \nu_{irt} \tag{1.3}$$

$$HomeGrowth_{irt} = \beta(D_{t-1} \times CN_{ir}) + \mathbf{X}_{irt}\Gamma + \delta_{ir} + \zeta_{rt} + \varepsilon_{irt} \tag{1.4}$$

where (1.3) is the first stage and (1.4) is the reduced form.

$HomeGrowth_{irt}$ is home price growth in census tract i within census region r in year t; $CNShare_{irt}$ is the proportion of Chinese house purchases in tract i within region r in year t; D_{t-1} is a lagged temporal demand shock in year t (GDP growth); CN_{ir} is a variable with spatial variation in the propensity of Chinese people to purchase houses in tract i, state s (2005 travel time from China); $\mathbf{X}_{irt}$ is a vector of covariates that vary across space and time, such as demographic characteristics and local labor market characteristics; δ_{ir} and η_{ir} are tract dummies; ζ_{rt} and ξ_{rt} are region-by-year dummies; ε_{irt} and ν_{irt} are error terms. Both the D_{t-1} and CN_{ir} difference-in-difference terms from the previous regression are absorbed by the region-by-year and tract dummies, respectively, in both regressions, and thus do not need to be included.

1.4 Results

1.4.1 Main results

To start, I first run a "naive" panel OLS regression of home price growth on Chinese home purchases:

$$HomeGrowth_{icrt} = \beta CNShare_{icrt} + \mathbf{X}_{icrt}\Gamma + \delta_{icr} + \zeta_t + \varepsilon_{icrt} \tag{1.5}$$

P_{irt} is average home price in census tract i within census region r in year t; H_{irt} is the percentage of Chinese house purchases in tract i within region r in year t; $\mathbf{X}_{irt}$ is a vector of controls; δ_{icr} is a tract dummy; ζ_t is a year dummy; ε_{icrt} is the error term.

I show in Table 3, panel A, column 1 that there is a positive and significant association between Chinese house purchases and home price growth. However, as discussed earlier, it is possible that some omitted variable is driving both Chinese house purchases and price growth. For example, people might move to an area because of increased jobs in an area from some productivity increase, which could drive up demand, increasing prices. Concurrently, this economic boom makes this area more salient to Chinese investors, who eye this area as having high growth potential. Thus, in column 2, I control for population, average wage, and unemployment rate at the county level, and show that the result is qualitatively similar.

However, even controlling for these potentially confounding factors, I still cannot say whether this relationship exists because Chinese people have some causal effect on the housing market or if Chinese people are skilled in selecting houses in areas with high growth potential. This is especially so if we think that the key role of these house purchases is for investment returns. In addition, although I have controlled for local demographic changes and local labor market conditions, which might predict real estate growth, I cannot account for the possibility that there still exist other unobserved factors that affect Chinese investors' house purchase decisions and local house price growth.

Thus, I instrument for Chinese home purchases by interacting lagged Chinese growth and base year travel time from China. Neither Chinese growth nor a fixed travel time should inform Chinese investors of where places with high growth potential are in a given year; my identifying variation should be orthogonal to contemporaneous local real estate market conditions, and so the coefficient I get should only reflect the effects of demand-side shocks from the Chinese side. In Table 4, column 1, I run a first-stage regression (i.e., equation (1.3)) of Chinese home purchases on my instrument, and find that my instrument does indeed predict

Chinese home purchases. The coefficient is positive, suggesting that low Chinese growth induces more Chinese investment in areas with shorter travel times, exactly as expected. In Table 3, panel C, column 1, I show the results from the two-stage least squares regression. As in the OLS regression, I find a positive and significant effect of Chinese home purchases on US home price growth: a one percent increase in the proportion of Chinese home purchases results in a 10 percent increase in home price growth. Interestingly, I find that the magnitude of the coefficient is higher than in the OLS regression; this would be consistent with Chinese investors being *bad* at selecting houses for potential growth (e.g., that those houses would counterfactually have not grown, but the Chinese activity canceled this out). This is in line with previous research on out-of-town buyers that finds that out-of-town buyers tend to be speculative and misinformed (e.g., Chinco and Mayer 2014).

At first glance, the magnitude of the coefficient seems unusually high. However, two things should be taken into account in interpreting this magnitude: Firstly, because the variance in tract-level house price growth is extremely high, in standard deviations, this only says that a standard deviation increase in the proportion of Chinese home purchases results in about a standard deviation increase in price growth (the average absolute year-to-year change in Chinese purchase share is 0.64 percentage points) Secondly, the measure of Chinese home purchases includes not only Chinese people from China but also people in the US with Chinese names, meaning that the number of Chinese home purchases is much higher than that of home purchases by Chinese investors. Although the deed data do not show how many home buyers are from China, I do a back-of-the-envelope calculation to get at an upper bound: In 2017, there were estimated to be 1.87 million HNWI in China, and for many years the number of HNWI in China has been steadily increasing. Among a sample of HNWI that year, 30 percent reported holding overseas property. Assuming all of that property were in the United States, that would be equivalent to 560,000 houses. In the deed data, approximately 6 million homes were purchased by individuals with Chinese last names

in 2015, meaning that at most, 10 percent of homes included in "Chinese home purchases" were actually purchased by a Chinese investor, and so the realized effect of Chinese investors is likely an order of magnitude smaller than the coefficient.

Another point to note is that the difference in the magnitudes of the OLS and instrumented coefficients reflects that the identifying variation in the instrumented case comes from Chinese investors, and specifically, Chinese investors who are spurred by domestic uncertainty. Because the independent variable is purchases by people with Chinese names, there is going to be variation coming from wealthy Chinese households, whose purchase decisions are most likely to be influenced by Chinese growth and travel times, but also other Chinese households (e.g., ordinary Chinese immigrants or Chinese-Americans), whose purchase decisions are unlikely to be related to Chinese growth and travel times. Thus, it makes sense that the OLS coefficient is attenuated since it averages across both the wealthy and non-wealthy purchases, and we expect non-wealthy purchases to have negligible effects relative to wealthy ones, especially if we believe that wealthy Chinese households have high propensity to overbid. In contrast, because the IV coefficient is identified off of variation in wealthy purchases, it should be larger than the OLS coefficient, and reflects the variation that we are interested in in the first place.

A potential concern with this instrument is the exclusion restriction. One could imagine that Chinese growth could be somehow indirectly linked to local housing markets in the US. For example, Chinese growth could have an indirect effect on local US housing markets, perhaps by affecting wages in areas that either trade more with China or compete more with Chinese exports, which could draw people into those areas or just increase people's willingness to pay for houses; this, in turn, could affect house price growth. Thus in column 3 I also control for share of employment in the manufacturing sector, and find qualitatively similar results; in fact, I find that the coefficient is larger with controls than without.

1.4.2 Mechanisms

Although my instrument allows me to attribute a causal effect to Chinese investment on US house price growth, this does not give an explanation for why we see these outcomes. Although mechanically the housing market is affected by Chinese investors simply through the increase in demand for US houses, whose supply is generally inelastic, we might expect there to be additional reasons for why house prices get pushed up by Chinese home purchases. Anecdotally, one of the key channels through which Chinese purchases affect price growth is aggressive offers that result in higher sales prices than if there were no Chinese purchases. Although the discrepancy between the OLS and IV results are consistent with that explanation, there could be other explanations that would produce such a discrepancy.

In Table 3.5, I interact purchases with average wage. Column 2 shows that the effect of Chinese home purchases is decreasing in the average county wage. That the effect of purchases is smaller in wealthier neighborhoods is consistent with Chinese households bidding high if we consider the fact that most home purchases in the US, particularly for those lower on the wealth distribution, are financed through borrowing; for a wealthier household, the cost of housing as a proportion of their total income is going to be much lower than that of a poorer household, and so a wealthier household would have more resources available and/or be more willing to counter high bids from Chinese purchasers, making outbidding a less appealing strategy to the Chinese. On the other hand, a middle-class household may, out of a precautionary motive, be less willing to put up extra cash when they are already relatively liquidity-constrained. Conceivably then, a Chinese buyer would be more likely to be guaranteed a house by raising their bid in less wealthy neighborhoods, and may then use overbidding as a strategy to reduce search time.

Of course, it is also possible that in wealthier neighborhoods there are still aggressive competing bids, but if native home buyers are aggressive as well, the likelihood of the

aggressive bidding leading to a Chinese purchase is lower. If it is the case that Chinese buyers focus on specific neighborhoods, then the coefficient we observe reflects both the effect of the successful purchase of a Chinese buyer as well as the effects of any failed purchases, both of which should be positive. This would suggest that we should expect to observe a *larger* effect in wealthy neighborhoods; however, we observe the opposite, thus suggesting that in wealthy neighborhoods there is less aggressive bidding overall.

Another possibility that could be consistent with Chinese purchases causing changes in home prices is that Chinese purchases have a neighbor effect (à la Saiz 2003, e.g.). However, because I have controlled for in-migration by including population as a covariate in the regression, my identifying variation should only come from investors who do not reside in their homes, for whom there should not be any neighbor effect. In addition, the literature on neighbor effects typically finds that an influx of foreign neighbors causes a downward trend in house prices, meaning that the estimated effect would actually an underestimate of pure up-bidding if it were the case that there were any neighbor effects.

On the supply side, one might think that Chinese interest could spur developers to construct more expensive homes to attract more Chinese investors. I argue though that this seems unlikely. As mentioned earlier, housing supply is relatively inelastic; in the US it typically takes at least six months to construct a house, not including the time it takes for demolition or permit acquisition, meaning that most of any supply-side response would at the earliest occur in the year following an increase in purchases rather than the same year. In addition, because the home price index is calculated from resale value of existing homes and not sales on new homes, the only way this channel could have an effect on HPI is through spillover effects from the new houses' value added to the neighborhood and not directly through the new houses themselves.

1.4.3 Robustness checks

Although I have shown that wealthy Chinese activity causes an increase in home price growth, there still may remain concerns that other factors could explain the observed results. I address a number of these concerns in this section.

Alternate instruments

One potential concern with the results is that estimating coefficients using travel times may be skewed because the travel time factors linearly into the regression. For example, one might think that the difference in effect for a tract 12 hours away versus 13 hours away may be different from a tract 16 hours away versus 17. In Table 5, I address this by rerunning my two-stage least squares regression with different variations of the instrument. In column 2, I include a squared term into the instrument and get similar results. In column 3, I use log travel time instead of travel time and also find little change.

In columns 4 and 5 I use two alternative instruments to check the robustness to the exact variables I use, lag Chinese growth and travel time. In column 3 instead of using travel time I use distance to the nearest airport with a direct flight to China. This addresses concerns that there may be differing effects closer to the West Coast perhaps related to shipping, which may be confounded with the shorter travel times to China. I still find a positive and significant effect, although its magnitude drops somewhat. In column 5, instead of Chinese growth I use the number of business visas issued by the US to Chinese people, to address concerns that the linkage between growth and purchases may seem tenuous; there is a clearer link between wealthy Chinese people acquiring US business visas and wealthy Chinese people purchasing houses in the US. I find that the results are nearly identical to using lagged Chinese growth.

Potential confounders

In this section I run a series of robustness checks for potential confounding variables and alternative explanations for the effect that I observe.

One explanation for the observed effect is that fluctuations in Chinese growth have other indirect effects. In particular, it could be that Chinese growth fluctuations affect its trade directly with the US, or indirectly through US trading partners such as Japan or Canada, which then has a ripple effect onto the US. It could be that based on spatial differences in trade competition, some regions experience some sort of trade shock, which then filters into house prices. This line of inquiry seems tenuous given that I have already included local labor market controls, but for extra robustness in Table 6 I control for lag growth in the US and its top three trading partners, Japan, Canada, and Mexico, interacted with the direct airport distance. In all cases I still find a positive, significant coefficient for Chinese home purchases, with the magnitudes actually being higher. This is not altogether surprising; in table A1, I run correlations between Chinese growth and growth of the US and its top trading partners for the period from 2005 to 2015, and find that while growth in the US and its major trading partners are all positively correlated with each other, none of them are correlated with Chinese growth.

Although not threatening the internal validity of the results, another potential concern is that the effect is mostly identified off of outlier cities. One possible concern is that the effect comes from the fact that the cities that the direct airports are in are somehow special, perhaps because these areas are economic powerhouses or have high population density. To account for this possibility, in Table 8, I rerun the regressions including an indicator for being in a 5, 10, 25, and 40 mile radius of these airports interacted with year fixed effects in the controls, shown in columns 1. In all cases, I find the coefficient to be roughly similar to before (if not bigger), suggesting that the cities with direct airports are not driving the effect.

Another possible concern is that the effect is driven by the fact that this period includes the Great Recession; I include an interaction between the recession and state fixed effects in column 5, and still find a positive and significant effect, although the effect size does drop somewhat. This implies that while the effect is larger in the recession years, the effect is not confined to the recession years and is a general effect.

In Table 3.5, I test a number of other potential confounding factors related to industry share. One potential spurious correlation is if Chinese growth connects to US localities through manufacturing exports; if localities compete directly with Chinese exports (e.g., Autor et al. 2013), then a growth shock could have an indirect effect on house prices through manufacturing. In column 1 I include share of wages in manufacturing at the county level as a control, and find no change in the results. Another potential confounding factor is if the increase in house prices actually comes from the rise of the tech industry; tech is concentrated in large cities, particularly on the west coast, and so if the overall trend of tech is spuriously correlated with Chinese growth, we would attribute the effect of tech on house prices to Chinese purchases. In columns 2 and 3 I include the share of wages to the information sector and telecommunication sector, respectively, and in both cases find little change.

1.4.4 Investor behavior and local impacts

Given that I find that Chinese purchases raise house prices, the next logical question is who in the United States is affected by these purchases and how so. Unlike in the cases of immigration or trade, where changes in labor supply and/or productivity are the main means by which locals are affected by foreigners (e.g., Butcher and Card 1991, Card 2009a, Ottaviano and Peri 2012, Foged and Peri 2016, Sequeira et al. 2020), when we look at the effect of foreign home investors, we expect locals to be affected through the housing market. Although the data tell us that there are Chinese investors buying houses in the US, and

anecdotal evidence suggests that these buyers are inclined to leave their houses vacant, there is little else that we can glean directly from the data in terms of what these investors are doing with the homes simply because there is no systematically collected data about what these investors do. Fortunately though, there are essentially only a few things that investors can do with their houses (move into the house, rent out the house, and leave the house vacant), making it possible to draw some basic conclusions about their activities by looking at a number of proxy outcomes.

To try to get at more definitive results concerning the behavior of investors, I look at the effect that Chinese investors have on rental prices. We should expect the effect on rental prices to depend on the propensity of investors to rent out their homes relative to their counterfactual local buyers. If it is the case that investors rent out their homes more, then we might expect lower rental prices due to an increase in the supply of rentals.[18] At the other side, if investors are overly prone to leaving their homes vacant, then like home buyers, renters may also be negatively impacted by an influx of foreign investors by decreasing the stock of rental homes. In Table 11 I look at the effect that Chinese purchases have on the average county rents. I find in Column 1 that for a 1% increase in Chinese purchases, studio apartment rents statistically significantly decrease by \$176.10[19]. For one-bedroom rentals, there is a small, marginally significant negative effect in the reduced form regression, but the instrumented coefficient is insignificant, and much smaller in magnitude compared with studios. For all other rentals, there is no statistical effect on rental prices. It would make sense that Chinese investors would be very unlikely to ever move to the US to live in a studio apartment, so it would make the most sense for them to rent out their studio apartments, versus a property with bedrooms, which they could have as a vacation home that they would

[18] Although given that home ownership is considered to be one of the most common ways to build wealth, if lower rental prices discourage people from buying houses, this may still end up hurting renters in the longer run.

[19] Again, since the actual year-to-year variation in Chinese purchase share is quite low, the average resulting price change is an order of magnitude smaller

eventually move into. Given that there is a modest decrease in rental prices, it makes sense that in Columns 2 and 3 of Table 12 that we do not see an increase in the number of homeless people. That we observe no positive price effects for any type of rental with bedrooms could mean that Chinese buyers rent out their non-studio properties at the same rate as their local counterparts, or that Chinese buyers do not purchase properties that typically enter the rental market.

Since there is no way to directly infer whether someone moves into a given house, I examine two outcomes that proxy for moving in: car registrations and electricity consumption. If we believe that the counterfactual people who would have bought the houses instead of the Chinese investors would already have cars, then we would expect there to be no change in car registrations if the investors were moving in or renting out their houses, and a decrease if they were leaving the houses vacant. Similarly with electricity consumption, if Chinese investors move in or rent out their houses at an equal or greater rate to locals, then we should expect no change in electricity usage, whereas if they leave the houses vacant at a greater rate, we should expect a decrease in usage. In both cases, we observe a negative effect (Table 14, columns 2 and 3), but in both cases they are also statistically insignificant, suggesting that Chinese investors do not leave their houses vacant at a higher rate. This may suggest that the counterfactual buyers for the houses that Chinese buyers purchase also have high rates of vacancy or renting. Although there may be power issues since the data for these outcomes is only measured at the state level, running the state-level house price index growth does produce a statistically significant coefficient. However, it should also be noted though that the F-statistic for these regressions are below the weak instrument threshold, so this should be taken into account when interpreting the results.

If local homeowners are competing with foreign buyers, then we expect home ownership rates among locals to be negatively impacted since the supply of homes is relatively inelastic, and so an increase in foreign buyers is equivalent to a decrease in the stock of available homes,

especially so if foreign buyers buy aggressively. This is further augmented if a significant proportion of competing buyers are would-be first time home buyers and/or if the decrease in rental prices from an influx of Chinese rentals encourages would-be home buyers to continue to rent. However, regardless of what Chinese buyers do with their houses, we expect local home ownership rates to drop simply because there are fewer houses and higher prices, and so we cannot use the effect on local home ownership rates to say anything more about the behavior of Chinese buyers.

A third group that may be affected by foreign home investors is local governments, via tax revenues. Especially if foreign up-bids have positive spillover effects on the prices of local contemporaneous home purchases (e.g., the "comps" effect), local governments may see benefits to their property tax revenue from attracting wealthy foreign buyers. In Table 10 Column 1 I show that an increase in Chinese purchase share results in a significant increase in property tax accrued by county governments. However, in Column 2 I show that there is no effect with sales tax revenues, showing that while the increase in house prices does in fact result in more property taxes collected, the price effect is not simply coming from locals becoming wealthier.

From these outcomes, we can use a simple accounting exercise to try to summarize what we can conclude about the likelihood for Chinese buyers to move into (m), rent out (r), and leave vacant (v) the houses they buy, relative to the counterfactual buyer (for example, if 34 percent of Chinese investors and 30 percent of local home buyers rent out their homes, then $r = 0.04$). Since the only things a homeowner can do with their house are to move in, rent out, or leave vacant, $m + r + v = 0$. If $m + r > 0$ (or equivalently, $v < 0$), then there should be an increase in the overall rate of home occupancy, and so we should expect the consumption of utilities and cars to increase. Instead, we see a weak decrease, so it must be that $m + r \leq 0$, and so $v \geq 0$. Because we see a decrease in rental prices for studios and some evidence of a decrease for 1-bedrooms, that implies that there is an increase in rental

supply, or that $r > 0$, so $m < 0$. Thus, the data suggest that Chinese buyers are less likely to move into their houses, but more likely to either rent out their houses or leave them vacant.

I find that in contrast with property taxes, the increase in sales tax revenues is small and insignificant, consistent with $m + r \geq 0$ if we think that occupancy rate and sales tax revenues go hand in hand, and so we conclude that $m + r = 0$ and hence, $v = 0$. Although there is no data available generally for the vacancy rate for counties or tracts, the US Housing Census does provide data on the owned-home vacancy rates for the 75 largest MSAs in the United States. Using this sample, I find in Table 13 Column 2 that Chinese purchase share has a small, positive, but statistically insignificant effect on the owned-home vacancy rate, also consistent with $v = 0$.

Of course, this simplified breakdown does not capture how actions may differ across types of rentals, account for consumption patterns for locals possibly being different from Chinese buyers, or any potential general equilibrium effects such as inducing a decrease in in-migration, changes in utilities or car consumption as a result of changes in the rental/purchase prices of houses, the effect that the rental rate of Chinese buyers has on the rental rate of locals, etc. It also only tells us the *relative* rates, and does not tell us about how likely locals are to pursue these activities. For example, if the counterfactual buyer is also an investor (e.g., an out-of-town buyer or second home buyer), then even if $v = 0$, it still may be the case that there is a high vacancy rate among Chinese buyers.

1.4.5 Pull factors

Local governments may care greatly about what aspects of an area (however loosely defined) are most appealing for foreign investors. If they wish to increase their tax revenues, they may wish to expand those appealing pull factors, whereas if they want to protect their constituents from the negative effects of foreign investment they might wish to curb those factors and/or

impose extra burdens on foreign buyers. Key to that decision-making process is knowing which pull factors are most attractive and which negative aspects are worth overlooking to those buyers.

For local governments, there may be a trade-off between increasing public funds by increasing property tax rates and attracting wealthy people by decreasing property taxes, particularly with wealthy foreign buyers, who, like other out-of-town buyers, have much more flexibility when it comes to where to buy a house relative to locals. However, it seems that this may be a false trade-off; in Table 15 column 1 I regress Chinese share on the instrument interacted with the county-average property tax find that the effect is actually increasing in the county-average property tax rate. It seems implausible that people look for houses *because* they have high property taxes; rather, this suggests that people buy houses *in spite* of the property taxes. Given that there is a weak negative correlation between travel time and property tax rate, it may just be that Chinese buyers pay little attention to the property tax when purchasing, and the increased likelihood of purchasing in high property tax areas is just because they are also more likely to have shorter travel times.

Like property tax, income taxes are another lever that local governments have at their disposal to pull in or push out people. In Column 2 I interact the instrument with the maximum total income tax rate in a state, and find that like with the property tax rate, buyers are actually more likely to purchase in states with high income tax, not less. Since Chinese buyers are less inclined to move to the houses they buy, we should not expect income taxes to act as a purchasing deterrent, especially if we do not even see property taxes as a deterrent, which is indeed we see.

Chinese home buyers who are interested in raising families in the US should be paying attention to the quality of schools in a neighborhood. While local governments may not have quite as much control over the quality of schools in the same way that they do tax rates, they still determine aspects such as school funding. I look at the average pass rate of

Common Core math and RLA (English) exams.[20] Regressing Chinese purchase share on the instrument and an interaction between the instrument and pass rates in columns 3 and 4, I find that neither math nor RLA pass rates differentially predict purchase rates, suggesting that grade school quality is not a major factor in the decision-making of Chinese buyers. If it is the case that Chinese buyers make purchases primarily for investment purposes rather than for moving in, then it would make sense for school factors to be unimportant.

Overall, there does not seem to be any evidence that Chinese home investors are put off by what we would normally think to be off-putting, and not attracted by any aspects that we would normally think to be attractive to local home buyers. This suggests that other than legislation that either explicitly encourages or discourages foreign property investment (or perhaps somehow negotiating a sky route to a nearby airport), local governments have little to no sway over the decision-making process of foreign property investors.

1.5 Conclusion

As wealthy Chinese households continue to lack domestic investment options that are readily available and have stable returns, we should expect their exploration into foreign investment to continue to grow. Focusing on one of the most popular investment assets among wealthy Chinese, American real estate, I show that home purchases by Chinese nationals are positively correlated with local US home price growth. Instrumenting for Chinese home purchases using lagged Chinese GDP growth interacted with travel time from China, I demonstrate that Chinese home purchases have a positive and significant causal impact on local US housing

[20] Because the fineness of the pass rate depends on the number of students (e.g., a small school district may only report a range of 80-90 percent of students passing, while a larger one may report a more specific range of 85-90 percent), I construct a score for each district, where a 0 means at least 0 but less than 10 percent of students pass, a 1 means at least 10 but less than 20 percent pass, etc. I then average scores in a county, ignoring school districts that cross county lines (4023 out of 13569 school districts are not confined to a single county).

prices. Moreover, this increase in US housing prices is driven by above-average house bids, consistent with observations that Chinese investors tend to bid aggressively for houses. Using a number of proxy outcomes, I also provide results suggesting that while Chinese investors are not necessarily leaving their houses vacant at a higher rate than their competitors, they are more likely to rent out their houses and less likely to move in, which results in a benefit for renters relative to home purchasers.

That foreign buyers have a real effect on local housing markets suggests that the protective policies that some local governments have been implementing to curb foreign real estate buyers may in fact be based on a substantive problem rather than anecdotally-based fear. Especially given the recent debate surrounding the lack of affordable housing in the US, the fact that forces external to localities may be worsening the housing unaffordability crisis could stoke concern about foreign buyers having a significant impact on the welfare of natives. Local governments will also face a dilemma of how to balance the benefits of increased revenues with the difficulties constituents face in transitioning from renting to owning, as wealthy buyers crowd out locals, drive up prices, and also make renting relatively more appealing through lower rental prices.

However, despite the rise in prices due to foreign buyers, their current level of activity is not enough to price out large swaths of local home buyers. As the number of wealthy individuals in China and other developing countries continues to climb up though, they may increasingly seek out these international options and move their money away from home, and so increasingly both domestic investment and foreign home buyers will be negatively affected by this movement of money. Further development and sophistication of domestic financial asset markets will be instrumental to disincentivize wealth from leaking out the country, and future research should explore push factors in more detail.

Chapter 2

Adaptation to Persistent Climate Shocks: Wind Erosion in Rural China

Abstract

I compare the effects of persistent land degradation to transient rainfall shocks in China on rural labor outcomes. I show that soil moisture remains lowered for several years following land degradation induced by a wind erosion shock, in contrast to the quick recovery from a rainfall shock. I also show that wind-induced degradation causes a persistent shift away from agriculture towards manufacturing and services for rural households, with no such shift for rainfall shocks, suggesting that the longer-term shock makes households reconsider the viability of continuing to focus on agriculture as their main means of income.

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2.1 Introduction

Desertification has been a problem throughout history around the world, as deteriorating land quality hurt agricultural productivity and forced people to relocate. With the increasing severity of climate change in the modern era, it is more and more important to understand the magnitude of impact of aspects of climate change such as desertification. Particularly now, as the world has become increasingly urbanized, desertification may widen the gap between rural and urban living standards/productivity and induce more rural-urban migration. This may have mixed desirability, as though urbanization brings agglomeration effects and added productivity (Brueckner and Lall 2015), rapid urbanization can bring influxes of people to cities that are not equipped to handle such large populations, resulting in slums and low-skilled unemployment (Henderson 2003). Although perhaps low-income countries in sub-Saharan Africa are the first to come to mind when the word "desertification" is mentioned, desertification is currently a major direct threat to countries across the spectrum of development, including countries such as Brazil, Romania, and Spain (Tomasella et al. 2018; Valdivia 2019), on top of causing dust storms that pollute the air in countries that neighbor desertifying regions (Baek et al. 2015), and so understanding the impacts of desertification has broad importance across the globe.

A main driver of desertification and land degradation is wind erosion, as high winds can blow away the thin layer of arable topsoil on croplands, revealing the arid, low productivity soil beneath, and reducing the viability of the land as cropland. The effects of wind erosion differ from the more frequently studied rainfall shocks in that lands affected by wind erosion take significant time to become usable again as cropland, whereas rainfall shocks typically only have transient effects on soil. Thus, households might react differently to a shock if they anticipate its effects will persist. While the direct impact of desertification on household well-being is likely unambiguously negative, through the channel of reducing agricultural

productivity, general equilibrium effects from adaptation may mitigate these effects. For example, desertification could induce a push to less risky or more profitable off-farm livelihood opportunities that might not otherwise have been taken because of inertia or risk-aversion, since the penalty of remaining fully in agriculture will be higher when the effects last longer. If there is a shift to other income sources that are more profitable, the added money could then fund technological investment that could improve agricultural productivity. In addition, selection on ability may induce low-productivity farmers to migrate away, increasing the average ability of farmers in desertified areas. For example, Chari et al. (2018) look at increasing property rights in China, showing that an improvement in property rights allow farmers of low productivity to rent their land to those of higher productivity. In addition, Bryan et al. (2014) show that selection on ability for urban productivity plays an important role in determining who migrates; however, ability for rural productivity is not discussed.

In this paper I study the effects of wind-induced desertification on the outcomes of rural households in China. Using an event study methodology, I show that wind shocks result in a prolonged reduction in soil moisture that takes several years to recover. I go on to show that rural households affected by wind shocks report a persistent decrease in arable land, as well as a reduction in grain outputs. As a result of this, households affected by wind shocks are more likely to persistently shift away from agriculture and towards off-farm wage labor in industries such as manufacturing or services. I do not find any change to temporary migrant labor; however, breaking down the location of migrant labor, I find limited evidence of a substitution away from within-township migrant labor towards labor outside of the township. In contrast, I find that while rain shocks do cause a transient drop in soil moisture, the negative impacts on household agricultural outcomes seem to be weaker and statistically insignificant. However, I still do observe a persistent shift away from agriculture, suggesting that even though the direct effect of rainfall may be transient, the effect may still be persistent if households discover that diversifying labor allocation is a net benefit.

Looking at how temporary migrant labor is affected by climate shocks, I find no effect for either wind shocks or rainfall shocks. In the case of wind shocks though, I do find some evidence of a substitution away from within-township migrant labor towards out-of-township migrant labor; however, this effect appears less persistent than the other impacts from wind shocks. In the case of rainfall shocks though I do not find any shift.

2.1.1 Related literature

While this paper contributes to a rich literature that explores how climate shocks affect migration or uses exogenous variation from climate shocks to predict migration (e.g., Munshi 2003, Barrios et al. 2006, Feng et al. 2012, Henderson et al. 2017), these papers mostly focus on the impact shocks such as temperature or rainfall shocks whose direct effects are transient rather than persistent like desertification; in the event of a shock with a transient effect, households may pursue a temporary measure to smooth over consumption for the season in which the shock occurs, whereas a persistent change may induce households to reoptimize into activities with higher fixed costs (e.g. changing occupation, migrating further, longer-run/permanent migration). This also differs from papers that look at the effect of longer-run climate changes (e.g., Peri and Sasahara 2019) in that in the case of shocks with persistent effects, households can anticipate the persistence of the shock, whereas in the case of, say, lower decadal precipitation, households may need time to be able to distinguish between a series of transient shocks and a longer-run shift, and as a result may not adapt as quickly.

This paper contributes to a small literature on desertification and land degradation, none of which as far as I know examines modern desertification. Hornbeck (2012) shows that counties in high-erosion regions experienced decreases in agricultural land value as well as migration outflows relative to low-erosion regions during the Dust Bowl. Li (2017)

also studies the Dust Bowl, showing that planting trees to prevent wind erosion resulted in increased agricultural revenue as well as a shift towards livestock. Neither paper has dynamic variation in desertification, instead looking at the effects of a singular shock, and so my paper contributes by making use of shocks that vary both geographically and temporally.

This paper also fits into a literature on persistent environmental shocks, most of which focuses on out-migration effects. Boustan et al. (2012) and Boustan et al. (2017) find migration patterns fluctuate in response to natural disasters, but that whether there was a net relative inflow or outflow was inversely related to the amount of government intervention following the disasters. Hornbeck and Naidu (2014) find that the Great Mississippi Flood of 1927 caused a persistent black out-migration from flooded areas, which then resulted in technological modernization in those areas as a result of the drop in low-wage labor supply. Although these papers that look at the effects of natural disasters are related to this paper, natural disasters and desertification differ in that desertification's effects are primarily concentrated in rural agriculture, whereas natural disasters often have negative impacts on infrastructure, both rural and urban. In that sense, my paper is closer related to other papers that look at persistent agricultural shocks. Taraz (2017) shows that farmers in India adapt their irrigation and crop practices in response to medium-run variation in rainfall. Finally, Barsanetti (2021) shows that a transient frost in Brazil severely curtailed coffee production for several years, resulting in a persistent decline in agricultural employment in affected areas as well as substantial out-migration from those areas. I am able to add to these papers by showing a wider variety of adaptation outcomes as well as contrasting the effects of persistent and transient shocks.

Fewer papers examine the link between longer-term climate change and migration. Research on the relationship between climate and urbanization within developing countries typically uses reduced-form cross-country regressions (e.g., Barrios et al. 2006, Brückner 2012) which miss out on important within-country variation. Henderson et al. (2017) make use of

district level data to show a modest effect of decreased moisture on urbanization in more industrialized areas, but like most papers exploring the effect of climate on urbanization, their focus is sub-Saharan Africa where the average level of industrialization is relatively low. Thus, their results may not extend to more industrialized countries due to differences in urban employment opportunities. In particular, high rural-urban migration can be more easily absorbed (and highly demanded) by industries such as services and manufacturing; poor/rural workers can be a huge boon to manufacturing exports by keeping the cost of labor competitively low, as has been seen in more industrialized developing countries such as China, Malaysia, the Philippines, etc. In addition, due to lack of data on migration, Henderson et al. (2017) are only able to show reduced form results on urban populations. With household survey data on migrant labor, I am able to provide more direct evidence on the effects of persistent climate change and migration.

The rest of the paper is organized as follows: Section 2.2 provides background information about general and China-specific desertification, as well as information about rural-urban migration in China. Section 2.3 describes the methodology and data. Section 2.4 shows the results on the effects of wind and rain shocks on household agricultural outcomes, and Section 2.5 summarizes and concludes.

2.2 Background

2.2.1 Desertification

In arid, semi-arid, and dry sub-humid regions, land degradation that results in a loss of vegetation cover is caused by several factors including climatic change and human activities, and is defined as desertification, as per the UN Convention to Combat Desertification. (Feng et al. 2015) Each year, desertification and drought account for US $42 billion loss in food

productivity worldwide. An estimated 32% of the world population is directly or indirectly affected by desertification. (Li et al. 2017) Despite the fact that desertification is one of the most important environmental challenges facing the world today, it is arguably one of the most under-reported.

Although poor farming practices are commonly blamed for desertification, the scientific literature on desertification suggests that direct human activity is not the primary driver of desertification. Geist and Lambin (2004) conclude from a meta-study that common single-factor explanations for desertification such as overworked land by rural dwellers and nomadic populations are not enough to satisfactorily explain variation in desertification, and that the interaction with biophysical factors is a key determinant of desertification. In addition, they note that causes of desertification differ across regions and periods, and that a thorough understanding of causes and underlying forces in a region are necessary in order to properly assess potential policy interventions. Similarly, a meta-analysis of the literature on desertification by Wang et al. (2008) comes to the conclusion that regarding China, "desertification ... is likely to be controlled by climate change and geomorphological processes, even though human impacts have undeniably exacerbated their effects."

Although the severity of the impact of desertification in China has become more prominent over the last few decades, records dating back as early as 1150 BC during the Shang dynasty provide evidence of China's continuous struggle with dust storms originating from the expanding Gobi Desert (Liu et al. 1981). Archeological evidence suggests that dynasties (particularly, dynasties centered in the northern regions of China, where the land more arid and closer to the Gobi Desert, and thus is most susceptible to desertification) flourished when desertification was on the decline and collapsed when deserts expanded. (Wang et al. 2010) These periods of high desertification always coincide with either low temperature or decreased precipitation, both of which decrease vegetation cover that inhibits desertification. In line with Geist and Lambin (2004) and Wang et al. (2008), Wang et al. (2010) suggest

that while human activity does have the potential to exacerbate desertification, it is not the primary driver; rather, they suggest that natural climatic change has been the main force behind desertification throughout China's history, pointing out that the overarching trends in desertification and rehabilitation over the past half-century are not in tandem with proxies for human impacts (e.g., land reclaimed for agriculture, livestock population, etc.) Wang et al. (2010) points to wind as a main source of climate variation that drive desertification. Wind activity plays a major role in desertification in that because large amounts of farmland in China consist of a thin layer of arable topsoil underneath which is dry soil that is difficult to grow crops in,[1] high winds can blow away parts of this topsoil, reducing the agricultural viability of the land. In addition, wind speeds can affect the potential for sand to be transported across long distances, which can further reducing the arability of the land.

2.2.2 Rural livelihood in China

The massive rural labor force that has shifted towards non-farm work such as manufacturing since the beginning of the post-Mao era economic reforms in 1978 has been cited as one of the primary drivers of China's rise as an export powerhouse, and has brought new prosperity to millions of rural Chinese workers. These reforms, such as the shift to the household responsibility system, loosened many restrictions on farmers by allowing them to allocate their labor and produce according to market demand rather than strict central planning. Similarly, as township and village enterprises as well as urban labor markets expanded, more and more agricultural households had access to wage labor opportunities. Accordingly, between 1985 and 1996 nearly doubled from 67 million to 130 million (Zhang et al. 2002),

[1]Several times throughout the past few centuries, previously unfarmed grasslands and loess were converted to farmlands with precarious topsoil conditions, most recently during the Great Leap Forward. (Marks 2017, pp. 331-335)

and between 1987 and 1999 the agriculture share of total income for rural households fell from over a half to under a third (Benjamin et al. 2005).

Part of this shift to off-farm labor includes temporary labor in urban areas. This migration occurs in spite of China's restrictive internal migration policy, known as *hukou* (or household registration) constrains the ability of rural migrants to become permanent urban dwellers. *Hukou* restricts local public services such as education, health care, and housing to people who are registered to live in those localities. The policy also restricts the types of employment available to those who are not registered as residents in a given area. One's *hukou* is determined by the *hukou* of one's parents, and converting from a rural *hukou* to an urban one is extremely challenging, effectively forcing rural dwellers to either stay in rural areas or work as temporary migrants in urban areas. Although there have been some experiments in liberalizing the *hukou* system to allow for greater freedom of movement, these experiments have tended to be short-lived (Kroeber 2016). Temporary migrants, also referred to as China's "floating population," are typically low-educated individuals from rural areas. They tend to work in industrial factories, concentrated in the Pearl River Delta and the Yangtze River Delta[2] but also in the large cities of their native provinces. Because of *hukou* restrictions, migrants typically work in physically demanding, low-skill, or dangerous jobs. Labor-intensive industries in China tend to be major exporters with high export-to-sales ratios.

2.3 Empirical methodology

2.3.1 Data

For climate data, I use the ERA5 dataset from the European Centre for Medium-Range Weather Forecasts (Hersbach et al. 2019). This is a gridded dataset of weather phenomena

[2]Around half of temporary migrants work in one of the two regions; initially more concentrated in the Pearl River Delta, but over time the Yangtze River Delta has begun attracting the larger share

across the globe collected monthly from 1985 to 2003 through remote sensing at fineness of $0.25° \times 0.25°$. I match grids to prefectures and average values within a year for my main analysis. The main variables that I use from this dataset to get climate shocks are the 10 meter wind speed (m/s) and total precipitation (m).

For data on agriculture outcomes, I use the National Fixed-Point Survey (NFS), a panel survey dataset on households in rural China spanning from 1986 to 2008, which is collected by the Research Center of Rural Economy of the Chinese Ministry of Agriculture. Representative villages were chosen across twelve provinces, and in each village households were randomly sampled and then followed across years. In this dataset villages lack geographic identifiers, and so I can only match province-level climate shocks. From this dataset I get information about household agricultural production as well as various labor outcomes. Because the format of the survey changed in 2003 resulting in some key variables such as total days of temporary migrant labor to be removed, for consistency I only use pre-2003 data in my main analysis, although the results remain qualitatively similar if I use the full dataset in analysis of variables for which there is the full span of years.

One limitation of the NFS data is that they do not include information about soil quality, and so to get a proxy result on the effect of climate shocks on soil quality I use data from the ERA5 dataset on soil moisture[3]. In particular, I use the soil moisture measure of percent water volume in soil layer 1 (0 - 7 cm). This soil moisture measure is not limited to farmland, and so will not perfectly capture farmland soil quality, but because farmland soil is often more sensitive to wind erosion than other types of land, studying the effect of wind shocks on overall soil moisture versus farmland soil should produce a more attenuated result rather than an upward bias.

[3]Soil moisture is estimated using a set of partial differential equations combining precipitation, snow melt, bare ground evaporation, and surface water runoff, which also depend on land surface type (e.g., high vegetation, bare ground, etc.) and soil texture (e.g., coarse, fine, loamy), and validated against soil samples. (Balsamo et al., 2009)

In Table 16 I show summary statistics for household outcomes. The most common main household business is agriculture, accounting for over a third of households, although this is just a lower bound of households that derive some income from agriculture since the survey asks households to pick their one main household business. Although agriculture is the industry that households are most likely to be in, many households also derive income from wage work; just above 40 percent of households have some wage income, and the average household wage income is 1687.80 yuan, accounting for just under a quarter of total net household income. Households also commonly supply labor as temporal migrants; about half of households report some positive number of days as migrant laborers, and the total number of days per household averages about a third of a year. This labor is split between within township and outside of township labor, with more labor supplied to outside-township migrant labor. Because of survey changes, the migrant labor question, along with some other questions like fertilizer and seed usage, only began being asked in 1995, and so the number of observations is much lower than for the rest of the variables.

2.3.2 Empirical strategy

Although desertification is driven by natural climatic variation that is plausibly exogenous to any outcomes of interest, other confounding factors may also play a role in desertification, which could bias results. For example, poor agricultural practices such as overgrazing could cause desertification as well as affect agricultural outcomes. Thus, to identify the effect of desertification, I rely on variation from climate shocks, and specifically, wind shocks. Although the effect of wind on soil erosion is well documented in the scientific literature on erosion, for validation it would be ideal to also show the relationship between wind shock and farm soil quality. However, due to data limitations, I do not observe soil quality of farms, and so the best I can do is to look at wind's effect on the average soil moisture in an area.

This should capture the effect of wind erosion, albeit with noise because wind shocks should only affect soil where the soil is sensitive to wind shocks to begin with, such as farm plots with a thin layer of topsoil with dry land underneath, and not soil in general.

It is possible that wind is correlated with other phenomena that have effects on soil moisture. The two that come to mind are rainfall shocks and typhoons. However, rainfall shocks are transient, and so there is no reason to expect to see direct effects on soil quality in post-periods (although there may be persistent effects due to behavioral adaptations such as changes in investments, work, etc.). Typhoons may have persistent effects due to flooding, but this would bias my coefficients downwards, as flooding would increase soil moisture, and so the effect I observe can be taken as a lower bound. As an added check, in some specifications I exclude coastal areas from my regressions, for which I find qualitatively similar results.

The approach I take follows the literature on natural disasters (e.g., Deryugina 2017); what is commonly done is to identify random shocks, and then use an event-study framework using the first shock an area receives as the treatment, such as below:

$$Q_{ipt} = \sum_{\tau=-5,\tau\neq-1}^{5} \beta_\tau W_{ip\tau} + \gamma_{ip} + \delta_t + \varepsilon_{ipt} \tag{2.1}$$

where Q_{it} is the a measure of soil quality in prefecture i, year t, τ is the number of years since the shock, and $W_{i\tau}$ is an indicator for whether area i experienced a shock τ years ago. This approach includes pre-shock terms in order to examine possible issues with pretrends, and I include five years of lags and leads. I normalize the effect in the year prior to the shock to zero, so $\beta_{-1} = 0$. I cluster standard errors at the province level to account for any potential spatial correlation within province as well as to be consistent across regressions where I have prefecture- or province-level variation, although for analyses where I have prefecture-level variation I run the regressions clustering at the prefecture level and find similar results.

Although using the first shock is typical, I instead randomly choose a shock per household

to study. The reason lies with data limitations, in that for the household data, the only geographic identifier available is the province that the household is in, and so the identifying variation I have is at the province-year level. Because of that, if I were to pick the first shock for each household, they will all occur in the same period for all households in the same province, and I will not have a way to differentiate between the effect of the wind shock and a spurious province-level effect that coincides with the year the wind shock occurs since I do not have fine enough variation to also include province-year fixed effects. By choosing shocks randomly per household, I can average out the effects across different shocks per province and avoid misattributing something spuriously correlated to the effect of a wind shock. Importantly, because wind shocks occur randomly and I select them randomly, this selection process should not introduce any bias into the estimation.[4]

2.4 Results

2.4.1 Soil quality

As mentioned previously, because the NFS data do not include farm soil quality measures, to contrast the differences in the persistence of wind versus rain shocks, I look at their effects on surface soil moisture at the prefecture level. Surface soil moisture is measured as the percent of volume of the top seven centimeters of soil that is water. In Figure 5, I show the effect of wind shocks on surface soil moisture. Following the literature on rainfall shocks (e.g., Jayachandran 2006), I use the 80th percentile of wind speeds within an area as the threshold for a wind shock.[5] Using a Cumby-Huizinga test (Cumby and Huizinga, 1992), I find no

[4]Although the large number of households per province should guarantee that the results do not depend on a specific randomization, I verify through re-randomizations that the results remain consistent.

[5]I also test the effect for higher percentile thresholds, and find results that are qualitatively similar but with more noise due to the reduction of total shocks. The figures for these can be made available upon request.

evidence of autocorrelation for wind shocks.[6]

As one can see, a wind shock results in a decrease in soil moisture of 0.75 percentage points in the initial year, followed by a gradual recovery across several years. In contrast, looking at the effect of a rainfall shock in Figure 6, which I define as being in the top 80th percentile of dry years[7], it seems that while there is an initial negative impact, the soil moisture returns to the original level by the next year.

It is possible that wind is correlated with other phenomena other than soil erosion that could affect soil moisture. For example, if a typhoon strikes an area, winds will be higher and the subsequent flooding will affect the soil. However, this would bias the effect in the opposite direction, since flooding would increase soil moisture, and so this should not be spuriously driving the effect I estimate. For robustness though, I also repeat the estimation excluding coastal provinces, and find a qualitatively similar result. I also control for temperature as a possible confounding factor, and also find that it does not seem to explain the observed effects of the climate shocks. Finally, I also examine whether rainfall shocks and wind shocks might confound each other, but find that the correlation between the two shocks is negligible ($\rho = 0.078$).

Although there is no data on soil quality in the household data, households do report the quantity of arable farmland they have. In Figure 7, I show that following a wind shock, there is an extended period of reduced arable land of around four percent, contrasted with Figure 8, where although there is a decrease, it is not statistically significant. The fact that there is no effect of rain on arable land is slightly puzzling given the drop in prefectural soil moisture observed in Figure 6, but could be explained by households being more able to mitigate a low-rain year with manual irrigation of their cropland. Although in this period there is

[6]The test yields a test statistic of $l = 2.483$, and the associated p-value is 0.115.

[7]Specifically, this is defined as being in the lowest 20th percentile of precipitation during the planting season from January to June. I exclude the harvest season, as Li et al. (2002) and Leight et al. (2015) note that in China during the harvest season precipitation can have the opposite effect and be negatively correlated with crop yield, owing to the concentrated nature of rainfall during the season that can actually result in flooding.

no data on field irrigation, starting in 2003 the survey begins asking about irrigation for a subsample of households. For these households, over a third report fully irrigated cropland and only a quarter report no irrigation, and so it seems that at least for this subsample, irrigation take-up is fairly high, although because this question is asked in 2003 this may be a response to previous rainfall shocks.

2.4.2 Agricultural impact

Given that we see that both shocks have a negative effect on soil moisture, the next point of interest should be the direct effect these shocks has on agricultural output. From the NFS data we can observe the impact on outputs that are sensitive to climate shocks. In particular, we would expect the production of grain (wheat, rice, corn, soybeans, and potatoes) to be sensitive to both types of shocks. In 1987, around 40 percent of total household income comes from agriculture, with around three-quarters of that coming from grain sales (Benjamin et al., 2005).

In Figure 9, we do see a decline in the IHS of grain output for several periods, although the second year is insignificant. Although there is a significant drop, it does seem that the $\tau = -1$ output is higher than those of $\tau = -2$ and -3, which seem closer to the values in the post-periods, and so as a test, I bin together the pre-periods and the post-periods and run a simple pre-post regression, i.e.,

$$y_{ipt} = \beta \sum_{\tau=0}^{5} W_{ip\tau} + \gamma_{ip} + \delta_t + \varepsilon_{ipt} \tag{2.2}$$

I estimate an effect of -0.098 (s.e. = 0.026), which is much smaller in magnitude than the average post-period coefficient but still a statistically significant reduction of around 10 percent on average in the five year post period in grain output. On the other hand, Figure 11 shows that for a rainfall shock, like in the case of arable land, for grain output we do see a

drop, but not a statistically significant one.

Looking at other outputs such as vegetables or fruits, I find no significant changes from a wind shock. The only other output where there seems to be any effect is pork (Figure 10). While it may seem that there is no link between pork and wind shocks, pigs are generally fed with grains, and so a decrease in grain output could affect pork production indirectly through an input shock. I find no corresponding effect with rain shocks (Figure 12), which makes sense given the lack of effect on grain output.

2.4.3 Adaptation

Given that wind shocks result in a persistent effect on the grain output, the natural next question is how households respond and adapt to these persistent shocks. I also explore outcomes related to possible ways households might react and adapt to persistent agricultural productivity shocks versus transient ones. One potential response to a productivity shock is to shift inputs to mitigate the effects. However, when I look at changes in seeds used or fertilizer used in Figures 13 and 14, I find that there do not appear to be any significant changes. Information about irrigation only was asked starting in 2003 for six years, and so there are not enough years to do an event study, and so I run a regression comparing the amount of irrigated land in the year of a wind shock to the year prior, but I find no significant change ($\beta = 0.089$, $s.e. = 0.164$)

Another potential response is to shift towards other sources of income. This is particularly relevant during this period since it coincides with China's reform period where agricultural production decision-making was decentralized, and off-farm work opportunities such as township and village enterprises became more available to the rural population (Zhang et al. 2002). In Figures 15 and 17, I show the impacts of wind and rain shocks on an indicator for whether the main family income source is agriculture. I find that there is evidence of a

persistent shift away from agriculture as a result of a wind shock and a rainfall shock, although in the case of the rainfall shock the effect is more marginally statistically significant when running a binned regression due to the pre-period levels being close to the post-period ones excepting $t-1$. That both shocks have a qualitatively similar effect suggests that while the dynamics of the effects of the shocks may differ, they may still result in the same behavioral outcome. This is especially likely if households discover upon temporarily switching out of agriculture that non-agricultural labor allocation is a net improvement because of risk reduction or higher income, and then decide to make that temporary switch permanent.

In line with the shift away from agriculture, I find that household wage income increases following a wind shock in Figure 16. Households facing wind shocks appear to shift most towards manufacturing and service industry labor, as shown in Figures 18 and 20, respectively, but the shifts are much smaller than that of agriculture, and only marginally significant. In Table 17 I show the results from a pre-post regression, and find a small significant increase of 1.25 percentage points for services and 0.2 percentage points for manufacturing, contrasted with the 5.1 percentage point drop in agriculture, suggesting that the shift away from agriculture is not directed disproportionately towards one specific industry. For rainfall shocks, although I don't find any effect on services, from Figure 19 there does appear to be a shift towards manufacturing. However, in a pre-post regression this does not translate to a statistically significant shift.

The literature on rainfall shocks (e.g., Munshi 2003) suggests that temporary migration is a commonly-used means to smooth income in response to a dry spell. In Figure 22 I show that there is no effect of a wind shock on days of temporary migrant labor. However, the survey also asks on top of number of days in temporary migrant labor how many days are outside of the township. I find that there is a marginally significant decrease in within-township migrant labor of 4.91 days ($s.e. = 1.59$) offset almost exactly by an increase in extra-township migrant labor of 4.93 ($s.e. = 2.42$). This result is consistent with other work showing long-distance

migration as a mitigation tool for climate shocks; however, the magnitude of the effect is relatively small and marginally significant, and does not have the consistency of the other results. Thus, while land degradation might be spurring rural-urban migration, it does not appear to be a large driver. In the case of rainfall shocks, I find no effect on migrant labor of any kind; although there is a decrease in out-of-township labor and an increase in in-township labor, neither is significant, binned or unbinned, in contrast with much of the literature on rainfall-induced migration. Given the other power issues with the impacts of rainfall shocks, finding finer exogenous variation will be necessary to determine whether this finding is actually because there is no effect of rainfall on migration.

2.5 Conclusion

Land degradation is a serious issue that agricultural households are facing around the world, partially caused by climatic factors and partially by human activity. In this paper, I highlight the differences between persistent and transient shocks by showing the differences in the effects of wind versus rain shocks, as high winds result in wind erosion of arable topsoil which takes several years to recover in quality, whereas the effect of a year of low rainfall is mostly confined to the year of occurrence. Lacking farm-level soil quality data, I use remote sensing data to confirm that wind shocks result in several years of lowered prefecture-level soil moisture, while a rain shock only affects soil moisture in the year that it occurs.

Looking at household-level outcomes, I find that wind shocks cause a persistent reduction in reported arable land as well as grain output, and subsequently shift the industry of their primary income source away from agriculture and towards wage income sources such as manufacturing and services. Although I do not find a significant drop in land or output for a rainfall shock, I still find a persistent shift away from agriculture, suggesting that transient shocks may still cause similar behavioral shifts as persistent ones if households discover that

the temporary measure they use to smooth consumption is actually preferable to their prior allocation of labor. Although I do find evidence of a substitution from intra-township migrant labor towards extra-township migrant labor in the case of wind shocks, the effect is small and the results are not strong, and likely require better data to get at a more definitive conclusion.

That the effect of a wind shock is a shift away from climate-risky agriculture does not mean that desertification is a wholly positive force. The environmental consequences of desertification cannot be stressed enough, not only because of the damage to local ecosystems but also because of the dust storms that desertification can exacerbate, which can have spread long-range and negatively affect health. In addition, agricultural households do not always thrive in non-agricultural work, and not all households have the same access to off-farm labor opportunities with which to mitigate output shocks.

Chapter 3

The Effects of Immigration Restriction: Evidence from the 1882 Chinese Exclusion Act

Abstract

To examine the effects of restrictive immigration policy, I exploit the natural experiment resulting from the Chinese Exclusion Act in 1882. Instrumenting for Chinese immigrant population using the timing of the Act interacted with pre-Act Chinese immigrant population, I find that the Act resulted in outflows of immigrants from initially high-immigrant population areas. The resulting labor market effects do not seem to have any benefit for natives, and I find evidence that manufacturing productivity is decreased by the outflow. Looking at how the Chinese immigrant population changes, I find evidence that intermarriage with natives increases relative to other immigrants, and Chinese immigrants become less likely to live in ethnic enclaves.

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3.1 Introduction

Understanding the outcomes of race-based migration restrictions at the national level has attracted more attention recently, owing in part from the United States travel ban in 2017 banning the entry of citizens from a number of Muslim-majority countries. Proponents argue that greater restrictions are necessary to protect local workers' jobs and wages, and also cite inability to assimilate into local culture as a reason to prohibit increased immigration. Opponents argue though that immigrants provide much-needed cheaper, younger labor to the labor force that can drive growth and labor demand, and that so-called "inability to assimilate" argument is coded racism.

To better understand the possible implications and effects that this current round of immigration restriction might have, as well as immigration restrictions in general, I examine one of the most prominent travel bans in United States history: the Chinese Exclusion Act. Passed in 1882, the Chinese Exclusion Act was the first national immigration policy that restricted immigration on the basis of origin country, broadly banning Chinese laborers from entering the United States. Like many of the other migration policies that followed it, the Act was brought about in part due to racism, and in part due to the perceived threat of cheap migrant labor stealing low-skilled jobs from Americans. While other immigration restrictions set quotas or literacy tests to limit movement, the Chinese Exclusion Act was a "clean" ban based solely on country of origin that also prohibited free movement even for immigrants who had arrived prior to the policy, providing exogenous variation not only in the timing of the ban but also across counties in the distribution of the Chinese immigrant population. In addition, for almost a half century following the Exclusion Act, there were few changes in immigration policy that affected other groups of immigrants, making it ideal for learning how immigration restriction impacts those who already live in the host country by reducing the number of potential confounding factors.

Determining the effects of immigration is difficult given the potential endogeneity in the timing and location decisions of immigrants. In particular, people may choose to move when wages are higher in the destination country, and may pick locations within the country where employment is plentiful, or forced to live in more affordable, less-developed locations. Any number of potential omitted factors may bias OLS estimates. Thus, I exploit two sources of exogenous variation in immigrant flows. The first is the timing of the Chinese Exclusion Act, which resulted in overall Chinese immigrant outflows irrespective of local idiosyncratic factors. The second is the fact that areas that initially have more Chinese immigrants prior to the Act have greater potential for outflows, simply because the initial number of immigrants upper-bounds the possible number of immigrants who leave.

Instrumenting for Chinese immigrant population using the interaction of initial Chinese population with the timing of the Act, I find no improvements in labor outcomes for natives as a result of the Act in either labor force participation rate or by occupational income score, and in fact I observe a small decrease in occupational income score, meaning that natives shifted into industries with lower pay. In terms of productivity, I find that a reduction in Chinese immigrants as a result of the Act has a negative effect on per acre farm value, proxying for farm productivity. I find no effect for manufacturing wages or total outputs, but I do find that per-worker manufacturing outputs decrease, suggesting both that Chinese immigrants were more productive in manufacturing than counterfactual workers and also that Chinese immigrants may not have been paid fairly given their higher productivity. Looking at the characteristics of immigrants who stay, I also see that stayers are more assimilated on various metrics such as intermarriage and living amongst neighbors of other ethnicities, suggesting that the Act could be successful in reducing cultural distance between groups by pushing out less-assimilated immigrants.

3.1.1 Related literature

This paper adds to a very long literature studying the impact of immigration on a wide range of outcomes, with some papers finding negligible or positive effects on native outcomes (e.g., Butcher and Card 1991; Card 2009b; Ottaviano and Peri 2012; Chassambouli and Peri 2015; Foged and Peri 2016; Sequeira et al. 2017) and others finding negative effects (e.g., Card 2001; Borjas 2003; Borjas 2005). Understanding the impacts of immigration restriction is particularly informative currently, given the recent wave of anti-foreign sentiment in the United States and Europe. However, while the subject of the impact of immigration restriction policies been studied in the past, these papers have primarily focused on outcomes of the immigrants affected (e.g., Chen 2015; Massey 2016). Only very recently has this literature turned to the impact on native and aggregate outcomes (Ager and Hansen 2017; Clemens et al. 2018; Tabellini 2019). Studying the Chinese Exclusion Act offers more breadth to this line of research in that the other restrictions studied were quota-based as opposed to the outright ban that the Chinese Exclusion Act was. This distinction is important in that the effect of future cohorts will differ greatly with a quota system that is likely to attract more skilled and/or productive workers in future waves of migration versus a ban that will make the change in composition of immigrants depend entirely on the selection of out-migrants. Like in the case of in-migration, out-migrants may be selected on various characteristics such as ability or skill; thus, one cannot simply extrapolate the effect of immigration restriction using evidence on the effect of immigration inflows, and indeed, previous research has found that return migrants are negatively selected on skill and employability (Lubotsky 2007; Ward 2017). I also add to this discussion of selection by showing that staying immigrants became more assimilated than immigrants from other countries that were unaffected by the Exclusion Act.

The rest of the paper is organized as follows: Section 3.2 gives historical background on

the events leading up to the Chinese Exclusion Act. Section 3.3 motivates the empirical strategy and discusses the data and econometric framework. Section 3.4 discusses the results on outcomes for natives, productivity, and assimilation of staying immigrants. Section 3.5 offers concluding remarks.

3.2 Historical Background

During the Age of Mass Migration (1850-1913), around 30 million immigrants arrived in the United States, attracted by cheaper travel costs, better working opportunities, and relatively open borders. While most immigrants were European, a small but significant portion of them were also from Asia, primarily from China. Unlike in the case of Europeans, anti-Chinese sentiment developed relatively quickly, with the first restriction on Chinese immigration being enacted in 1882, only about three decades after the first wave of Chinese immigrants came to America.

Concurrent with the beginning of this Age of Mass Migration, China had been going through turmoil. People viewed the government of the Qing dynasty as heavily bureaucratic and corrupt, and saw relatively little opportunity for upward mobility (Chang 2003, pp. 7-9). Most Chinese people during this time were peasants, and only a very small minority were able to attain official positions through China's strict and difficult national examination system. In addition, multiple losses against the British Navy in the Opium Wars (1839-1842, 1856-1860) had left resources depleted and people demoralized with the ability of the government to provide for and protect its citizens. As such, throughout the nineteenth century, a number of rebellions and civil wars occurred, the largest and most well-known being the Taiping Rebellion (1850-1864) (Spence 1990, pp. 168-175).

The chaos of the Taiping Rebellion in the south of China led many Chinese people to

leave China,[1] through the southern port of Guangzhou (known to the West as Canton), to seek a better life abroad. Like their European counterparts, Chinese immigrants were also drawn to America by promises of striking it rich during the Gold Rush (1848-1855). They were also lured by employment opportunities in construction of the Transcontinental Railroad (1863-1869). While the cost of traveling to the United States from China could be four to six times greater than the per capita income in China (Galenson 1984), wages in the United States were significantly greater than those in China (Allen et al. 2009), leading many Chinese to believe there was enough incentive to leave home for America.[2]

Most immigrants from China during this time were young single men who intended to work in America, accumulate wealth, and then return home.[3] Very few Chinese women came to America, since most of the available employment opportunities were in hard manual labor. The industry that employed the most Chinese by far was mining; in 1880, about a quarter of Chinese were employed in some sort of mining. Agriculture and laundering services were the next largest employers of Chinese people, accounting for another ten percent each. Although initially many Chinese came to the US to work on the construction of the First Transcontinental Railroad, its completion in 1869 meant that by 1880 the rail industry only accounted for about 4.5 percent of Chinese employment. In contrast with the Chinese, native citizens had no particular industry that dominated their employment.

Chinese immigrants during this time were in one way or another dependent on the Six Companies, an organization of Chinese merchants in America. (Spence 1990, p. 205) In exchange for organization fees, the Six Companies would arrange for a number of services

[1] Although officially the Chinese government was opposed to its citizens leaving the country, in practice it did very little, if anything, to stop people from leaving.

[2] While on their own Chinese immigrants may have been unable to afford the cost of traveling, families would commonly pool together their money to send one person, often the son, to the United States (Chang 2003, p. 18).

[3] Of those who were married, most of them did not bring their spouses with them. In fact, many villages purposely arranged marriages to wives that would remain in the village, as an extra means of assurance that they would continue to send remittances back home (Chang 2003, pp. 18-19).

for Chinese immigrants, including temporary lodging, basic healthcare, and assurances that their remains would be sent back to China in the event of an untimely death. In addition, for those who did not have the money to make the voyage to America, the Six Companies would loan them the money under a form of labor debt contract.[4] (Cloud and Galenson 1987)

As the main port of entry in the United States on the West Coast was San Francisco, most Chinese people ended up settling in California. Figure 1 shows the Chinese immigrant population in the United States in 1880 by county, where one can see that the Chinese were concentrated on the West Coast, with lower concentrations the further away a county was from San Francisco, and virtually no Chinese people west of the Midwest. Although Chinese people made up a very small percentage of the population in the United States, they were a large minority in California, totalling around nine percent of the Californian population in 1880. In addition, they were the dominant immigrant group in California, making up around a quarter of all immigrants there, followed by the Irish (22%) and the Germans (14%).

Although initially praised for their work ethic, as more and more Chinese arrived and entered the labor force, this praise was soon replaced by resentment. The Chinese were primarily discriminated against during this time because they were typically willing to work for lower wages than natives or European immigrants, breeding resentment among other low-skill workers, both native and foreign, who perceived the Chinese as stealing their jobs and depressing their wages (Chang 2003, pp. 116-7). In addition to discrimination for economic reasons, the Chinese were also viewed as fundamentally culturally different; Chinese people typically were not Christian, spoke little English, dressed in traditional Chinese robes, and wore their hair in the traditional Manchu queue as mandated by the Qing dynasty (Chang 2003, p. 119). These stark differences led many Americans to believe that a so-called "Yellow

[4]The Six Companies had an agreement with steamship companies such that the companies would not sell a ship ticket to a Chinese person unless they could produce a certificate from the Six Companies stating that they had repaid their debt. As most Chinese immigrants during this time intended to return home after accumulating some wealth, this was usually a good enough incentive for people to not run away after coming to America (Cloud and Galenson 1987)

Peril" was threatening western civilization.[5]

In addition to this general xenophobia people had towards Chinese people, Chinese women were singled out as also being overtly lascivious. This misconception stemmed from the fact that the initial male-female ratio was heavily skewed towards males, leading to a number of prostitutes to be imported from China to satisfy the demand for female companionship among the mostly bachelor Chinese men. As these prostitutes were more prominently visible among the small number of Chinese women, a widespread belief grew among Americans that *all* Chinese women were, in fact, prostitutes.[6]

Despite this anti-Chinese sentiment from other workers though, the Chinese were seen as a source of cheap labor by mining companies, especially given the lack of white laborers willing to work in heavy labor at the time. The Chinese were also perceived as being more reliable and diligent than other workers; this was partially due to the fact that Chinese people almost never drank, in stark contrast to, say, the Irish, and so the Chinese rarely had the "blue Mondays" that plagued other workers (Chang 2003, p. 60). In addition, the Chinese were seen a key source of tax revenue. In the early periods of westward expansion, local governments had little money to draw from public funds, and so Chinese people were seen as a valuable source of tax revenue, to the point where they were strategically taxed higher than other workers (Kanazawa 2005). Thus, industries that were heavily reliant on manual labor such as the mining industry tolerated and even supported Chinese immigrants and immigration.

[5]One early proponent of excluding the Chinese, Senator John F. Miller, in a speech to his fellow senators in 1881, called upon them to:

"...[preserve] American Anglo-Saxon civilization without contamination or adulteration ... [from] the gangrene of oriental civilization... Why not discriminate? Why aid in the increase and distribution over ... our domain of a degraded and inferior race, and the progenitors of an inferior sort of men?" (Chang 2003, p. 130)

[6]The American Medical Association conducted a study seeking to link Chinese women to higher rates of venereal disease. Despite finding no substantive evidence to support that hypothesis, the association's president still claimed that "... even boys eight and ten years old have been syphilized by these degraded wretches..." (Chang 2003, p. 123)

Eventually, as public funds stabilized, Chinese immigrants were seen as less and less of an asset, and stoked by increasing xenophobic sentiment exemplified by nativist groups such as the Know-Nothings, Congress passed the Chinese Exclusion Act in 1882, barring all Chinese people from entering the United States without express permission from the Chinese government. In addition to the restrictions on new Chinese immigrants, an amendment to the Act in 1884 expanded the scope of the restriction to include people of Chinese descent, and a further amendment in 1888 prevented those immigrants who had arrived prior to the Act from re-entering the United States if they chose to return home. Finally, on top of travel restrictions, the Act prevented Chinese immigrants from becoming naturalized citizens in the same way that the right had been offered to European immigrants. Thus over less than a ten-year time span, the incentives for immigrants who had immigrated prior to the Act to remain permanently in the United States had been drastically reduced, since they would be unable to visit family back home, and would not be granted the legal rights of naturalization, even if their children were citizens. In addition, given the skewed sex imbalance among Chinese immigrants, it was highly unlikely that the mostly single Chinese men would be able to marry a Chinese wife and have a traditional Chinese family if they stayed in America.

Figure 25 shows the population of Chinese immigrants and non-Chinese immigrants in the United States by year. Prior to the Chinese Exclusion Act, both populations grow in a roughly linear fashion. In addition, the non-Chinese population continues to grow in a roughly linear fashion, while the Chinese population reverses trend. Thus, as a kind of "back-of-the-envelope calculation", I plot a linear prediction of the Chinese population in dotted line using the pre-Act data. Although it is certainly not possible to know whether the Chinese population would have continued to grow in the same trend, or to what extent the change reflected a change in the return rate of old immigrants versus a change in the arrival rate of new immigrants, adding the linear prediction at least gives a sense of how far below trend the Chinese population fell after the Act was passed. In 1890 there is virtually no

growth in immigrant population, suggesting that the influx of immigrants between 1880 and 1882 gets offset by out-migration, and as the years go on the population steadily continues to fall. In Figure 26 I also show the population of immigrants who migrated to the US prior to 1882 by year as a percentage of the 1880 population for Chinese and non-Chinese immigrants. While both fall over time, the Chinese population decreases faster than the non-Chinese population, primarily between 1880 and 1900, consistent with an outflow of Chinese immigrants caused by the Exclusion Act.

While initially a temporary measure for ten years, the Chinese Exclusion Act was renewed for ten more years in 1892 with the Geary Act, and then renewed indefinitely in 1902. During the early 20th century, growing anti-immigrant sentiment developed to the point where a more far-reaching immigration restriction was passed by Congress: the Immigration Act of 1917 imposed a literacy requirement, and also barred Southeast Asians, South Asians, and Middle Eastern people (those from the so-called "Asiatic Barred Zone") from immigrating to the United States. In 1924, a new ban introduced a quota on immigration, and fully banned Asian immigrants. While the Chinese Exclusion Act was repealed in 1943 by the Magnuson Act, strict quotas remained in place and it was not until 1965 that the heavily restrictive quota system of the Immigration Act of 1924 was relaxed by the Immigration and Nationality Act.

3.3 Methods

3.3.1 Empirical motivation

A simple OLS regression of change in Chinese population on economic outcomes such as wages or land value may not produce a causal estimate of the impact of immigrants/immigrant restrictions, because Chinese immigrants may naturally gravitate towards places that have

high wages or productivity, as their main goal was to immigrate to earn wages and not to settle, and so would be unlikely to settle in areas where wages were low. If Chinese immigrants left areas in response to them becoming unproductive (i.e., a reverse causality story), an OLS regression would be unable to differentiate between that explanation and one where Chinese immigrants cause places to be productive.

The instrument that I propose, 1880 Chinese population percentage interacted with a post-Act dummy, attempts to resolve this issue by exploiting the exogenous timing of the implementation of the Chinese Exclusion Act, which caused outflows of Chinese immigrants across the US. The idea behind interacting with the 1880 Chinese population percentage is that areas with initially high Chinese populations have higher potential to lose a larger number Chinese immigrants because their initial Chinese population stock is higher. To see this, suppose that an equal proportion of Chinese immigrants leaves every county. Then, areas with initially higher Chinese immigrants lose more immigrants. Even if it were the case that areas with low Chinese immigrant populations lost larger *proportions* of Chinese immigrants, because of their lower initial levels, it is unlikely that this would translate into higher *levels* of outflows relative to high-population areas.

The primary concern with this identification strategy is the possibility that there is some other factor that affected labor outcomes concurrently with the Chinese Exclusion Act that is correlated with Chinese population share. For example, if other immigrants also stop coming as a response to fear of nationalistic policy, and the location choices of immigrants are correlated, then the coefficient would capture the effects of all immigrants. However, Figure 25 shows that the non-Chinese immigrant population continued to grow at a similar rate following the Chinese Exclusion Act whereas the Chinese immigrant population stalled and then reversed course, suggesting that there was no concurrent immigration response by non-Chinese immigrants. Another possible concern would be that industries that Chinese people were primarily working in faced a shock following 1880 for some reason unrelated

to Chinese immigrants; however, we would expect an industry-wide shock to have uniform effects on industry-level outcomes and not vary based on Chinese population share, which I show in the results to not be the case.

3.3.2 Econometric specification

To determine the effect of an outflow of Chinese immigrants, I run the following regression:

$$y_{ist} = \beta \Delta CP_{ist} + \delta_i + \zeta_{st} + \varepsilon_{ist} \tag{3.1}$$

y_{ist} is the outcome of interest in county i, state s, year t; ΔCP_{ist} is the difference between Chinese population proportion in year t and 1880; δ_i is a county fixed effect, ζ_{st} is a state-by-year fixed effect; ε_{ist} is the error term. Because Chinese immigrants are concentrated on the west coast, I restrict my sample to counties in west coast states (Washington, Oregon, California), although the results are similar with the full sample as well.

To address the endogeneity concerns mentioned in the previous section, I then use the difference-in-difference style instrument of post-Act interacted with pre-Act Chinese population to instrument for the change in Chinese population percentage. I show below the first-stage regression associated with this two-stage least squares estimation:

$$\Delta CP_{ist} = \pi(CP1880_{is} \times 1\{t > 1882\}) + \varphi_i + \xi_{st} + \nu_{ist} \tag{3.2}$$

where $CP1880_{is}$ is the 1880 Chinese population proportion, which is interacted with an indicator for being in the post-Act period.

3.3.3 Data

The demographic data I use come from the U.S. decennial censuses. I use census microdata for the period from 1860 and 1870 compiled by Ancestry.com, a genealogy database, made available by the National Bureau of Economic Research (NBER). For the period from 1880 to 1930, I use census microdata compiled and made available by the Integrated Public Use Microdata Series (IPUMS) (Ruggles et al. 2021). In addition, for outcomes I use county-aggregated census data (Haines 2010) for data on manufacturing outputs and and agricultural census data (Haines, Fishback, and Rhode 2018) for data on farm values[7]. I also use the county-aggregated census data to get aggregated demographic data for 1890, for which census microdata is unavailable.[8]

In Table 18, I show summary statistics of all Chinese immigrants, non-Chinese immigrants, and US-born in 1880. In Panel A, I show demographic characteristics. Compared with both non-Chinese immigrants and US-born, Chinese immigrants are overwhelmingly male. In addition, they are much more likely to live in group quarters and the vast majority are in the labor force, far more than other immigrants, let alone US-born individuals. In Panel B, I restrict the sample to working-age men in the labor force and look at labor characteristics. The three main sectors that Chinese immigrants work in are mining, services, agriculture, and manufacturing, with mining and services being the predominant sectors, accounting for about half the population. Non-Chinese people are also work primarily in agriculture and manufacturing, with a heavy skew towards agriculture, especially for US-born individuals.

[7]The manufacturing census data are unavailable for 1910, and the agriculture data for 1890.

[8]Most of the 1890 census, which would be a useful year of data to have, was destroyed in a fire in 1921. Although some states' population schedules do still exist, California, the predominant destination of Chinese immigrants during this era, is not included among these states.

3.4 Results

3.4.1 Native labor outcomes

In Table 19, I show the results of first-stage regression of the instrument on change in Chinese population percentage. I find that places with initially higher percentage of Chinese population see larger decreases in Chinese population share. I look at county-average native labor outcomes in Table 20 for working-age native males. Panel A shows OLS estimations using equation 3.1, Panel B the reduced form estimation, and Panel C the 2SLS estimation using the instrumenting in 3.2. Although in the census microdata there is no data on employment status, there is data on labor force participation, and in column 1 I show that there is no apparent effect on labor force participation rate, regardless of estimation method. Column 2 looks at the occupational income score, which is the median total income for people in 1950 with the same occupation; using this variable gives a rough proxy for occupational standing. In Panel C I find a positive coefficient, suggesting that a decrease in the Chinese immigrant population from the Exclusion Act resulted in a decrease in the occupational standing of native men. Occupation score is given in hundreds of 1950 dollars, and so the interpretation of the result is that a 1 percentage point decrease in Chinese immigrant county share results in a 18.1 dollar decrease (approximately worth 190 dollars in 2021) in the average of the industry-median total income of workers in that county. Although not insignificant, this shift is not particularly large, amounting to less than 1 percent of the 1880 mean score (15.90, sd = 2.690), and especially so given that the average drop in Chinese population share between 1880 and 1890 was less than 1 percentage point. Nevertheless, this does suggest that the decrease in Chinese immigrant population that the Exclusion Act caused did not have the positive labor effects for natives that the policy's effects had been touted as.

3.4.2 Productivity

Using county-level census data, I show results for the impact of the Exclusion Act on work productivity in agriculture and manufacturing, two industries that Chinese immigrants were commonly employed in. For agriculture, the measure that I have is per acre farm value, which will reflect farm returns. Column 1 of Table 21 shows a positive effect of Chinese immigrants on per acre farm value across all estimation methods, meaning that a decrease in Chinese population causes a decrease in per acre farm value. The mechanism that this effect works through is less straightforward though, as decreases in Chinese population could also affect other factors such as population density of local markets, which would also influence farm values. As for manufacturing, in columns 2 and 3 I find no effect on manufacturing wage or total manufacturing output. In Column 4 though, I do find that manufacturing output per worker is negatively affected by a decrease in the share of Chinese immigrants, suggesting a decrease in efficiency. The fact that wages remain constant despite a decrease in efficiency is surprising, but could be explained if Chinese workers were more efficient but not fairly compensated for their work, and following the Exclusion Act manufacturing companies substituted for Chinese workers using less efficient non-Chinese workers in higher quantities to produce a similar amount of output.

3.4.3 Selection of out-migrants

Although it does not seem to be the case that the Chinese Exclusion Act was successful in improving labor outcomes for natives, it is still possible that the Act was successful in terms of reducing cultural tensions if the remaining Chinese immigrant population became more assimilated, either actively or by inducing outflows of less assimilated Chinese immigrants. To better understand these potential social impacts, I use individual-level census data to explore how stayers and leavers differ. For this, I use individual-level census microdata of

immigrants in the United States. The set-up I use is a difference-in-difference approach, where the treatment group is Chinese immigrants, and the after-period is the years after the Chinese Exclusion Act is passed. The relevant control group is non-Chinese immigrants, who were not subject to immigration restrictions . To control for cohort effects from new non-Chinese immigrants entering the sample, I restrict my sample of interest to immigrants who immigrated to America in or before 1882, the year the Exclusion Act was passed.

In regression form, this would be:

$$y_{ijcst} = \beta(Ch_{ijcst} \times Post_t) + X_i'\Gamma + \delta_j + \zeta_c + \eta_{st} + \varepsilon_{ijcst} \tag{3.3}$$

where y_{ijcst} is the outcome of interest for person i from country j who is observed in county c, state s, and year t. Ch_{ijcst} indicates whether a person was born in China, and X_i is a vector of covariates; the census microdata do not match individuals across years, and so instead of a panel I have a repeated cross-section of immigrants, and so in lieu of individual fixed-effects I control for various individual-level characteristics such as age, sex, and urban/rural. Because the treatment is a policy that varies based on nationality, I cluster standard errors by country of origin.

Thus, β gives a difference-in-difference estimate: the average outcome for Chinese immigrants as compared to the pre-Act period, relative to the control group made up of non-Chinese immigrants. Interpreting coefficients from difference-in-difference regressions as causal effects though relies on the assumption of parallel trends; that is, that the treatment and control groups would have had similar trends in outcomes over time had the Act not been passed. However, the outcomes that I look at are not available in earlier rounds of the census prior to 1880, and so I cannot verify the existence of any pre-trends. Regardless of causality though, it is still informative to see to what extent Chinese immigrant stayers became assimilated relative to other immigrants.

Given the negative views and inflammatory rhetoric used against the Chinese during this period, a potential source of concern is that the estimates of β would pick up not only the effects of the Chinese Exclusion Act, but also changing attitudes towards Chinese people as a result of increased racism. To address this, I also run a regression including a dummy for being Asian[9] interacted with the post-period. That is,

$$y_{ijcst} = \beta^C(Ch_{ijcst} \times Post_t) + \beta^A(As_{ijcst} \times Post_t) + X_i'\Gamma + \delta_j + \zeta_c + \eta_{st} + \varepsilon_{ijcst} \qquad (3.4)$$

The interpretation of β^C is then the change in outcome for Chinese immigrants after the Exclusion Act, relative to other Asian immigrants. Essentially, the control group becomes non-Chinese Asian immigrants, and the inclusion of non-Asian immigrants in the sample is to add precision on the overall year fixed effects and state-by-year fixed effects. One thing to note is that the effects through the Exclusion Act will be a combination of a selection effect (e.g., stayers are more assimilated than leavers) plus an adaptive effect (e.g., stayers are motivated to actively assimilate), which I cannot differentiate between.

The first outcome that I look at in Table 22 is whether a household with a serial number 1 greater or lower is headed by someone of the same ethnicity as an individual.[10] This approach follows Logan and Parman (2017), who show that household serial number in census data reflects the order in which households were surveyed, suggesting that households with adjacent serial numbers are highly likely to be neighbors, or at least in the same neighborhood. Thus, this variable acts as a proxy for whether someone lived in an ethnic enclave, and I find in Column 1 that there is a significant reduction in this outcome. Another proxy for ethnic enclaves I look at is an indicator for whether an individual lived in group quarters, as group

[9]I only classify immigrants from East Asian and Southeast Asian countries as "Asian", as the physical appearance of South Asian immigrants tends to be much more different from Chinese immigrants than East and Southeast Asian immigrants. This definition does not significantly change the results.

[10]Without the 100 percent 1900 census data though, I cannot calculate this for 1900, which is why the number of observations is lower.

quarters were common among temporary laborers. I find here, too, that there is a reduction in Chinese immigrants who live in group quarters, although surprisingly the reduction is much smaller than that of Column 1. Looking at the raw numbers, I find that what is happening is that for other Asians, there is an increase in same-country neighbors as well as group quarter status, although the increase in group quarter status is smaller than that of same-country neighors. In contrast, for Chinese immigrants there is a relatively uniform drop in both these outcomes. In Table 23 I run the regression in Equation 3.3 instead, and still find that there is a reduction for both of these ethnic enclave outcomes, but that they are much closer to each other than when running Equation 3.4.

The law did not grant rights to Chinese immigrants who married natives, and in fact, it was possible for a native to lose their citizenship under miscegenation laws. Nevertheless, intermarriage between Chinese immigrants and whites following the implementation of the Chinese Exclusion Act was common enough that it received coverage in newspapers (although it was usually negative coverage) and was depicted even in cartoons and plays. (Chang 2003, pp. 110-112) In Column 3 of Table 22, I look at outcomes relating to intermarriage. Although my data do not indicate pairs of married people in general, it does indicate who is the spouse of the household head for each household. Thus I can at least look at the rate of intermarriage for household heads. Since Chinese household heads (and household heads in general) are almost all male, I restrict my sample to male household heads. I find that there is an increase in intermarriage with native wives relative to other Asian immigrants. However, I find a negative effect in Column 3 of Table 23, meaning that relative to all other immigrants, Chinese immigrants were actually less likely to intermarry, which could indicate that while Chinese immigrants were upwardly mobile relative to other immigrants, race was still an impeding factor to social integration.

3.4.4 Possible confounders

Concurrent changes in immigration or immigration policy to other immigrant groups could bias my results, which is why I only analyze results up to 1920, before the Immigration Act of 1924. One change in immigration policy that could potentially affect the results is the Gentlemen's Agreement. An informal agreement between the Japanese and American governments, the Gentlemen's Agreement was created in 1907 whereby the American government would not restrict Japanese immigration to America in exchange for the Japanese government discontinuing issuing passports to its citizens. However, since this agreement did not have any effect on those who already possessed passports, such those who had immigrated to America prior to the Chinese Exclusion Act (i.e. the sample of interest), the agreement should have no direct effect on the results.

Another possible confounding effect could come from Chinese immigrants differing from other Asian immigrants, particularly in terms of human capital and/or skill. While demographically Chinese immigrants seem somewhat close to other Asian immigrants, census data does not consistently report education or literacy. During this period, most Asian countries, including China, did not have widespread literacy and education. The exception was Japan; efforts to modernize the country following the Meiji Restoration (1868) increased the level of human capital among the Japanese through education reform, which may have altered the composition of workers coming to the United States. However, within the first decade of the Restoration, there would be few adults who would have been able to take advantage of the increased availability of modernized education.[11] Thus, I argue that the results should not be directly affected by this channel.

One change in *Chinese* immigration following the Exclusion Act that could affect the

[11] An ideal robustness check would be to restrict the sample to those who immigrated prior to 1868; however, this would be an extremely small sample that would eliminate virtually all the Japanese. Another possible check would be to exclude the Japanese from the sample, but given that Japanese are the main non-Chinese Asian group, this would suffer from the same small sample issue.

results was the 1906 San Francisco earthquake. A fire that resulted from the earthquake destroyed public birth records, making it possible for Chinese immigrants in the United States to claim that they were actually citizens. Although I do not have any data on citizenship claims, the fire would only affect the results if there was selection on which people took advantage of the fire to claim citizenship, and subsequently exit the analysis sample. In addition, this would not affect the results for 1900. If I only consider results significant for those variables whose coefficients have significant results in 1900, this changes the conclusions for very few outcome variables. I interpret this relative consistency of the coefficients to mean that the bias from selection from citizenship claims is negligible.

One exception to the Chinese Exclusion Act was that it did not initially restrict immigration to Hawaii, since in 1882 Hawaii was not even a territory of the United States. Only until Hawaii became an official American territory in 1898 did the Exclusion Act extend to it. This still occurs prior to the first post-period, 1900, so it should not drastically affect the results, but as an added robustness exercise I exclude Hawaii from my sample of analysis, and find that the results remain qualitatively unchanged.[12]

3.5 Conclusion

I study the effects of immigration restriction using the historical natural experiment arising from the 1882 Chinese Exclusion Act. I find that the Chinese Exclusion Act not only stemmed the flow of immigrants from China to the US but also induced Chinese immigrants to leave. Using the fact that areas with initially high proportions of Chinese immigrants were more likely to see outflows, I instrument for Chinese immigrant population using the timing of the Act interacted with pre-Act Chinese immigrant population. I find that agricultural productivity, as proxied by farm values, declines as a result of outflows, and also find that

[12]Tables can be made available upon request.

per-worker manufacturing output declines. That manufacturing wages do not also fall in response to a decline in worker productivity suggests that Chinese workers may not have been fairly compensated for their labor. I also examine what characteristics predict staying, and find that the population of staying Chinese immigrants become more assimilated Chinese post-Act, which could suggest that cultural division could be a significant factor driving immigrants to leave.

That the productivity of sectors reliant on Chinese immigrants drop as a result of the Exclusion Act suggests that while successful in pushing out Chinese immigrants from the labor market, economically the Act may have also worked against the workers it was meant to help. On the other hand, the restrictions could have helped in reducing ethnic tensions by increasing the proportion of immigrants who were more assimilated if cultural differences were a significant factor in anti-immigrant attitudes. Follow-up work should investigate attitudes towards immigrants.

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Appendices

Figure 1: $t-1$ Chinese growth and percent change in yuan-dollar exchange rate

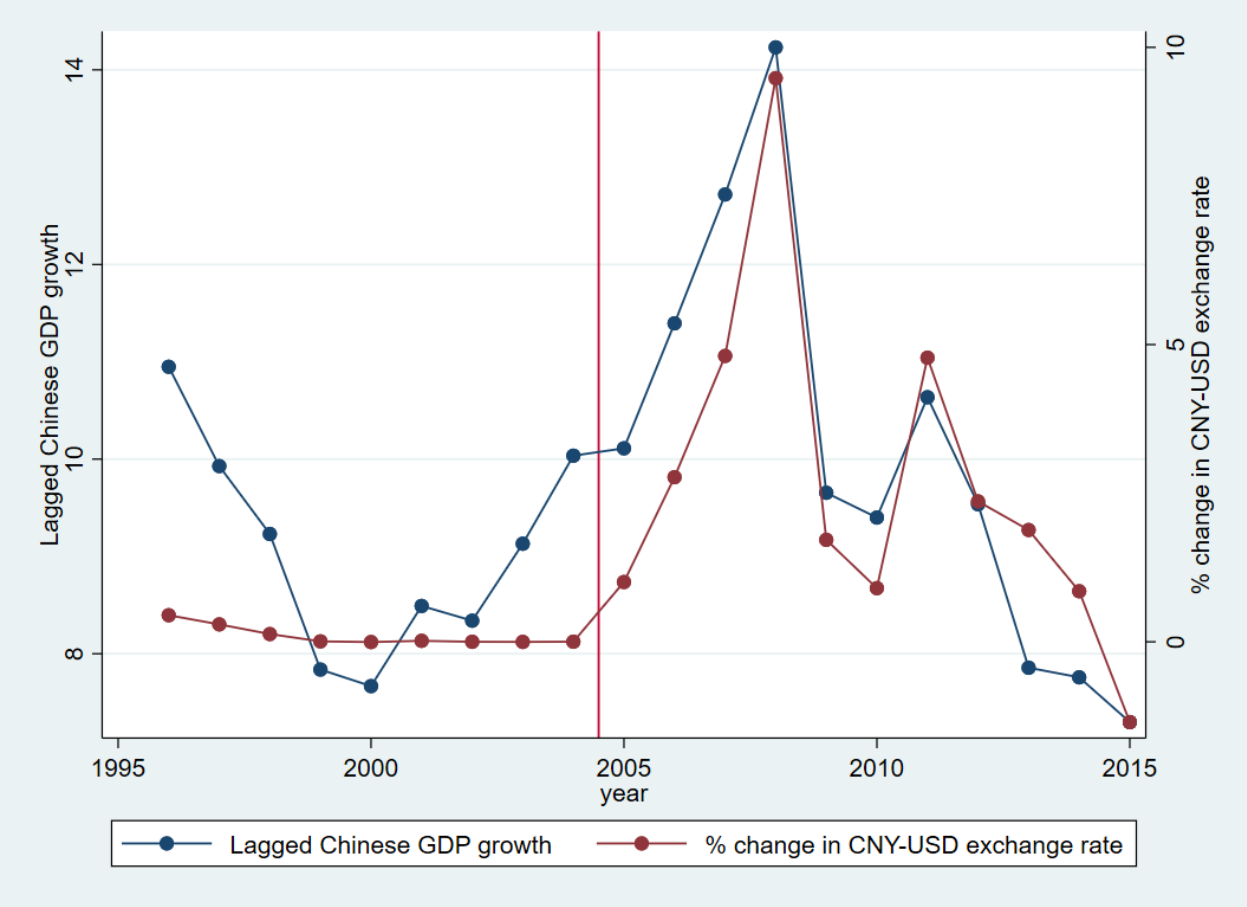


Figure 2: Relation between lag Chinese growth and variables related to Chinese capital outflows

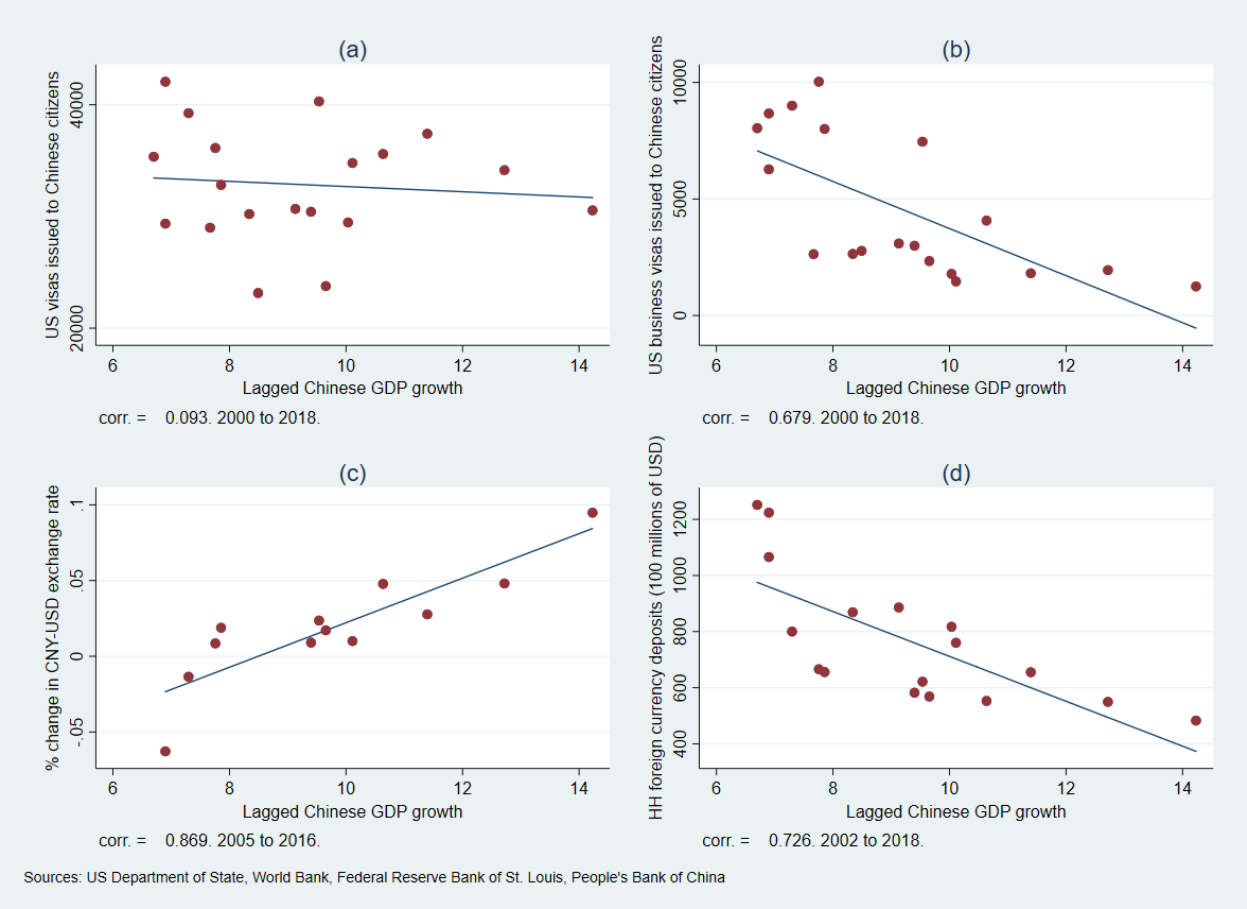
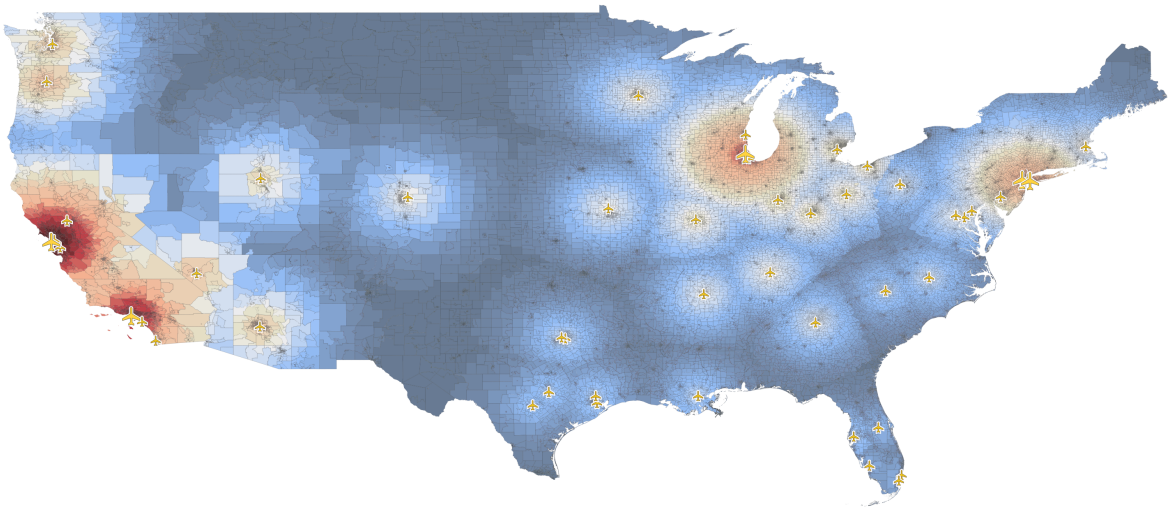


Table 1: Summary statistics

	Mean	Standard deviation
Home price growth	1.286	9.469
Chinese home purchase share (%)	0.913	2.590
Annual wage (county)	43.87	11.09
Unemployment rate (county)	6.801	2.626
Manufacturing share (%) (county)	10.56	6.925
Population (county)	10.08	18.89

Wage is in $1,000s of dollars. Population is in 100,000s.

Figure 3: Travel time from China, 2005



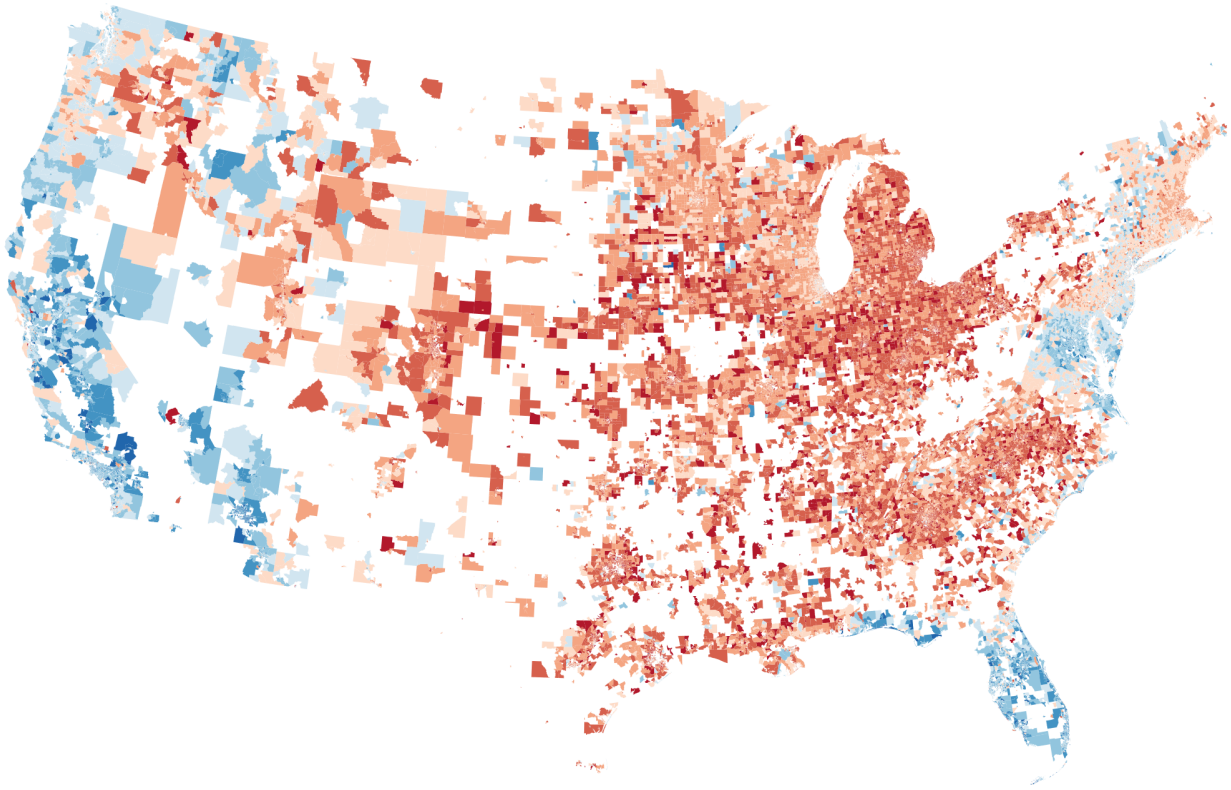
Note: Red shades indicate shorter times and blue shades indicate longer times

Table 2: "Difference-in-difference" instrument validation

Lag Chinese growth x travel time	0.037***
	(0.001)
Lag Chinese growth	-0.697***
	(0.016)
Travel time x 10 (hrs.)	-0.125***
	(0.003)
Number of observations	469780

* p < .1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses, clustered at the census tract level.

Figure 4: House price index growth, 2005



Note: Darker shades indicate larger magnitudes. Red tracts have negative growth while blue tracts have positive growth.

Table 3: Effect of Chinese home purchase share on home price growth

	Dependent variable: HPI growth		
	(1)	(2)	(3)
Panel A: OLS			
Chinese home purchase share	0.088***	0.076***	0.076***
	(0.008)	(0.008)	(0.008)
Panel B: Reduced form			
Lag Chinese growth x travel time	0.323***	0.315***	0.315***
	(0.004)	(0.005)	(0.005)
Panel C: Two-stage least squares			
Chinese home purchase share	10.34***	17.41***	17.40***
	(0.320)	(0.889)	(0.889)
Local labor market covariates		✓	✓
Manufacturing share			✓
Tract & year FEs	✓	✓	✓
Region-by-year FEs	✓	✓	✓
Kliebergen-Paap F-statistic	1130.8	401.1	400.8
Number of observations	469780	469780	469780

* p < .1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses, clustered at the census tract level. Each cell represents a coefficient from a separate regression. Chinese home purchase share is equal to the number of homes whose purchaser has a Chinese last name divided by total purchases times 100. Local labor market covariates include population, employment rate and average annual wage, at the county level.

Table 4: Effect of $t-1$ Chinese GDP growth interacted with distance to direct-flight airport on Chinese home purchase share, OLS (First stage)

	Dependent variable: Chinese home purchase share		
	(1)	(2)	(3)
Lag growth x travel time	0.031***	0.018***	0.018***
	(0.001)	(0.001)	(0.001)
Local labor market covariates		✓	✓
Manufacturing share			✓
Tract & year FEs	✓	✓	✓
Region-by-year FEs	✓	✓	✓
Number of observations	469780	469780	469780

* p < .1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses, clustered at the census tract level. Each cell represents a coefficient from a separate regression. Chinese home purchase share is equal to the number of homes whose purchaser has a Chinese last name divided by total purchases times 100. Local labor market covariates include population, employment rate and average annual wage, at the county level.

Table 5: Effect of Chinese home purchase share on home price growth, 2SLS: Instrument robustness checks)

	Dependent variable: HPI growth			
	(1)	(2)	(3)	(4)
Chinese home purchase share	17.40***	15.17***	17.04***	16.59***
	(0.889)	(0.841)	(0.872)	(0.960)
Instrument:				
Lag growth X travel time	✓			
Lag growth X travel time & lag growth X squared travel time		✓		
Lag growth X log travel time			✓	
Chinese business visas X travel time				✓
Local labor market covariates	✓	✓	✓	✓
Manufacturing share	✓	✓	✓	✓
Tract & year FEs	✓	✓	✓	✓
Region-by-year FEs	✓	✓	✓	✓
Kleibergen-Paap F-statistic	400.8	200.7	397.5	318.2
Number of observations	469780	469780	469780	469780

* $p < .1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses, clustered at the census tract level. Each cell represents a coefficient from a separate regression. Chinese home purchase share is equal to the number of homes whose purchaser has a Chinese last name divided by total purchases times 100. Local labor market covariates include population, employment rate and average annual wage, at the county level.

Table 6: Effect of Chinese home purchase share on home price growth, including US trading partner covariates, 2SLS (instrument: $t-1$ Chinese GDP growth interacted with travel time)

	Dependent variable: HPI growth			
	(1)	(2)	(3)	(4)
Net Chinese home purchases	19.27***	19.08***	18.56***	18.93***
	(1.070)	(1.042)	(1.007)	(1.039)
Lag USA growth x state FE	✓			
Lag JPN growth x state FE		✓		
Lag CAN growth x state FE			✓	
Lag MEX growth x state FE				✓
Local labor market covariates	✓	✓	✓	✓
Manufacturing share	✓	✓	✓	✓
Tract & year FE	✓	✓	✓	✓
Region-by-year FE	✓	✓	✓	✓
Kliebergen-Paap F-statistic	338.4	350.8	355.2	347.8
Number of observations	469780	469780	469780	469780

* p < .1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses, clustered at the census tract level. Each cell represents a coefficient from a separate regression. Chinese home purchase share is equal to the number of homes whose purchaser has a Chinese last name divided by total purchases times 100. Local labor market covariates include population, employment rate and average annual wage, at the county level.

Table 7: Effect of Chinese home purchase share on home price growth, 2SLS (instrument: $t-1$ Chinese GDP growth interacted with travel time): Industry wage share robustness

	Dependent variable: HPI growth		
	(1)	(2)	(3)
Net Chinese home purchases	17.40***	17.41***	17.61***
	(0.889)	(0.887)	(0.908)
Information share of wages		✓	
Telecommunication share of wages			✓
Local labor market covariates	✓	✓	✓
Manufacturing share	✓	✓	✓
Tract & year FEs	✓	✓	✓
Region-by-year FEs	✓	✓	✓
Kliebergen-Paap F-statistic	400.8	401.6	392.0
Number of observations	469780	469780	469780

* p < .1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses, clustered at the census tract level. Each cell represents a coefficient from a separate regression. Chinese home purchase share is equal to the number of homes whose purchaser has a Chinese last name divided by total purchases times 100. Local labor market covariates include population, employment rate and average annual wage, at the county level.

Table 8: Effect of Chinese home purchase share on home price growth, 2SLS (instrument: $t-1$ Chinese GDP growth interacted with travel time): Outlier robustness

	Dependent variable: HPI growth				
	(1)	(2)	(3)	(4)	(5)
Net Chinese home purchases	17.31***	18.20***	18.92***	22.96***	13.24***
	(0.879)	(0.944)	(0.992)	(1.577)	(0.649)
5 mile radius x year FE	✓				
10 mile radius x FE		✓			
25 mile radius x FE			✓		
40 mile radius x FE				✓	
Recession x state FE					✓
Local labor market covariates	✓	✓	✓	✓	✓
Manufacturing share	✓	✓	✓	✓	✓
Tract & year FEs	✓	✓	✓	✓	✓
Region-by-year FEs	✓	✓	✓	✓	✓
Kliebergen-Paap F-statistic	405.2	387.1	381.5	218.1	442.2
Number of observations	469780	469780	469780	469780	469780

* p < .1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses, clustered at the census tract level. Each cell represents a coefficient from a separate regression. Chinese home purchase share is equal to the number of homes whose purchaser has a Chinese last name divided by total purchases times 100. Local labor market covariates include population, employment rate and average annual wage, at the county level.

Table 9: Heterogeneous treatment effect of Chinese home purchase share interacted with average county wage on home price growth, 2SLS (instrument: $t-1$ Chinese GDP growth interacted with travel time and wage)

	Dependent variable: HPI growth	
	(1)	(2)
Chinese home purchase share	17.40***	24.20***
	(0.889)	(1.256)
Chinese share x average wage (10000s)		-1.649***
		(0.111)
Local labor market covariates	✓	✓
Manufacturing share	✓	✓
Tract & year FEs	✓	✓
Region-by-year FEs	✓	✓
Kleibergen-Paap F-statistic	400.8	111.5
Number of observations	469780	469780

* p < .1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses, clustered at the census tract level. Each cell represents a coefficient from a separate regression. Chinese home purchase share is equal to the number of homes whose purchaser has a Chinese last name divided by total purchases times 100. Local labor market covariates include population, employment rate and average annual wage, at the county level.

Table 10: Effect of Chinese home purchase share on tax revenues

	Property tax rev.	Sales tax rev.
	(1)	(2)
Panel A. OLS		
Chinese sale pct.	2.391**	0.380*
	(1.099)	(0.203)
Panel B. Reduced form		
Lag growth x travel time	0.574***	0.063**
	(0.129)	(0.027)
Panel C. 2SLS		
Chinese sale pct.	89.15***	1.041
	(18.97)	(2.413)
Local labor market covariates	Yes	Yes
Manufacturing share	Yes	Yes
County and year FEs?	Yes	Yes
Region-by-year FEs?	Yes	Yes
Kliebergen-Paap F-statistic	16.60	16.60
Number of observations	19089	19089

* p < .1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses, clustered at the county level. Tax revenues are in 10000s of dollars. Local labor market covariates include population, employment rate and average annual wage.

Table 11: Effect of Chinese home purchase share on rental prices

	Avg. rent - 0bd	Avg. rent - 1bd	Avg. rent - 2bd	Avg. rent - 3bd	Avg. rent - 4bd
	(1)	(2)	(3)	(4)	(5)
Panel A. OLS					
Chinese sale pct.	1.192*	1.555**	2.006**	2.532**	3.628***
	(0.667)	(0.660)	(0.828)	(1.114)	(1.379)
Panel B. Reduced form					
Lag growth x travel time	-0.634***	-0.270*	-0.236	-0.091	-0.008
	(0.158)	(0.160)	(0.244)	(0.368)	(0.481)
Panel C. 2SLS					
Chinese sale pct.	-176.1***	-51.65	-38.94	13.02	44.32
	(61.54)	(52.61)	(77.99)	(117.8)	(155.1)
Local labor market covariates	Yes	Yes	Yes	Yes	Yes
Share manufacturing	Yes	Yes	Yes	Yes	Yes
County and year FEs?	Yes	Yes	Yes	Yes	Yes
Region-by-year FEs?	Yes	Yes	Yes	Yes	Yes
Kliebergen-Paap F-statistic	14.28	14.28	14.28	14.28	14.28
Number of observations	24479	24479	24479	24479	24479

* $p < .1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses, clustered at the county level. Local labor market covariates include population, employment rate and average annual wage.

Table 12: Effect of Chinese home purchase share on home price growth and homelessness

	Dependent variable		
	HPI growth	Overall homeless	Unsheltered homeless
	(1)	(2)	(3)
Panel A: OLS			
Chinese home purchase share	0.0773	37.90	-107.2
	(0.170)	(157.8)	(79.88)
Panel B: Reduced form			
Lag Chinese growth x travel time	0.295**	25.83	3.991
	(0.117)	(25.46)	(15.28)
Panel C: Two-stage least squares			
Chinese home purchase share	7.704**	801.7	122.1
	(3.129)	(767.8)	(470.2)
CoC & year FEs	Yes	Yes	Yes
Kliebergen-Paap F-statistic	10.66	9.873	10.07
Number of observations	4188	3376	3335

* p < .1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses, clustered at the continuum-of-care level. Each cell represents a coefficient from a separate regression. Chinese home purchase share is equal to the number of homes whose purchaser has a Chinese last name divided by total purchases times 100.

Table 13: Effect of Chinese home purchase share on home price growth and home vacancy rates

	Dependent variable	
	HPI growth	Owned-home vacancy rate
	(1)	(2)
Panel A: OLS		
Chinese home purchase share	-0.585*	-0.039
	(0.295)	(0.058)
Panel B: Reduced form		
Lag Chinese growth x travel time	0.564***	0.000
	(0.093)	(0.013)
Panel C: Two-stage least squares		
Chinese home purchase share	15.87***	0.012
	(3.132)	(0.278)
MSA & year FEs	✓	✓
Kliebergen-Paap F-statistic	37.84	37.84
Number of observations	722	722

* p < .1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses, clustered at the MSA level. Each cell represents a coefficient from a separate regression. Chinese home purchase share is equal to the number of homes whose purchaser has a Chinese last name divided by total purchases times 100.

Table 14: Effect of Chinese home purchase share on proxy outcomes

	Megawatt-hours	Car registrations
	(1)	(2)
Panel A. OLS		
Chinese sale pct.	13.31	-5.099
	(12.83)	(3.187)
Panel B. Reduced form		
Lag growth x travel time	-1.041	-0.140
	(1.105)	(0.164)
Panel C. 2SLS		
Chinese sale pct.	-54.80	-7.168
	(60.54)	(7.484)
Local labor market covariates	Yes	Yes
Manufacturing share	Yes	Yes
State and year FEs?	Yes	Yes
Region-by-year FEs?	Yes	Yes
Kliebergen-Paap F-statistic	6.864	6.864
Observations	520	520

* $p < .1$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses, clustered at the state level. Each cell represents a coefficient from a separate regression. Chinese home purchase share is equal to the number of homes whose purchaser has a Chinese last name divided by total purchases times 100. Local labor market covariates include employment rate and average annual wage, at the state level.

Table 15: Differential Chinese purchase rates

	Dependent variable: Chinese sales percentage			
	(1)	(2)	(3)	(4)
Instrument	0.000406***	0.000383***	0.000379***	0.000340***
	(0.0000212)	(0.0000212)	(0.0000194)	(0.0000413)
Instrument x Property tax rate	0.00000179***			
	(0.000000657)			
Instrument x Income tax rate		0.00000263***		
		(0.00000100)		
Instrument x Math			-0.00000169	
			(0.00000178)	
Instrument x RLA				0.00000209
				(0.00000165)
Tract & year FEs?	Yes	Yes	Yes	Yes
Region-by-year FEs?	Yes	Yes	Yes	Yes
Number of observations	450006	450006	462972	468827

* p < .1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses, clustered at the tract level. Each column represents a coefficient from a separate regression. The instrument is lagged Chinese growth interacted with travel time. Math and RLA are the average county Common Core math and English exam pass rate, respectively. Property tax is the average property tax rate from the 2010-2014 ACS. Income tax rate is the maximum state income tax rate.

Table A1. GDP growth of major US trading partners

	CHN	CAN	MEX	JPN	USA
CHN	1.000				
CAN	0.196	1.000			
MEX	0.250	0.894	1.000		
JPN	0.164	0.853	0.874	1.000	
USA	0.063	0.861	0.858	0.868	1.000

Each cell contains the correlation coefficient between the GDP of the row and column countries, for the period between 2005 and 2015.

Table 16: Summary statistics

Variable	Mean	Standard deviation	Number of observations
Working arable land (mu)	5.884	9.947	93825
Main household business - agriculture	0.362	0.481	93826
Main household business - manufacturing	0.024	0.154	93826
Main household business - services	0.037	0.189	93826
Main household business - construction	0.008	0.088	93826
Main household business - transportation	0.020	0.140	93826
Output - grain (kg)	2135.0	3257.5	93825
Output - pork (kg)	117.5	575.5	93826
Wage income (yuan)	1687.8	5821.7	93824
Total household net income (yuan)	7756.2	14616.9	93826
Fertilizer purchased (kg)	491.4	2104.1	44275
Seeds used (kg)	36.62	73.90	44281
Days temporary migrant labor	113.1	201.3	44274
Days temporary migrant labor - in township	42.14	133.3	44274
Days temporary migrant labor - out of township	70.96	158.5	44275

Table 17: Effect of wind shock (80th percentile) on labor outcomes

	Main industry: agriculture	Main industry: manufacturing	Main industry: services	Main industry: construction	Main industry: transportation	Wage income
	(1)	(2)	(3)	(4)	(5)	(6)
Post-wind shock	-0.0507**	0.00592**	0.0125*	0.00144	0.00251	404.8**
	(0.0181)	(0.00242)	(0.00634)	(0.00130)	(0.00208)	(155.3)
Year FE?	Yes	Yes	Yes	Yes	Yes	Yes
Household FE?	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	93826	93826	93826	93826	93826	93824

Standard errors in parentheses, clustered at the province level. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Figure 5: Effect of wind shock (80th percentile) on surface soil moisture

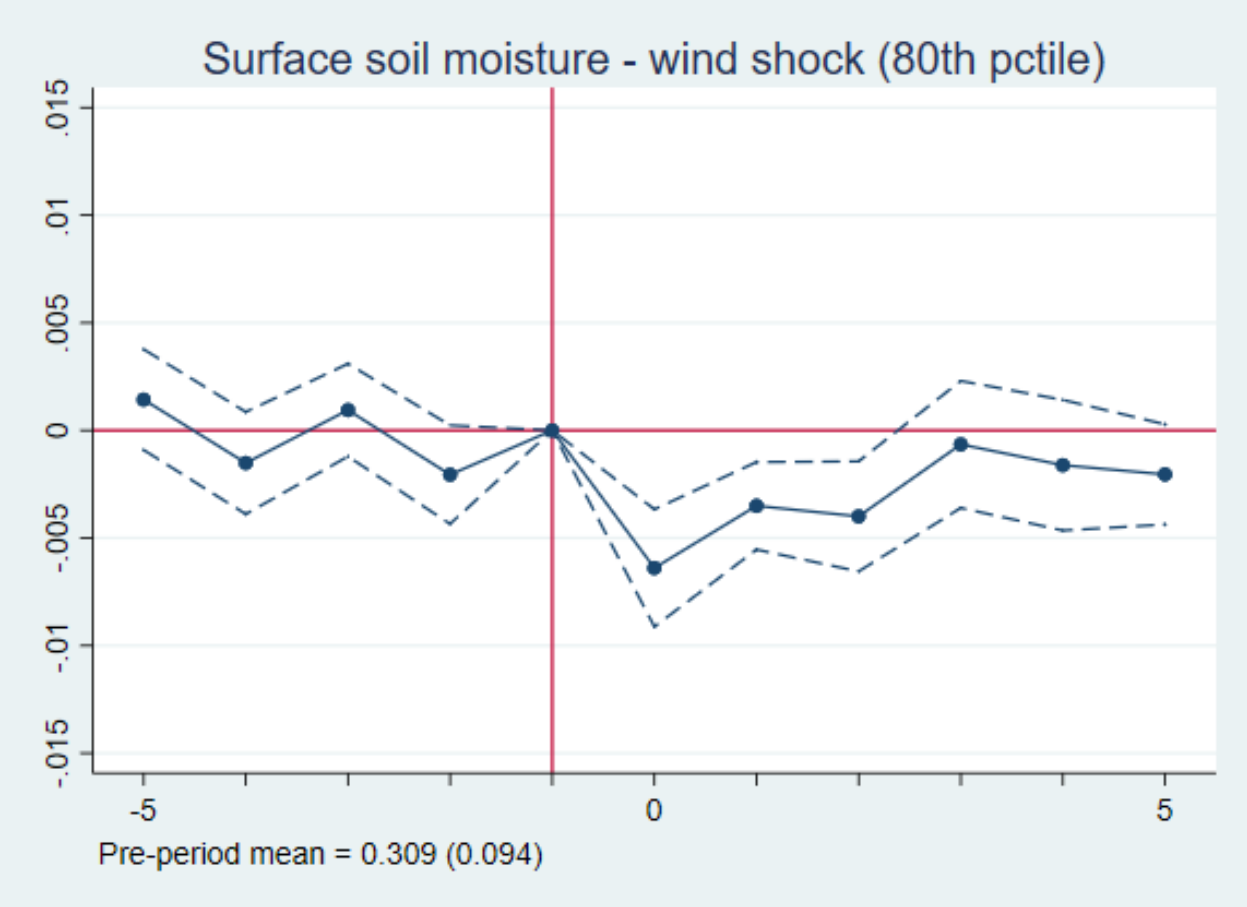


Figure 6: Effect of rainfall shock (80th percentile) on surface soil moisture

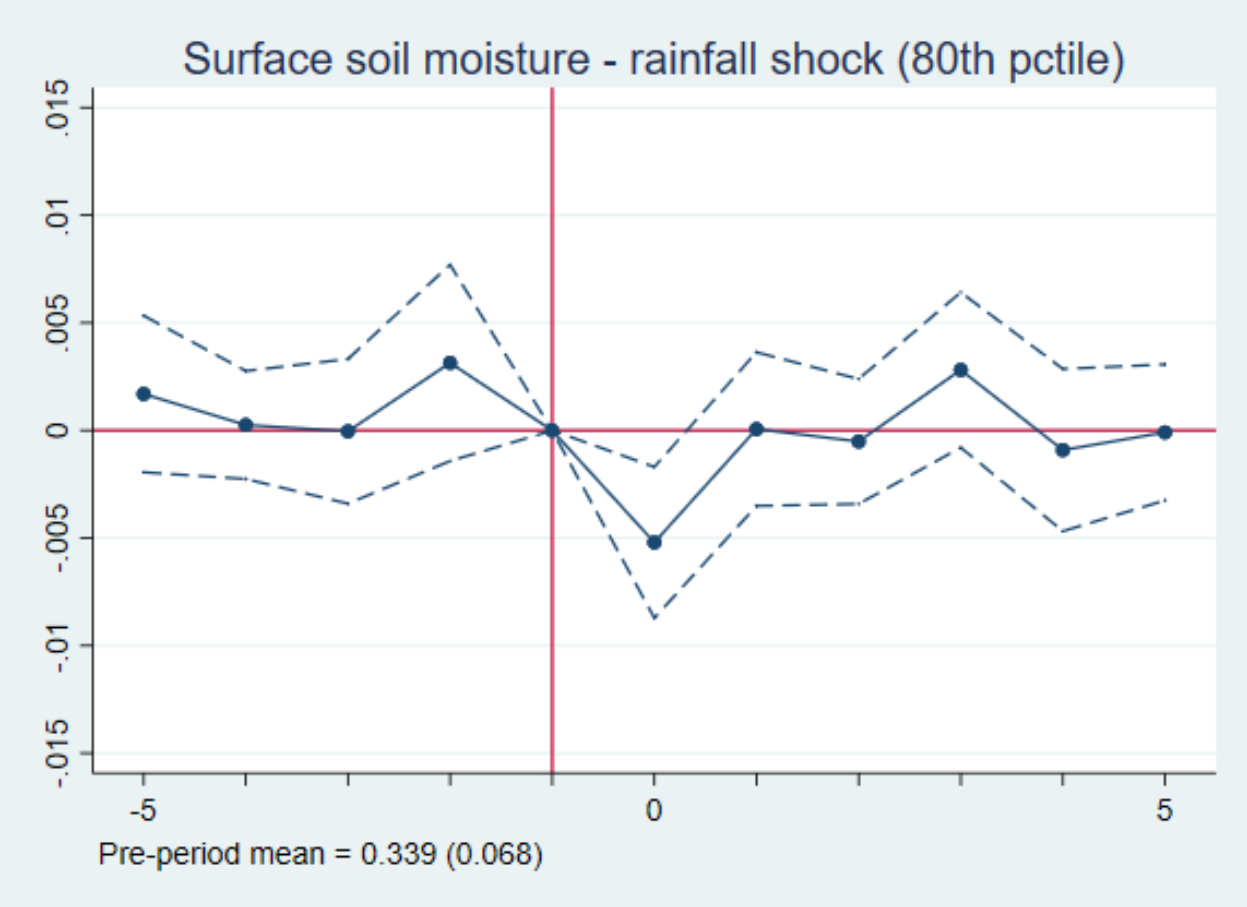


Figure 7: Effect of wind shock (80th percentile) on IHS(arable land)

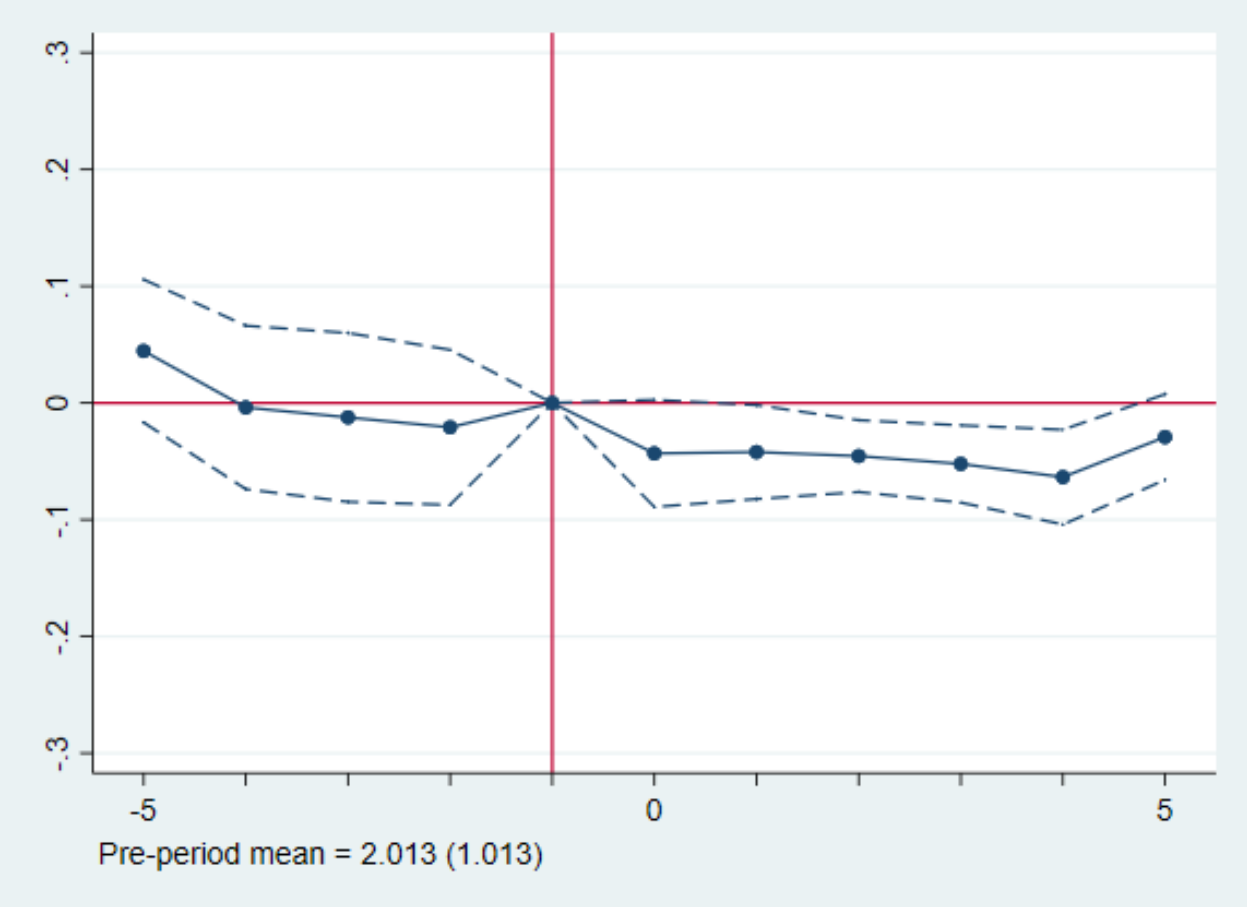


Figure 8: Effect of rainfall shock (80th percentile) on IHS(arable land)

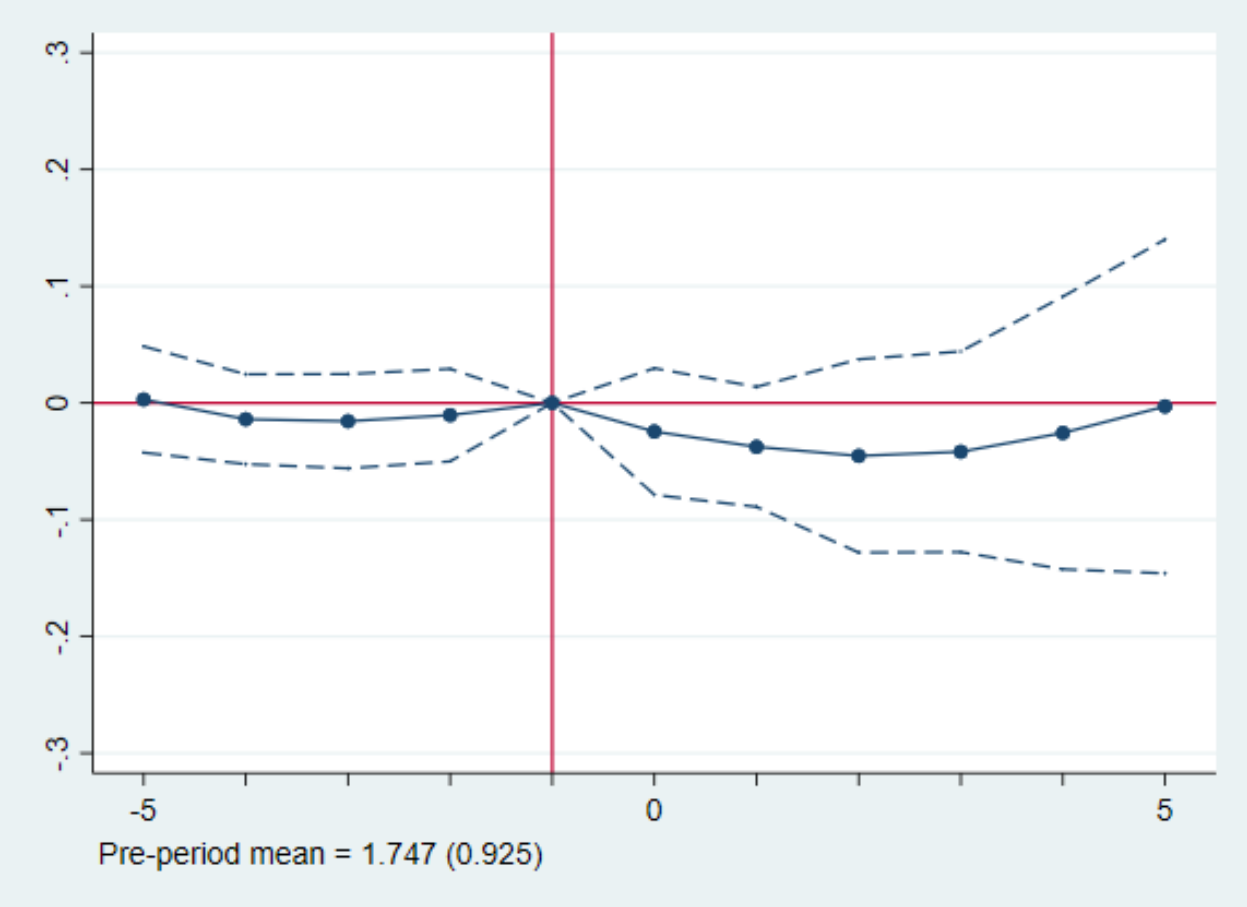


Figure 9: Effect of wind shock (80th percentile) on IHS(grain output)

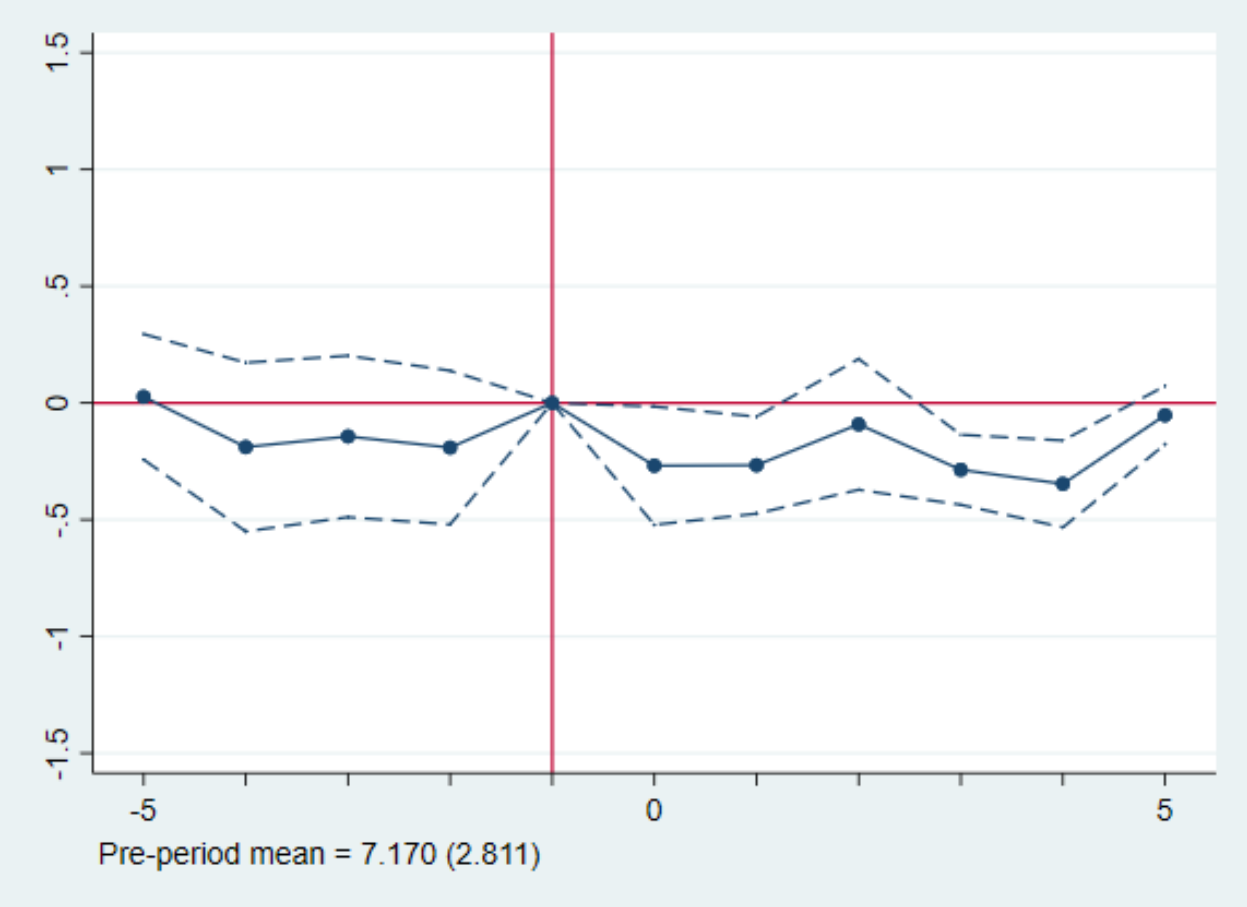


Figure 10: Effect of wind shock (80th percentile) on IHS(pork output)

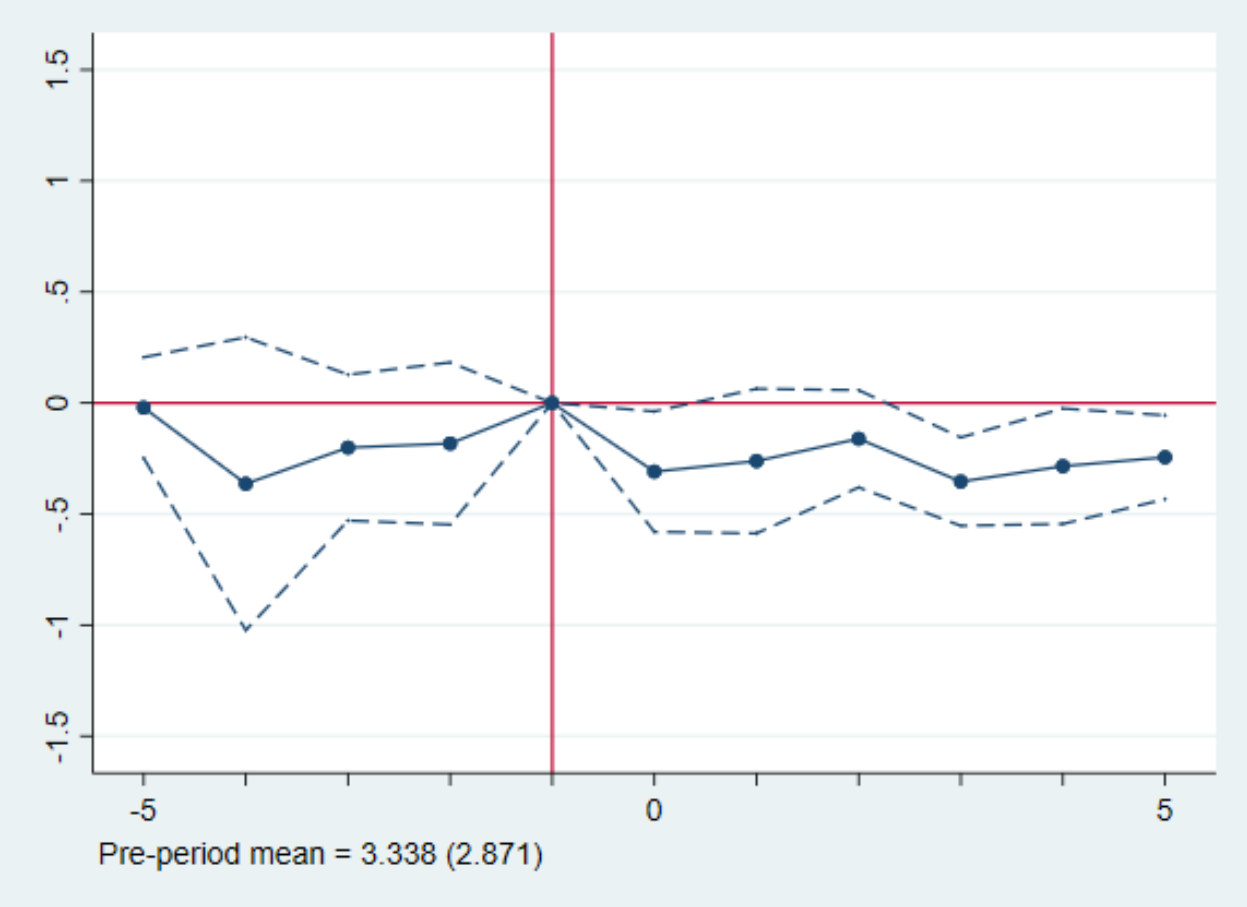


Figure 11: Effect of rainfall shock (80th percentile) on IHS(grain output)

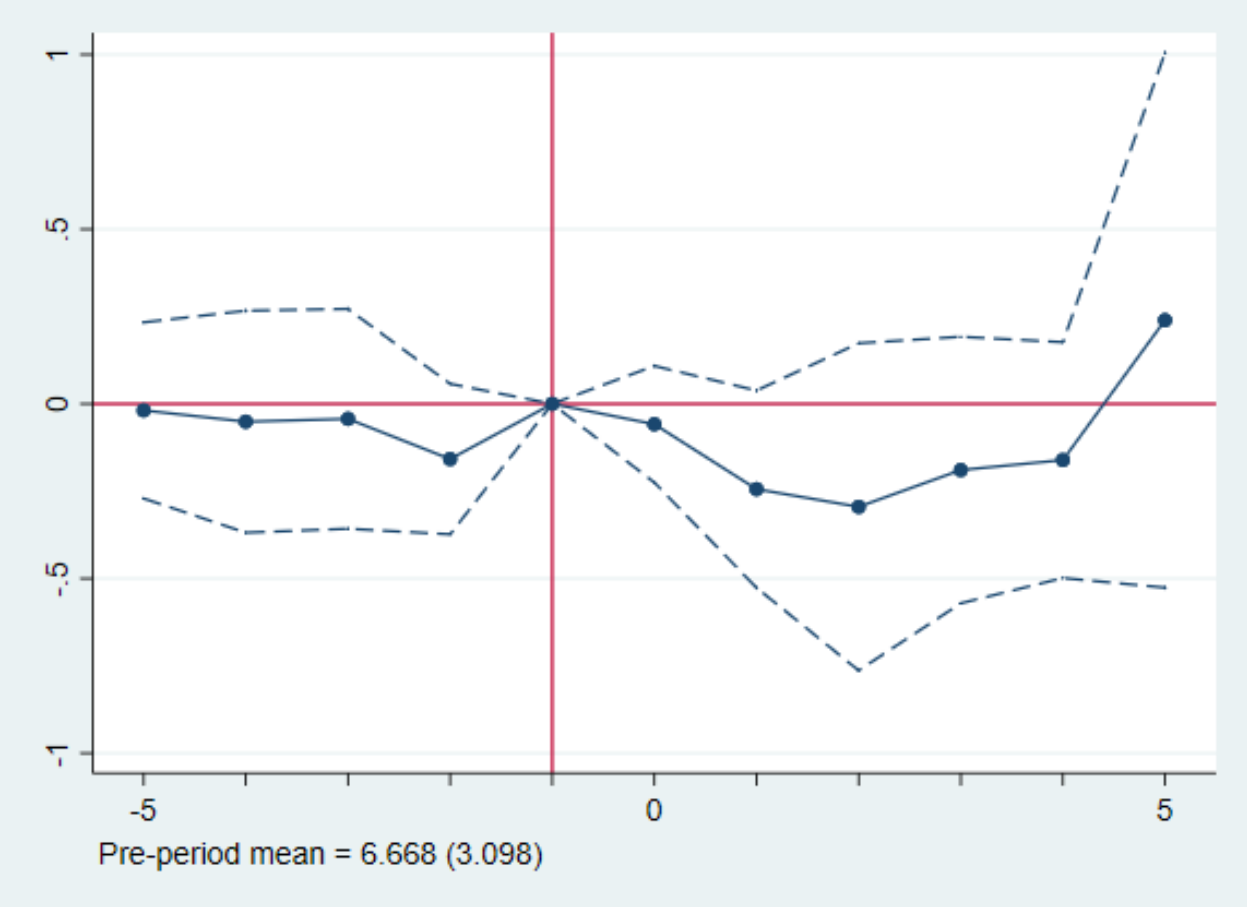


Figure 12: Effect of rainfall shock (80th percentile) on IHS(pork output)

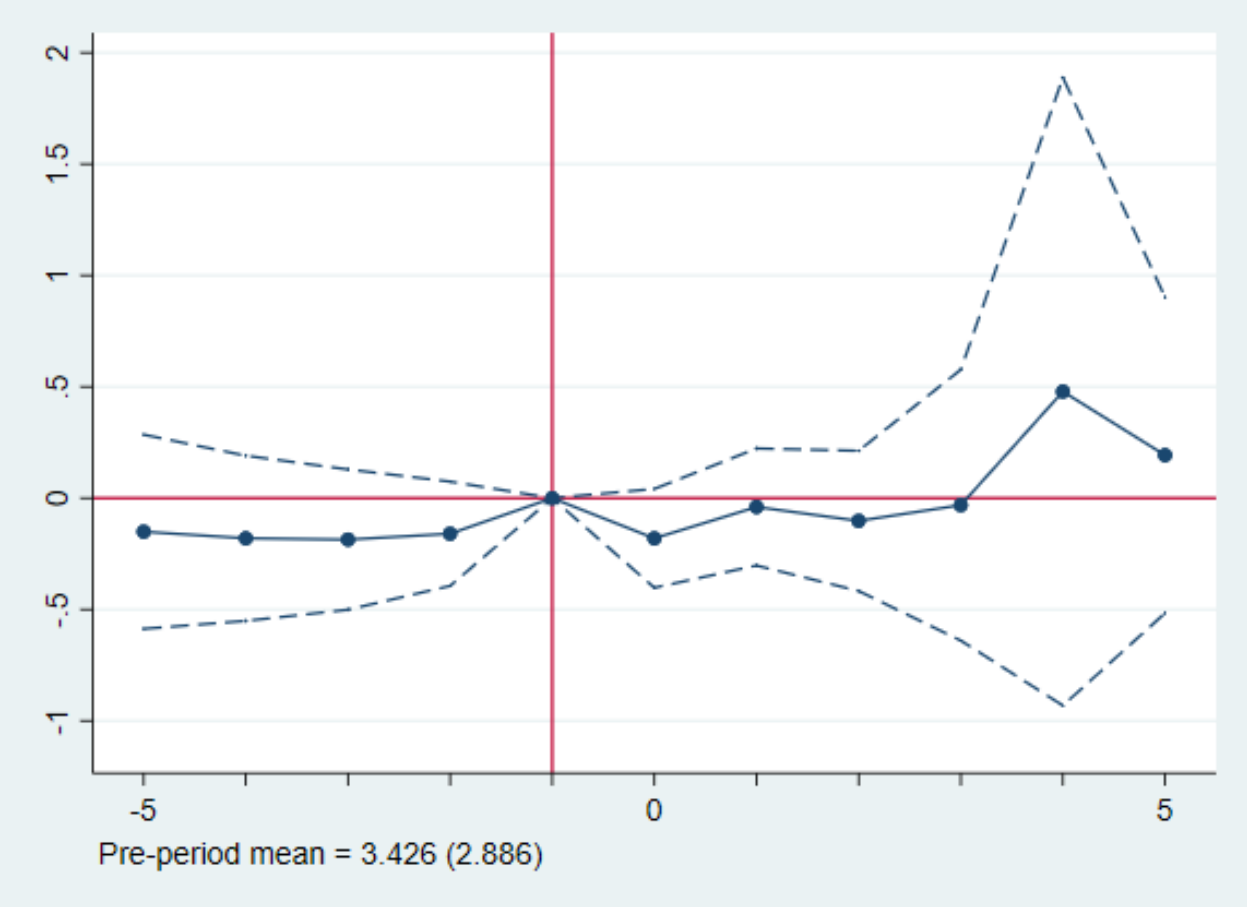


Figure 13: Effect of wind shock (80th percentile) on total seeds used (kg)

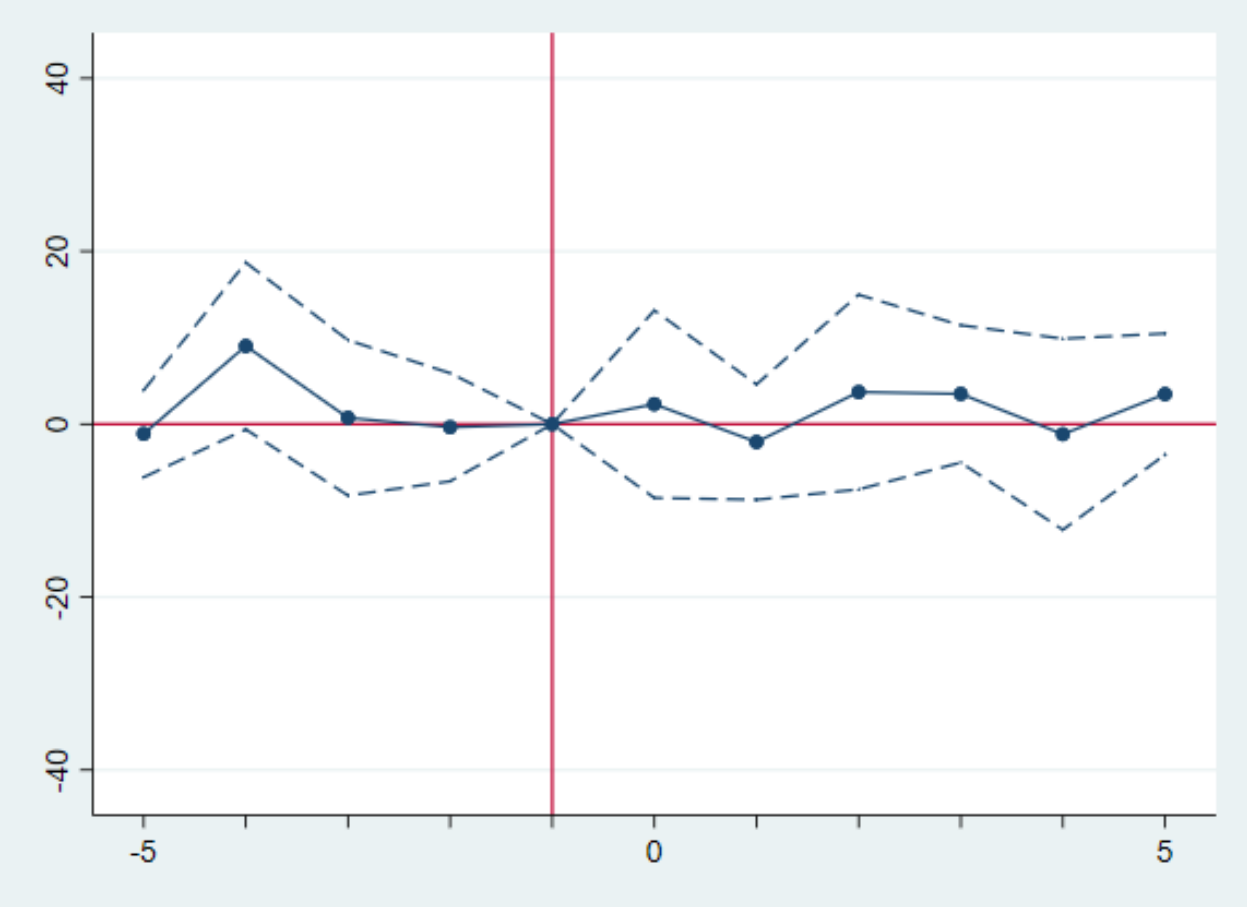


Figure 14: Effect of wind shock (80th percentile) on total fertilizer used (kg)

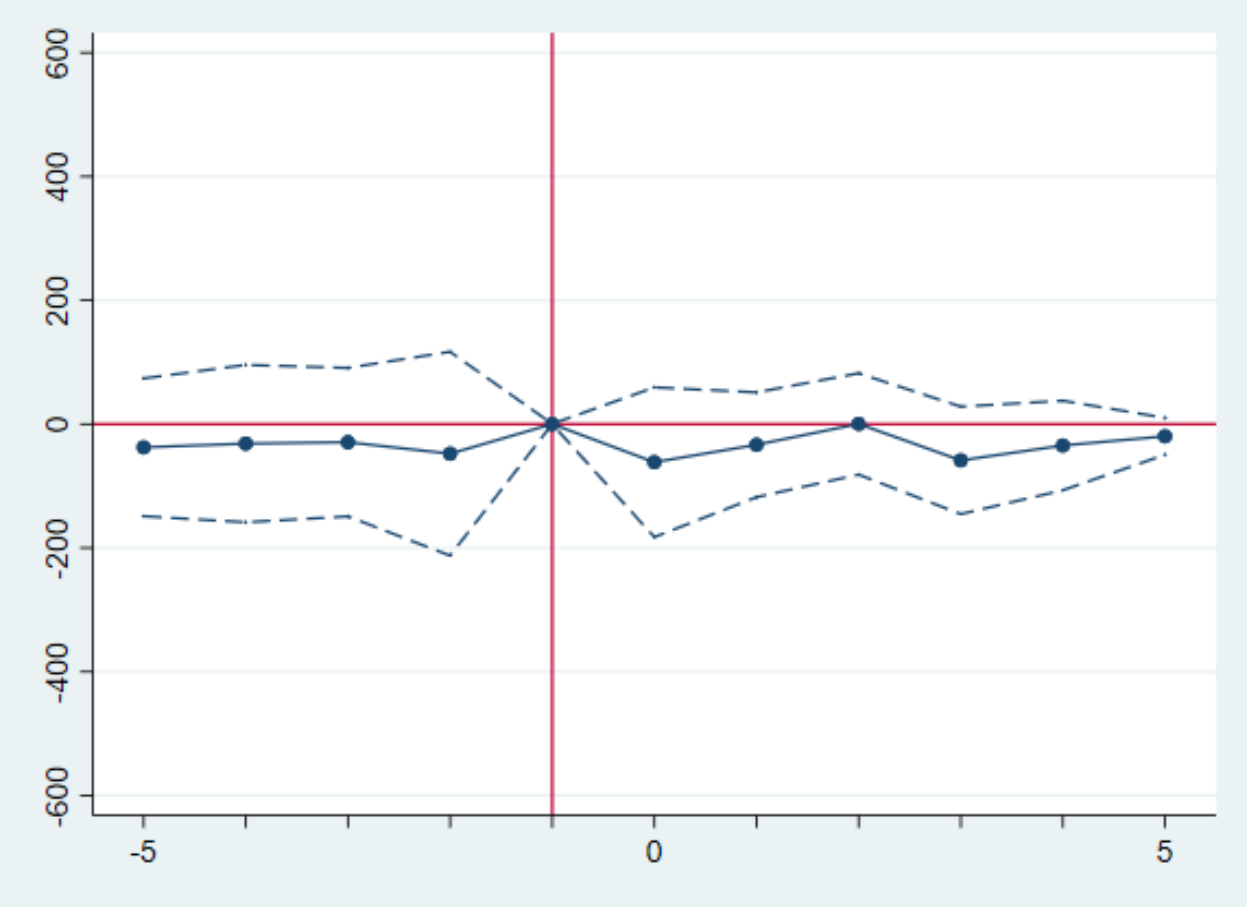


Figure 15: Effect of wind shock (80th percentile) on household main income source being agriculture

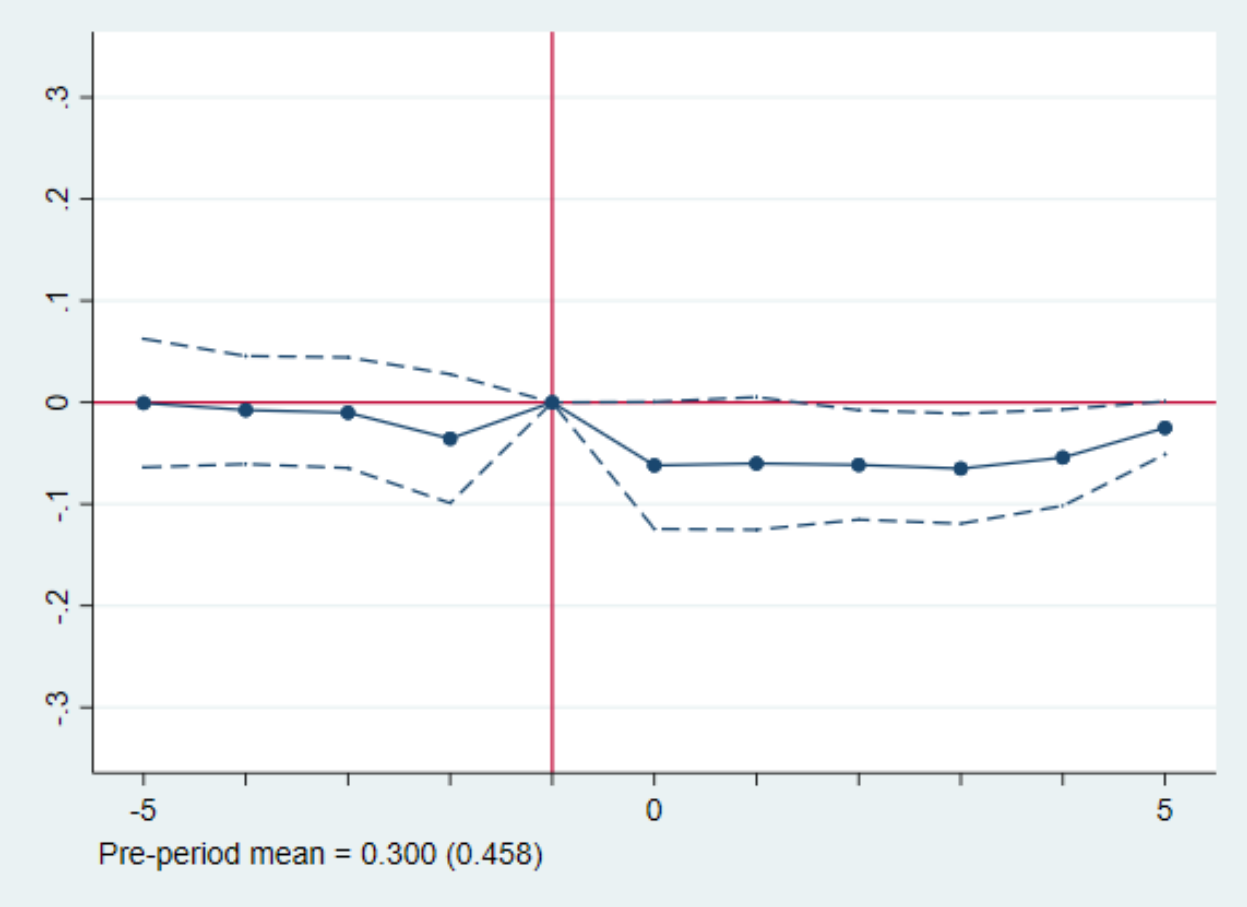


Figure 16: Effect of wind shock (80th percentile) on wage income

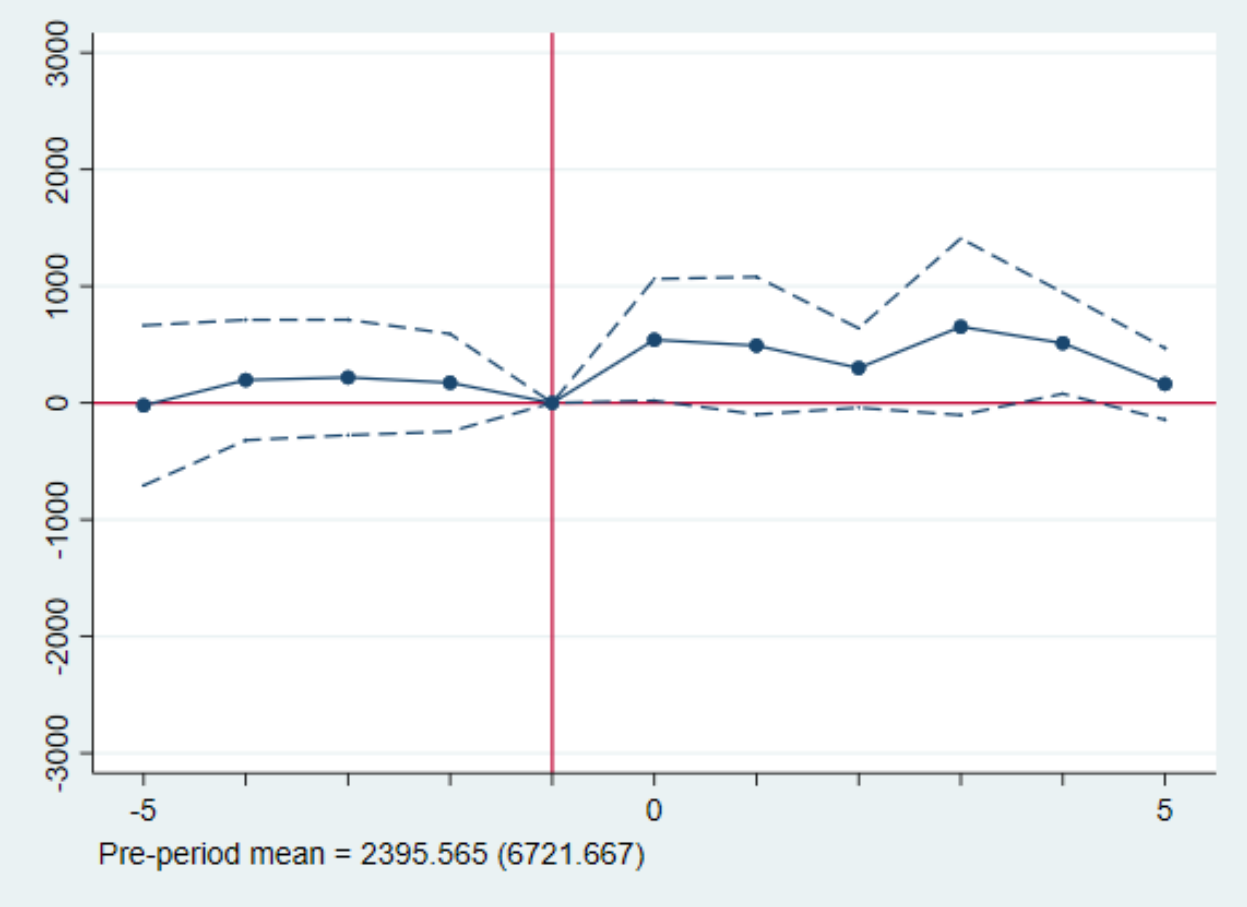


Figure 17: Effect of rainfall shock (80th percentile) on household main income source being agriculture

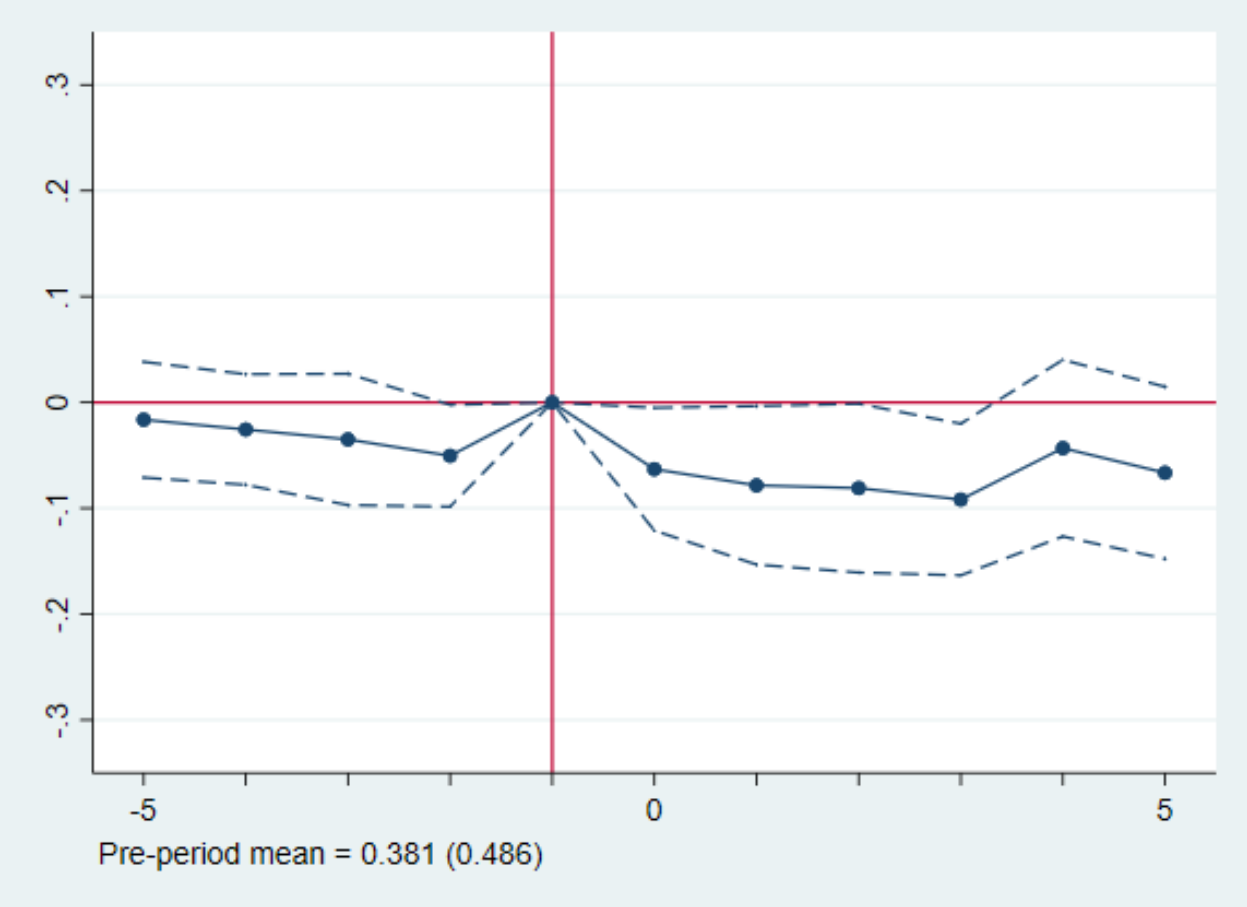


Figure 18: Effect of wind shock (80th percentile) on household main income source being manufacturing

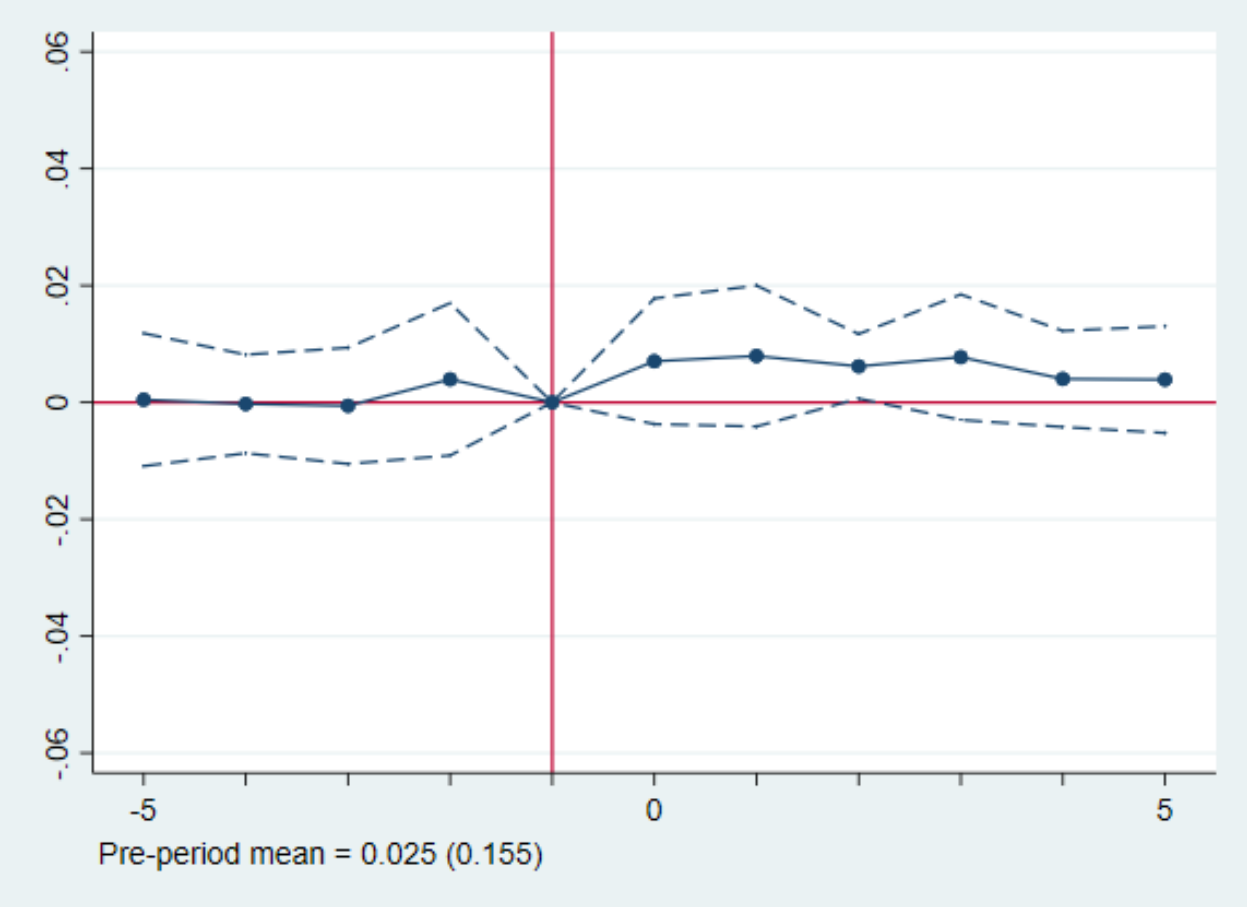


Figure 19: Effect of rainfall shock (80th percentile) on household main income source being manufacturing

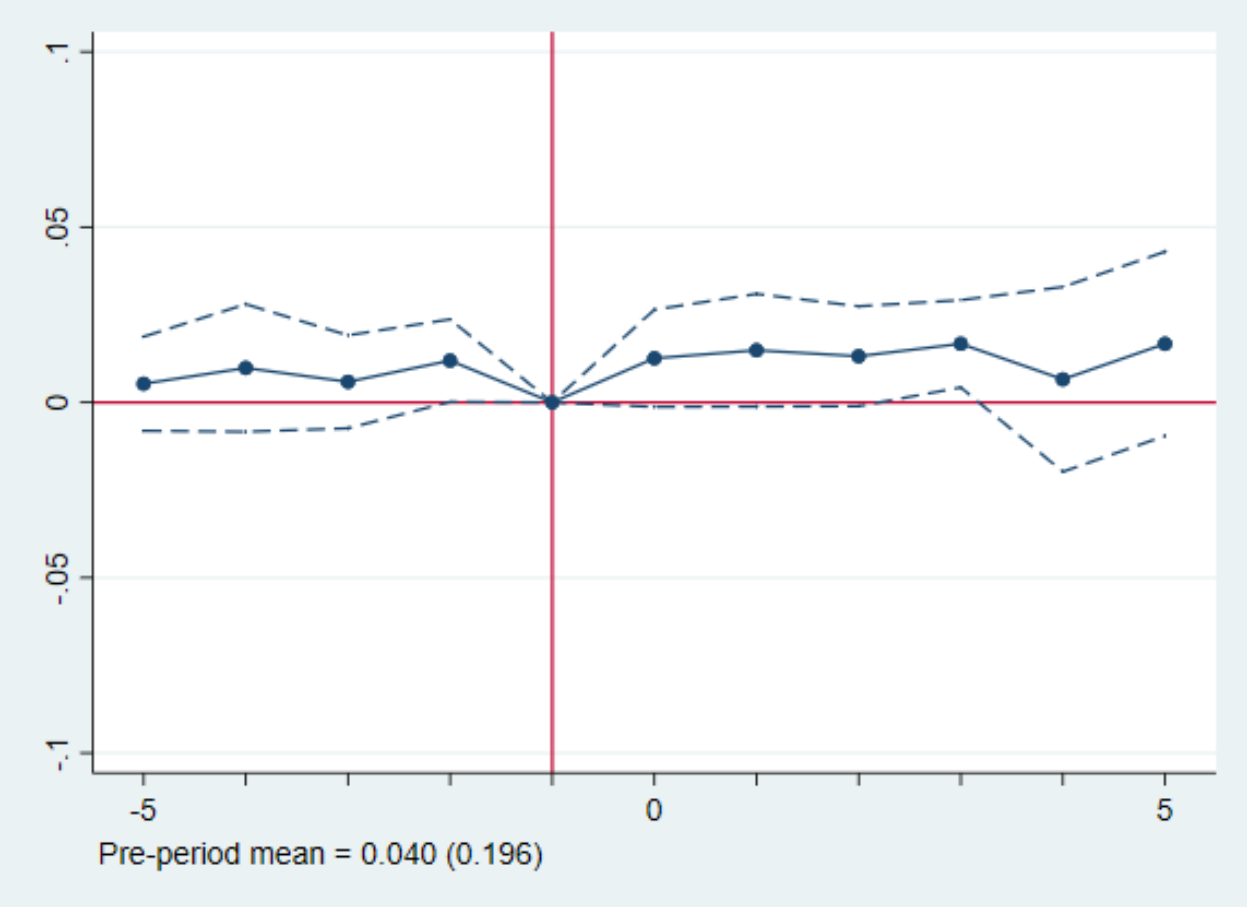


Figure 20: Effect of wind shock (80th percentile) on household main income source being services

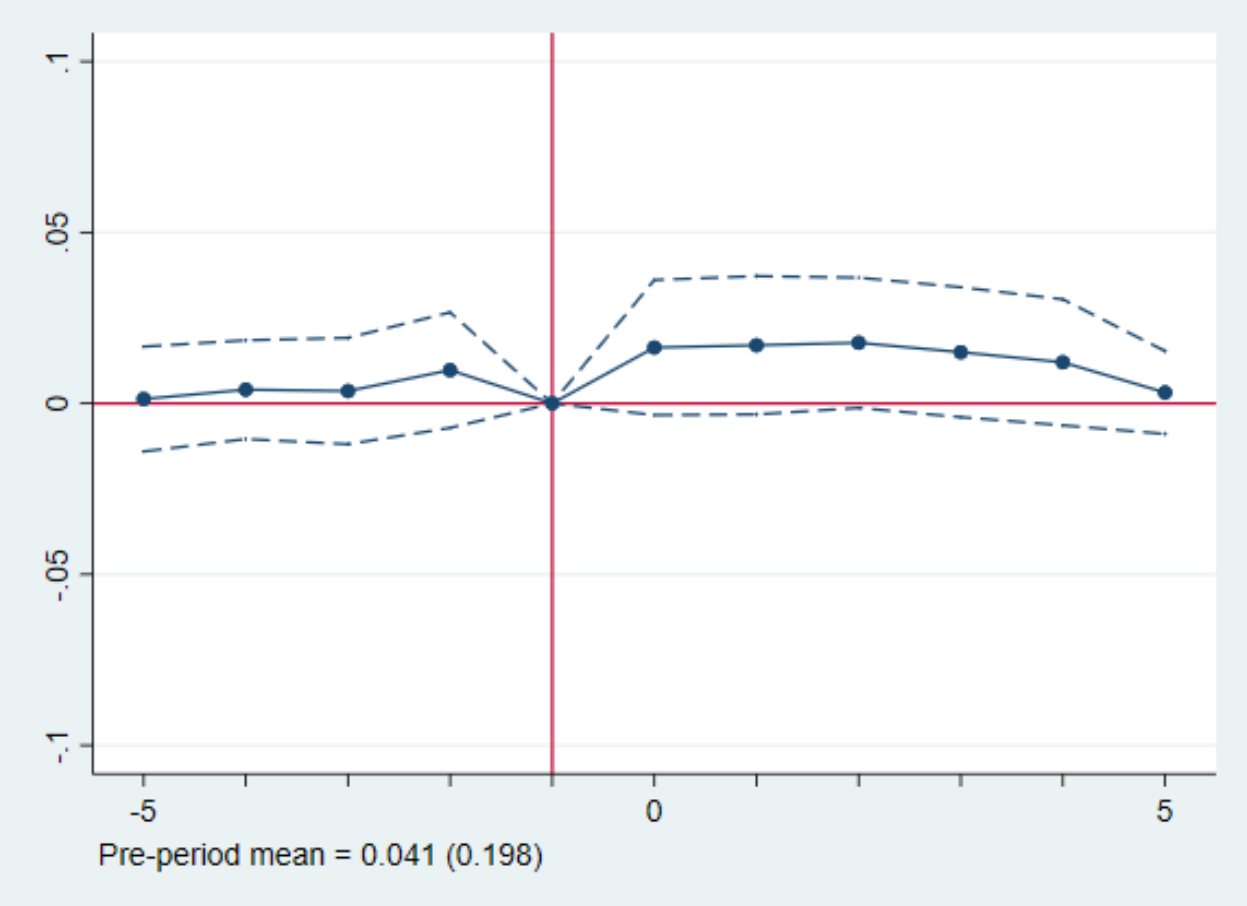


Figure 21: Effect of rainfall shock (80th percentile) on household main income source being services

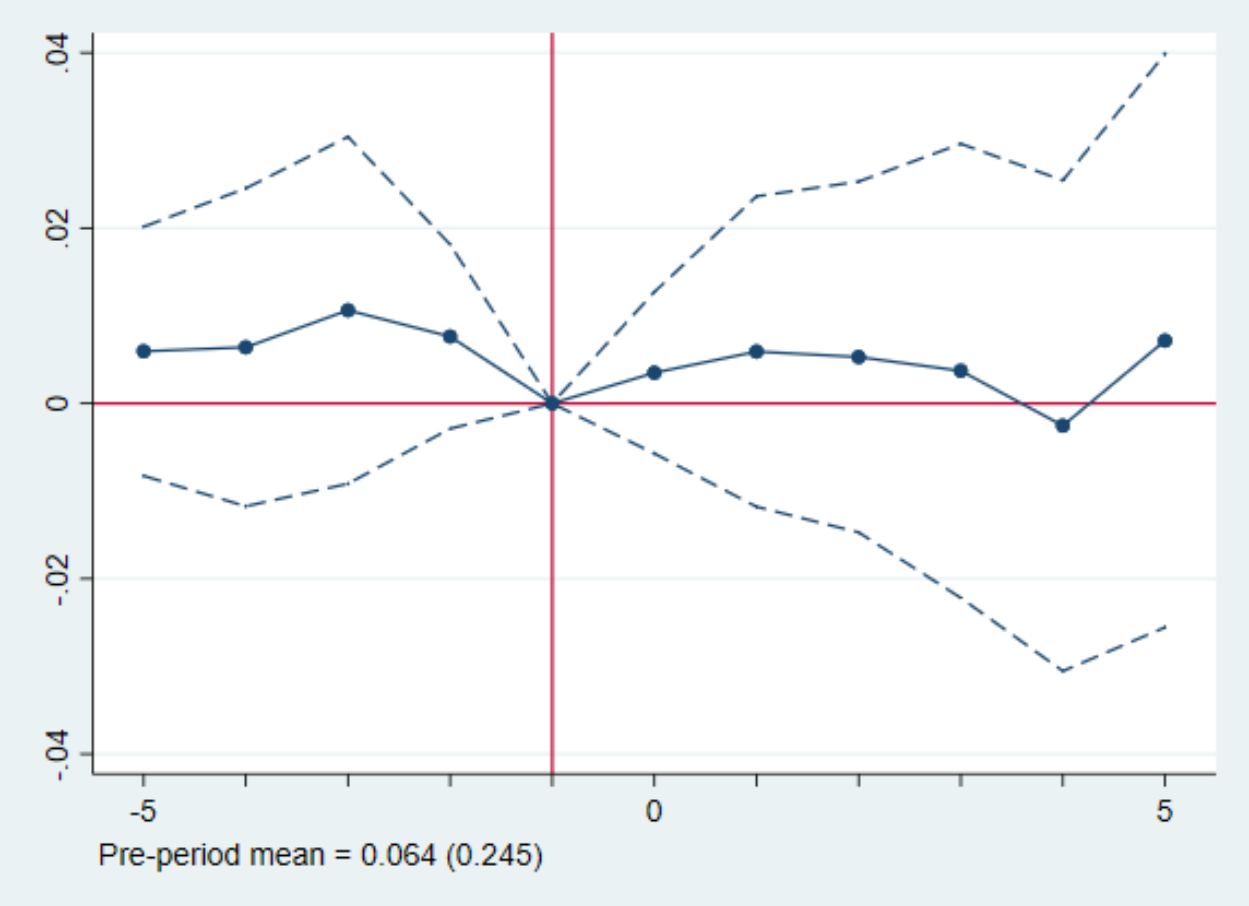


Figure 22: Effect of wind shock (80th percentile) on days of temporary migrant labor

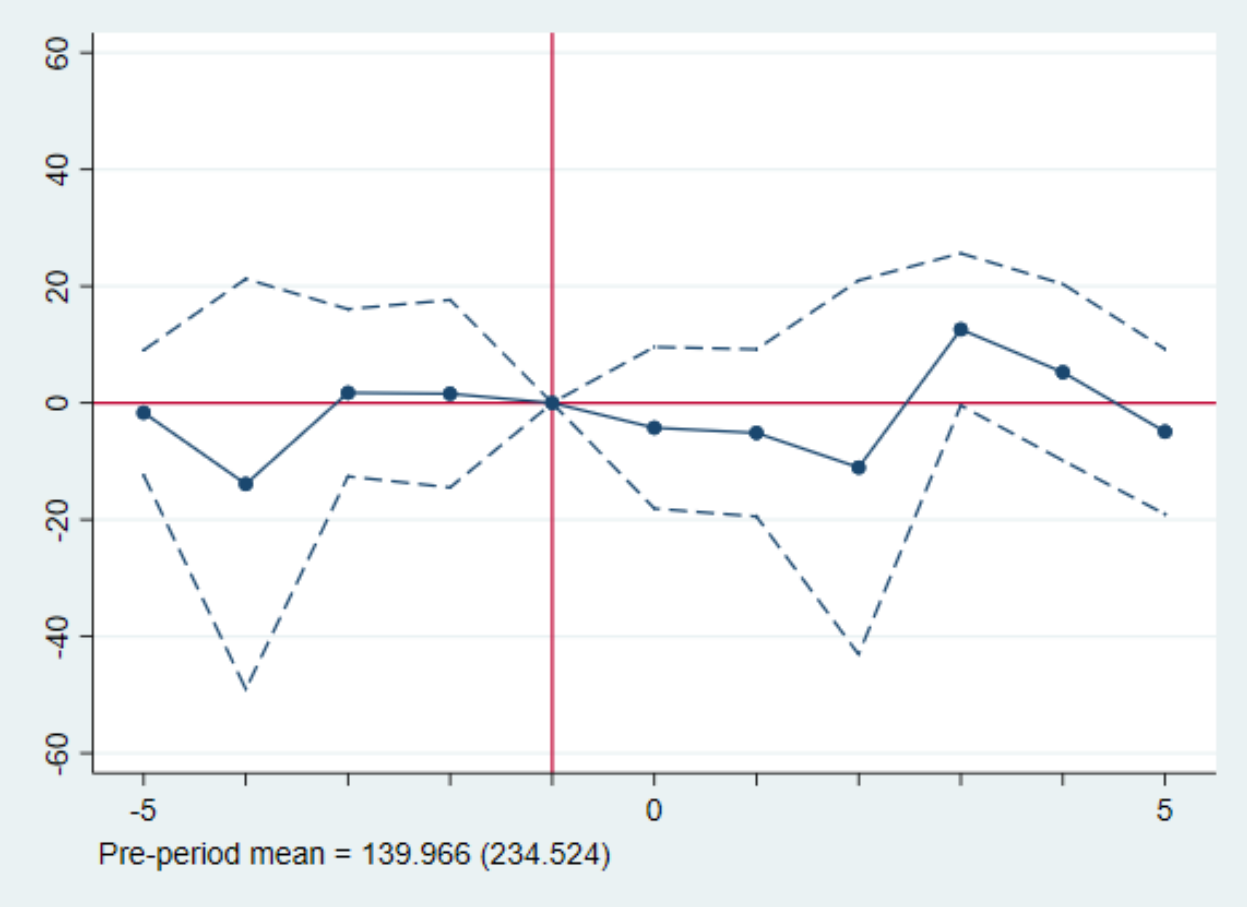
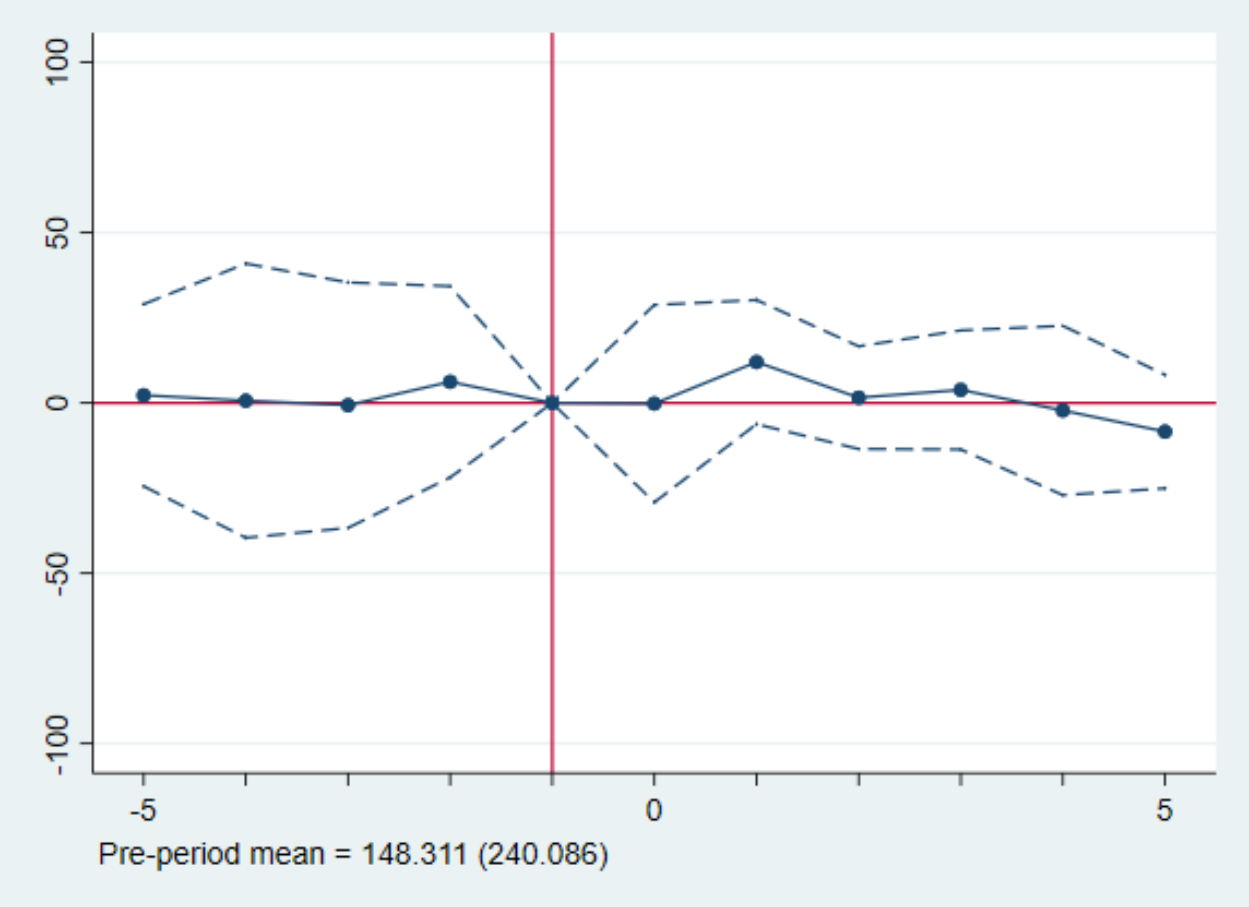


Figure 23: Effect of rainfall shock (80th percentile) on days of temporary migrant labor



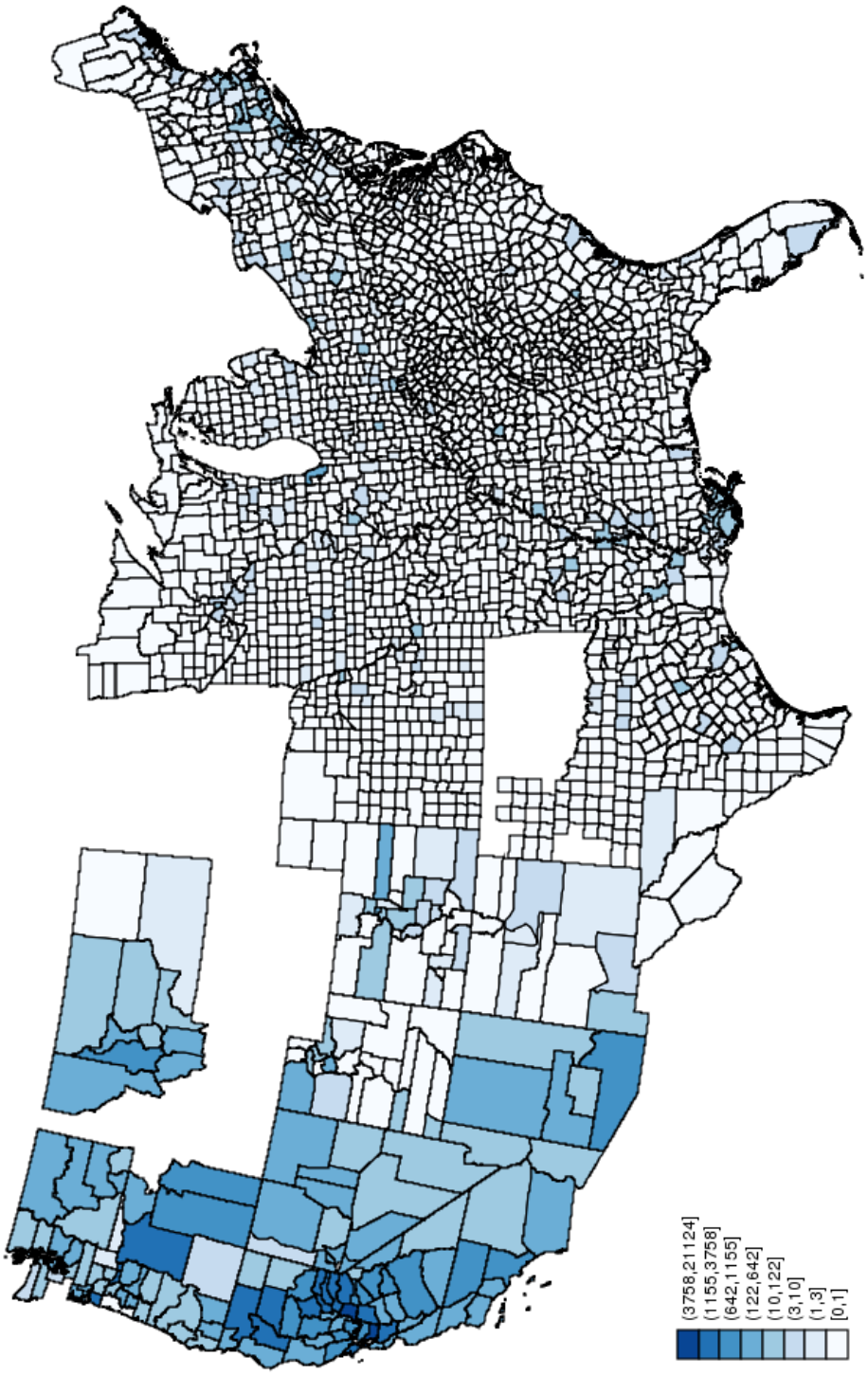


Figure 24: Chinese immigrant population in 1880, by county

Figure 25: Immigrant population in the US, 1850 to 1920

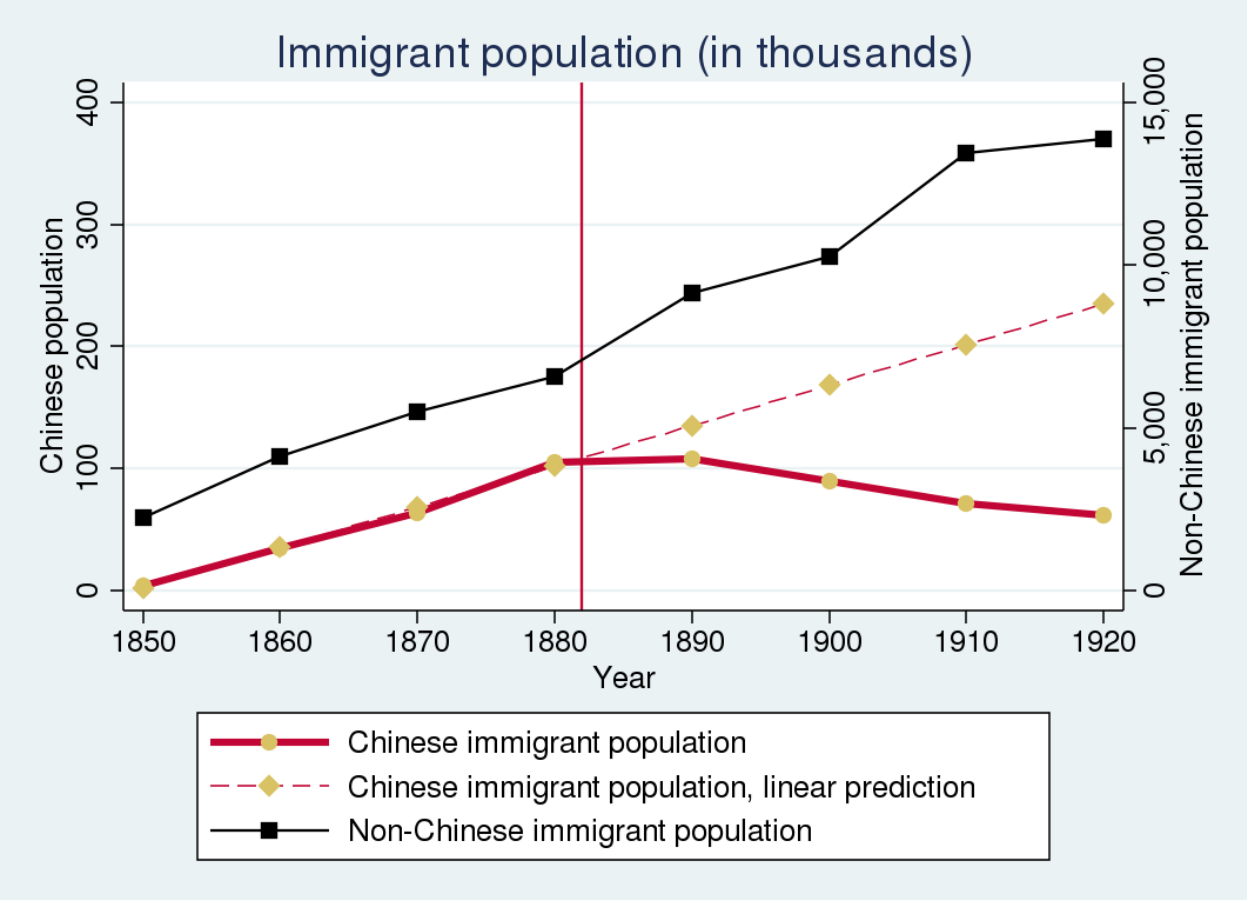


Figure 26: Population of immigrants who migrated prior to 1882

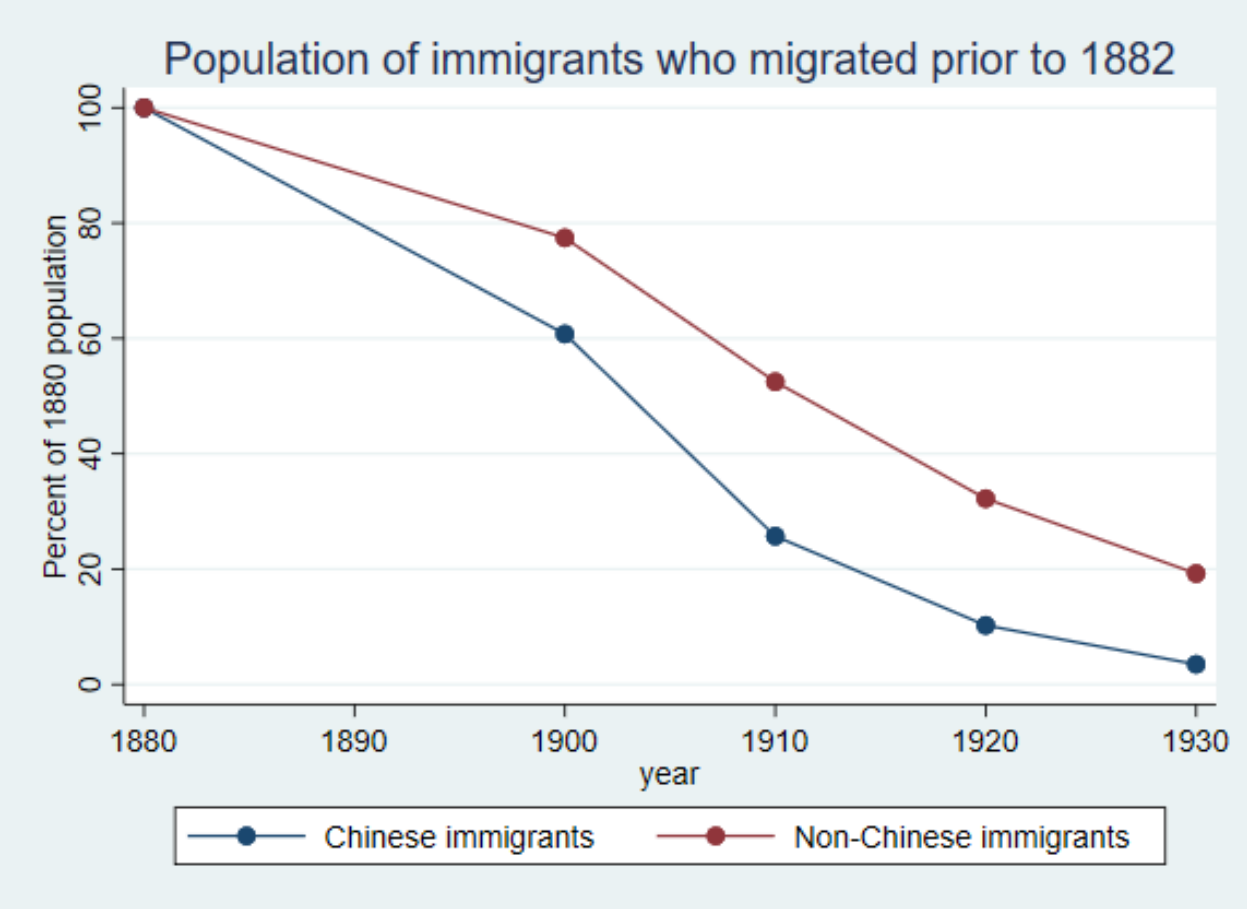


Table 18: Demographic characteristics, 1880

	Chinese immigrants		Other immigrants		American-born	
	Mean	St. dev.	Mean	St. dev.	Mean	St. dev.
Panel A. All individuals						
Age	31.57	10.77	38.22	16.15	21.98	18.03
Male	0.957	0.204	0.537	0.499	0.503	0.500
Urban	0.323	0.467	0.510	0.500	0.227	0.419
Married	0.310	0.462	0.617	0.486	0.311	0.463
Group quarters	0.416	0.493	0.049	0.217	0.017	0.130
In labor force	0.930	0.255	0.537	0.499	0.293	0.455
Number of observations	104501		6575897		43460084	
Panel B. Working-age men in the labor force						
Occupation score	19.58	7.912	22.17	9.036	19.22	10.51
Employed in agriculture	0.117	0.321	0.275	0.446	0.520	0.500
Employed in mining	0.232	0.422	0.039	0.195	0.012	0.110
Employed in construction	0.004	0.063	0.060	0.237	0.046	0.210
Employed in manufacturing	0.107	0.309	0.199	0.399	0.103	0.305
Employed in transportation	0.044	0.206	0.061	0.239	0.046	0.208
Employed in retail/services	0.232	0.422	0.142	0.349	0.094	0.292
Number of observations	95227		2953241		10362452	

Table 19: First stage: Instrumenting for change in percent Chinese immigrant

	Dependent variable
	Δ % Chinese
Base % Chinese x Post	-55.21***
	(9.593)
County FE?	Yes
State-by-year FE?	Yes
Number of observations	765

* p < .1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses, clustered at the county level. Each cell represents one regression. Observations are an unbalanced panel at the county-year level, from 1860 to 1930. Base percent Chinese is the population percentage that is Chinese in 1880, the last census year prior to the Act. Change percent Chinese is the difference in population percentage that is Chinese in a given year versus 1880. Sample consists of counties in Washington, Oregon, and California.

Table 20: Impacts of Chinese Exclusion Act on native labor outcomes

	Native LFP rate	Native earnings scores
	(1)	(2)
Panel A: OLS		
Δ % Chinese	0.024	0.101***
	(0.099)	(0.028)
Panel B: Reduced form		
Base % Chinese x Post	-2.168	-10.87***
	(7.845)	(2.380)
Panel C: 2SLS		
Δ % Chinese	0.036	0.181***
	(0.132)	(0.048)
F-stat	41.42	41.42
County FE?	Yes	Yes
State-by-year FE?	Yes	Yes
Number of observations	666	666

* p < .1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses, clustered at the county level. Each cell represents one regression. Observations are an unbalanced panel at the county-year level, from 1860 to 1930. Base percent Chinese is the population percentage that is Chinese in 1880, the last census year prior to the Act. Change percent Chinese is the difference in population percentage that is Chinese in a given year versus 1880. Sample consists of counties in Washington, Oregon, and California, and outcomes are averaged across working-age males.

Table 21: Impacts of Chinese Exclusion Act on productivity

	Dependent variable		
	Per acre farm value	Manufacturing wages	Manufacturing output
	(1)	(2)	(3)
Panel A: OLS			
Δ % Chinese	0.003***	0.254	0.113***
	(0.001)	(1.421)	(0.033)
Panel B: Reduced form			
Base % Chinese x Post	-0.200**	-80.91	-6.168**
	(0.082)	(86.31)	(3.024)
Panel C: 2SLS			
Δ % Chinese	0.003***	1.484	0.113**
	(0.001)	(1.434)	(0.044)
F-stat	39.90	26.97	26.97
County FE?	Yes	Yes	Yes
State-by-year FE?	Yes	Yes	Yes
Number of observations	673	634	634

* p < .1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses, clustered at the county level. Each cell represents one regression. Observations are an unbalanced panel at the county-year level, from 1860 to 1930. Base percent Chinese is the population percentage that is Chinese in 1880, the last census year prior to the Act. Change percent Chinese is the difference in population percentage that is Chinese in a given year versus 1880. The sample consists of counties in Washington, Oregon, and California.

Table 22: Characteristics of Chinese immigrant stayers - versus other Asian immigrants

	Dependent variable		
	Neighbor same country-of-origin	Lives in group quarters	Intermarriage with native-born
	(1)	(2)	(3)
Chinese x Post	-0.474***	-0.200***	0.167***
	(0.0155)	(0.0443)	(0.0467)
County FE?	Yes	Yes	Yes
State-by-year FE?	Yes	Yes	Yes
West coast only	Yes	Yes	Yes
Number of observations	669056	685085	251560

* p < .1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses, clustered at the country-of-origin level. Each cell represents one regression. Observations are pre-1882 arrival immigrants from a repeated cross-section, from 1860 to 1930, living in Washington, Oregon, and California. The sample for column (1) does not include 1900, where the serial numbers are unavailable, and the sample for column (3) only includes male household heads. The comparison group is other Asian immigrants.

Table 23: Characteristics of Chinese immigrant stayers - versus all other immigrants

	Dependent variable		
	Neighbor same country-of-origin	Lives in group quarters	Intermarriage with native-born
	(1)	(2)	(3)
Chinese x Post	-0.158***	-0.113***	-0.076***
	(0.008)	(0.009)	(0.013)
County FE?	Yes	Yes	Yes
State-by-year FE?	Yes	Yes	Yes
West coast only	Yes	Yes	Yes
Number of observations	669056	685085	251560

* p < .1, ** p < 0.05, *** p < 0.01. Standard errors in parentheses, clustered at the country-of-origin level. Each cell represents one regression. Observations are pre-1882 arrival immigrants from a repeated cross-section, from 1860 to 1930, living in Washington, Oregon, and California. The sample for column (1) does not include 1900, where the serial numbers are unavailable, and the sample for column (3) only includes male household heads.