Essays on Local Determinants of Economic Growth

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Abstract

The fundamental concept unifying this thesis is that outcomes at small geographical units can shed light on key economic questions of interest for both macroeconomics and finance. Some of the questions I explore in my work include whether bank networks facilitate access to financial capital by small businesses in the US, whether lending to small businesses is important for short-term economic growth, and whether different cultural and institutional endowments improve economic outcomes in the long run.

Small Business Lending and the Bank-Branch Network: In this chapter, I examine the role of banks in propagating local economic shocks from one area to another through their network of bank branches, by exploiting a newly developed branch-level dataset. Specifically, I examine the change in the geographical distribution of small business loans within each bank network in response to: 1) increases in deposit growth due to presence in areas with new fracking wells; 2) changes in the profitability of real estate loans due to presence in areas experiencing real estate booms. I evaluate how the supply-driven changes in lending following these shocks impact real economic activity. I find that banks export the increase in liquidity from the fracking areas and fund more small business loans at other, more distant branches. Borrowers from banks with a higher exposure to fracking experience faster establishment growth at areas beyond 100 miles from the fracking activity. The results for the

real estate booms show that increases in the return of real estate loans contributed to a decrease in small business lending at branches away these booms. Borrowers from banks with high exposure to residential appreciation experienced slower establishment growth even within areas at a significant distance from the real estate booms.

Does It Matter Where You Came From? Ancestry Composition and Economic Performance of US Counties, 1850 - 2010: The United States provides a unique laboratory for understanding how the cultural, institutional, and human capital endowments of immigrant groups shape economic outcomes. In this paper, we use census micro-samples to reconstruct the country-of-ancestry composition of the population of US counties from 1850 to 2010. We also develop a county-level measure of GDP per capita over the same period. Using this novel panel data set, we show that the evolution of the country-of-origin composition of a county is significantly associated with changes in county-level GDP. The cultural, institutional, and human capital endowments from the country of origin drive this association. Particularly important are attitudes towards cooperation with others. Using an instrumental variable strategy, we identify a significant effect of changes in the ancestry-weighted endowments on economic development. Finally, our results suggest that while the fractionalization of ancestry groups is positively related to county GDP, fractionalization in attributes such as trust is negatively related to local economic performance.

Culture: Persistence and Evolution: This paper presents evidence on the speed of evolution (or lack thereof) of a wide range of values and beliefs of different generations of European immigrants to the US and interprets the evidence in the light of a simple model of socialization and identity choice. The main result is that persistence differs greatly across cultural attitudes. For instance, many family values, political orientation, and most deep personal religious values converge slowly to the prevailing US norm. Others, such as attitudes toward cooperation, children's independence, and sexual matters, converge rather quickly. The results obtained studying higher generation immigrants differ greatly from those found when the analysis is limited to the second generation, as typically done in the literature, and they imply a lesser degree of persistence than previously thought. Finally, we show that persistence is "culture specific" in the sense that the country from which one's ancestors came matters for the pattern of generational convergence.

Contents

Chapter 1

Small Business Lending and the Bank-Branch Network

1.1 Introduction

In this paper, I examine the role of banks in propagating local economic shocks from one area to another through their network of bank branches. There is a significant literature that studies the extent of spillovers of local shocks both across industries and geographies. Spillovers are usually transmitted through the labor market – either by labor migration due to wage differentials or by improved productivity due to sharing of labor pools or technology.[1] Here, I provide a novel mechanism that can explain how local shocks can spill into areas farther away from their origin. Simply put, banks with branches in areas with local shocks experience changes in their ability to lend and impose positive or negative credit supply shocks in the rest of their markets, affecting the real activity of bank-dependent borrowers in these distant locations.

[1]Blanchard and Katz (1992) use a structural model to study how employment and migration respond to local shocks. Black et al (2005) examine the effect of the boom/bust of coal industry had on other local industries. Greenstone et al (2010) study whether productivity of incumbent plants changes when a new plant is built within a county. Freyrer et al (2015) study both geographical and industry spillovers of fracking and argue that the size of commuting zones can explain the positive effects on income and employment as far as 100 miles away from fracking.

To focus on the effect of credit supply on bank-dependent borrowers I study small businesses. Small businesses contribute nearly 40% of the US private nonfarm output each year. Yet, many of them depend on relationship-based lending, which takes into account "soft" information (Berger and Udell (2003)). Since "soft" information is not easily transmitted across the hierarchical layers of a bank (Liberti and Mian (2009)) or across space (Agarwal and Hauswald (2010)), small businesses can be forced to borrow locally. Banks, on the other hand, are not constrained in their ability to allocate capital across different markets and do so in response to local shocks. The combined effect of locally constrained borrowers and locally *unconstrained* lenders can lead to spillovers of economic shocks across distant locations. In this paper, the branch network exposes banks to changes in two local economic factors: new fracking wells increase local deposits; residential booms increase the profitability of construction loans. Intermediaries transmit these changes across their network by optimally expanding or reducing lending, ultimately affecting real activity.

This paper studies how capital is allocated across the bank network, by going beyond the bank-level information, with data on lending at distinct offices. The dataset combines locations of small businesses, reported under the Community Reinvestment Act (CRA), and locations of bank branches. The distance between businesses and the nearby bank offices is used to associate census-tract lending to the closest branches, providing a granular geographical distribution of lending activity over time. The resulting geographical and temporal variation is critical for the identification of the changes in the credit supply at different branches following local funding or asset price shocks. I consider these shocks because they directly affect a portion of the network with the changes in the rest of the branches being driven by internal capital allocation. The geographical separation from the origin of the shocks is important because distance can attenuate the direct correlation between the local shock and the credit demand conditions. It also highlights the extent to which bank networks can propagate shocks across locations. The presence of multiple banks in the same credit market allows me to control for common fluctuations in credit demand and rule out explanations of the spillovers which are based on the local market-wide changes.

The novel data allows me to analyze how business credit and real activity change in response to two distinct local shocks: drilling of new fracking wells and residential real estate booms. This paper is not the first to utilize the fracking revolution as an exogenous increase in deposits and to analyze the resulting effect on lending and real activity. Plosser (2014) emphasizes the exogeneity of the fracking revolution and shows that banks use the increase in deposits from the energy booms to expand total lending and liquid securities. Gilje et al (2014) show that banks, which have a higher proportion of total branches in counties with fracking, originate more mortgages in counties that do not have fracking. Gilje (2012) and Freyrer et al (2015) study the impact of the energy booms on the local economy. The effect of residential appreciation on bank lending and real outcomes has also been previously studied. Chakraborty et al (2014) document that bank-holding companies which are located in states with higher residential prices increase their investments in mortgages and decrease commercial lending to bigger firms. The authors show that firms borrowing from these bank-holding companies decrease investments. Loutskina and Strahan (2015) show that the geographical variation in the residential prices caused banks to allocate their internal capital towards areas where mortgages are more profitable.

One of the novelties in this paper is that it considers the sensitivity of small business lending to each of the two shocks.[2] While the previous literature has focused on total lending, mortgages, and commercial loans to bigger firms, there is no evidence

[2]For other uses of the small business lending data: Brevoort and Hannan (2006) study the distance between the physical branch location and the location where the loan was given. Keeton (2009) examines the effect of an aggregate shock on small business lending at the headquarters of the bank versus the rest of the network. Greenstone et al (2014) separate local changes in small business lending for each bank-holding company into an effect common to all lenders in the county and to banks specifically. Nguyen (2014) uses the most disaggregated version of the CRA data and studies the impact of branch closures on small business lending in markets where M&A activity creates redundant branches.

that loans to small enterprises are affected. Small business lending is of particular interest since it is a main source of financing for a big portion of small firms (Berger and Udell (2003)). It also tends to be geographically concentrated around the branches of the lending banks (Brevoort et al (2010)). The dependence of firms on this type of loans makes it likely that credit supply shocks will affect real activity. As a result bank networks can have a special role in transmitting local shocks across locations.

A second novelty of the paper is the rich geographical structure considered. I characterize bank lending at the level of the branch by utilizing a geographical algorithm which matches locations of borrowers with bank offices. When analyzing the effects of the two shocks on lending, previous papers have resorted to various levels of geographical aggregation. Gilje et al (2014) consider total mortgage origination at counties away from energy booms. Chakraborty et al (2014) rely on state house price indices and percent of total deposits in each state in order to determine the level of bank exposure to real estate booms. Loutskina and Strahan (2015) aggregate total mortgage origination at the CBSA level. To analyze variations in lending which is aggregated at particular geographical units one needs to assume that banks allocate credit according to the same units. I do not make this assumption in this paper. Instead, I assume that banks allocate funding to each of their branches, which, in turn, lend to borrowers in the proximity. These borrowers can cross county, MSA, or state lines, as long as they are close to the branch that provides credit.[3]

Finally, this paper contributes to the literature on the real estate and energy shocks by documenting that these shocks induce changes in credit which affect real economic activity. I argue that the precise channel involves smaller banks which engage in local lending. Gilje (2012) suggests that the additional liquidity from fracking benefits financially-dependent industries within counties with energy booms. I examine locations away from energy booms and show that the liquidity provided by the bank

[3] Laderman (2008) provides evidence that the amount of out-of-county lending is not trivial.

network boosts economic activity there. Within the literature on real estate booms, Chakraborty et al (2014) document that bank-holding companies reduce credit to bigger firms, which, in turn, reduce investment. The particular location of these firms is not explicitly considered. Here, I focus on much smaller firms and study the number of establishments at different zip codes. Moreover, I emphasize the importance of regional banks rather than bank-holding companies.

I provide evidence that fracking generates important changes in bank lending and real activity. I find that geographical proximity to new fracking wells boosts liquidity at local bank branches. While this leads to a substantial increase in deposits for smaller banks, defined as those having less than 30 branches, the rest of the intermediaries with local presence are not affected. A small bank with offices next to two new fracking wells sees a 0.5% increase in total deposit growth, 45% increase in large deposit growth, and a 10 basis points decrease in interest expense relative to banks without exposure. In the aggregate, small banks with exposure to new wells receive $2.6 billion of additional deposits over the sample period of 2001 to 2007, a 10.4% of the total deposits held by these banks each year. The additional liquidity allows these intermediaries to expand lending to small businesses at branches outside fracking areas. A small bank with two new wells increases originations by approximately 9% relative to competitors in the same credit market with no exposure. The combined increase in originations over the sample is over $5 billion, which is 15% of the total originations of all small banks within 200 miles of areas with fracking activity. I show that lending activity expands not only in areas close to fracking but also at locations more than 100 miles away. Finally, zip codes containing borrowers from banks exposed to fracking experience faster establishment growth compared to the rest of the zip codes. In particular, these locations experience 0.5% to 1% faster establishment growth.[4] This amounts to approximately 50,000 new establishments between 2001

[4]This excludes industries in mining, construction, finance and real estate.

and 2007, a 13% of the aggregate change in the number of U.S. establishments for this period. Each $100,000 in small business loans is associated with an additional establishment.

The evidence from the real estate booms points to the important role of bank networks in allocating capital across locations. The results are significant both for banks with small and big networks. I use two different measures of real estate exposure: 1) the fraction of branches in areas with appreciation in the top decile; 2) the average quarterly appreciation at the median branch for each bank network.

A small (big) bank with 70% (38%) of branches in the top decile, an average level of exposure, has 0.5% (0.9%) *more* higher concentration in construction and development (C&D) loans. In terms of actual lending, banks with branches in residential booms increase total C&D loans by approximately 1%. The increased investment in land development is financed by a reduction in small business lending at branches away from the real estate booms. Small banks with average exposure contract origination growth by 78% relative to competitors in the same credit market, while big banks contract by 23%. The aggregate reduction implied by the coefficient estimates is $0.4 and $3.5 billion, respectively. These are substantial decreases in lending activity, representing 25% and 9% of aggregate originations by the exposed banks in areas outside of the residential booms. The amounts of credit reduction surpass the overall increase in C&D lending, indicating that the affected banks increased other types of lending in the booming areas. Importantly, the decrease in lending by small banks impacts real activity. Zip codes where credit was provided by small banks with average exposure experience 0.9% slower establishment growth. This amounts to a reduction in the number of establishment of approximately 13,000, or 4.4% of the total new establishments added between 2001 and 2005. A reduction of $170,000 in small business lending is associated with the closure of one establishment. Qualitatively similar results emerge when one identifies a real estate boom using appreciation at the median branch – banks which are more exposed to appreciations decrease small business lending at branches not directly subject to rapid appreciation. The decrease in lending captured by this measure leads to a slower establishment growth at locations where credit was reduced.

Efficient market theory predicts that lending in one credit market is independent of conditions elsewhere. In order for credit to be affected by shocks to liquidity or alternative investments, banks should be subject to frictions in accessing external financing. This is not enough to generate changes in bank lending. I also assume that credit markets are segmented due to high switching costs for borrowers. The first friction explains why banks are unable to expand lending unless their deposits increase. The second friction explains why there are more loans to be made – other banks cannot profitably extend all of the loans in a given market. The results in this paper can be viewed as an evidence for the relevance of the two frictions. The departure from efficient market theory implies that the internal allocation of bank capital resulting from local shocks can have substantial real effects.

Finally, the identification strategy in this paper is related to the recent literature on bank lending which focuses on cross-country spillovers of financial shocks. The seminal papers by Peek and Rosengren (1997, 2000) study the effect of a shock to the bank balance sheet which originates from Japan on lending in the US.[5] Similarly to these papers, I separate the origin of a bank shock from the areas where I examine the effects, in order to minimize the correlation between the shock and demand conditions.

This paper proceeds as follows. Section 2 introduces the dataset. Section 3 outlines a simple model of multi-branch lending and discusses the identification assumptions. Section 4 includes the methodology and results regarding small business lending. Section 5 presents results regarding the impact on real activity. Section 6 includes

[5]For additional papers in this literature see: Schnabl (2012), Cetorelli and Goldberg (2012).

robustness and extensions. Section 7 concludes the paper.

1.2 Dataset

This section outlines how I measure the lending activity to small businesses at individual branches of different bank retail networks. I also discuss the data sources for each of the two local shocks that generate changes in banks' lending.

1.2.1 Bank Network and Small Business Lending

Information on the origination of commercial and industrial (C&I) loans and loans secured by nonresidential real estate with value of less than $1 million (small business loans) is filed each year by banks that fall within the requirements set in the Community Reinvestment Act. Generally, these are independent commercial banks and savings institutions with more than $250 million in assets or banks owned by a bank-holding company with more than $1 billion in total assets.[6] The bank filings consist of the gross originations amounts, together for both types of loans, and the total count of small business loans by distinct geographical categories. The provided information allows me to identify total bank loan originations by census tract or by groups of census tracts.[7]

The exact locations of bank branches are listed in the Summary of Deposits (SOD), compiled by the Federal Deposit Insurance Corporation (FDIC). The CRA data effectively maps the locations and lending volumes for different small-business borrowers for each of the banks in the sample. In this form, the data allows me to investigate the effect of credit on real activity but it does not capture the overall lending activity across retail branches of banks and across different credit markets. In order

[6]After 2004 the asset requirement for commercial banks not owned by bank-holding companies was increased to $1 billion

[7]Please refer to the data appendix for more information.

to measure lending done at distinct bank branches, I match borrowers with the set of closest locations of the bank they borrowed from. The underlying assumption in this matching is that distance matters and businesses use the closest bank locations. This is supported by general findings using the National Survey of Small Business Finance.[8]

The matching algorithm involves several steps. First, I compute the distance between a given lending location and all of the retail branches of the lending bank. Locations farther than 186mi (300km) from any branch are not associated. For the rest of the locations, I extend the distance to the closest branch of the lending bank by 25% and use this distance as the radius of the circle that contains the branches that likely originated the loan. For each of these branches I use the inverse of the distance to the borrower to capture the likelihood they provided the funding. Finally, each branch is assigned the expected value of the total origination of business loans based on this likelihood i.e. the total origination amount times the probability of origination for the particular branch. Similarly, each branch is assigned the expected number of small business loans observed at the lending location. This process is repeated for each of the lending locations reported in the CRA filings and for each bank that provided this information. The resulting dataset includes the expected origination value (and count) of small business lending at each branch of the bank network. I use the unique branch number, provided by the SOD, to create the panel data of branch observations. Notice that the matching algorithm implies that opening/closing of physical locations will decrease/increase the expected value of loan originations at branches that remain open. To account for this I control for the change in the number of bank offices in all of the estimated models in this study.

Bank balance sheet data comes from the Consolidated Report of Condition and

[8]Findings by Petersen and Rajan (2002) indicate that the median distance between a business and the bank lender is between 2 and 5 miles. Brevoort et al (2010) show that this relationship has persisted over time.

Income (Call Reports) provided by the FDIC. The reports for each bank are matched to the Summary of Deposits data using the bank certificate number. The balance sheet variables are the annual average of quarterly observations.

Data on the number of establishments is taken from the County Business Patterns (CBP). CBP is maintained by the US Census and provides detailed information on the annual number of businesses with paid employees as of March 12th.[9] Businesses are separated into industries according to the 6-digit NAICS industry classification. I use the information at the zip code level and aggregate the industry classification to the 2-digit. The industries of mining, construction, finance, and real estate are excluded from this study as they can be directly affected by the shocks considered in this paper.

1.2.2 Shocks

The first shock, namely the increase in bank deposits, is a result of a technological break-through that allowed for profitable drilling in several states in the US. The implementation of hydraulic fracturing in horizontal wells allowed access to oil and natural gas reserves at a much lower cost than previously considered. Plosser (2014) and Giljie (2012), both using different data sources, document the impact that this break-through had on deposits at banks in the areas where drilling was initiated. Gilje et al (2014) provide evidence that banks with branches in counties with fracking wells had higher deposits growth and lower interest expense.

This paper uses a newly released data source from the U.S. Geological Survey which examines the historical development of drilling that utilized hydraulic fracturing between 1947 and 2010 (Gallegos and Varela, (2015)). The data provides locations of both horizontal and directional wells, aggregated to the 8-digit hydrologic unit code

[9] To match the reporting frequencies of the rest of the data, I assign the total number of establishments reported as March 12th of a given year to the end of the previous year.

areas (HUC), in order to conceal the precise well locations.[10] Plosser (2014) and Giljie (2012) suggest that the purchase of the rights to drill provides a significant one-time payment for the owner of the land. Consequentially, I use the the number of new horizontal wells in a given area to capture deposit growth. Figure 1 plots the location of new horizontal wells for the period of interest between 2001 and 2007.

The second shock considered in this paper is related to the housing real estate boom before the recession. Rapid increases in residential prices lead to an increased investment construction and development loans, especially by smaller banks (FDIC (2012)). Changes in residential appreciation across the US affect the relative return of lending to small businesses versus lending to land developers. I use the real estate booms to proxy for the shock to the profitability of real estate loans. The information on house prices is provided by the Federal Housing Finance Agency (FHFA). The agency maintains a quarterly House Price Index (HPI) both for MSAs and for the state areas outside of the MSAs. The index is compiled by tracking price changes for repeat house sales. I use the average quarterly HPI appreciation to capture the intensity of the housing boom across locations. The evolution of this measure can be seen in Figure 2. Areas in California, Arizona, Florida, and D.C. experienced unprecedented real estate booms, while the growth in the rest of the U.S. does not exhibit a particular pattern. In close parallel with the definition of the energy shock, I capture the bank exposure to real estate booms by the fraction of branches in the areas with appreciation above the 90^{th} percentile for the country. Alternatively, I parametrize the bank network exposure to real estate booms by the appreciation at the median branch. The parameterization of both the deposit shock and the real estate shock are tightly related to the simple model that I present below.

[10] The original source for the well location is the proprietary IHS database (IHS Energy (2011)).

1.3 Model and Identification Issues

This section outlines a simple econometric model of internal allocation of bank capital. The purpose of the model is to provide intuition for a possible mechanism of capital allocation between different branches and to bring to light some important identification issues. Importantly, the model highlights the necessary frictions which can allow financial intermediaries to propagate local shocks through their network.

The setup is an extension of Khwaja and Mian (2008). It assumes that banks lend to two different types of firms at different physical offices. Banks, indexed by i, have more than one branch and each of the branches, indexed by j, provides credit to one small business, L_{ij}, and to one land developer, K_{ij}. While j refers to a particular branch of a bank, I use it interchangeably to refer to the credit market where the branch is located. This is done in order to simplify notation. Each bank is assumed to be a monopolist with respect to both the small business and the land developer. One justification of this assumption is the existence of high switching costs for the borrowers.[11] The marginal return to L_{ij} is $r_j^L + r_i^L - \alpha_L L_{ij}$, and the marginal return to K_{ij} is $r_j^K + r_i^K - \alpha_K K_{ij}$. I assume that the marginal return to each of the loan types has a local component, indexed by j, and a bank component, indexed by i. Each branch can collect deposits up to D_{ij} at no cost. Finally, the bank can borrow B_i form the interbank market at the marginal cost of $\alpha_B^i B_i$, which is specific to each bank.

There are two periods. During the first period, t, bank i maximizes profits by choosing L_{ij}^t and K_{ij}^t at each branch subject to the constraint that total lending is equal to the total bank liabilities, $\sum_j L_{ij}^t + \sum_j K_{ij}^t = \sum_j D_{ij}^t + B_i^t$. At the end of the first period, the bank observes three different shocks: 1) the marginal return to L_{ij} increases by η_{ij}; 2) the marginal return to K_{ij} increases by κ_{ij}; 3) the deposits that

[11]The reason why even a land developer may have significant switching costs has to do with the local nature of information regarding real estate. Land developers will need to invest significant resources in educating lenders about the real estate opportunities in a given market.

the bank can collect at each branch increase by δ_{ij}. Each of these shocks is specific to a branch of i. After observing the shocks, at the beginning of $t+1$ the bank chooses L_{ij}^{t+1} and K_{ij}^{t+1} at each branch to maximize profits.

The details of the maximization problem and the derivation of the solution for the change in small business lending between the two periods are provided in Appending A2. Intuitively, the bank chooses K_{ij} and L_{ij} in order to equalize the marginal return of each of the loans, at each of the locations, to the marginal cost of borrowing from the interbank market.[12] It is worth emphasizing that the final expression for small business lending assumes for tractability that $\alpha_B^i = \gamma/N_i$. The assumption leads to the implication that lending depends on the average of the deposit shocks as well as the average of the shocks to the return of real estate loans. The justification of the assumption rests on the arguments in Stein (1998) of asymmetric information about banks' assets and on the discussion in Stein (2002) that horizontally integrated small banks lend to more opaque firms.

Solving for the optimal allocation at each branch and taking the difference between the two periods, I get:

$$\triangle L_{ij} = a\eta_{ij} - b_1 \frac{1}{N_i} \sum_{\bar{j}} \eta_{ij} - b_2 \frac{1}{N_i} \sum_{j} \kappa_{ij} + b_3 \frac{1}{N_i} \sum_{j} \delta_{ij} \tag{1.1}$$

where $\bar{j}$ refers to the branches of i different from j. a, b_1, b_2, and b_3 are positive parameters.

The model highlights how the marginal return of each loan type at different branches and the deposits throughout the network affect lending to a small business. When there is an increase in the marginal return to L at branch ij, the bank increases L_{ij}. This effect is captured by the positive term in front of η_{ij}. An increase in the marginal return to L at any other branch, $\bar{j}$, of i will decrease L_{ij}. Intuitively, when the return is higher at another location, the bank increases lending there and

[12]This assumes that the bank cannot provide all of the lending using only its deposits.

decreases lending at ij. This is the mirror image of the effect of η_{ij}. When the marginal return to K increases at any branch, including ij, L_{ij} will decrease. The intuition is exactly the same as when the marginal return to L increases at another branch of the network. The only difference is that local increases in the return to K, κ_{ij}, will decrease L_{ij}. Finally, an increase in deposits at any branch of the bank will increase L_{ij}. Higher deposits imply that the bank will rely less on external borrowing, which will lower the marginal cost of funds. The lower cost of funds allows the bank to fund loans that have lower marginal return.

Two frictions in this model play a key role in the allocation of funds across the bank network. The first friction comes from the assumption that the bank is a monopolist and implies that borrowers cannot access alternative sources of financing. It is justified by the existence of high switching costs for borrowers, who may find it prohibitively expensive to switch lenders. The assumption implies that each bank faces a downward sloping curve for L and K. Alternatively, if banks share a credit market, the effects of each of the shocks will depend on the complementarity or substitutability of the lending of each bank. The second friction in the model is that banks are constrained in accessing external capital. This is captured by the fact that the marginal cost of bank borrowing depends on the total amount borrowed and on the size of the bank. In particular, I have assumed that a bank with more branches will have a lower marginal cost of borrowing, for any amount borrowed. As the size of the bank goes to infinity the cost of borrowing becomes constant in the limit. This implies that only the local shock to the marginal return of L, η_{ij} matters for L_{ij}.

The parameter b_3 captures the effect of an increase in bank deposits on lending. Let us assume that there are no real estate shocks, κ. The model highlights the importance of using an exogenous shift in deposits when identifying b_3. Usually, changes in deposits are related to changes in the marginal return of loans. I can identify their effect on lending, ceteris paribus, only with exogenous changes in deposits. This is the main reason why I resort to deposit shocks driven by the fracking revolution – Gilje (2012) and Plosser (2014) have argued that fracking is not related to changes in the marginal return of lending. If I assume that the deposit shocks from fracking are exogenous and that the shocks to the marginal return of small business lending are common to all banks within a credit market (a county) i.e. $\eta_{ij} = \eta_j$ for all i in a location j, then I can use the entire sample of bank branches, within and outside of the energy boom areas, to identify the effect of higher deposits. This is because I can include a control for the common credit-market year shocks, such as county-year fixed effects. I do not follow this approach. Instead, I exclude the areas within the energy booms. It is likely that within fracking areas $\eta_{ij} \neq \eta_j$. Banks that specialize in lending to industries related to fracking can experience an increase in the marginal return of lending within the fracking areas. Other banks may not be impacted. This means that a county-year fixed effect will not be an adequate control for demand conditions at places with energy booms. Additionally, in the case that there is a positive correlation between local deposit shocks and the local marginal return of lending, the estimate of the effect of deposits on small business lending at branches away from fracking will be a lower bound. This correlation is, nevertheless, likely to be small.

The effect of an increase in the return of real estate loans is captured by b_2. Let us assume that there are no deposit shocks, δ. I use residential appreciation to capture changes in the return of RE loans. I can identify the effect of the shock to the return of RE loans on business lending by using the entire sample of branches under two conditions: 1) local shocks η_{ij} are common to all i in the area j; 2) $\text{Corr}(\eta_{ij}, \kappa_{ij}) = 0$ i.e. local shocks to the return of each loans are not correlated. The first condition implies that county-year fixed effects will adequately control for local shocks. The second condition implies that residential appreciation will only capture the effect of changes in the return of RE loans.

It is likely that the two conditions are violated in the case of RE booms. In particular, within areas where residential appreciation results in an increase to the return of RE loans there will also be increases in the return of business loans, i.e. $\mathrm{Corr}(\eta_{ij}, \kappa_{ij}) > 0$. It is also plausible that in these areas the shocks to the return of business loans are not common to all of the banks, i.e. $\eta_{ij} \neq \eta_j$ for all i in the area j where $\kappa_{ij} > 0$. The first assumption implies that I will not be able to identify the effect of the shock to the RE loans separately from that to the business loans. The second assumption implies that a county-year fixed effect will not adequately control for local shocks at the areas with booms. In order to accommodate both assumptions, I exclude from the estimation branches which are directly exposed to shocks to the return of RE loans. Branches not affected by a local κ shock will be affected by a κ and possibly by a η shock somewhere else in the network. Both effects lower L locally since they capture the combined increase in L and K at other branches of the network. Therefore, at branches without a local κ shock, I can identify the combined effect of higher lending elsewhere in the network. I focus on these branches in the empirical section assuming that outside of areas with RE booms I can control for local shocks to the return of business loans with county-year fixed effects.

1.4 Local Supply Shocks and Small Business Lending

In this section, I study how local economic factors in certain areas – discovery of oil or increased demand for construction lending – affect the balance sheet of banks which have geographical presence in these areas through their branch network. I, then, explore whether the affected banks re-optimize their lending to small businesses in accordance with the model in the previous section, particularly in the part of their branch network that is not directly exposed to the local shocks. Financial intermediaries which have a limited access to external borrowing and therefore depend on additional deposits to fund new investments are expected to optimally respond to the two local shocks. This coordinated response across the branch networks allows banks to propagate economic factors across areas at significant distance.

The literature on small business lending has provided theoretical arguments as well as empirical evidence for the difference in the types of loans originated by banks of varying size. Stein (2002) argues that loans based on "soft" information favor organizations with a high degree of horizontal integration, while "hard" information loans are best handled by vertically integrated organizations. Nakamura (1994) puts forward a complementary argument suggesting that small banks have a cost advantage compared to bigger banks in providing credit to opaque businesses. Berger et al (2005) and Brickley et al (2003) find empirical evidence for the organizational difference across bank size and in terms of the type of loans extended. Smaller banks are also restricted in their ability to expand their assets both for regulatory reasons (Nakamura (1994)) and for agency problems arising in the interbank-lending market (Kashyap and Stein (1997)). More broadly, financial intermediaries of different assets size and geographical scope are considered to be fundamentally different in terms of the business model they follow and the types of customers they service. DeYoung and Rice (2004) show that intermediaries with less than $1 billion in assets follow a traditional lending-based business model, while bigger intermediaries increasingly focus on a non-interest, fee-based, business model driven by investment banking and securitization activities. In keeping with this distinction in the literature I differentiate between two categories of intermediaries using the size of the branch network. More specifically, I define banks as small if they have no more than 30 branches. This definition roughly corresponds to banks with less than $1.1 billion in assets. In the robustness section, I show that the results in this section are not sensitive to the particular definition of bank size.

In order to identify the effect of exposure independently from other differences in the bank characteristics I include a set of balance sheet controls from the Call Reports.[13] Table 1 lists the bank-year averages for each of the years considered here, divided into banks below/above 30 branches.

1.4.1 Deposit Shock

First, I study the effect that new fracking wells have on the deposits made at local bank branches located in the same areas. Banks with branches in these areas can be subject significant increases in liquidity which lower the cost of funding investments. These banks can choose to expand their loan portfolios or match the increased liabilities with liquid securities. I focus on the effect on small business loan originations for the period between 2001 and 2007.

Methodology and Summary Statistics

The main premise behind the effect of fracking on bank liabilities is that land owners receive renumeration from the oil companies which they deposit at the local branches. It follows that communities which include owners of land used for fracking will be an important source of deposits for banks servicing these areas. I assume that most of the owners live in proximity to the wells and that the deposits are made relatively close to the actual drilling locations. Since the data on the fracking wells is aggregated at Hydrological Unit Codes (HUC), I designate a branch as exposed to fracking deposits if it is located within one of the HUCs with new horizontal wells. To confirm that the owners are likely to inhabit the areas where fracking is being done I compare some key census statistics for zip codes within fracking areas to zip codes outside of these areas. This information is provided in Table 2. The average zip code with fracking locations has slightly lower population and income compared to the zip codes outside.

[13]The list of controls includes one year lags of Log of Assets, Deposits over Assets, Interest Expense on Deposits, Tier-1 Capital Ratio, C&I Loans over Assets, Mortgage Loans over Assets, Net Income over Assets, Unused Loan Commitments over Assets, and also Indicators for Bank Holding Company Ownership, Change in the number of offices.

Importantly, areas with fracking are not significantly more rural or less populated than the average for the U.S.. This suggests that land owners are not expected to live away form the fracking locations.

Banks source their deposits from different areas. This is reflected in the proportion of deposits held at different branches of the same bank. The fracking areas can be an important source of deposits for some banks, while for others the branches in these areas are primarily lending outlets. I measure bank exposure to the liquidity shock with the weighted average of new wells across the network. The weights used are the share of bank deposits collected at each branch in the previous year. Formally:

$$Exp_t^i = \sum_{b \in B_{i,t}} DepShare_{i,t-1}^b \times NewWells_{HUC,t} \tag{1.2}$$

$B_{i,t}$ is the set of bank branches of bank i in year t. $DepShare_{i,t-1}^b$ is the share of total bank deposits collected at branch b during the previous year. New $\text{Wells}_{HUC,t}$ is the number of new horizontal wells in Hydrological Unit HUC. The weights in this measure also eliminate from the sample branches which did not exist or were owned by a different bank in the previous year. Table 3 lists the medians for the bank-level averages for well exposure, deposit growth, cost of deposits, and small business origination growth for each year in the sample. The average exposure across all years for small banks is 3.65 while the median is 0.8. There are a total of 305 bank x year observations of exposed small banks. For big banks the average is 1.3 and the median is 0.15. There are 410 bank x year observations of exposed big banks.

It is worth noticing that small banks with positive exposure experience higher growth in deposits and loan origination and lower interest expense compared to small unexposed banks, during most of the sample years. This is in line with my assumption that the exposure to new wells is a proxy for a deposit shock. This is, however, not true for the big banks.

The effect of new wells on deposits at individual branches and on the bank liabilities is estimated with the following equations:

$$\triangle \ln \text{Dep}^i_{b,t} = \alpha_1 \left(\text{Small}^i \times \text{NewWells}_{HUC,t}\right) + \alpha_2 \left(\text{Big}^i \times \text{NewWells}_{HUC,t}\right) + \beta_1 X^i_t + \sigma_t + \epsilon^i_{b,t} \tag{1.3}$$

$$\triangle \ln \text{Dep}^i_t = \alpha_3 \left(\text{Small}^i \times Exp^i_t\right) + \alpha_4 \left(\text{Big}^i \times Exp^i_t\right) + \beta_2 X^i_t + \phi_i + \sigma_t + \epsilon^i_{b,t} \tag{1.4}$$

$$\triangle \text{Interest Expense}^i_t = \alpha_5 \left(\text{Small}^i \times Exp^i_t\right) + \alpha_6 \left(\text{Big}^i \times Exp^i_t\right) + \beta_3 X^i_t + \phi_i + \sigma_t + \epsilon^i_{b,t} \tag{1.5}$$

where $\triangle \ln \text{Dep}^i_{b,t}$ is the branch-level growth in deposits, while $\triangle \ln \text{Dep}^i_t$ and $\triangle\text{Interest Expense}^i_t$ are, respectively the bank-level growth in deposits and change in interest expense over deposits between year t and $t-1$. I consider the growth in both the overall deposits and deposits over \$100,000. The latter will better capture big deposits from local landowners. X^i_t includes bank-level controls.[14] ϕ_i and σ_t are bank fixed effects and year fixed effects. The first regression examines the effect of new wells in a given HUC area on the growth of deposits at individual branches. The second and third regression estimate the impact of bank exposure on deposit growth and interest expense. All of the idiosyncratic errors are assumed to be correlated within a given bank and are clustered at the bank level. While the last two regressions document the effect of bank exposure to fracking on the total deposit growth and deposit expense, the first regression provides evidence that the effect can be traced to individual branches in areas with energy booms.

In the next step I examine whether banks exposed to liquidity inflows, proxied by new wells, re-optimize their small business loans portfolio. In particular, I focus on the extent to which higher deposits contribute to expanded loan originations at branches outside of the fracking areas. I estimate:

$$\triangle \ln SBL^i_{b,t} = \alpha_1 \left(\text{Small}^i \times Exp^i_t\right) + \alpha_2 \left(\text{Big}^i \times Exp^i_t\right) + \beta X^i_t + \phi_i + \eta_{c,t} + \epsilon^i_{b,t} \tag{1.6}$$

[14] Control variables include the lags of Log of Assets, Deposits/Assets, C&I Loans/Assets, Mortgage Loans/Assets, Unused Loan Commitments / Assets, and the change in the number of branches.

$SBL^i_{b,t}$ is the small business originations by branch b of bank i in year t. Exp^i_t is allowed to have a different effect across banks with less and more than 30 branches. $\eta_{c,t}$ is a county-year fixed effect. In all samples I exclude branches located within areas with fracking wells.[15] Following the discussion in Section 3, I do this in order to provide a lower bound estimate for the effect of deposits in the case that the marginal return of small business loans is positively correlated with the local deposit shock.

The parameters of interest are α_1 and α_2. Positive estimates imply that new wells allow for increases in small business lending at branches outside of the energy booms. Under the assumption that exposure to fracking delivers additional liquidity to the affected banks, positive estimates are evidence that these intermediaries expand lending to small businesses only when deposits increase. In other words, the affected banks are dependent on internal sources of funding. It is worth noticing that the inclusion of the county-year fixed effect, $\eta_{c,t}$, implies that α_1 and α_2 are identified by comparing the originations of small business loans by banks of varying degree of exposure in the same county in a given year.[16]

I use the growth of loan originations, rather than the level, for two reasons. The first reason is that small business loans generally have short terms. Assuming that the average maturity is twelve months implies that most of these loans are rolled over each year. These show up as new originations in the data. The second reason is that loan refinancing is reported as a new origination. As a result, the origination amount at a given branch may include the stock of previous loans. Finally, to control for the fact that some banks may refinance more than others or provide loans with longer maturity, I also include a bank fixed effect in the main equation.

In the baseline sample, I exclude branches within fracking areas. This may not

[15] I exclude branches in areas with new horizontal wells as well as places with existing horizontal and directional wells. Excluding areas with wells is warranted under the concern that demand shocks are correlated with active drilling.

[16] This is the case because the effect of exposure in a location where all banks have the same exposure (or no exposure) cannot be distinguished from the county-year fixed effect.

be sufficient to achieve identification of the liquidity shock for two reasons. First, fracking can be correlated with demand shocks in the areas surrounding these energy booms i.e. the development of the new wells may require an additional supporting infrastructure in nearby areas. Any increases in lending in these areas cannot, therefore, be attributed solely to changes in the bank credit supply. Second, the landowners may deposit their checks at branches just outside of the fracking areas. This implies that differences in the lending of treated and untreated banks will not capture differences in the available liquidity. Both of these concerns imply that I should exclude additional branches located near the energy booms. I provide additional coefficient estimates using only branches located at least 24 mi, 30 mi, 50 mi, and 100 mi away from any fracking wells.[17]

Finally, I use the proxy for liquidity shocks directly, rather than as an instrument for deposit growth, since it is likely that the exogeneity assumption will be violated. It is possible that fracking not only affects deposit growth but carries information about the stability of the deposit growth over time. If lending depends both on deposit growth and the stability of this growth, an instrumental variable approach will not be justified.

Results

The results from the estimation of equations (1.3), (1.4), and (1.5) are presented in Table 4. The estimates from the branch-level regression suggest that new fracking wells boost the liquidity at local branches. The effect is significant and similar in magnitude for banks with small and big networks, which is consistent with local land owners who do not have a preference for one type of branch over another. Branches located within areas with two new wells experience 10bps faster deposit growth relative to branches with no new wells in the proximity. The coefficient of exposure in

[17]I have done this analysis using degrees as a measure of distance. In the paper, I report the approximate distance in miles.

second regression in Table 4 is positive and significant only for banks with less than 30 branches. It appears that the additional deposits at the branch level do not have a significant impact at the balance sheet level of the big banks. For small banks, an average exposure of 2 new wells is associated with 0.5% faster total deposit growth and 45% faster growth in large deposits relative to banks with no exposure. The evidence from the growth in large deposits is particularly compelling since one expects that fracking payments lead to large deposits. This increase in deposit growth translates into a decrease in interest expense by close to 10bps.[18] Big banks are not affected.

How significant is the implied increase in deposits that results from the new fracking wells? To provide a simple answer, I calculate the expected increase in bank deposits using the coefficient estimate for small banks from the second column of Table 4, the overall bank exposure, and the stock of deposits from the previous year. The aggregate results for all small banks are listed in the first two columns of Table 6. The first column lists the annual increase in deposits while the second column lists the cumulative increase. The cumulative increase in each year is a more appropriate measure for the additional deposits available to exposed banks at each year given that retail deposits have relatively long duration. The drilling of new fracking wells has added an additional $2.6 billion of deposits to the small banks with branches in areas of the wells. This is a substantial increase relative to the $25 billion deposits held by these institutions.

The results from the estimation of equation (1.6) can be found in Table 5. The first regression excludes all branches within areas with active wells in the current and previous year. While the effect of exposure for small banks is positive, it is marginally significant. The coefficient increases and becomes significant at 5% when I exclude from the sample branches within 24 miles of fracking areas. Further excluding branches within 30, 50, and 100 miles leads to a stable and similar coefficient across

[18]Interest expense is in percentage units. I use the change in the interest expense rather than the level because the interest expense is extremely persistent.

the estimations. All of the estimates for small banks imply that increased liquidity has a substantial effect on the banks' lending activity. After controlling for local variation in demand at the county level, I find that a branch of a small bank with 2 new wells increases origination growth of small business loans by 9% relative to a branch of a bank with no branches in fracking areas. The county-year fixed effects are crucial for identification in this estimation. Fracking can invigorate local demand for small business loans. As long as this leads to a county-wide increase, this effect will be controlled for with the fixed effects. My results, therefore, imply that even in counties that experience an overall increase in credit demand due to the energy booms, the banks with a liquidity shock increase their credit supply more relative to the banks with no liquidity shocks. The effect of exposure for big banks is not significant for any of the samples. This is consistent with the fact that these banks did not experience a liquidity shock from presence in fracking areas.

There seems to be a smaller difference between the lending of exposed versus unexposed banks at branches close to fracking areas. As discussed in the previous subsection, this is a result of a combination of spatially correlated demand shocks originating from the fracking areas and liquidity shocks experienced by banks located strictly outside the energy booms. Comparing lending activity at bigger distances, the effect of the liquidity shock stabilizes in size and remains significant.

I calculate the aggregate amount of additional loan originations by small banks following the procedure I applied for the aggregate deposits. The third column of Table 4 lists the incremental lending amounts resulting from the liquidity shock. Over the entire sample originations increased by over $5 billion. The average annual originations for locations within 200 miles of the energy booms are close to $33 billion, making the identified credit-supply increase substantial. Interestingly, almost the entire increase in the stock of deposits was invested in new originations between 2001 and 2005. While this estimate is higher than what is estimated by Plosser (2014), it is not necessarily comparable since it uses the deposit increases only from the drilling of new wells.

How far do small banks export liquidity? This question is important since smaller banks have a somewhat limited geographic span. Figure 3 plots the α_1 coefficient from equation (1.6) with the 95% confidence bands for samples that sequentially exclude branches within the indicated distance. The figure also includes the distribution of the branches of small banks by distance from the fracking areas. The coefficient plot indicates that liquidity has a big impact on lending within the band between 30 to 60 miles outside of fracking areas. Still, the impact is significant when I use only variation form branches beyond 100 miles. Beyond 130 miles, the effect of liquidity converges to zero. This is likely due to the fact that there are not too many branches of small banks beyond this distance.

The credit-supply effect is identified by comparing competing branches in different credit markets. To confirm that this comparison is justified and to make sure that the small banks exposed to fracking are not fundamentally different, I compare some key statistics from the balance sheet of exposed and unexposed banks. I also compare performance across the two bank categories by examining key components of the ROE.[19] The information for the two relevant categories of small banks – with no exposure, located within 100 miles of fracking and with positive exposure – is listed in Table 7. Treated banks have a higher concentration in commercial and consumer lending and a lower concentration in loans secured by real estate and in securities. They fund their investments with a higher fraction of deposits and lower borrowing. The two groups have similar profitability, with the exposed banks earning slightly more non-interest income. The health of the portfolio is also similar. Overall, the information does not suggest that the treated banks are fundamentally different.

The identification rests on the important assumption that banks do not expand

[19] Here I follow the modified Dupont analysis introduced by MacDonald and Koch (2014)

their networks in a strategic way. In particular, I assume that banks that face an increase in the marginal return of small business loans outside of fracking areas do not enter fracking areas in order to finance the increase loan demand. Evidence in Plosser (2014) and Gilje et al (2014) suggests that banks did not chase funds within fracking counties. In the robustness section I show that the results are not sensitive to the dropping from the sample of recently acquired/new branches in fracking areas.

1.4.2 Real Estate Shock

In the previous section, the particular geographical location of the branch networks allowed some banks access to a cheap deposits due to fracking. Similarly, in this section the location of the branch network placed some intermediaries in the midst of local construction booms in the run up to the recession of 2007. I document the association between the exposure of banks to surging house prices and their concentration in construction and development loans.[20] I, then, study how these intermediaries, with branches both inside and outside areas with residential booms, re-optimized their credit supply to small businesses.

Methodology and Summary Statistics

The identification strategy for the effect of a real estate boom is closely linked to the model presented in Section 3. In parallel with the setup for the deposit shocks, the real estate shocks, κ_{ij}, can be set to one at locations with relatively high appreciation, and set to zero everywhere else. This effectively defines booming zones where every bank is exposed to real estate shocks. I identify these zones with residential appreciation in the top 90^{th} percentile for the US. Alternatively, I use the residential appreciation at the median branch of each bank to capture the exposure to real estate booms. The

[20] Compared to other loans secured by real estate, such as traditional mortgages, construction and development loans are not usually securitized by the originating banks. As a result, they remain on the balance sheet.

first measure is area specific, while the second measure is bank specific.

Booming Zones: In this setup, I parametrize the variation in the exposure to real estate booms by the fraction of branches located inside areas with appreciation in the top decile for the US:

$$Exp_t^i = \frac{1}{TotBr_{i,t}} \sum_{b \in B_i^t, t} I_b(Boom_{c,t})$$

$TotBr_{i,t}$ and B_i^t are, respectively the total number of branches of bank i, in year t, and the set of all branches. $Boom_{c,t}$ takes the value of 1 if the quarterly growth rate of HPI of county c is in the top decile for the year t. $I_b(Boom_{c,t})$ takes a value of 1 if the branch b of bank i is located in a county with a boom. Table 8 lists the bank averages for real estate exposure, deposit growth, cost of deposits, and small business origination growth for each year in the sample. The average exposure for an exposed small (big) bank is 70% (38%). In all but one year, small banks with positive exposure experience both higher loan origination growth and higher deposit growth, compared to small unexposed banks. Similar pattern is observed for the big banks.

The increased exposure to real estate booms is assumed to increase the marginal return of construction and development loans. In other words, banks with a higher fraction of branches within areas with surging house prices will be better positioned to provide these loans due to access to local information about the profitability of these investments. Higher profitability can lead to increased lending as banks maximize their return on equity. Ideally, I would use information on branch-level lending related to real estate and show that it increases within areas with high residential appreciation. Since I do not have this information, I use balance sheet variables instead, and estimate:[21]

$$C\&D_t^i/Assets_t^i = \alpha_1 \left(\text{Small}^i \times Exp_t^i\right) + \alpha_2 \left(\text{Big}^i \times Exp_t^i\right) + \beta_1 X_t^i + \phi_i + \sigma_t + \epsilon_{b,t}^i \quad (1.7)$$

[21] Loutskina and Strahan (2015) show that banks originate more mortgages at parts of their network which experience higher appreciation.

$C\&D_t^i$ is construction and development loans on the balance sheet. Additionally, I estimate the same equation using construction and development loans plus the unused commitments for these loans, as well as using the total amount of real estate based loans plus unused commitments. The latter two dependent variables provide a more comprehensive picture of the amount of real estate loans extended by financial intermediaries. X_t^i includes bank controls as defined in the previous section; ϕ_i is a bank fixed effect; σ_t is a year fixed effect. Idiosyncratic errors are clustered by bank. The parameters of interest here are the set of α's. Positive α_1 or α_2 imply that higher geographical concentration in residential booms is associated with higher investment concentration in construction and development loans. This measure of exposure, therefore, captures the extent to which the geographical distribution of the branch network allows banks to invest in loans other than small business loans.

Banks which increase their concentration in construction and development loans can maintain their lending activity in the rest of the credit markets they service. They can do this by increasing their leverage through additional wholesale funding – brokered deposits, FHLB advances, or fed funds. This funding strategy will increase the interest expense and reduce the net interest income. It will also expose the bank to a liquidity risk inherent in wholesale funding. Alternatively, the additional construction and development loans can be financed by reallocating funding from other investments such as small business loans. To identify the extent to which banks engaged in the second funding strategy, I estimate the equation:

$$\triangle \ln SBL_{b,t}^i = \alpha_1 \left(\text{Small}^i \times Exp_t^i\right) + \alpha_2 \left(\text{Big}^i \times Exp_t^i\right) + \beta_1 X_t^i + \phi_i + \eta_{c,t} + \epsilon_{b,t}^i \tag{1.8}$$

Following the same logic as in the case of fracking, I exclude all branches within areas with appreciation above the 90^{th} percentile, as these locations are likely subject to positive demand shocks. I also re-estimate the above equation with a sample that excludes branches within 24, 30, 50, and 100 miles of the areas with residential booms.

Negative α's imply that banks finance their increased concentration in construction and development loans by reducing credit to small businesses in areas away from the residential booms. It should be emphasized that the identification of this effect is not driven by differences in overall economic conditions in different counties – the county-year fixed effects already accommodate these differences.

Median Branch: In this setup I use the median residential appreciation at distinct branches of the network to quantify bank exposure to real estate booms. Here there are two dimension of variation in appreciation: 1) across different banks; 2) within a given bank. Banks with higher median appreciation should be more exposed to changes in the marginal return of real estate loans. Within banks, these marginal returns are not likely to be uniform across the branch network. In particular, branches with above-median appreciation are likely to be more exposed to real estate than the rest of the branches. I assume that these branches are directly affected by shocks to the return of real estate loans. It is likely that the return to small business lending also increases at these branches due to a positive local correlation between the shocks to the returns. In this case I can only identify the combined effect of the increase in the return of both loans on lending. As discussed in the section 3, this effect is consistently estimated only at the branches with appreciation equal to or less than the median for the network. Therefore, I remove branches with above median appreciation when I estimate the effect on small business lending.

The variation in the appreciation at the median branch across different banks captures the extent of geographical concentration in residential booms. To provide evidence for this, I compare the loan concentration in construction and development lending across banks with different median appreciation. More specifically, I estimate:

$$C\&D_t^i/Assets_t^i = \alpha_1 \left(\text{Small}^i \times Median_t^i\right) + \alpha_2 \left(\text{Big}^i \times Median_t^i\right) + \beta_1 X_t^i + \phi_i + \sigma_t + \epsilon_{b,t}^i \quad (1.9)$$

where $Median_t^i$ is the residential appreciation at the median branch of bank i in year t. Additionally, I estimate the same equation using construction and development loans plus the unused commitments for these loans, as well as using the total amount of real estate based loans plus unused commitments. Positive α's confirm the association between geographical and portfolio concentration.

As discussed above, increased investment in construction and development loans can be achieved through a decreased funding available for small business loans. To identify the extent to which banks engage in this strategy, I estimate:

$$\triangle \ln SBL_{b,t}^i = \alpha_1 \left(\text{Small}^i \times Median_t^i\right) + \alpha_2 \left(\text{Big}^i \times Median_t^i\right) + \beta_1 X_t^i + \phi_i + \eta_{c,t} + \epsilon_{b,t}^i \quad (1.10)$$

where X_t^i includes lagged bank controls for assets and asset composition. $\eta_{c,t}$ is a county-year fixed effect. I use the variation in the residential appreciation within each of the bank network to exclude from the sample credit markets where banks can experience increased profitability of both construction and development loans and small business loans. In particular, I exclude from the sample credit markets where any of the competing banks faces residential appreciation above its respective median. I further exclude from the sample, bank networks for which less than 15% of branches are above median.[22] The resulting sample includes only the portion of the branch networks which are not subject to a direct shock to the return of construction and development loans as captured by residential appreciations.

The parameters of interest here are the set of α's, which capture the effect of higher median branch appreciation on small business lending at branches with no real estate booms, which here are bank-specific. *Negative* α's imply that small business lending *decreases* at branches away from the real estate shocks for banks with *higher* exposure to these shocks. Under the assumption that real estate booms increase the return

[22] I have experimented with removing from the sample banks with less than 25%, 35%, and 45% of branches above the median. The results are qualitatively similar but rely on a significantly smaller sample of banks.

of both real estate and small business loans locally, the set of α's will capture the combined effect of higher loan origination in the part of the network which is excluded form the sample.

Results

Booming Zones: The association between the investment concentration in construction lending and the geographical concentration in residential booms, captured by the fraction of branches in the top decile, is explored in Table 9. The coefficient estimates for $C\&D$ loans are statistically significant and positive for both bank categories. Adding the off-balance-sheet commitments for these loans further increases the size of the coefficients implying that banks increased their exposure to real estate beyond what is evident from examining just the balance sheet activity. A small (big) bank with an average level of exposure of 70% (38%) increases $(C\&D + Unused)/Assets$ by 0.5% (0.9%) relative to banks with no exposure. The results for all loans secured by real estate including the unused commitments imply that small banks did not just increase their concentration in $C\&D$ loans – a small banks with average exposure invested 0.7% more of its assets in real estate. The first two columns of Table 11 list the implied aggregate increases in construction loans for exposed banks. Over the entire sample, small (big) banks with branches in the top decile areas increase construction loans by \$0.3 (3.1) billion. Annually, these increases represent close to 1% of the total construction and development loans extended by these banks.

The results from the estimation of equation (1.8) are given in Table 10. The sample for the first results excludes only branches in the top decile. Regression (2) to (5) exclude branches within 24 to 100 miles from a residential boom. The effect of exposure to residential booms is negative and significant for both small and big bank networks. This is consistent with the fact that both bank categories increased their exposure to loans related to construction and development. It is expected that bigger banks will face a lower marginal cost of borrowing from the interbank market and will be able to expand lending to land developers without decreasing small business loans compared to smaller banks. This expectation is borne out by the data – the coefficient for big banks is half the size of the small bank coefficient for most of the estimates. For both bank types, the effect increases once the branches close to residential booms are eliminated. There can be two explanations for this: 1) positive demand shocks affect areas close but outside the booming areas; 2) close to the booms branches of different banks are impacted similarly despite differences in the measure of exposure.[23]

To quantify the results, consider estimation (3) from Table 10. At a branch more than 30 miles away from the residential boom, a small bank with 70% exposure will decrease loan origination growth by 78% relative to a branch of a bank with no exposure. The difference in origination drops to 23% if we consider all branches outside the booms. Focusing on big banks, a 38% difference in exposure leads to a 23% difference in loan origination growth if we only consider branches that are at least 30 miles away. If we consider all branches the difference drops to 14% and is marginally significant.

The results indicate that geographical concentration in areas with surging residential prices allows banks to take a relatively bigger positions in C&D investments. These are financed not through an increase in leverage but through a substitution away from small business credit in markets outside residential booms. This pattern is consistent across the two bank categories. The implied aggregate decrease in small business originations in provided in the last column of Table 8. On average small banks reduce small business credit outside residential booms by $0.4 billion, while big banks reduce credit by $3.5 billion. These numbers represent respectively

[23]There is an additional reason that the effect of exposure can have either sign in locations close to the boom. On one hand small business lending in a location with increasing housing prices should decrease because small businesses will rely on financing through home equity lines. Adelino et al (2013) document this mechanism. On the other hand small business loans should increase due to a demand boom that results from increases in household wealth as housing prices increase.

25% and 9% of the aggregate originations by the exposed banks outside of residential booms. The reduction in small business credit is significantly higher than the increase in C&D loans. This suggests that the credit reduction is used to finance other types of bank investments, possibly small business loans in the areas of residential booms. In other words, an overall increase in the demand for bank capital in the booming areas can explain the negative credit supply shift that banks impose on small businesses.

The contraction in credit can be traced to more than 100 miles away. Figure 4 plots the geographical extent of the credit reduction. Small banks contract credit predominantly within 30 to 100 miles away from the booming area. This periphery practically contains all of their branches outside. For big banks, the contraction in credit is more pronounced at branches beyond 100 miles. The combined effect for both bank types suggests that there was an overall reduction in credit to small businesses – at closer distance credit was reduced by small banks, while at bigger distances this was done by big banks.

Table 12 lists a selection of balance sheet and performance measures for small banks with and without exposure to residential booms. Small banks with positive exposure are relatively bigger than other small banks within 100 miles of the residential booms. Both groups hold the same fraction of real estate loans, with the exposed banks holding a higher fraction of commercial and consumer loans. Unexposed banks hold a higher fraction of their assets in liquid investments. The difference in the loan mix makes exposed banks more profitable, partially due to the higher asset utilization (aTA/aTE) and partially due to the slightly higher leverage. The portfolio health of both groups is very similar. The overall differences between the two groups are consistent with the increases in the profitability of investments available to banks with higher geographical concentration in areas with residential booms.

Median Branch: The alternative measure of exposure to residential booms – appreciation at the median branch – accommodates the continuous distribution of residential appreciation. While some bank networks may not have branches within the top decile areas, they may still be located within areas with significant appreciation and be able to invest in profitable construction projects. The results in Table 9 suggest that the appreciation at the median branch of bank networks captures the variation in the incentive to invest in construction projects. In particular, coefficient estimates form regression (5) confirm that for both groups of intermediaries increases in network exposure to residential appreciation is associated with higher concentration in C&D loans. A small (big) bank with a 1% higher median appreciation has a 0.6% (0.4%) higher concentration in C&D (including commitments) loans. This evidence implies that even banks outside of the top decile areas take advantage of the booming house market and increase their investments in real estate. The first two columns of Table 14 list the implied aggregate increases in construction loans for exposed banks. Over the entire sample, variations in residential appreciation at the median branch for small (big) banks explain a $2 (4.6) billion increase in C&D loans (including commitments). Annually, these increases represent close to 1.5% of the total construction and development loans extended by small banks and close to 0.8% of the total credit by big banks.

The impact of the real estate booms on small business lending is explored in Table 13. The table includes results from estimating equation (12) for three different samples: 1) no branches above the median; 2) no branches above the median and in areas in the top 95^{th} percentile; 3) no branches above the median and in areas in the top 90^{th} percentile. The evidence across all estimations suggests that an increase in the median appreciation for small banks leads to a decrease in lending growth at the part of the network with lower appreciation. The effect of median appreciation is marginally significant for big banks but has the same direction. Focusing on counties where the residential appreciation is below the median for each bank, a small bank in the top quartile of exposure (2.6%) decreases origination growth by 13%-16% relative to competitors in the first quartile of exposure (1%). The advantageous geographical locations of some banks allows them to increase their profitability by investing in construction lending, which is offset on the balance sheet by a decrease in credit to small businesses in counties where the residential market experiences relatively slower appreciations. Notice that this effect is not driven by county-level differences across the U.S. – the county-year fixed effects accommodate this variation. The results indicate that within a county with a lower residential appreciation, banks with exposure to "hotter" markets decrease local credit to businesses at a higher rate.

The implied aggregate decrease in credit to businesses in counties with below median appreciation for all bank competitors is listed in Table 14. On average, each year small banks decreased lending by $2.1 billion while big banks decreased lending by $4.4 billion. These contractions are significant since they represent close to 20% of total originations in these market by small banks and close to 10% of total originations for big banks. Similarly to the case of the top decile areas, the credit reduction is bigger than the increase in C&D loans, implying that banks substitute between small business lending at below median branches and a combination of C&D loans and other types of lending in areas with higher residential appreciation.

Table 15 compares performance and asset composition of small banks above and below 1.4% (the median) of appreciation at the median branch. Higher exposure to residential appreciation is related to a higher concentration in loans secured by real estate and lower concentration in commercial and consumer lending. This is consistent with the increased incentive for investing in real estate when banks have a geographical advantage. Also consistent with the interpretation that real estate booms increase the profitability of real estate loans, higher median appreciation is associated with higher bank profitability. This is driven by higher asset utilization and slightly higher leverage. The health of the portfolio across the two groups is similar.

The results, taken together, are consistent with the argument that small banks extend more loans related to real estate when parts of their networks experience rapid residential appreciation. This leads to a decease in capital allocated for small business credit at branches where real estate prices are not growing as fast relative to the bank median. The shift is tantamount to a negative lending-supply shock for small businesses in areas which do not experience abrupt price appreciation of residential real estate. The results are consistent with evidence provided by Loutskina and Strahan (2015), who show that banks increase the growth rate of mortgage originations at the counties of their network where prices are higher. Chakraborty et al (2014) show that banks with exposure to real estate appreciations increase the real estate loans in their portfolios. My findings are also consistent with the evidence from the literature on the lending channel of monetary policy where smalls banks (as defined by assets (Kashyap and Stein (2000)) or by BHC affiliation (Campello (2002), Schnabl (2012)) are unable to alleviate funding shocks and decrease the supply of credit. Here banks face a higher return when investing in loans secured by residential real estate. They fund these loans by decreasing small business lending at locations that are not subject to real estate booms.

1.5 Small Business Lending and Real Activity

The results so far indicate that deposit growth from fracking and residential booms, combined with the dependence on traditional sources of funding, lead to considerable credit supply shifts to small businesses. I estimate that small banks with exposure to new wells increased loan originations by $5 billion between 2001 and 2007. In response to surging house prices and increased investment in construction loans, small banks decreased originations to small businesses in areas with slower appreciation between \$0.4 and \$2.1 billion annually depending on the measure – about 20% of total annual originations for these banks. Big banks reduced originations by close to 10% of their annual volume. This section investigates whether these credit supply shifts impacted real activity measured by establishment growth.

1.5.1 Methodology

Studying the independent effect of credit on real activity is challenging – one is likely to observe both increases in credit and establishment growth not only because increased credit allows for economic expansion, but also because increases in business activity are associated with higher demand for credit.

While the amount of lending in a given geographical area is clearly endogenous with respect to the level of economic activity, one can argue that bank exposure to deposit growth or residential appreciation in other, disconnected, markets is not. In other words, it is unlikely that a small business, far from an energy boom, is more likely to be established when the bank in the proximity has more physical branches in an area with new fracking wells.[24] This allows me to investigate the link between the supply-driven changes in lending, proxied by bank exposure to the shocks, and establishment growth.

In order to study the impact on real activity I focus on the locations of *borrowers* rather than the locations of *branches*, as I have done in the previous sections. I compile a measure of how exposed a set of borrowers is to banks which, in turn, are

[24] A business within an industry that is directly related to mining is likely to be established in response to new fracking wells, even if the business is not in direct proximity to the energy boom. I exclude industries that are directly impacted by the shocks that I consider in the paper in order to avoid this source of endogeneity.

subject to shocks. It is defined as:

$$AreaExp_{zip,t} = \frac{1}{\text{TotalBanks}_{zip,t}} \sum_{\text{BankSet}_{zip,t}} BankExposure_{i,t} \tag{1.11}$$

where $BankSet_{zip,t}$ and $\text{TotalBanks}_{zip,t}$ are, respectively, the set of distinct banks providing credit at a given zip code, and their total number. $BankExposure_{i,t}$ depends on the definition used for each of the shocks:

- Deposit Shock: $BankExposure_{i,t} = \sum_{b \in B_{i,t}} DepShare^{b}_{i,t-1} \times NewWells_{HUC,t}$
- Real Estate Shock, Booming Zones: $BankExposure_{i,t} = \frac{1}{TotBr_{i,t}} \sum_{b \in B^{t}_{i},t} I_b(Boom_{c,t})$
- Real Estate Shock, Median Branch: $BankExposure_{i,t} = \text{Low}^{i}_{b,t}$

Area exposure to the deposit shocks is defined as the average of new wells exposure across all of the banks which provide credit to borrowers in a zip code. The area exposure to the real estate appreciation captured by booming zones is defined as the average fraction of branches within the top decile for banks that provide credit to a zip code. The area exposure to the real estate appreciation captured by median appreciation is defined as the fraction of at-or-below median branches which provide credit to a zip code. The first measure captures the increase in credit to borrowers due to fracking, while the second and third measures capture the decrease in credit to borrowers induced by real estate booms.[25]

The area exposure to small banks with new fracking wells for 2004 is shown in Figure 5. As expected, the areas closest to the locations of the energy booms have a higher exposure, yet there is significant variation in exposure away from the booms. The plot for the real estate shock using exposure to the top decile exhibits a similar

[25] A possible concern with the third definition is that it is related to the local conditions, since it does not rely on bank-level exposure. Yet, the relative position of a branch within a bank depends on the conditions at the rest of the branches. Additionally, locations where credit is provided exclusively by below median branches will not provide identification due to the zip code fixed effects included in all estimations.

pattern. In each of the cases, having areas with no exposure close to areas with exposure will be important for the identification of the effect of the balance sheet shocks.

I measure the impact of credit supply shift on establishment growth with:

$$\triangle \ln Est^{ind}_{zip,t} = \alpha_1 AreaExpSmall_{zip,t} + \alpha_2 AreaExpBig_{zip,t} + \delta_{ind,state,t} + \theta_{zip,ind} + \varepsilon_{ind,zip,t} \tag{1.12}$$

$\triangle \ln Est^{ind}_{zip,t}$ is the log difference of the number of total establishments of industry *ind* in area *zip* during year t. Industries are defined at the 2-digit NAICS level and exclude mining, construction, finance, and real estate (and insurance).[26] $AreaExpSmall_{zip,t}$ and $AreaExpBig_{zip,t}$ are defined as in (1.11), using only small or only big banks. $\delta_{ind,state,t}$ is an industry-state-year fixed effect which absorbs time-varying demand shocks at the industry level in each state. $\theta_{zip,ind}$ is a location-industry fixed effect which allows for differences in the permanent industry endowments at the zip code. Some of the difference in exposure can be explained by the level of urbanization of zip codes. The location-specific controls accommodate this source of variation. The identification of the area exposure effect is achieved by comparing establishment growth for the same industry within the same state but at different zip codes. In all estimations I restrict the sample to the zip codes outside of the source of the shocks. I further exclude zip codes at increasing distance from the shocks in order to gauge whether there is an overlap between the credit supply shocks and the variation in establishment growth.

The coefficients of interest in this specification are the set of α's. Positive coefficients in the case of the energy booms imply that locations where credit was provided by banks with new fracking wells, grow faster than locations where credit is provided by the rest of the banks. Negative coefficients in the case of real estate booms imply that location where credit was reduced by banks investing in real estate loans grow

[26] These industry are possibly affected directly by the shocks considered here.

slower than locations where this decrease was smaller.

It should be noted that the evidence from estimating equation (1.12) will not directly imply that the increase in the establishment growth is linked to changes in small business credit. While the results in the previous section indicate that the liquidity and real estate shocks impacted small business credit, the effect that these shocks have on establishment growth could be explained by a change in a different type of bank lending.

1.5.2 Results – Deposit Shock

The results from the estimation of specification (1.12) is provided in Table 16. The first estimation excludes zip codes which intersect with areas with fracking activity in the current or previous year. Estimations (2) to (5) exclude additional zip codes within 24 to 100 miles to fracking areas. Figure 6 shows how distant the zip codes in each of the specifications are.

The coefficient for area exposure to small banks is statistically significant and positive for all but the first samples. The point estimate is higher when more zip codes are excluded but the standard error increases as well. To quantify the impact, assume that credit in a given zip code is provided by a bank with two new wells and that the zip code is more than 30 miles from a fracking area. The results form regression (3) imply that this zip code experiences 0.5% faster establishment growth relative to a zip code where credit is provided by a bank with no new wells. This effect goes up to almost 1% if we consider the results form estimation (5). The impact of the positive credit supply shock is substantial given that the average (median) zip code establishment growth is 0.8% (0%). The change in the coefficient for small banks is consistent with the pattern of lending. At branches close to fracking there was not a significant difference in lending between exposed and unexposed banks. This was due to the fact that unexposed banks close to fracking also received a positive liquidity shock. This can explain why close to fracking zip codes with low exposure experience similar establishment growth as zip codes with high exposure – all of these zip codes likely experience credit inflow.

The implied aggregate change in establishments due to the increase in the credit supply is approximately 50,000 between 2001 and 2007.[27] This accounts for 13% of the aggregate change in the number of U.S. establishments during the period, which was approximately 380,000. These estimates suggest that a $105 thousand increase in small business originations is associated with the creation of a new establishment. At the zip code level, a 1% increase in small business origination growth is associated with a 5bps increase establishment growth.

The zip codes where bank exposure lead to establishment growth are closely matched with the areas where branches increased lending as shown in Table 5. This match can be further confirmed from Figure 7, which shows the coefficient plot for the area exposure to small banks. Comparing this to Figure 3, it is evident that zip codes, more than 100 miles away, experienced faster establishment growth when they received credit from branches of banks exposed to fracking.

How different are zip codes where credit was provided by small banks with exposure to fracking? Table 17 compares the industry composition and population characteristics for zip code with and without exposure to fracking credit. Zip codes without exposure more agricultural, construction, and transportation establishments, while those with exposure have more FIRE, and professional services establishments. This is consistent with the fact that zip codes with exposure are more urban, have a higher income, population, and education levels. This comparison underscores the importance of controlling for differences in the endowments across locations in the main regression. Even though the results are not driven by these fixed differences, it appears that the increase in lending and in establishments occurred mostly in areas

[27]This estimate uses the small bank exposure coefficient of 0.00239.

with urban characteristics.

1.5.3 Results – Real Estate shock: Booming Zones

The effect of the negative credit supply shift on real activity is presented in Table 18. The results focus on a set of samples that sequentially exclude zip codes in proximity to the residential boom. Contraction of credit by small banks has a significant negative impact on establishment growth. The effect is statistically significant and has a similar value across all of the samples. A zip code where credit was provided by banks with 70% of branches in booms experiences 0.9% slower establishment growth relative to a zip code with credit from banks with no branches in booms. This difference in *bank* exposure at individual banks lead to a 78% decrease in lending growth.

The implied aggregate decrease in the number of establishments at zip codes where credit was provided by small banks with branches in the top decile is approximately 13,000 between 2001 and 2005. This represents 4.4% of the total new establishments added during the same period. The total decrease in originations for this period is \$2.2 billion, implying that a \$170 thousand decrease in small business lending is associated with the closure of an establishment.

The effect of credit contraction by big banks does not have a significant effect on establishment growth. The contraction was likely substituted away by businesses from alternative sources. This is consistent with the idea that borrowers form bigger banks rely on transactions-based lending and are less constrained in terms of alternative sources of credit. Notice from Figure 4 that big banks reduced credit at branches more than 100 miles from residential booms. At such a distance, there is no evidence that small banks also contracted credit. It is, therefore, likely that businesses substituted the credit reduction from big banks with credit from small banks.

Figure 8 plots the effect of exposure to small banks as different zip codes are eliminated from the sample. The reduction in real activity matches well the contraction in credit by small banks. As expected, the effect goes to zero as branches at larger distances are eliminated. While small bank networks have a limited geographic span, they can still generate negative effects on real activity beyond 100 miles from areas with booms.

Table 19 compares the characteristics of zip codes across exposure to banks with branches in the top decile. Similarly to the case of fracking, zip codes where credit is provided by small banks with exposure to residential booms are more urban. They have a higher share of professional and health care services establishments, higher population, and income. While urban areas with high levels of income and eduction are the hubs of innovation and business start-ups, being located in these areas is not sufficient. The availability of business credit appears to be critical for growth in real activity.

1.5.4 Results – Real Estate shock: Median Branch

Table 20 lists the relevant results from the estimation of specifications (1.12), using the fraction of median, or below-median, branches as a measure of exposure. The first regression uses the entire sample and effectively compares establishment growth at zip codes that borrow from below versus above median branches. The second regression excludes zip codes intersecting with areas in the 90^{th} percentile of appreciation. The last two estimations further exclude zip codes within 50 and 100 miles from the 90^{th} percentile areas.

The results show that borrowing from below median branches of small banks has a statistically significant, negative effect on establishment growth. The magnitude of the effect decreases when zip codes with high residential appreciation or zip codes in the proximity are excluded from the sample. This is a result from the fact that these areas likely experience faster growth. To quantify the impact of the credit reduction, assume that a zip code is located within 50 miles of an area in the top decile and it borrowers only from below-median branches. This zip code will experience 0.34% slower establishment growth relative to a zip code which borrows only from above-median branches. Previous evidence showed that banks with geographical advantage in areas with residential appreciation will increase their concentration in C&D loans, financing them with a contraction in originations at the part of their network where residential appreciation is relatively lower. With the increase in the fraction of banks for which a zip code is below median, driven by a pickup in the housing market somewhere else, originations in the zip code contract and establishment growth slows down.

The implied aggregate decrease in the number of establishments explained by the fraction of below-median branches is approximately 37,000 between 2001 and 2005.[28] This represents 11.5% of the total new establishments added during the same period. The total decrease in originations by small banks at branches that were below the median is $10.6 billion. This implies that a $283 thousand decrease in small business lending is associated with the closure of an establishment.

Table 21 compares the characteristics of zip codes where the fraction of below median branches is less than a half with the rest. The two groups of zip codes are very similar. This suggests that the locations with lower fraction of below median branches are not fundamentally different. The major difference is that banks lowered their loan concentration in the first group and increased their concentration in the second.

The combined results form both specifications of residential booms imply that real activity is negatively affected by bank capital re-allocation following asset price appreciations. Small banks are limited in their ability to expand their assets and so they increase lending to land developers at the expense of small businesses away from the booms. Despite not being as limited in their ability to expand, big banks

[28] The estimate uses the coefficient from regression (2), -0.00277.

also decrease lending to small businesses. Only the credit supply shock from small banks affects real activity. This is in line with the argument that big banks lending to businesses with alternative sources of credit. As a result, big banks are able to finance residential expansions without affecting small business activity. When small banks engage in the same activity, this can have serious cost to small businesses.

1.6 Robustness and Extensions

This section extends the results for small business lending by exploring the extensive margin. In addition, I examine whether the effects of each of the shocks is robust to: using an asset-based definition of bank size; controlling for both shocks at the same time; excluding new branches; controlling for the headquarter effect or home bias; controlling for the average distance between a branch and the borrowers.

Asset-based Bank Groups The main results in the paper distinguish between two groups of banks based on whether the branch network has less than 30 branches. The group of small banks closely overlaps with institutions with less than $1.1 billion in assets. Table 22 provides some key regression results based on the asset-based definition. The coefficient estimates are close to those in the main section.

The Extensive Margin The information provided in the CRA filings allows me to infer not only the gross origination amounts, but also the total number of loans at distinct bank branches. The results from the extensive margin are hard to interpret – when banks increase the amount of credit to existing customers, they have discretion over whether they report this as one origination or two separate originations. For this reason, it is hard to distinguish if the bank is serving new customers and refinancing less or whether the bank is just refinancing more loans. Most importantly, finding that a coefficient is not statistically different form zero does not imply that no loans to new businesses are made.

The results are reported in Table 23. The first estimation presents the impact of new wells on the growth rate in the number of originations, excluding from the sample branches within 30 miles of fracking activity. While the coefficient for small banks is positive, the effect is not statistically significant. The second set of results focuses on the fraction of branches in areas with residential booms (top 90^{th} percentile of appreciation). The coefficient for small banks is statistically significant and negative. This indicates lower origination activity for banks with higher exposure to residential booms. The effect is not significant for bigger banks. The last set of results focuses on the effect of real estate appreciation at the median branch. The coefficients for both bank categories are negative but not significant.

Controlling for Both Shocks The identification strategy for each of the shocks has implicitly assumed that they are not related. The rationale for this is the particular geography of each of the shocks – drilling was mostly done in the central part of the country, while the residential booms where most significant at the areas near the East and the West coast. Furthermore, given that small banks were mostly affected, one need not worry about the spillovers between the two shocks due to the limited span of their networks. A simple way to introduce possible interactions between the two shocks is to include the measure of both shocks simultaneously. In particular, I focus on the period between 2001 and 2005, the overlap between the two shocks, and estimate the lending equation with both measures of exposure.

The estimates are presented in Table 24. The first estimation only uses exposure to new wells, while the second uses only the fraction of branches within areas in the top decile. The sample in both estimations is identical. In the last regression, I include both measures simultaneously. Coefficients are almost identical in each of the estimations. This suggests that the two shocks are close to orthogonal to each other.

Network Selection, Headquarter Effect, and Distance to the Branch The main results related to fracking assume that banks do not deliberately open new branches within areas with new fracking wells in order to capture additional liquidity. Over the period between 2001 and 2007 there is indeed a significant number of branch acquisitions and construction of new branches. 168 (647) of the 819 (4,038) branches of small (big) banks that have been in proximity to new fracking wells have either been acquired or established. To explore the sensitivity of the main results to the changes in the branch network I exclude these branches from the sample when calculating bank exposure. The results based on branches farther than 50 miles from fracking are listed in the first column of Table 25. The coefficient for small banks does not change. This is an indication of the fact that most of the branch acquisitions involved institutions which already had an exposure to fracking.

Results by Keeton (2009) and Presbitero et al (2014) suggest that bank headquarters are treated differently, either because of home bias or due to informational problems. I explore the sensitivity of my results to this by examining whether the effects of the shocks are different at the headquarter branch. This is done by interacting each of the measures of exposure to a particular shock with an indicator for whether the branch is also the main bank branch. The results are listed in Table 25. In the case of fracking, there is some evidence that lending is expanded at non-headquarter branches while the main branch does not experience much of a change. In the case of branches in top decile, it seems that the headquarter reduces lending more than the rest of the branches. The fracking result can be explained by the fact that most of the investment opportunities are at the non-headquarter branches. The real-estate result can be due to the fact that the expansion of lending to construction and development done at the headquarter.

The literature on borrower distance and small business lending argues that relationship lending is conducted at close proximity to the borrowers (Degryse and Ongena (2005)). Therefore, branches that serve more distant businesses provide credit to less opaque firms. In order to see whether the baseline results are sensitive to the type of firms each branch is serving (as proxied by average distance to the firm), I control for the average distance between the branch and the lending locations. In particular, I interact average distance between the branch and the firms that it serves with the measure of exposure to each of the shocks. Notice that the average distance could alternatively capture branches that lend in rural areas where firms are more geographically dispersed. The results are listed in Table 25. The coefficients for the impact of exposure are mostly unaffected. In the case of appreciation at the median branch, exposed banks reduce lending primarily at branches that serve more distant customers.

1.7 Conclusion

This study investigates how shocks to the bank balance sheet affect small business lending at different branches of the network. In particular, it quantifies the sensitivity of the small business lending at different branches to: 1) increases in deposits due to bank presence in fracking counties; 2) changes in asset profitability of real estate loans due to presence in areas with high residential appreciation. I further evaluate the effect of the supply-driven changes in small business loans on real economic activity at zip codes. The results for the funding shock imply that small banks export liquidity across the bank network, funding small business loans in locations away from the source of the boom. These loans have a real economic impact. Locations that have a higher exposure to the fracking boom through bank presence experience faster establishment growth. The results for the real-estate shock show that bank asset substitution contributes to a decrease in small business lending at branches away from the real estate booms. Areas serviced by banks with high exposure to these booms experience slower establishment growth.

Tables and Figures

Table 1: Summary Statistics for Intermediaries Reporting Small Business Loans

Banks with less than 30 branches

Year	N	ln Assets	Deposits / Assets	Interest Expense / Deposits	Securities / Assets	Tier1 Capital / Assets	C&I / Assets	Mortgages / Assets	Net Income / Assets	Unused Commit / Assets
2001	1,222	13.029	0.788	0.009	0.218	0.088	0.097	0.250	0.007	0.217
2002	1,308	13.048	0.788	0.006	0.228	0.088	0.094	0.230	0.007	0.171
2003	1,436	13.082	0.788	0.004	0.234	0.089	0.092	0.217	0.007	0.192
2004	1,369	13.131	0.787	0.004	0.229	0.090	0.096	0.204	0.007	0.237
2005	668	13.547	0.770	0.005	0.236	0.089	0.091	0.211	0.007	0.297
2006	614	13.639	0.774	0.007	0.219	0.091	0.093	0.208	0.007	0.220
2007	581	13.711	0.760	0.008	0.186	0.097	0.102	0.205	0.006	0.300

Banks with more than 30 branches

Year	N	ln Assets	Deposits / Assets	Interest Expense / Deposits	Securities / Assets	Tier1 Capital / Assets	C&I / Assets	Mortgages / Assets	Net Income / Assets	Unused Commit / Assets
2001	238	15.368	0.727	0.008	0.209	0.074	0.114	0.231	0.007	0.202
2002	256	15.497	0.726	0.005	0.226	0.075	0.108	0.223	0.008	0.202
2003	255	15.501	0.728	0.003	0.231	0.075	0.101	0.226	0.007	0.199
2004	238	15.545	0.728	0.003	0.231	0.077	0.102	0.235	0.007	0.207
2005	242	15.608	0.730	0.004	0.213	0.077	0.102	0.237	0.008	0.222
2006	238	15.663	0.734	0.006	0.195	0.079	0.103	0.227	0.007	0.248
2007	245	15.629	0.734	0.007	0.179	0.080	0.108	0.218	0.006	0.234

Notes: The table reports medians for the bank controls for each of the years in the sample. Interest expense is reported at the quarterly level.

Table 2: Census Statistics for Fracking and Non-Fracking Zip Codes

	Zip Codes Inside Fracking			Zip Codes Outside Fracking		
	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Population	9695	10323.03	(12392.93)	153177	11686.24	(14123.91)
Median Age	9695	36.62965	(5.139222)	153177	37.481	(5.233941)
Median Income	9695	35234.14	(12451.33)	153177	41664.27	(16368.72)
Income Per Capita	9695	17153.05	(6010.743)	153177	20159.59	(8704.774)
Poverty Percentage	9694	17.90%	(10.65%)	152943	14.07%	(10.77%)
Urban	9694	39.01%	(41.69%)	153073	45.08%	(43.64%)
Fraction with Bachelor's Degree	9694	9.86%	(6.78%)	153031	11.96%	(7.77%)

Notes: The table lists the summary statistics for key characteristics for two categories of zip codes: those within areas where fracking occurs and those outside. The information is from the 2000 U.S. Census.

Table 3: Summary Statistics for Banks Exposed to Fracking

Banks with less than 30 branches

	No Exposure					*Positive Exposure*				
	N	New Wells	$\triangle \ln SBL$	$\triangle \ln Dep$	$\frac{\text{Interest Expense}}{\text{Deposits}}$	N	New Wells	$\triangle \ln SBL$	$\triangle \ln Dep$	$\frac{\text{Interest Expense}}{\text{Deposits}}$
2001	1,015	0.000	0.248	0.081	0.96%	37	0.893	0.217	0.139	0.82%
2002	1,058	0.000	0.058	0.072	0.57%	36	0.395	0.024	0.076	0.52%
2003	1,101	0.000	0.085	0.082	0.41%	43	1.136	0.122	0.067	0.36%
2004	1,120	0.000	0.011	0.055	0.33%	84	0.953	0.047	0.049	0.29%
2005	588	0.000	0.030	0.074	0.44%	32	0.346	0.074	0.076	0.43%
2006	525	0.000	0.007	0.080	0.66%	19	1.682	0.025	0.092	0.67%
2007	445	0.000	0.018	0.048	0.83%	54	0.642	0.012	0.051	0.76%

Banks with more than 30 branches

	No Exposure					*Positive Exposure*				
	N	New Wells	$\triangle \ln SBL$	$\triangle \ln Dep$	$\frac{\text{Interest Expense}}{\text{Deposits}}$	N	New Wells	$\triangle \ln SBL$	$\triangle \ln Dep$	$\frac{\text{Interest Expense}}{\text{Deposits}}$
2001	168	0.000	0.227	0.085	0.85%	52	0.064	0.413	0.061	0.84%
2002	198	0.000	0.063	0.077	0.50%	42	0.069	0.068	0.042	0.49%
2003	209	0.000	0.047	0.089	0.36%	37	0.229	0.082	0.089	0.34%
2004	175	0.000	0.021	0.066	0.30%	59	0.140	0.053	0.056	0.26%
2005	181	0.000	0.045	0.092	0.41%	54	0.133	0.036	0.087	0.39%
2006	163	0.000	0.044	0.076	0.61%	69	0.436	0.006	0.093	0.60%
2007	137	0.000	0.033	0.049	0.75%	97	0.321	-0.036	0.038	0.73%

Notes: The table lists averages for bank exposure to fracking, growth in originations, growth in deposits, and interest expense, across small and big banks, and across exposed and unexposed banks.

Table 4: Effect of New fracking Wells on Deposit Growth

Dependent Variable	△ ln Branch Deposits	△ ln Bank Tot. Deposits	△ ln Bank $100K+ Deposits	△ Interest Expense
	(1)	(2)	(3)	(4)
New Wells in Proximity × Small Bank	0.000487**			
	(0.000238)			
New Wells in Proximity × Big Bank	0.000395***			
	(0.000130)			
Avg. New Wells × Small Bank		0.00225***	0.223**	-0.0386**
		(0.000871)	(0.102)	(0.0155)
Avg. New Wells × Big Bank		-0.00154	-0.0245	-0.0296
		(0.00211)	(0.191)	(0.0425)
	Bank Controls			
ln Assets$_{t-1}$	-0.00305	-0.142***	-6.304**	0.380
	(0.00189)	(0.0266)	(2.456)	(0.744)
Deposits/Assets$_{t-1}$	0.0896**	-0.190**	-27.51***	-0.319
	(0.0410)	(0.0759)	(5.861)	(9.993)
Securities/Assets$_{t-1}$	-0.0227	-0.121***	-14.32***	0.890
	(0.0467)	(0.0446)	(4.974)	(1.345)
C&I/Assets$_{t-1}$	-0.207***	-0.0586	-4.601	20.32
	(0.0623)	(0.0878)	(11.29)	(14.76)
Mortgages/Assets$_{t-1}$	0.0844	-0.0664	1.292	-2.625
	(0.0551)	(0.0579)	(7.060)	(5.038)
Unused Loan Commitments/Assets$_{t-1}$	0.00650	0.000718	-0.371	0.249
	(0.00756)	(0.00387)	(0.956)	(0.251)
△ TotalBranches × Small Bank	0.0851***	0.178***	10.43***	-3.711
	(0.0225)	(0.0305)	(2.131)	(2.935)
△ TotalBranches × Big Bank	0.0391	0.355***	15.91***	-0.416
	(0.0240)	(0.0838)	(3.325)	(0.318)
△I(Small Bank)	-0.0219	0.0245	0.383	0.163
	(0.0173)	(0.0287)	(1.598)	(0.414)
Observations	310,206	7,490	7,177	7,490
R-squared	0.007	0.546	0.427	0.405
Bank FE	No	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Bank Clustered SE	Yes	Yes	Yes	Yes

Notes: *** p<0.01, ** p<0.05, * p<0.1. The table provides coefficient estimates for the impact of new fracking wells on, respectively, branch-level deposit growth, bank-level total deposit growth, bank-level $100K+ deposit growth , and bank-level change in interest expense. Interest expense is in percentage units and is at an annual basis. Each of the controls is the quarterly average from the previous year. Sample covers 2001 to 2007.

Table 5: Effect of New fracking Wells on Small Business Lending

Dependent Variable	△ ln Small Business Lending				
	No Branches in Fracking (1)	No Branches within 24mi (2)	No Branches within 30mi (3)	No Branches within 50mi (4)	No Branches within 100mi (5)
Avg. New Wells × Small Bank	0.0191*	0.0256**	0.0450***	0.0406**	0.0414**
	(0.0107)	(0.0120)	(0.0157)	(0.0180)	(0.0206)
Avg. New Wells × Big Bank	-0.00181	0.00153	0.00187	0.00270	0.0119
	(0.00631)	(0.00496)	(0.00509)	(0.00545)	(0.0124)
	Bank Controls				
ln Assets_{t-1}	-0.0316	-0.0399	-0.0479	-0.0606	-0.0615
	(0.0480)	(0.0474)	(0.0477)	(0.0501)	(0.0485)
Deposits/Assets_{t-1}	-0.0662	-0.125	-0.156	-0.226	-0.331
	(0.299)	(0.289)	(0.288)	(0.306)	(0.342)
Cost of Deposits_{t-1}	3.453	5.297	5.645	7.848	15.16
	(9.471)	(9.501)	(9.650)	(10.06)	(10.48)
Securities/Assets_{t-1}	0.178	0.253	0.256	0.291	0.250
	(0.225)	(0.228)	(0.229)	(0.234)	(0.261)
Tier1 Capital/Assets_{t-1}	-0.472	-0.841	-0.996	-1.493	-1.657
	(1.322)	(1.325)	(1.336)	(1.380)	(1.450)
C&I/Assets_{t-1}	0.106	0.213	0.252	0.401	0.579
	(0.382)	(0.370)	(0.372)	(0.377)	(0.411)
Mortgages/Assets_{t-1}	0.936***	0.930***	0.928***	0.901***	1.038***
	(0.349)	(0.337)	(0.331)	(0.314)	(0.336)
Net Income/Assets_{t-1}	0.0159	-0.179	0.0786	0.212	2.059
	(4.536)	(4.660)	(4.680)	(4.857)	(5.305)
Unused Loan Commitments/Assets_{t-1}	0.0432	0.0429	0.0464	0.0525*	0.0475*
	(0.0305)	(0.0288)	(0.0293)	(0.0301)	(0.0288)
Is Part of Multi-BHC?	-0.0148	-0.00655	-0.00382	-0.000497	0.0181
	(0.0880)	(0.0880)	(0.0877)	(0.0875)	(0.0973)
Is Part of Single-BHC?	0.0266	0.0296	0.0307	0.0269	0.0321
	(0.0889)	(0.0893)	(0.0892)	(0.0892)	(0.0969)
△ TotalBranches × Small Bank	-0.462***	-0.453***	-0.454***	-0.462***	-0.443***
	(0.0948)	(0.0976)	(0.0989)	(0.111)	(0.117)
△ TotalBranches × Big Bank	-0.146**	-0.178**	-0.185**	-0.199***	-0.177**
	(0.0738)	(0.0704)	(0.0724)	(0.0769)	(0.0705)
$\triangle I$(Small Bank)	0.0845*	0.0687	0.0614	0.0508	0.0784
	(0.0488)	(0.0504)	(0.0516)	(0.0557)	(0.0645)
Observations	263,105	239,519	230,845	210,678	169,632
R-squared	0.178	0.178	0.177	0.175	0.174
County x Year FE	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Bank Clustered SE	Yes	Yes	Yes	Yes	Yes

Notes: *** p<0.01, ** p<0.05, * p<0.1. The table provides coefficient estimates for the impact of new fracking wells on the growth in originations of small business loans at different branches of the bank network. Each of the regressions excludes branches in areas with horizontal or directional wells as well as areas with drilling activity in the previous year. The first regression excludes branches within areas with fracking activity (as defined by Hydrological Unit Codes). Regressions (2) to (5) exclude branches within the corresponding distance from the boundary of an area with fracking activity. Each of the samples covers the period form 2001 up to 2007.

Table 6: Small Banks: Implied Changes in Aggregate Deposits and Loan Originations

Year	Annual △ Deposits	Cumulative △ Deposits	Annual △ Loan Originations
2001	$33,020	$33,020	$73,573
2002	$80,391	$113,411	$208,321
2003	$127,117	$240,528	$241,382
2004	$466,253	$706,781	$962,551
2005	$1,272,668	$1,979,449	$2,499,601
2006	$159,252	$2,138,701	$370,304
2007	$441,304	$2,580,005	$823,608

Notes: The table lists implied increase in deposits for small banks exposed to new fracking wells. These are calculated by multiplying the coefficient from Table 4 regression (2) with the amount of exposure for each bank and with the total bank deposit for the previous year. The same calculation is used for the last column using the coefficient from Table 5 regression (3) and the amount of originations in the previous year. The second column list cumulative increases in deposits.

Table 7: Small Bank Comparison: Fracking vs Non-fracking exposure

	No Exposure, within 100mi			Positive Exposure		
	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Average Total Assets (aTA)	1764	777975	(1585136)	310	995670	(1951839)
RE Loans / aTA	1764	0.4701	(0.1796)	310	0.4391	(0.1627)
Commercial Loans / aTA	1764	0.0917	(0.0871)	310	0.1098	(0.0804)
Consumer Loans / aTA	1764	0.0542	(0.0763)	310	0.0621	(0.0725)
Total Loans / aTA	1764	0.6330	(0.1798)	310	0.6390	(0.1693)
Loan Loss Allowance / aTA	1764	0.0086	(0.0050)	310	0.0080	(0.0034)
Total Investments / aTA	1764	0.2889	(0.1789)	310	0.2757	(0.1694)
Other Real Estate / aTA	1764	0.0014	(0.0027)	310	0.0014	(0.0033)
Total Deposits / aTA	1764	0.7944	(0.1123)	310	0.8036	(0.1063)
FHLB Advances / aTA	1764	0.0671	(0.0871)	310	0.0573	(0.0838)
Common and Pref Stock / aTA	1764	0.0959	(0.0389)	310	0.0949	(0.0243)
ROE	1764	0.1394	(0.0977)	310	0.1380	(0.0745)
ROA	1764	0.0124	(0.0092)	310	0.0126	(0.0071)
aTA / aTE	1764	11.3271	(2.6917)	310	11.0927	(2.2635)
Total Operating Income / aTA	1764	0.0712	(0.0241)	310	0.0732	(0.0209)
Profit Margin	1760	0.1873	(0.2002)	307	0.1857	(0.0756)
Operating Expense / aTA	1764	0.0537	(0.0202)	310	0.0562	(0.0205)
Interest Expense / aTA	1764	0.0215	(0.0091)	310	0.0200	(0.0090)
Non-interest Expense / aTA	1764	0.0294	(0.0143)	310	0.0337	(0.0179)
Provision for Loan Loss / aTA	1764	0.0028	(0.0061)	310	0.0025	(0.0032)
Non-interest Income / aTA	1764	0.0117	(0.0182)	310	0.0145	(0.0185)
Interest Spread Earned	1764	0.0384	(0.0131)	310	0.0392	(0.0088)
Loan Charge-offs / Total Loans	1764	0.0043	(0.0080)	310	0.0040	(0.0051)
90+ Past Dues Loans / Total Loans	1764	0.0019	(0.0039)	310	0.0013	(0.0016)
Non-accruing Loans / Total Loans	1764	0.0073	(0.0089)	310	0.0064	(0.0070)

Notes: The table lists asset composition and performance statistics for small banks with no exposure to fracking which are located within 100 miles of fracking areas and for small banks with positive exposure. Information is calculated from Call Reports.

Table 8: Summary Statistics – Top Decile of Residential Real Estate Appreciation

Banks with less than 30 branches

	No Exposure			*Positive Exposure*		
	Exp	$\triangle \ln SBL$	$\triangle \ln Dep$	*Exp*	$\triangle \ln SBL$	$\triangle \ln Dep$
2001	0	0.212	0.143	0.733	0.227	0.139
2002	0	0.005	0.120	0.752	0.023	0.130
2003	0	0.058	0.131	0.691	0.073	0.160
2004	0	-0.027	0.082	0.661	-0.024	0.194
2005	0	0.009	0.129	0.623	-0.092	0.236

Banks with more than 30 branches

	No Exposure			*Positive Exposure*		
	Exp	$\triangle \ln SBL$	$\triangle \ln Dep$	*Exp*	$\triangle \ln SBL$	$\triangle \ln Dep$
2001	0	0.112	0.106	0.417	0.221	0.094
2002	0	0.036	0.084	0.489	0.067	0.097
2003	0	0.030	0.095	0.337	0.065	0.087
2004	0	-0.066	0.077	0.368	-0.016	0.097
2005	0	-0.021	0.101	0.310	-0.008	0.141

Notes: The table lists averages for exposure to real estate boom, the average small business origination growth, and the average deposit growth across banks with no exposure and banks with positive exposure, and across size. Exposure here is defined as the fraction of branches in the areas where average quarterly appreciation of residential real estate is in the top decile for the U.S..

Table 9: Balance Sheet Effects of Real Estate Shocks

Dependent Variables	*Booming Zones*			*Median Branch*		
	C&D /TA (1)	C&D +Unused/TA (2)	RE +Unused/TA (3)	C&D /TA (4)	C&D +Unused/TA (5)	RE +Unused/TA (5)
Fraction of Branches in Top 90^{th} × Small Bank	0.00477**	0.00676**	0.0103**			
	(0.00186)	(0.00302)	(0.00519)			
Fraction of Branches in Top 90^{th} × Big Bank	0.0166***	0.0236***	0.00506			
	(0.00533)	(0.00660)	(0.0123)			
Appreciation at Median Branch × Small Bank				0.351***	0.574***	0.462**
				(0.0997)	(0.144)	(0.198)
Appreciation at Median Branch × Big Bank				0.309*	0.412**	0.130
				(0.172)	(0.207)	(0.298)
		Bank Controls				
ln $Assets_{t-1}$	0.00110	0.00106	-0.000957	0.00115	0.00159	0.00131
	(0.00298)	(0.00428)	(0.00762)	(0.00297)	(0.00422)	(0.00694)
Deposits/$Assets_{t-1}$	-0.0369***	-0.0380*	0.0742*	-0.0443***	-0.0469**	0.0535
	(0.0141)	(0.0207)	(0.0385)	(0.0141)	(0.0208)	(0.0367)
Cost of $Deposits_{t-1}$	-0.967	-1.205	-1.753	-0.913	-1.086	-1.458
	(0.664)	(0.931)	(1.668)	(0.656)	(0.918)	(1.595)
Securities/$Assets_{t-1}$	-0.0721***	-0.102***	-0.188***	-0.0733***	-0.103***	-0.201***
	(0.0131)	(0.0190)	(0.0358)	(0.0133)	(0.0192)	(0.0343)
C&I/$Assets_{t-1}$	-0.00603	-0.0436	-0.222***	-0.00443	-0.0413	-0.228***
	(0.0224)	(0.0322)	(0.0554)	(0.0224)	(0.0321)	(0.0564)
Mortgages/$Assets_{t-1}$	-0.0492***	-0.0724***	0.0586	-0.0484***	-0.0713***	0.0562
	(0.0157)	(0.0236)	(0.0406)	(0.0155)	(0.0231)	(0.0404)
Tier1 Capital/$Assets_{t-1}$	0.0542	0.0276	-0.0739	0.0634	0.0462	-0.0471
	(0.0439)	(0.0839)	(0.116)	(0.0434)	(0.0849)	(0.115)
Net Income/$Assets_{t-1}$	0.0533	0.199	-0.108	0.0505	0.185	0.0144
	(0.158)	(0.212)	(0.413)	(0.156)	(0.211)	(0.384)
Unused Loan Commitments/$Assets_{t-1}$	0.000126	6.12e-05	0.00230***	7.89e-05	2.46e-05	0.00220***
	(0.000336)	(0.000717)	(0.000756)	(0.000340)	(0.000719)	(0.000748)
$\triangle$ TotalBranches × Small Bank	0.000864	0.000834	0.00439	0.000375	0.000138	0.00383
	(0.00258)	(0.00408)	(0.00685)	(0.00256)	(0.00403)	(0.00694)
$\triangle$ TotalBranches × Big Bank	-0.00133	-0.00339	-0.0189	-0.00245	-0.00476	-0.0200
	(0.00465)	(0.00674)	(0.0158)	(0.00459)	(0.00661)	(0.0156)
$\triangle I$(Small Bank)	-0.000794	-0.000718	-0.00530	-0.00300	-0.00498	-0.0120
	(0.00314)	(0.00443)	(0.00892)	(0.00338)	(0.00456)	(0.00859)
Observations	5,550	5,550	5,550	5,500	5,500	5,500
R-squared	0.939	0.943	0.945	0.939	0.944	0.946
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Bank Clustered SE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: *** p<0.01, ** p<0.05, * p<0.1. The table provides the coefficient estimates for the impact real estate booms on the bank balance sheet. The first three regressions use fraction of the bank network in areas with real estate price appreciations in the top decile as a measure of exposure to the real estate booms, while the last three use the appreciation at the median bank branch as a measure of exposure. The dependent variables are construction and development loans as a fraction of assets, construction and development loans + unused commitments as a fraction of assets, and loans secured by real estate + unused commitments as a fraction of assets . Sample covers 2001 to 2005.

Table 10: The Effect of the Fraction of Network in Top Decile on Small Business Lending

Dependent Variable	△ ln Small Business Lending				
	No Branches in Top 90^{th}	No Branches within 24mi	No Branches within 30mi	No Branches within 50mi	No Branches within 100mi
	(1)	(2)	(3)	(4)	(5)
Fraction of Branches in Top 90^{th} × Small Bank	-0.335**	-0.659**	-1.111***	-1.267***	-1.322**
	(0.169)	(0.296)	(0.311)	(0.452)	(0.596)
Fraction of Branches in Top 90^{th} × Big Bank	-0.369*	-0.587**	-0.599**	-0.645*	-0.785**
	(0.201)	(0.291)	(0.304)	(0.346)	(0.369)
Bank Controls					
ln Assets_{t-1}	0.101	0.134	0.142	0.161	0.166
	(0.117)	(0.122)	(0.125)	(0.129)	(0.135)
$\text{Deposits/Assets}_{t-1}$	0.0720	0.231	0.243	0.340	0.417
	(0.421)	(0.448)	(0.448)	(0.460)	(0.481)
Cost of Deposits_{t-1}	13.73	6.687	5.660	4.010	1.418
	(13.81)	(13.95)	(13.86)	(13.85)	(14.06)
$\text{Securities/Assets}_{t-1}$	0.104	0.0892	0.120	0.189	0.218
	(0.344)	(0.356)	(0.362)	(0.377)	(0.398)
Tier1 $\text{Capital/Assets}_{t-1}$	0.269	0.405	0.625	0.854	1.472
	(2.210)	(2.218)	(2.232)	(2.292)	(2.346)
$\text{C\&I/Assets}_{t-1}$	-0.115	-0.157	-0.225	-0.284	-0.532
	(0.574)	(0.615)	(0.625)	(0.657)	(0.701)
$\text{Mortgages/Assets}_{t-1}$	0.785**	0.856***	0.858***	1.017***	0.994***
	(0.337)	(0.330)	(0.329)	(0.338)	(0.336)
Net $\text{Income/Assets}_{t-1}$	1.734	1.649	1.360	1.178	1.067
	(5.151)	(5.208)	(5.213)	(5.195)	(5.207)
Unused Loan $\text{Commitments/Assets}_{t-1}$	-0.0426	-0.0428	-0.0451	-0.0431	-0.0403
	(0.0411)	(0.0403)	(0.0406)	(0.0396)	(0.0378)
Is Part of Multi-BHC?	0.0858	0.0638	0.0811	-0.0658	-0.0252
	(0.128)	(0.127)	(0.130)	(0.123)	(0.135)
Is Part of Single-BHC?	-0.0236	-0.0631	-0.0449	-0.189*	-0.144
	(0.110)	(0.108)	(0.111)	(0.101)	(0.116)
△ TotalBranches × Small Bank	-0.501***	-0.496***	-0.496***	-0.463***	-0.459***
	(0.0912)	(0.0962)	(0.0981)	(0.0988)	(0.102)
△ TotalBranches × Big Bank	-0.0390	-0.0378	-0.0377	-0.0342	-0.0405
	(0.106)	(0.109)	(0.111)	(0.113)	(0.122)
$\triangle I$(Small Bank)	0.0974	0.0909	0.0919	0.0775	0.0770
	(0.0686)	(0.0719)	(0.0733)	(0.0756)	(0.0789)
Observations	177,429	165,300	161,574	154,177	143,735
R-squared	0.204	0.211	0.212	0.215	0.216
County x Year FE	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Bank Clustered SE	Yes	Yes	Yes	Yes	Yes

Notes: *** p<0.01, ** p<0.05, * p<0.1. The table provides coefficient estimates for the impact of real estate booms, measured by the fraction of the network in areas with real estate appreciation in the top 90^{th} on small business originations. The first regression excludes branches within areas with residential booms. Regressions (2) to (5) exclude branches within the corresponding distance from the boundary of an area with residential booms. Sample covers the period between 2001 and 2005.

Table 11: Fraction in Top Decile: Implied Changes in C&D Loans and Loan Originations

Year	△ C&D + Unused	Cumul. △ C&D + Unused	△ Loan Originations
		Small Banks	
2001	$66,242	$66,242	-$357,869
2002	$72,182	$138,423	-$363,224
2003	$74,438	$212,862	-$409,630
2004	$75,784	$288,646	-$478,427
2005	$65,901	$354,547	-$616,593
		Big Banks	
2001	$715,235	$715,235	-$3,180,941
2002	$835,756	$1,550,990	-$3,746,167
2003	$601,135	$2,152,125	-$3,400,864
2004	$790,590	$2,942,715	-$3,408,468
2005	$1,000,050	$3,942,765	-$3,958,372

Notes: The table lists implied increase in C&D loans plus commitments for small and big banks with branches in the top decile areas. These are calculated by multiplying the respective coefficients from Table 9, (2) with the amount of exposure for each bank and with the total C&D loans plus commitments. The same calculation is used for the last column using the respective coefficients from Table 10, (3) and the amount of originations in the previous year. The second column list cumulative increases in C&D loans plus commitments.

Table 12: Small Bank Comparison: Fraction in Top Decile

	No Exposure			No Exposure, within 100mi			Positive Exposure		
	N	Mean	Std. Dev.	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Average Total Assets (aTA)	3651	623196	(564411)	551	663599	(625700)	317	1290240	(1136938)
RE Loans / aTA	3651	0.4952	(0.1547)	551	0.5095	(0.1508)	317	0.5082	(0.1874)
Commercial Loans / aTA	3651	0.0933	(0.0732)	551	0.0817	(0.0810)	317	0.0972	(0.0752)
Consumer Loans / aTA	3651	0.0554	(0.0685)	551	0.0434	(0.0560)	317	0.0430	(0.0660)
Total Loans / aTA	3651	0.6643	(0.1497)	551	0.6478	(0.1376)	317	0.6674	(0.1584)
Loan Loss Allowance / aTA	3651	0.0086	(0.0037)	551	0.0087	(0.0037)	317	0.0088	(0.0040)
Total Investments / aTA	3651	0.2580	(0.1473)	551	0.2721	(0.1336)	317	0.2588	(0.1562)
Other Real Estate / aTA	3651	0.0013	(0.0027)	551	0.0006	(0.0018)	317	0.0008	(0.0017)
Total Deposits / aTA	3651	0.7909	(0.1003)	551	0.7797	(0.1108)	317	0.7734	(0.1033)
FHLB Advances / aTA	3651	0.0698	(0.0802)	551	0.0762	(0.0800)	317	0.0745	(0.0844)
Common and Pref Stock / aTA	3651	0.0951	(0.0269)	551	0.0965	(0.0284)	317	0.0944	(0.0285)
ROE	3650	0.1363	(0.0664)	551	0.1241	(0.0673)	317	0.1337	(0.0614)
ROA	3651	0.0123	(0.0057)	551	0.0114	(0.0067)	317	0.0120	(0.0052)
aTA / aTE	3650	11.1854	(2.4113)	551	11.0966	(2.5272)	317	11.3610	(2.6480)
Total Operating Income / aTA	3651	0.0692	(0.0178)	551	0.0682	(0.0159)	317	0.0703	(0.0165)
Profit Margin	3650	0.1826	(0.1499)	551	0.1694	(0.0612)	317	0.1799	(0.0696)
Operating Expense / aTA	3651	0.0518	(0.0157)	551	0.0513	(0.0127)	317	0.0523	(0.0160)
Interest Expense / aTA	3651	0.0207	(0.0089)	551	0.0216	(0.0095)	317	0.0207	(0.0100)
Non-interest Expense / aTA	3651	0.0288	(0.0127)	551	0.0279	(0.0093)	317	0.0298	(0.0138)
Provision for Loan Loss / aTA	3651	0.0023	(0.0031)	551	0.0018	(0.0028)	317	0.0018	(0.0026)
Non-interest Income / aTA	3651	0.0107	(0.0141)	551	0.0091	(0.0120)	317	0.0111	(0.0133)
Interest Spread Earned	3650	0.0387	(0.0081)	551	0.0389	(0.0074)	317	0.0389	(0.0089)
Loan Charge-offs / Total Loans	3654	0.0031	(0.0041)	553	0.0025	(0.0040)	317	0.0025	(0.0032)
90+ Past Dues Loans / Total Loans	3654	0.0016	(0.0026)	553	0.0011	(0.0020)	317	0.0011	(0.0019)
Non-accruing Loans / Total Loans	3654	0.0058	(0.0058)	553	0.0045	(0.0042)	317	0.0054	(0.0050)

Notes: The table lists asset composition and performance statistics for small banks with no exposure to top decile, with no exposure to top decile and within 100 miles of top decile areas, and with positive exposure. Information is from Call Reports.

Table 13: The Effect of Appreciation at the Median Branch on Small Business Lending

Dependent Variable	$\triangle$ ln Small Business Lending		
	Exclude Above Median Branches (1)	Exclude Above Median Branches & Top 95^{th} in US (2)	Exclude Above Median Branches & Top 90^{th} in US (3)
Appreciation at Median Branch × Small Bank	-8.703**	-9.741**	-8.182**
	(3.548)	(3.817)	(4.068)
Appreciation at Median Branch × Big Bank	-4.651*	-4.810*	-4.709*
	(2.615)	(2.634)	(2.637)
	Bank Controls		
ln Assets_{t-1}	0.166	0.166	0.162
	(0.107)	(0.108)	(0.109)
Deposits/Assets_{t-1}	0.462	0.475	0.453
	(0.487)	(0.490)	(0.498)
Cost of Deposits_{t-1}	29.13*	29.83*	28.02*
	(15.32)	(15.66)	(16.03)
Securities/Assets_{t-1}	0.240	0.222	0.216
	(0.385)	(0.391)	(0.404)
Tier1 Capital/Assets_{t-1}	-0.196	-0.448	0.0545
	(2.771)	(2.833)	(2.941)
C&I/Assets_{t-1}	0.958	0.934	0.848
	(0.637)	(0.643)	(0.661)
Mortgages/Assets_{t-1}	0.909**	0.913**	0.916**
	(0.429)	(0.431)	(0.442)
Net Income/Assets_{t-1}	0.195	0.162	0.538
	(5.673)	(5.700)	(5.737)
Unused Loan Commitments/Assets_{t-1}	-0.329	-0.327	-0.311
	(0.230)	(0.231)	(0.231)
Is Part of Multi-BHC?	-0.157	-0.104	0.0674
	(0.267)	(0.254)	(0.282)
Is Part of Single-BHC?	-0.258	-0.202	-0.0421
	(0.252)	(0.237)	(0.264)
$\triangle$ TotalBranches × Small Bank	-0.540**	-0.536**	-0.459**
	(0.218)	(0.222)	(0.219)
$\triangle$ TotalBranches × Big Bank	0.135	0.133	0.135
	(0.0999)	(0.101)	(0.100)
$\triangle I$(Small Bank)	0.0831	0.0760	0.0756
	(0.0753)	(0.0781)	(0.0788)
Observations	88,974	87,717	85,669
R-squared	0.259	0.258	0.259
County x Year FE	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Bank Clustered SE	Yes	Yes	Yes

Notes: *** p<0.01, ** p<0.05, * p<0.1. The table provides coefficient estimates for the impact of real estate booms, measured by appreciation at the median branch, on small business originations. The first regression uses the entire sample, the second two exclude areas in the top 95^{th} percentile of real estate appreciation, and the third excludes areas in the top 90^{th} percentile. Indicator for below median branch includes the median. Sample covers the period between 2001 and 2005.

Table 14: Median Appreciation: Implied Changes in C&D Loans and Loan Originations

Year	△ C&D + Unused	Cumul. △ C&D + Unused	△ Loan Originations
		Small Banks	
2001	$246,061	$246,061	-$1,258,601
2002	$242,442	$488,503	-$2,374,454
2003	$315,262	$803,765	-$1,275,108
2004	$630,044	$1,433,809	-$3,562,762
2005	$629,559	$2,063,369	-$2,181,094
		Big Banks	
2001	$1,276,315	$1,276,316	-$2,875,137
2002	$1,191,743	$1,437,804	-$3,303,070
2003	$1,313,159	$1,801,662	-$4,025,190
2004	$2,259,089	$3,062,854	-$6,121,165
2005	$3,180,749	$4,614,559	-$5,855,837

Notes: The table lists implied increase in C&D loans plus commitments for small and big banks with exposure defined by median appreciation. For more information refer to Table 11.

Table 15: Small Bank Comparison: Median Appreciation

	Median Appreciation $\leq$ 1.4%			Median Appreciation $>$ 1.4%		
	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Average Total Assets (aTA)	762	659819	(572621)	746	945033	(877517)
RE Loans / aTA	762	0.4957	(0.1402)	746	0.5252	(0.1688)
Commercial Loans / aTA	762	0.0996	(0.0672)	746	0.0888	(0.0678)
Consumer Loans / aTA	762	0.0593	(0.0515)	746	0.0475	(0.0659)
Total Loans / aTA	762	0.6792	(0.1254)	746	0.6824	(0.1386)
Loan Loss Allowance / aTA	762	0.0087	(0.0034)	746	0.0088	(0.0039)
Total Investments / aTA	762	0.2382	(0.1249)	746	0.2396	(0.1343)
Other Real Estate / aTA	762	0.0019	(0.0029)	746	0.0010	(0.0021)
Total Deposits / aTA	762	0.7841	(0.0919)	746	0.7792	(0.0979)
FHLB Advances / aTA	762	0.0821	(0.0832)	746	0.0806	(0.0865)
Common and Pref Stock / aTA	762	0.0943	(0.0229)	746	0.0940	(0.0267)
ROE	762	0.1293	(0.0612)	746	0.1334	(0.0659)
ROA	762	0.0117	(0.0051)	746	0.0121	(0.0066)
aTA / aTE	762	11.1510	(2.2262)	746	11.2998	(2.3240)
Total Operating Income / aTA	762	0.0723	(0.0137)	746	0.0698	(0.0189)
Profit Margin	762	0.1766	(0.2918)	746	0.1763	(0.0649)
Operating Expense / aTA	762	0.0561	(0.0128)	746	0.0518	(0.0157)
Interest Expense / aTA	762	0.0224	(0.0089)	746	0.0198	(0.0093)
Non-interest Expense / aTA	762	0.0309	(0.0097)	746	0.0301	(0.0132)
Provision for Loan Loss / aTA	762	0.0028	(0.0029)	746	0.0019	(0.0029)
Non-interest Income / aTA	762	0.0119	(0.0083)	746	0.0114	(0.0154)
Interest Spread Earned	762	0.0396	(0.0081)	746	0.0398	(0.0084)
Loan Charge-offs / Total Loans	762	0.0041	(0.0043)	746	0.0025	(0.0043)
90+ Past Dues Loans / Total Loans	762	0.0020	(0.0029)	746	0.0012	(0.0021)
Non-accruing Loans / Total Loans	762	0.0075	(0.0059)	746	0.0053	(0.0053)

Notes: The table lists asset composition and performance statistics for small banks with median appreciation $\leq$ 1.4% and with median appreciation $>$ 1.4%. Information is from Call Reports.

Table 16: Real Effects of Fracking Shock

Dependent Variable	△ln Total Establishments in Zip Code				
	No Zip Code in Fracking (1)	No Zip Codes within 24mi (2)	No Zip Codes within 30mi (3)	No Zip Codes within 50mi (4)	No Zip Codes within 100mi (5)
Area Average Bank Exposure to New Wells, Small Banks	0.000908*	0.00231***	0.00239***	0.00327**	0.00460**
	(0.000502)	(0.000716)	(0.000813)	(0.00156)	(0.00219)
Area Average Bank Exposure to New Wells, Big Banks	-0.000305	-9.27e-05	5.79e-05	-0.000192	-0.000225
	(0.000411)	(0.000430)	(0.000448)	(0.000601)	(0.00179)
Observations	1,198,465	1,095,673	1,059,251	968,891	759,595
R-squared	0.188	0.192	0.193	0.197	0.208
Zip x Industry FE	Yes	Yes	Yes	Yes	Yes
State x Industry x Year FE	Yes	Yes	Yes	Yes	Yes
State x Industry Clustered SE	Yes	Yes	Yes	Yes	Yes

Notes: *** p<0.01, ** p<0.05, * p<0.1. The table provides coefficient estimates for the impact of zip code exposure to banks with branches in fracking areas. Each of the regressions excludes zip codes in areas with horizontal or directional wells as well as areas with drilling activity in the previous year. The first regression excludes zip code within areas with fracking activity (as defined by Hydrological Unit Codes). Regressions (2) to (5) exclude zip codes within the corresponding distance from the boundary of an area with fracking activity. Each of the samples covers the period form 2001 up to 2007.

Table 17: Zip Codes Statistics: Exposure to Small Banks Exposed to Fracking

	Zip Exposure to Small=0			Zip Exposure to Small>0		
	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Share Agriculture, Forestry, Hunting	6206	2%	(5%)	2758	1%	(5%)
Share Mining	6206	1%	(4%)	2758	1%	(3%)
Share Utilities	6206	1%	(3%)	2758	1%	(3%)
Share Construction	6206	15%	(10%)	2758	12%	(8%)
Share Manufacturing	6206	6%	(5%)	2758	6%	(5%)
Share Wholesale Trade	6206	6%	(5%)	2758	6%	(5%)
Share Retail Trade	6206	16%	(7%)	2758	15%	(6%)
Share Transportation and Warehousing	6206	5%	(6%)	2758	4%	(4%)
Share Information	6206	2%	(2%)	2758	2%	(2%)
Share Finance and Insurance	6206	5%	(4%)	2758	6%	(3%)
Share Real Estate Rental and Leasing	6206	4%	(4%)	2758	5%	(3%)
Share Professional, Scientific, and Technical Services	6206	8%	(6%)	2758	9%	(7%)
Share Management of Companies	6206	1%	(1%)	2758	1%	(1%)
Share Administrative	6206	5%	(4%)	2758	5%	(3%)
Share Educational Services	6206	1%	(2%)	2758	1%	(1%)
Share Health Care and Social Assistance	6206	9%	(6%)	2758	9%	(6%)
Share Arts, Entertainment, and Recreation	6206	2%	(3%)	2758	2%	(3%)
Share Accommodation and Food Services	6206	9%	(6%)	2758	9%	(6%)
Share Other Services	6206	12%	(6%)	2758	11%	(5%)
Share Public Administration	6206	0%	(1%)	2758	0%	(1%)
Population	6141	13209	(15516)	2724	18546	(17580)
Median Age	6141	37	(5)	2724	35	(6)
Median Income	6141	40173	(14568)	2724	43146	(16166)
Income Per Capita	6141	18734	(6909)	2724	20241	(7953)
Poverty Percentage	6140	15%	(10%)	2724	15%	(11%)
Urban	6140	46%	(43%)	2724	63%	(41%)
Fraction with Bachelor's Degree	6140	11%	(7%)	2724	13%	(8%)

Notes: The table lists shares of establishments by industry and key population statistics for two categories of zip codes: those serviced by small banks with positive fracking exposure and those serviced by small banks with no exposure and within 100 miles. The population information is from the 2000 U.S. Census and the industrial composition is from the County Business Patterns.

Table 18: Real Effects of Fraction of Branches in the Top Decile

Dependent Variable	△ln Total Establishments in Zip Code				
	No Zip Code in 90^{th}	No Zip Codes within 24mi	No Zip Codes within 30mi	No Zip Codes within 50mi	No Zip Codes within 100mi
	(1)	(2)	(3)	(4)	(5)
Area Average Banks in 90^{th}, Small Banks	-0.0167***	-0.0131**	-0.0127**	-0.0162**	-0.0155**
	(0.00548)	(0.00611)	(0.00640)	(0.00704)	(0.00751)
Area Average Banks in 90^{th}, Big Banks	-0.00422	-0.00859	-0.00748	-0.00600	-0.00676
	(0.0121)	(0.0128)	(0.0129)	(0.0132)	(0.0141)
Observations	959,198	912,749	898,049	863,821	802,821
R-squared	0.210	0.211	0.211	0.213	0.218
Zip x Industry FE	Yes	Yes	Yes	Yes	Yes
State x Industry x Year FE	Yes	Yes	Yes	Yes	Yes
State x Industry Clustered SE	Yes	Yes	Yes	Yes	Yes

Notes: *** p<0.01, ** p<0.05, * p<0.1. The table provides coefficient estimates for the impact of zip code exposure to banks with branches in areas with residential booms (90^{th} percentile of appreciation). Each of the regressions excludes zip codes in areas with horizontal or directional wells as well as areas with drilling activity in the previous year. The first regression excludes zip code within areas with residential booms. Regressions (2) to (5) exclude zip codes within the corresponding distance from the boundary of an area with a residential boom. Each of the samples covers the period form 2001 up to 2005.

Table 19: Zip Codes Statistics: Exposure to Small Banks with Branches in the Top Decile

	Zip Exposure to Small=0			Zip Exposure to Small>0		
	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Share Agriculture, Forestry, Hunting	3743	3%	(6%)	11150	2%	(4%)
Share Mining	3743	1%	(3%)	11150	1%	(2%)
Share Utilities	3743	1%	(3%)	11150	1%	(2%)
Share Construction	3743	17%	(11%)	11150	15%	(10%)
Share Manufacturing	3743	6%	(7%)	11150	5%	(5%)
Share Wholesale Trade	3743	6%	(5%)	11150	5%	(4%)
Share Retail Trade	3743	16%	(8%)	11150	15%	(7%)
Share Transportation and Warehousing	3743	6%	(6%)	11150	5%	(6%)
Share Information	3743	2%	(3%)	11150	2%	(2%)
Share Finance and Insurance	3743	5%	(4%)	11150	5%	(3%)
Share Real Estate Rental and Leasing	3743	4%	(4%)	11150	4%	(3%)
Share Professional, Scientific, and Technical Services	3743	8%	(6%)	11150	9%	(6%)
Share Management of Companies	3743	1%	(1%)	11150	1%	(1%)
Share Administrative	3743	6%	(5%)	11150	6%	(4%)
Share Educational Services	3743	1%	(3%)	11150	1%	(2%)
Share Health Care and Social Assistance	3743	8%	(6%)	11150	9%	(6%)
Share Arts, Entertainment, and Recreation	3743	3%	(4%)	11150	2%	(3%)
Share Accommodation and Food Services	3743	9%	(8%)	11150	9%	(6%)
Share Other Services	3743	12%	(7%)	11150	12%	(6%)
Share Public Administration	3743	0%	(1%)	11150	0%	(1%)
Population	3605	8518	(11043)	10915	14599	(16095)
Median Age	3605	38	(6)	10915	38	(5)
Median Income	3605	40526	(15804)	10915	45508	(18412)
Income Per Capita	3605	19656	(8021)	10915	22296	(10344)
Poverty Percentage	3595	15%	(11%)	10894	13%	(10%)
Urban	3600	36%	(41%)	10906	56%	(43%)
Fraction with Bachelor's Degree	3600	11%	(7%)	10902	14%	(8%)

Notes: The table lists shares of establishments by industry and key population statistics for two categories of zip codes: those serviced by small banks with positive exposure to top deciles and those serviced by small banks with no exposure and within 100 miles. The population information is from the 2000 U.S. Census and the industrial composition is from the County Business Patterns.

Table 20: Real Effects of Median Branches

Dependent Variables	△ln Total Establishments in ZIP Area			
	All Areas	Exclude Top 90th	Exclude 50 mi from Top 90th	Exclude 100 mi from Top 90th
	(1)	(2)	(3)	(4)
Area Fraction of Below Median Branches, Small Banks	-0.00340***	-0.00277**	-0.00286**	-0.00263*
	(0.00125)	(0.00132)	(0.00137)	(0.00141)
Area Fraction of Below Median Branches, Big Banks	-0.000251	-0.000219	-0.000617	-0.000792
	(0.00151)	(0.00151)	(0.00161)	(0.00169)
Observations	1,108,536	943,633	829,916	771,159
R-squared	0.208	0.216	0.220	0.224
Zip x Industry FE	Yes	Yes	Yes	Yes
State x Industry x Year FE	Yes	Yes	Yes	Yes
State x Industry Clustered SE	Yes	Yes	Yes	Yes

Notes: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. The table provides coefficient estimates for the impact of zip code exposure to at-or-below median branches. Estimation (1) includes all zip codes and estimation (2) excludes zip code with residential appreciation in the top decile. Estimations (3) and (4) exclude zip codes 50 and 100 miles from areas with residential appreciation in the top decile. Sample include year between 2001 and 2005.

Table 21: Zip Codes Statistics: Exposure to Small Banks with Below-median Branches

	<50% of Branches Below Median			>50% of Branches Below Median		
	N	Mean	Std. Dev.	N	Mean	Std. Dev.
Share Agriculture, Forestry, Hunting	72578	2%	(5%)	31633	2%	(4%)
Share Mining	72578	1%	(3%)	31633	1%	(4%)
Share Utilities	72578	1%	(3%)	31633	1%	(3%)
Share Construction	72578	15%	(10%)	31633	14%	(9%)
Share Manufacturing	72578	6%	(6%)	31633	6%	(5%)
Share Wholesale Trade	72578	6%	(6%)	31633	6%	(6%)
Share Retail Trade	72578	16%	(8%)	31633	16%	(7%)
Share Transportation and Warehousing	72578	5%	(6%)	31633	5%	(6%)
Share Information	72578	2%	(2%)	31633	2%	(2%)
Share Finance and Insurance	72578	5%	(4%)	31633	5%	(4%)
Share Real Estate Rental and Leasing	72578	4%	(3%)	31633	4%	(3%)
Share Professional, Scientific, and Technical Services	72578	8%	(6%)	31633	8%	(6%)
Share Management of Companies	72578	1%	(1%)	31633	1%	(1%)
Share Administrative	72578	5%	(4%)	31633	5%	(4%)
Share Educational Services	72578	1%	(2%)	31633	1%	(2%)
Share Health Care and Social Assistance	72578	8%	(6%)	31633	8%	(6%)
Share Arts, Entertainment, and Recreation	72578	2%	(3%)	31633	2%	(3%)
Share Accommodation and Food Services	72578	9%	(6%)	31633	9%	(6%)
Share Other Services	72578	12%	(6%)	31633	12%	(6%)
Share Public Administration	72578	0%	(1%)	31633	0%	(1%)
Population	71337	12333	(14404)	31176	12750	(14640)
Median Age	71337	37	(5)	31176	37	(5)
Median Income	71337	42664	(17164)	31176	40783	(15082)
Income Per Capita	71337	20623	(9137)	31176	19815	(8088)
Poverty Percentage	71200	14%	(11%)	31144	14%	(11%)
Urban	71270	48%	(44%)	31162	47%	(43%)
Fraction with Bachelor's Degree	71247	12%	(8%)	31154	12%	(8%)

Notes: The table lists shares of establishments by industry and key population statistics for two categories of zip codes: those serviced by less than 50% below-median branches of small banks and those serviced by more than 50%. The population information is from the 2000 U.S. Census and the industrial composition is from the County Business Patterns.

Table 22: Small Business Lending: Asset-based Bank Groups

Dependent Variables	$\triangle$ ln Small Business Lending		
	No Branches 30mi to Fracking	No Branches 30mi to Top 90^{th}	No Branches Above Median
Avg. New Wells $\times$ (Assets$\leq$ \$1.1 billion)	0.0619***		
	(0.0199)		
Avg. New Wells $\times$ (Assets$>$ \$1.1 billion)	0.00227		
	(0.00498)		
Fraction of Branches in Top 90^{th} $\times$ (Assets$\leq$ \$1.1 billion)		-1.707***	
		(0.449)	
Fraction of Branches in Top 90^{th} $\times$ (Assets$>$ \$1.1 billion)		-0.672**	
		(0.304)	
Appreciation at Median Branch $\times$ (Assets$\leq$ \$1.1 billion)			-9.166***
			(3.463)
Appreciation at Median Branch $\times$ (Assets$>$ \$1.1 billion)			-4.943*
			(2.646)
Bank Controls			
ln Assets$_{t-1}$	-0.0478	0.144	0.167
	(0.0477)	(0.123)	(0.109)
Deposits/Assets$_{t-1}$	-0.155	0.0454	0.475
	(0.288)	(0.440)	(0.491)
Cost of Deposits$_{t-1}$	5.552	14.17	30.85*
	(9.640)	(14.64)	(15.75)
Securities/Assets$_{t-1}$	0.255	-0.139	0.227
	(0.229)	(0.357)	(0.392)
Tier1 Capital/Assets$_{t-1}$	-0.996	1.086	-0.601
	(1.336)	(2.427)	(2.829)
C&I/Assets$_{t-1}$	0.255	-0.0642	0.955
	(0.372)	(0.626)	(0.643)
Mortgages/Assets$_{t-1}$	0.927***	0.837**	0.921**
	(0.331)	(0.337)	(0.432)
Net Income/Assets$_{t-1}$	0.115	1.508	0.182
	(4.681)	(6.082)	(5.697)
Unused Loan Commitments/Assets$_{t-1}$	0.0465	-0.0801	-0.323
	(0.0293)	(0.0731)	(0.232)
Is Part of Multi-BHC?	-0.00375	0.0775	-0.113
	(0.0877)	(0.146)	(0.251)
Is Part of Single-BHC?	0.0307	-0.0466	-0.210
	(0.0892)	(0.124)	(0.235)
$\triangle$ TotalBranches $\times$ Small Bank	-0.453***	-0.466***	-0.540**
	(0.0988)	(0.106)	(0.222)
$\triangle$ TotalBranches $\times$ Big Bank	-0.185**	-0.0520	0.130
	(0.0724)	(0.0927)	(0.101)
$\triangle I$(Small Bank)	0.0623	0.105	0.0370
	(0.0516)	(0.0731)	(0.0769)
Observations	230,845	156,166	87,717
R-squared	0.177	0.217	0.258
County x Year FE	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Bank Clustered SE	Yes	Yes	Yes

Notes: *** p<0.01, ** p<0.05, * p<0.1. The table provides coefficient estimates for the impact of each of the shocks on the originations. Bank groups are defined based on asset sizes. For variable definitions and sample restrictions refer to the notes for the baseline results.

Table 23: The Extensive Margin of Small Business Lending

Dependent Variables	$\triangle$ ln Number of Small Business Originations		
	No Branches 30mi to Fracking	No Branches 30mi to Top 90^{th}	No Branches Above Median
Avg. New Wells × Small Bank	0.00315		
	(0.0247)		
Avg. New Wells × Big Bank	-0.00132		
	(0.00804)		
Fraction of Branches in Top 90^{th} × Small Bank		-0.888***	
		(0.324)	
Fraction of Branches in Top 90^{th} × Big Bank		-0.639	
		(0.549)	
Appreciation at Median Branch × Small Bank			-7.255
			(4.426)
Appreciation at Median Branch × Big Bank			-2.590
			(3.572)
Bank Controls			
ln Assets$_{t-1}$	-0.193**	-0.0222	0.128
	(0.0789)	(0.126)	(0.142)
Deposits/Assets$_{t-1}$	0.0749	0.00580	0.831
	(0.473)	(0.621)	(0.895)
Cost of Deposits$_{t-1}$	3.240	-27.29	15.97
	(20.30)	(39.08)	(36.24)
Securities/Assets$_{t-1}$	-0.0423	-0.660	-0.713
	(0.297)	(0.616)	(0.683)
Tier1 Capital/Assets$_{t-1}$	-2.102	-5.022**	-6.285**
	(1.582)	(2.496)	(2.637)
C&I/Assets$_{t-1}$	0.844	-0.424	1.015
	(0.803)	(0.886)	(1.160)
Mortgages/Assets$_{t-1}$	0.933	0.569	0.651
	(0.623)	(0.585)	(0.826)
Net Income/Assets$_{t-1}$	-6.555	-5.981	-6.403
	(6.378)	(6.478)	(6.704)
Unused Loan Commitments/Assets$_{t-1}$	0.0934	0.0316	0.182
	(0.0587)	(0.0441)	(0.285)
Is Part of Multi-BHC?	0.0662	-0.0514	-0.216
	(0.110)	(0.141)	(0.311)
Is Part of Single-BHC?	0.106	-0.152	-0.281
	(0.107)	(0.137)	(0.308)
$\triangle$ TotalBranches × Small Bank	-0.378***	-0.470***	-0.397*
	(0.144)	(0.0845)	(0.205)
$\triangle$ TotalBranches × Big Bank	0.0264	0.295	0.451
	(0.162)	(0.336)	(0.293)
$\triangle I$(Small Bank)	0.157*	0.241	0.287**
	(0.0811)	(0.158)	(0.143)
Observations	230,845	161,574	88,974
R-squared	0.213	0.264	0.320
County x Year FE	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Bank Clustered SE	Yes	Yes	Yes

Notes: *** p<0.01, ** p<0.05, * p<0.1. The table provides coefficient estimates for the impact of each of the shocks on the number of originations. For variable definitions and sample restrictions refer to the notes for the baseline results.

Table 24: Interactions between Fracking and Residential Booms

Dependent Variables	$\triangle$ ln Small Business Lending		
	No Branches in Fracking or 90^{th}	No Branches in Fracking or 90^{th}	No Branches in Fracking or 90^{th}
	(1)	(2)	(3)
Avg. New Wells × Small Bank	0.0433**		0.0436**
	(0.0201)		(0.0197)
Avg. New Wells × Big Bank	0.0204		0.0206
	(0.0204)		(0.0207)
Fraction of Branches in Top 90^{th} × Small Bank		-0.332*	-0.337*
		(0.178)	(0.178)
Fraction of Branches in Top 90^{th} × Big Bank		-0.360*	-0.360*
		(0.193)	(0.191)
Bank Controls			
ln Assets_{t-1}	0.0209	0.0300	0.0287
	(0.0988)	(0.0998)	(0.0994)
Deposits/Assets_{t-1}	-0.0914	-0.0962	-0.102
	(0.385)	(0.385)	(0.386)
Cost of Deposits_{t-1}	19.53	21.20	20.93
	(14.64)	(15.13)	(14.99)
Securities/Assets_{t-1}	0.234	0.197	0.200
	(0.362)	(0.357)	(0.356)
Tier1 Capital/Assets_{t-1}	-1.118	-1.245	-1.207
	(2.190)	(2.198)	(2.187)
C&I/Assets_{t-1}	0.126	0.174	0.204
	(0.554)	(0.554)	(0.560)
Mortgages/Assets_{t-1}	0.729**	0.648*	0.652*
	(0.358)	(0.348)	(0.345)
Net Income/Assets_{t-1}	1.815	1.683	1.525
	(5.487)	(5.493)	(5.497)
Unused Loan Commitments/Assets_{t-1}	-0.00776	-0.0143	-0.0132
	(0.0202)	(0.0219)	(0.0215)
Is Part of Multi-BHC?	0.0942	0.0945	0.0922
	(0.129)	(0.129)	(0.129)
Is Part of Single-BHC?	0.0219	0.0248	0.0230
	(0.113)	(0.113)	(0.113)
$\triangle$ TotalBranches × Small Bank	-0.480***	-0.485***	-0.484***
	(0.0948)	(0.0955)	(0.0955)
$\triangle$ TotalBranches × Big Bank	-0.156	-0.151	-0.154
	(0.0959)	(0.0940)	(0.0951)
$\triangle I$(Small Bank)	0.0620	0.0615	0.0581
	(0.0708)	(0.0713)	(0.0719)
Observations	132,576	132,585	132,576
R-squared	0.210	0.210	0.210
County x Year FE	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes
Bank Clustered SE	Yes	Yes	Yes

Notes: *** p<0.01, ** p<0.05, * p<0.1. The table provides coefficient estimates for the impact of fracking controlling for fraction of branches in areas with residential appreciation in the top decile. The sample covers 2001 to 2005. It excludes branches close to fracking and branches in areas with residential booms.

Table 25: Network Selection, Headquarter Effect, Distance to Borrower

Dependent Variables	△ ln Small Business Lending						
	Old Branches	Headquarter Effect			Distance to Borrower		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Avg. New Wells × Small Bank	0.0431**	0.0466***			0.0348*		
	(0.0186)	(0.0158)			(0.0204)		
Avg. New Wells × Big Bank	0.00261	0.00188			0.000837		
	(0.00543)	(0.00510)			(0.00505)		
Fraction of Branches in Top 90^{th} × Small Bank			-1.055***			-1.022**	
			(0.317)			(0.431)	
Fraction of Branches in Top 90^{th} × Big Bank			-0.599**			-0.425*	
			(0.305)			(0.245)	
Appreciation at Median Branch × Small Bank				-8.515**			-6.311*
				(3.430)			(3.439)
Appreciation at Median Branch × Big Bank				-4.054			-2.451
				(2.523)			(2.598)
Avg. New Wells × Small Bank × Is HQ?		-0.0510*					
		(0.0308)					
Avg. New Wells × Big Bank × Is HQ?		-0.00165					
		(0.0109)					
Fraction of Branches in Top 90^{th} × Small Bank × Is HQ?			-0.917**				
			(0.431)				
Fraction of Branches in Top 90^{th} × Big Bank × Is HQ?			0.0476				
			(0.252)				
Appreciation at Median Branch × Small Bank × Is HQ?				1.081			
				(1.341)			
Appreciation at Median Branch × Big Bank × Is HQ?				-0.107			
				(1.731)			
Avg. New Wells × Small Bank × ln(1+Dist)					0.0305		
					(0.0260)		
Avg. New Wells × Big Bank × ln(1+Dist)					0.00803		
					(0.0259)		
Fraction of Branches in Top 90^{th} × Small Bank × ln(1+Dist)						-0.315	
						(0.868)	
Fraction of Branches in Top 90^{th} × Big Bank × ln(1+Dist)						-0.682	
						(0.506)	
Appreciation at Median Branch × Small Bank × ln(1+Dist)							-9.921***
							(2.993)
Appreciation at Median Branch × Big Bank × ln(1+Dist)							-9.536***
							(3.187)
Observations	210,644	230,845	161,574	92,435	230,845	161,574	92,435
R-squared	0.175	0.177	0.213	0.257	0.177	0.213	0.259
County x Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Clustered SE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: *** p<0.01, ** p<0.05, * p<0.1. The table provides coefficient estimates for specifications that extend the baseline models. Specifications (1) and (4) allow the main effects to differ at the headquarter and according to the distance to between the branch and the borrower, for the case of fracking. Estimations (2) and (5), and (3) and (6) do this for the case of fraction of branches in the top decile and appreciation at the median branch.

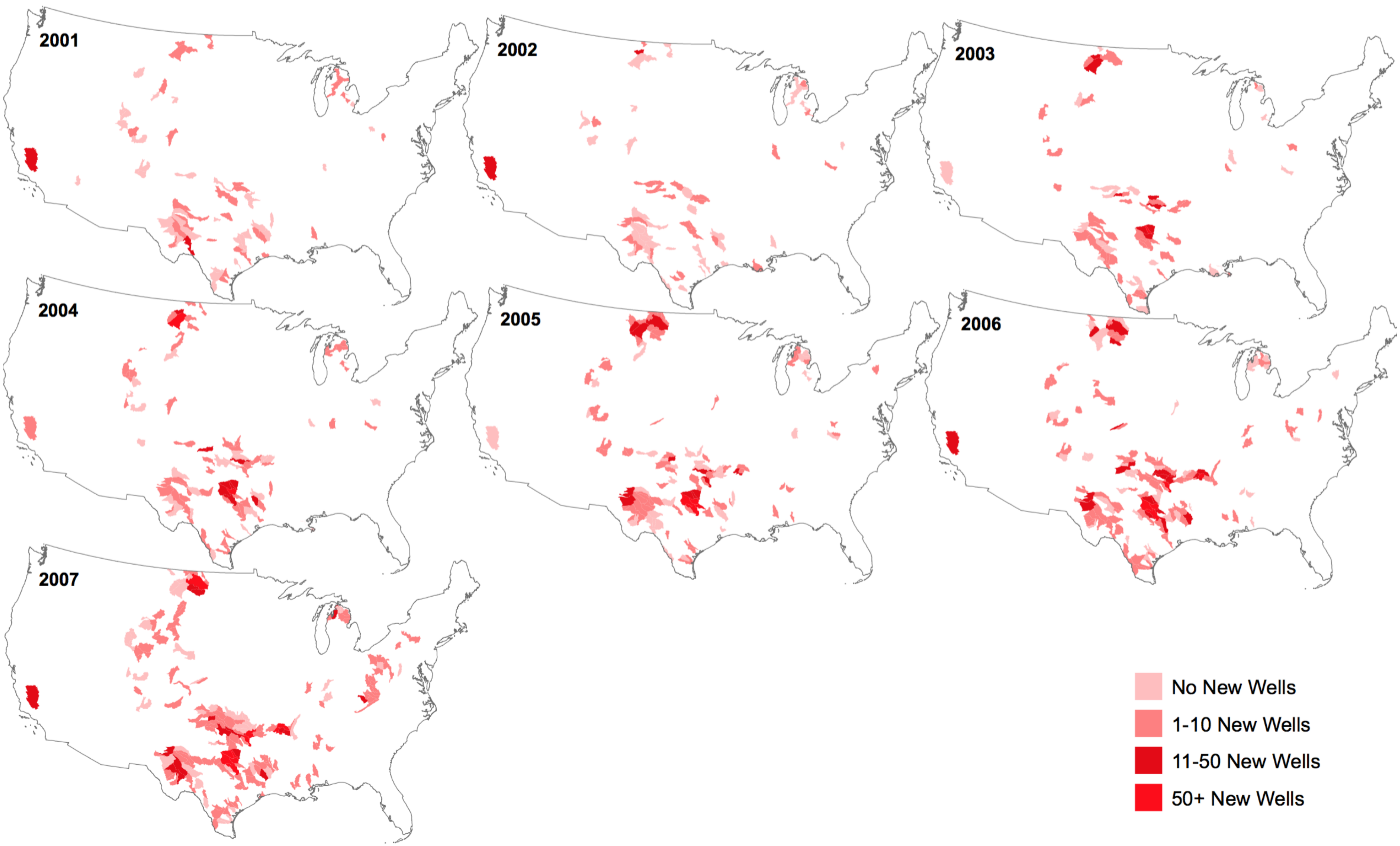


Figure 1: Changes in Number of Horizontal Wells between 2001 and 2007

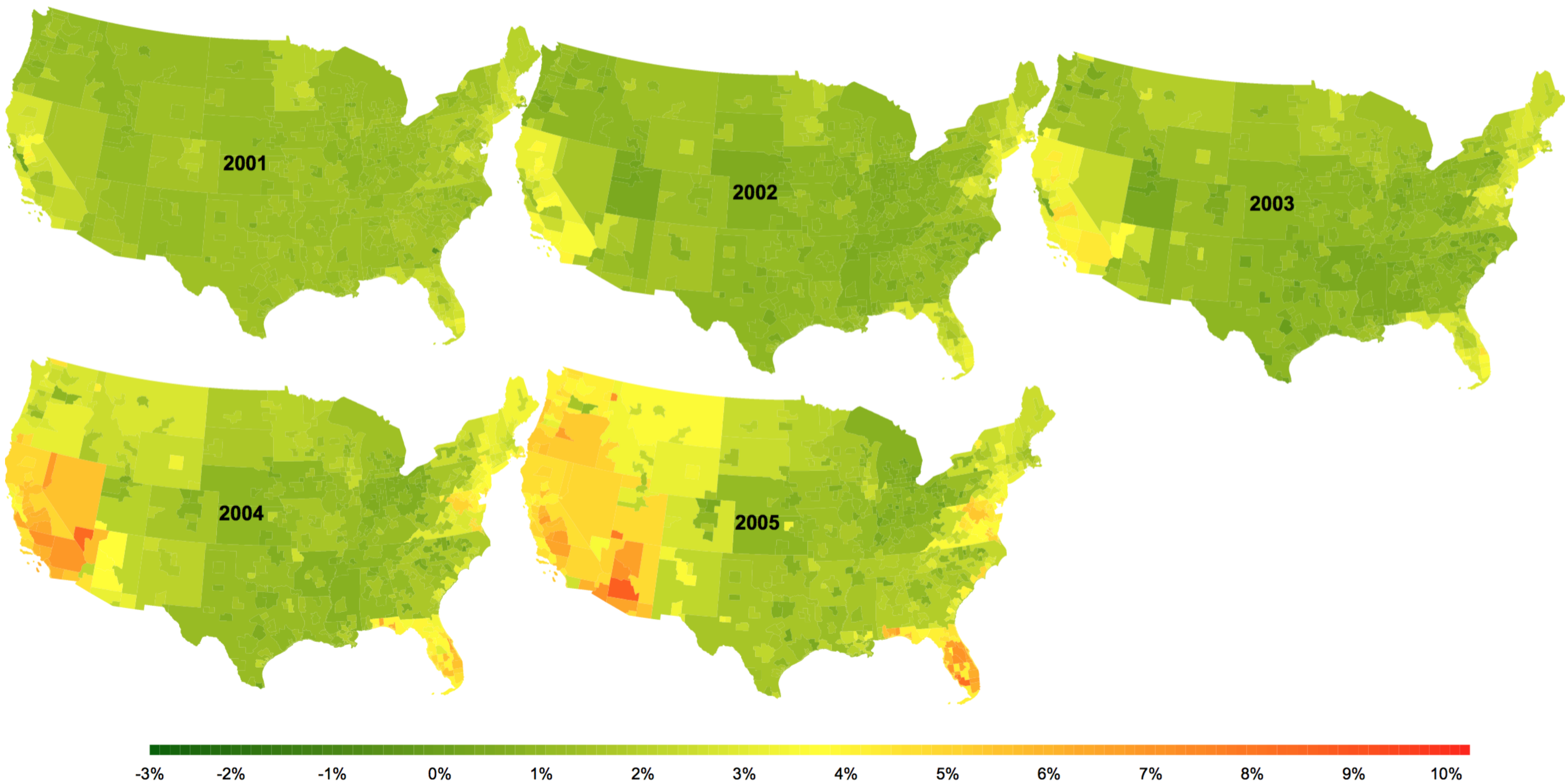
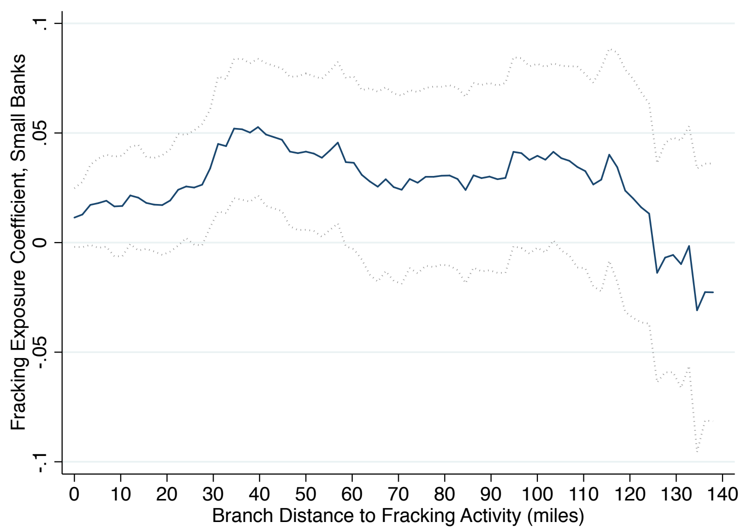


Figure 2: Average Annual Growth of HPI between 2001 and 2005



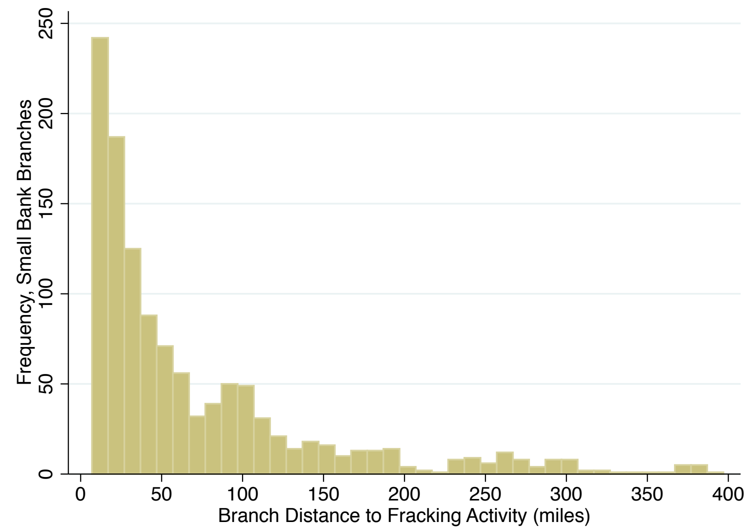


Figure 3: Coefficient Plot of Exposure to Fracking and Branch Distribution, Small Banks

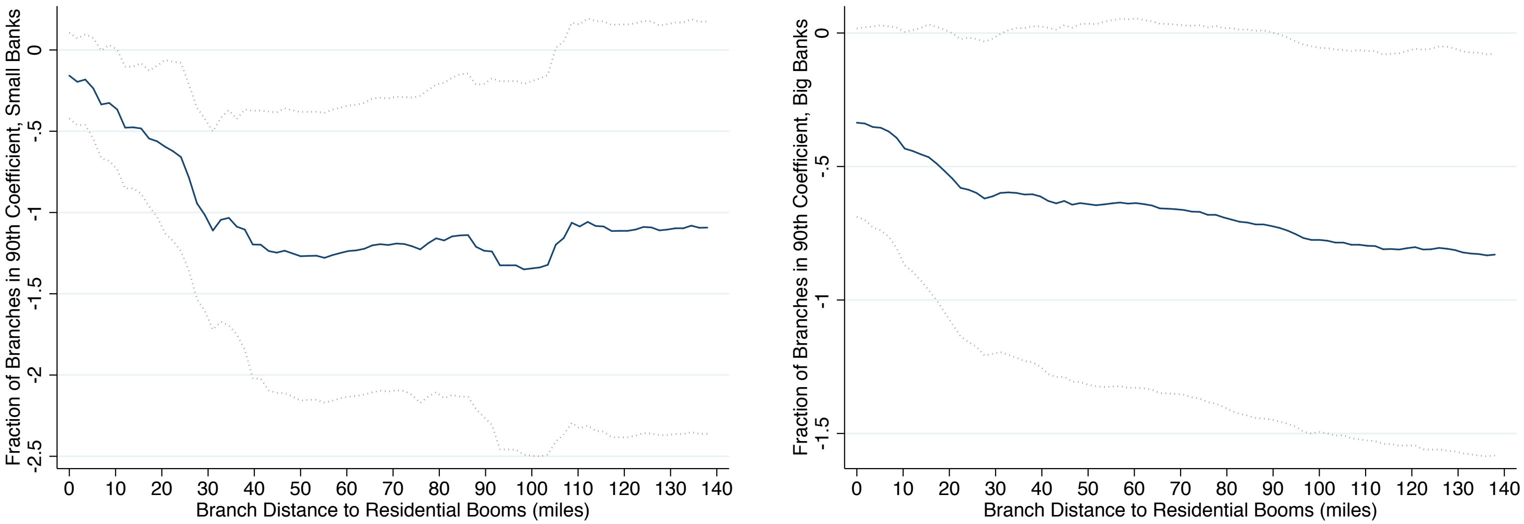


Figure 4: Coefficient Plot of the Effect of Fraction of Branches in Areas with Residential Booms, Small and Big Banks

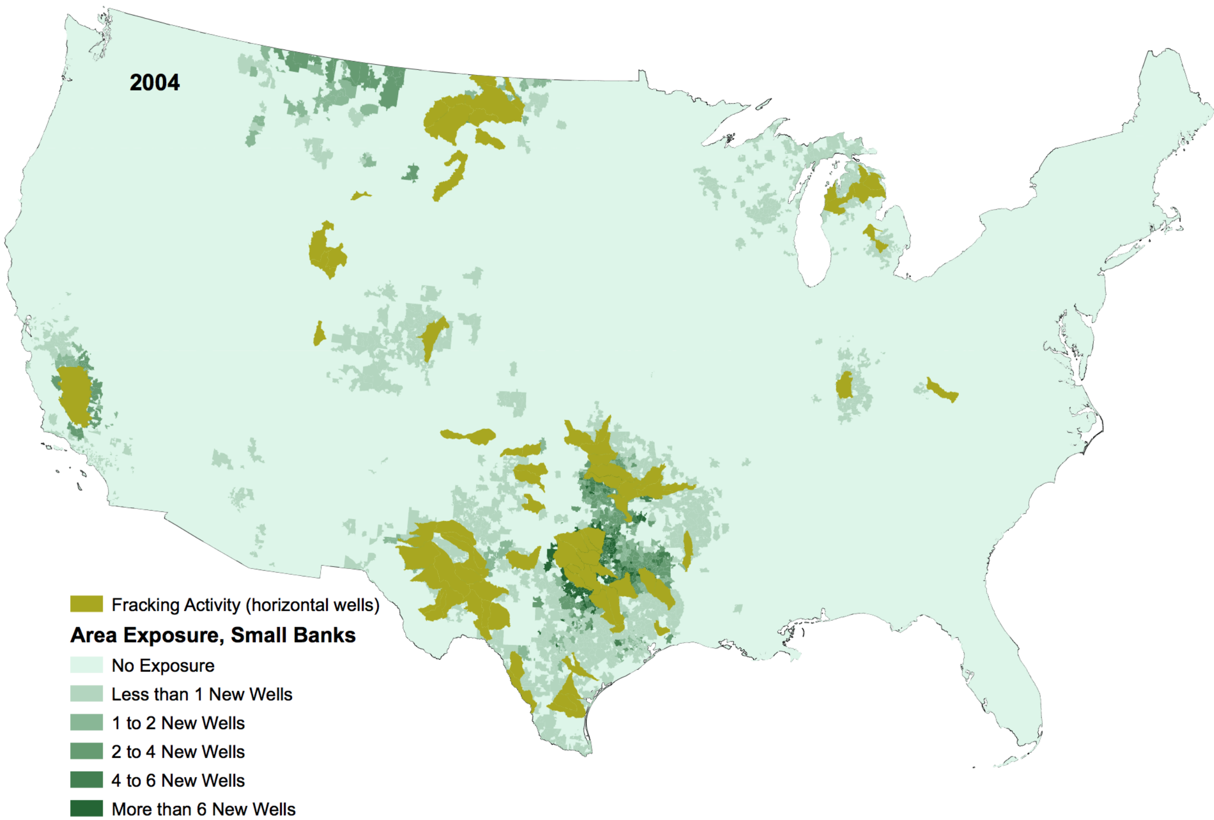


Figure 5: Area Exposure to Small Banks with Branches in Fracking Areas, 2004

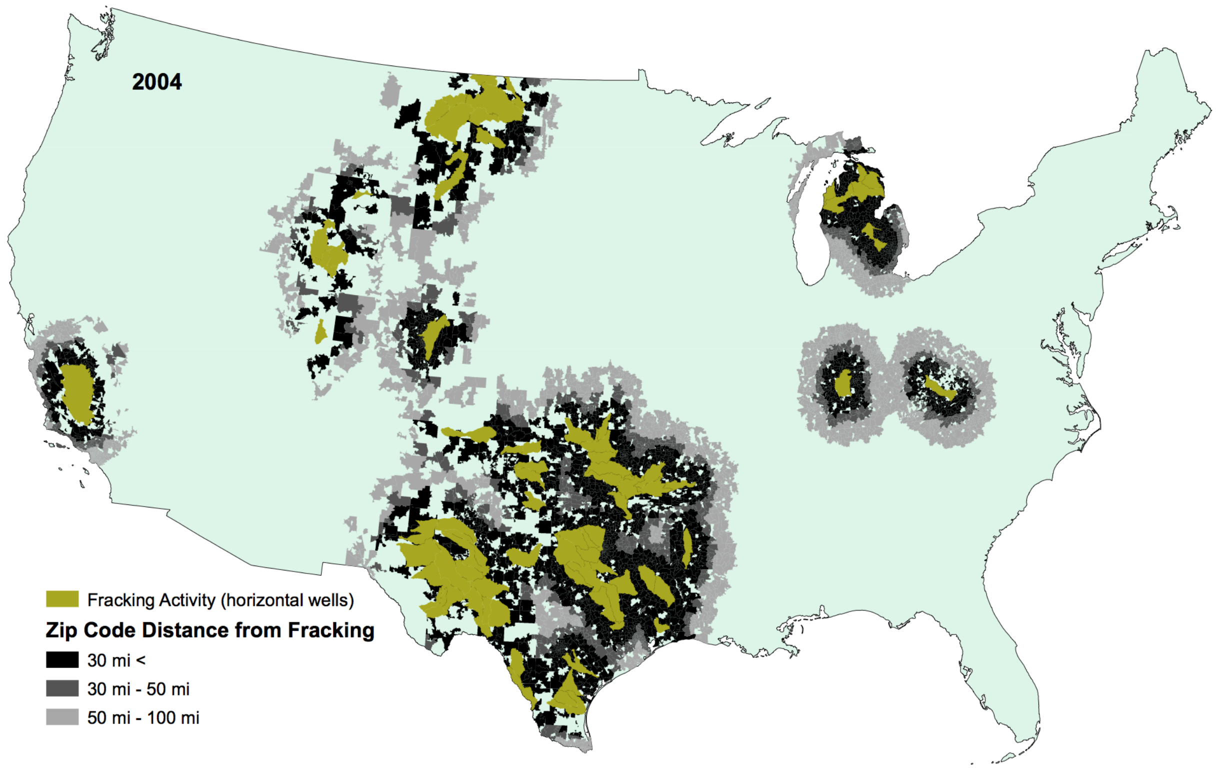


Figure 6: Distance of Zip Code from Fracking Areas, 2004

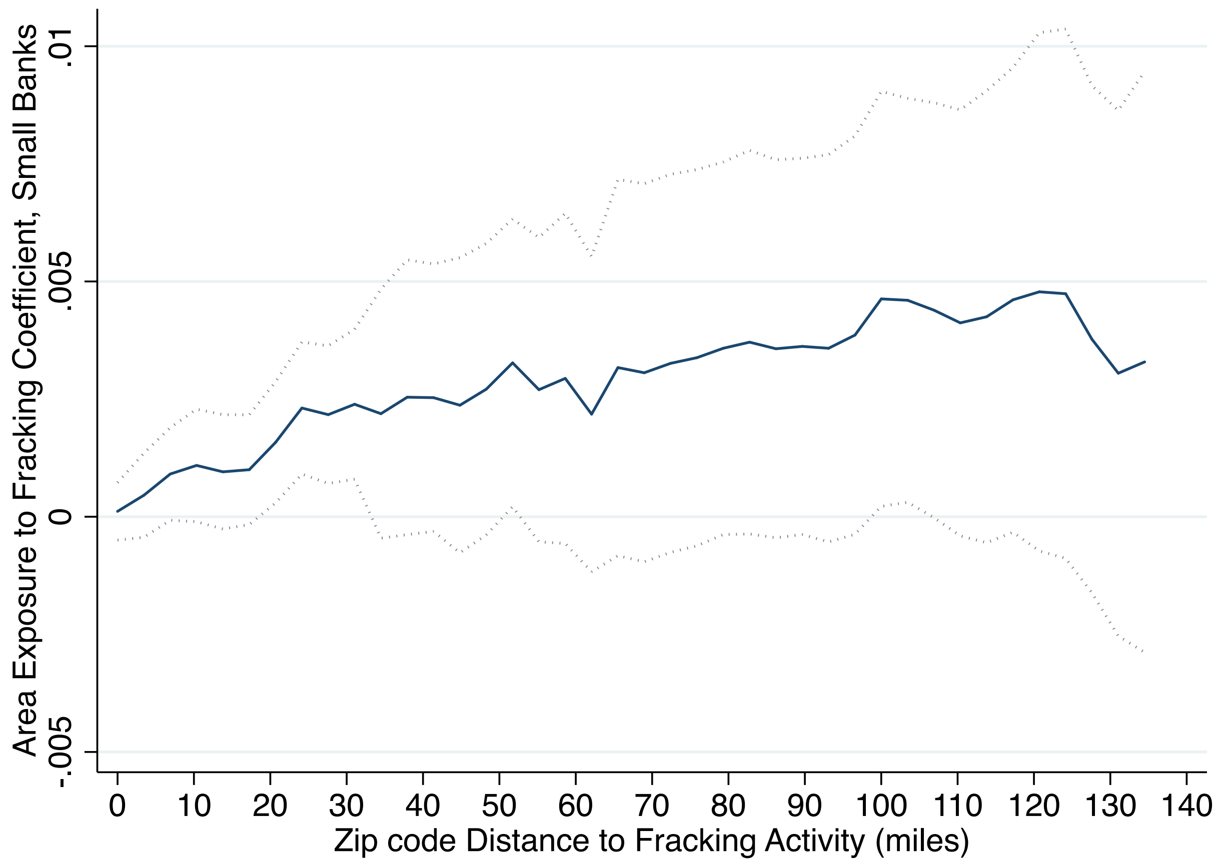


Figure 7: Coefficient of Area Exposure to Small Banks with Branches in Fracking Areas

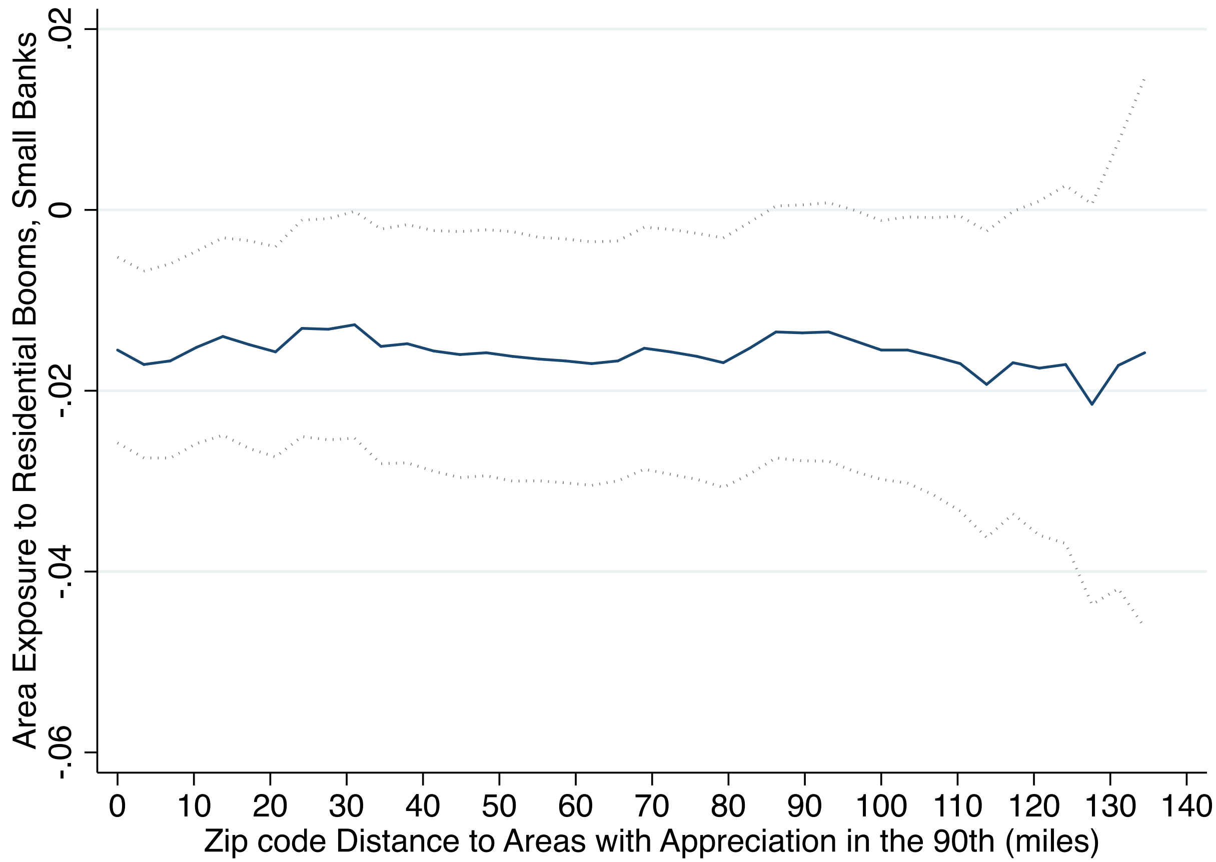


Figure 8: Coefficient of Area Exposure to Small Banks with Branches in Residential Booms

Appendix

A1 - Data Appendix

CRA Census Tract Lending

Each bank that falls under the CRA reporting criteria is required to submit to the Federal Financial Institutions Examination Council (FFIEC) detailed information on each of the new small business loans it has originated between January 1st and December 31st of each year. A small business loan is defined as either a commercial and industrial (C&I) loan or a loan secured by nonresidential real estate with amount of less than $1 million. The bank is to disclose for each loan the location of the borrower (census tract) and the amount of the loan that has been extended. This detailed information is processed by the FFIEC and after extensive review for accuracy is released to the public. To preserve the privacy of the customers of each bank the public information aggregates the total gross originations into three categories – less than $100,000, between $100,000 and $250,000, and between $250,000 and $1,000,000. Only the totals within each category are reported. Additionally, the bank reports total originations to firms with revenue below $1,000,000. This study uses all of the small business loan originations by adding the total amounts originated in each of the subcategories listed above. The geographical information is aggregated to the county level where separate totals are reported for the metropolitan and the non-metropolitan area of the county (if applicable). Within the MSA-county and the nonMSA-county areas further distinction is made between the origination amounts extended across different income level areas (based on the census tract income level). Since each bank is required to report the census tracts and the income level at each census tract where at least one new loan was extended I am able to decrease the level of aggregation in the public disclosures. This information allows me to eliminate the census tracts where no loans are originated. The total origination amounts for a given

MSA-county or nonMSA-county across different income levels are distributed equally to all of the census tracts according to the particular income level. If there's only one census tract with a particular income level within the county area this census tract gets the precise amount of originations.

Branch Locations

The second source of data for this paper comes from the Summary of Deposits information maintained by the Federal Deposit Insurance Corporation (FDIC). FDIC provides a list of addresses of all active physical branches of all commercial banks and thrifts that are in operation in a given year. For example, the 2000 file includes 85,493 branches of all banks in operation[29]. Of the 85,493 locations about 86% have the precise branch GPS coordinates while the remaining 14% only list an address. The branches with missing coordinates were geo-coded separately for each year based on the US address[30]. Consequently, each of the bank branches in operation for the period between 2000 and 2009 was associated with a particular GPS-coordinate location[31].

Matching Bank Networks Over the Sample Period

The final step in the creation of the dataset has to do with the associations of bank networks over time. It is customary in this literature to use a method called force-merging that will account for mergers and acquisitions of banks over the years. This method merges the balance sheet of two or more banks in the year before the merger occurs and thus maintain the relative size of the assets and liabilities between the two years. This paper deviates from this practice. In what is described above, I have assumed that a given client of a bank receives a loan from the closest super-branch of that bank. To use the force-merging method I will have to assume that the client of

[29]This number excludes ATM locations.

[30]This was done with the geo-coding service SmartyStreets.

[31]Some of the addresses are not very accurate and this is reflected in the precision of the GPS coordinates.

a bank can choose to go to a super-branch of the actual bank that has extended the loan *or* to a super-branch of the bank that merges with the first bank in the following period. This is obviously inconsistent. The method that this paper uses instead is to match the spatial distribution of a bank network at two different points in time. The nodes of a network of a bank in one year are matched with only those nodes that exist in the following year in the same location and belong to the same bank. The dataset, therefore, only includes observations for networks that report under the CRA for at least two consecutive years and at least one node of the network is in the same location between the two years.

Aggregation of Census Tracts to ZIP Code Areas

The CRA information is provided at the census tract level while the CBP information on the number of establishments is provided at the USPS ZIP code level. The census tracts are slightly smaller than the ZIP areas so I aggregate the CRA information to the ZIP code level. To do this I overlay the ZIP areas over the census tracts and compute the percentage of the area of each ZIP area that is comprised of each census tract that overlaps with the ZIP area. Average exposure is converted from the census tract level to the ZIP level using percentage of total area as a weight.

A2 - Model

Each bank, i, has multiple branches, indexed by j. Assuming that each bank has one branch per credit market, j can also refer to the credit market where the branch is located. The total number of branches if i are N_i. I assume that the bank is a monopolist and at each branch, ij, it can:

- Lend to one small business an amount of L_{ij} with a marginal return $r_j^L + r_i^L - \alpha_L L_{ij}$,

- Lend to one land developer an amount of K_{ij} with a marginal return $r_j^K + r_i^K - \alpha_K K_{ij}$,

- Collect up to D_{ij} in deposits at no cost.

The marginal returns to each of the loans has a local component, indexed by j, and a bank component, indexed by i. The bank can also borrow funds from the inter-bank market of amount B_i at a marginal cost of $\alpha_B^i B_i$.

There are two periods, t and $t+1$. After period t the bank experiences three different branch-specific shocks to:

- The return of the business loan such that the return becomes $r_j^L + r_i^L - \alpha_L L_{ij} + \eta_{ij}$,

- The return of the real estate loan such that the return becomes $r_j^K + r_i^K - \alpha_K K_{ij} + \kappa_{ij}$,

- The deposits such that the branch can collect $D_{ij} + \delta_{ij}$.

In the first period the bank chooses L_{ij}^t and K_{ij}^t at each branch to maximize profits subject to its budget constraint:

$$\max_{\{L_{ij}^t\},\{K_{ij}^t\}} \Pi_i^t = \sum_j L_{ij}^t R_{ij}^L(L_{ij}^t) + K_{ij}^t R_{ij}^K(K_{ij}^t) - B_i^t R_i^B(B_i^t) \tag{1.13}$$

$$\text{s.t.} \sum_j L_{ij}^t + \sum_j K_{ij}^t = \sum_j D_{ij}^t + B_i^t \tag{1.14}$$

where $R_{ij}^L(L_{ij}^t)$, $R_{ij}^K(K_{ij}^t)$ is the interest charged on the two loans and $R_i^B(B_i^t)$ is the interest paid on external borrowing. There are two sets of FOCs for each loan type. They require that at the optimal allocation the return to each loan at each branch is equalized to the marginal cost of bank borrowing. Plugging in the budget constrain in the FOCs, I get:

$$\alpha_L L_{ij}^t + \alpha_B^i \sum_j L_{ij}^t + \alpha_B^i \sum_j K_{ij}^t = r_j^L + r_i^L + \alpha_B^i \sum_j D_{ij}^t \tag{1.15}$$

$$\alpha_K L_{ij}^t + \alpha_B^i \sum_j K_{ij}^t + \alpha_B^i \sum_j L_{ij}^t = r_j^K + r_i^K + \alpha_B^i \sum_j D_{ij}^t \tag{1.16}$$

To solve for the optimal allocation, I express the conditions in matrix, using block-matrix notation:

$$\begin{bmatrix} G & \alpha_B^i J_{N_i} J'_{N_i} \\ \alpha_B^i J_{N_i} J'_{N_i} & \tilde{G} \end{bmatrix} \begin{bmatrix} L_i^t \\ K_i^t \end{bmatrix} = \begin{bmatrix} R_j^L \\ R_j^K \end{bmatrix} + \begin{bmatrix} r_i^L J_{N_i} \\ r_i^K J_{N_i} \end{bmatrix} + \begin{bmatrix} (\alpha_B^i \sum_j D_{ij}^t) J_{N_i} \\ (\alpha_B^i \sum_j D_{ij}^t) J_{N_i} \end{bmatrix} \tag{1.17}$$

where L_i^t and K_i^t are $(N_i \times 1)$ vectors that include the respective lending at each branch. R_j^L and R_j^K similarly are $(N_i \times 1)$ vectors which include the location component of the marginal return. J_{N_i} is a $(N_i \times 1)$ vector of ones. Finally, G and $\tilde{G}$ are $(N_i \times N_i)$ symmetric matrices with α_B^I entries off the main diagonal. G has $(\alpha_L + \alpha_B^i)$ on the main diagonal and $\tilde{G}$ has $(\alpha_K + \alpha_B^i)$.

To solution for L_i^t and K_i^t is:

$$\begin{bmatrix} L_i^t \\ K_i^t \end{bmatrix} = \begin{bmatrix} G & \alpha_B^i J J' \\ \alpha_B^i J J' & \tilde{G} \end{bmatrix}^{-1} \left(\begin{bmatrix} R_j^L \\ R_j^K \end{bmatrix} + \begin{bmatrix} r_i^L J \\ r_i^K J \end{bmatrix} + \begin{bmatrix} (\alpha_B^i \sum_j D_{ij}^t) J \\ (\alpha_B^i \sum_j D_{ij}^t) J \end{bmatrix} \right) \tag{1.18}$$

where I have abbreviated J_{N_i} with J. This expression fully characterizes the optimal lending at each of the branches during period t. At the end of period t, the bank observes the shocks to the return of each of the loans and the deposits and maximizes profits by allocating funds to each of the loan types. I get:

$$\begin{bmatrix} L_i^{t+1} \\ K_i^{t+1} \end{bmatrix} = \begin{bmatrix} G & \alpha_B^i JJ' \\ \alpha_B^i JJ' & \tilde{G} \end{bmatrix}^{-1} \left(\begin{bmatrix} R_j^L \\ R_j^K \end{bmatrix} + \begin{bmatrix} \eta \\ \kappa \end{bmatrix} + \begin{bmatrix} r_i^L J \\ r_i^K J \end{bmatrix} + \begin{bmatrix} (\alpha_B^i \sum_j D_{ij}^t + \delta_{ij})J \\ (\alpha_B^i \sum_j D_{ij}^t + \delta_{ij})J \end{bmatrix} \right) \tag{1.19}$$

where η and κ are $(N_i \times 1)$ vectors that include the branch-specific shocks to the marginal return to both loans and δ_{ij} are the shocks to the deposits. Taking the difference, I get:

$$\begin{bmatrix} \triangle L_i \\ \triangle K_i \end{bmatrix} = \begin{bmatrix} G & \alpha_B^i JJ' \\ \alpha_B^i JJ' & \tilde{G} \end{bmatrix}^{-1} \left(\begin{bmatrix} \eta \\ \kappa \end{bmatrix} + \begin{bmatrix} (\alpha_B^i \sum_j \delta_{ij})J \\ (\alpha_B^i \sum_j \delta_{ij})J \end{bmatrix} \right) \tag{1.20}$$

To find an expression for small business lending, L_{ij}^t, at each branch, I need to invert the block matrix on the left hand side. I do this by using the formula for an inverse of a block matrix:

$$\begin{bmatrix} G & \alpha_B^i JJ' \\ \alpha_B^i JJ' & \tilde{G} \end{bmatrix}^{-1} = \begin{bmatrix} (G - (\alpha_B^i)^2 JJ'\tilde{G}^{-1}JJ')^{-1} & -\alpha_B G^{-1}JJ'(\tilde{G} - (\alpha_B^i)^2 JJ'G^{-1}JJ')^{-1} \\ -\alpha_B \tilde{G}^{-1}JJ'(G - (\alpha_B^i)^2 JJ'\tilde{G}^{-1}JJ')^{-1} & (\tilde{G} - (\alpha_B^i)^2 JJ'G^{-1}JJ')^{-1} \end{bmatrix}$$

I focus only on the matrices in the first row since I am interested in characterizing the optimal small business lending at each branch.

I use extensively the guess and verify method for finding the inverse of matrices that have one term on the main diagonal and a different term off the diagonal. In particular, I make a guess that the inverse takes the same form – one term on the main diagonal and one term off the diagonal – and use the restrictions from $GG^{-1} = I$ to find what the two terms in the inverse are. Using this method, one can show that G^{-1} is a symmetric matrix with $\left(\frac{1}{\alpha_L} - \frac{\alpha_B^i}{\alpha_L(\alpha_L + N_i\alpha_B^i)}\right)$ on the main diagonal and $\left(-\frac{\alpha_B^i}{\alpha_L(\alpha_L + N_i\alpha_B^i)}\right)$ off the main diagonal. Similarly, $\tilde{G}^{-1}$ is a symmetric matrix with

$\left(\frac{1}{\alpha_K} - \frac{\alpha_B^i}{\alpha_K(\alpha_K+N_i\alpha_B^i)}\right)$ on the main diagonal and $\left(-\frac{\alpha_B^i}{\alpha_K(\alpha_K+N_i\alpha_B^i)}\right)$ off the main diagonal. I use the expressions for G^{-1} and $\tilde{G}^{-1}$ and the guess and verify method to find that:

$$(G - (\alpha_B^i)^2 JJ'\tilde{G}^{-1}JJ')^{-1} = (a-b)I_{N_i} + bJJ' \tag{1.21}$$

$$-\alpha_B G^{-1}JJ'(\tilde{G} - (\alpha_B^i)^2 JJ'G^{-1}JJ')^{-1} = \tilde{a}JJ' \tag{1.22}$$

where:

$$a = \frac{1}{\alpha_L}\left(\frac{N_i\alpha_K\alpha_B^i + N_i\alpha_L\alpha_B^i + \alpha_K(\alpha_L - \alpha_B^i)}{N_i\alpha_K\alpha_B^i + N_i\alpha_L\alpha_B^i + \alpha_K\alpha_L}\right) \tag{1.23}$$

$$b = -\frac{\alpha_K\alpha_B^i}{\alpha_L(N_i\alpha_K\alpha_B^i + N_i\alpha_L\alpha_B^i + \alpha_K\alpha_L)} \tag{1.24}$$

$$\tilde{a} = -\frac{\alpha_B^i}{(N_i\alpha_K\alpha_B^i + N_i\alpha_L\alpha_B^i + \alpha_K\alpha_L)} \tag{1.25}$$

I order to make the solution more tractable, I assume that $\alpha_B^i = \gamma/N_i$. This allows me to express each of the three parameters as:

$$a = \frac{1}{\alpha_L}\frac{\gamma\alpha_K + \gamma\alpha_L + \alpha_K(\alpha_L - \gamma/N_i)}{\phi} \tag{1.26}$$

$$b = -\frac{1}{N_i}\frac{\gamma\alpha_K}{\phi} \tag{1.27}$$

$$\tilde{a} = -\frac{1}{N_i}\frac{\gamma}{\phi} \tag{1.28}$$

where $\gamma\alpha_K + \gamma\alpha_L + \alpha_K\alpha_L = \phi$. The first parameter is positive while the last two are negative. Finally, I can use the parameters to provide the explicit solution for $\triangle L_{ij}$:

$$\triangle L_{ij} = a\eta_{ij} - \frac{\gamma\alpha_K}{\phi}\frac{1}{N_i}\sum_{\bar{j}}\eta_{ij} - \frac{\gamma}{\phi}\frac{1}{N_i}\sum_j \kappa_{ij} + \frac{\gamma}{\alpha_L}\frac{\gamma\alpha_L + \alpha_K\alpha_L}{\phi}\frac{1}{N_i}\sum_j \delta_{ij} \tag{1.29}$$

where $\bar{j}$ refers to the set of branches outside of j. Re-writing we get:

$$\triangle L_{ij} = a\eta_{ij} - b_1 \frac{1}{N_i} \sum_{\bar{j}} \eta_{ij} - b_2 \frac{1}{N_i} \sum_{j} \kappa_{ij} + b_3 \frac{1}{N_i} \sum_{j} \delta_{ij} \tag{1.30}$$

where:

$$a = \frac{1}{\alpha_L} \frac{\gamma\alpha_K + \gamma\alpha_L + \alpha_K(\alpha_L - \gamma/N_i)}{\phi} \tag{1.31}$$

$$b_1 = \frac{\gamma\alpha_K}{\phi} \tag{1.32}$$

$$b_2 = \frac{\gamma}{\phi} \tag{1.33}$$

$$b_3 = \frac{\gamma}{\alpha_L} \frac{\gamma\alpha_L + \alpha_K\alpha_L}{\phi} \tag{1.34}$$

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Chapter 2

Does It Matter Where You Came From? Ancestry Composition and Economic Performance of US Counties, 1850 - 2010

2.1 Introduction

Over its history, the United States of America has absorbed more immigrants than all other nations combined [17]. Unlike most countries composed largely of the descendants of immigrants, such as Australia or Argentina, the United States absorbed immigrants in significant numbers from a wide variety of countries [37, pp. 24-25]. These immigrants came to the United States from different parts of the world with diverse histories and cultures. Some were brought against their will as slaves; others decided to come for economic reasons, or seeking religious or political freedom. Once here, the immigrants and their descendents had to negotiate economic, cultural, and institutional relationships with other groups who were there before them or settled after them.

The United States thus provides a unique laboratory for understanding how the cultural, institutional, and human capital endowments brought by immigrants from their country of origin and passed on to their offspring shape economic outcomes.

To understand the importance and role of different groups, we build two unique new data sets. First, we create the geographical country-of-ancestry distribution for the United States from 1850 to 2010. Using micro samples from the census and building iteratively from previous censuses, we construct the fraction of every county's population that is descended from ancestors who migrated from a particular country or region.[1] Crucially, we produce a stock measure of ancestry, not of the flow of recent immigrants, and so we can consider the lasting legacy of immigrant groups and their descendents beyond the first generation. Our measure is highly correlated with ethnic mappings based on questions from recent censuses, but unlike such subjective questions, our mapping goes back in time and does not change based on the prevailing cultural attitudes towards ethnicity.

Second, we construct a measure of county-level GDP per capita that is consistently measured over the entire period and includes services. While manufacturing and agricultural output have been available at the county level, such measures miss the large and growing service sector, and so undervalue urban areas and miss the important and changing role played by the transportation, distribution, and financial sectors.

Using this novel county-level panel data set, we investigate whether changes in the composition of ancestral origin matter for local economic development, and the channels through which the history of the country of origin affects current outcomes in US counties. It always a challenge to cleanly identify the effects of institutions, culture, or other social factors on economic development because such factors typically evolve endogenously. This is particularly true when only a single cross-section is available, since it is then impossible to fully control for the unobservable character-

[1]Since after 1940 the data are reported only for groups of counties, we aggregate the data somewhat to maintain consistency over the entire time period and use such groups as the unit of analysis. We continue to use "county" for short. There are 1154 such county groups as opposed to 3143 counties. Our county groupings approximately correspond to 1980 Public Use Microdata Areas (PUMAs), as defined by the census. See Appendix 2.6 for details.

istics of a place. The clear advantage of our approach is that, by creating a long and consistently measured panel, we can remove the fixed effect of a place, and so we can examine unambiguously whether and how what people bring with them is related to economic development. Moreover, a panel allows us to address possible endogeneity issues due to ancestry specific movements in response to economic shocks.

We start by documenting that the country-of-origin composition of a county is significantly associated with county GDP, even after controlling for unobservable time-invariant county-level effects, state-period effects, county specific trends, race, population density, and county education. The estimated effects of individual ancestries are highly correlated with summary measures of economic development of the country of ancestry, both today and in the past. Whatever qualities make some countries more productive are correlated with the impact the descendants of immigrants from those countries have in the US. Since immigrants necessarily leave the geography of their home country behind, these qualities might include their culture, their institutional experience, or the human capital they brought with them and pass on to their children. The estimated ancestry effects are positively correlated with measures of culture such as trust in others and thrift, and negatively with the importance given to obedience in children, as measured in recent surveys. They are positively correlated as well with measures of state centralization in 1500 [74], although we find little evidence that political participation at the time of migration has an impact. The ancestry effects are also positively associated with the human capital that immigrants brought with them.

These general conclusions also hold in more parsimonious representations of the relationship between ancestry and local economic development. For each of the variables capturing the endowment immigrants brought with them, we construct a weighted average value for each county using the fraction of people from each country of ancestry as weights. Changes in ancestry-weighted measures of the culture, institutions, and human capital are all significantly related to changes in county GDP per capita. Combining measures, our results suggest that ancestry-weighted cultural attitudes towards cooperation are those more strongly and robustly associated with local development.[2] These results do not necessarily show that other endowments are not relevant, but that attitudes towards cooperation appear to be more important at the local level.[3]

Many of theses results are reversed when we do not control for fixed county differences, which illustrates the importance of having a panel. This reversal reflects the fact that over the broad sweep of US history, people from high-income countries settled both in urban and rural areas while later migrants from poorer countries went predominantly to cities. For example, the English are disproportionally present in rural areas in the poor South and Appalachian states, while the Italians and Irish settled and stayed in metropolitan areas, especially in the Northeast.

While these results establish that the endowment that people bring with them matters, they do not show the mechanism behind the association. There are two reasons why changes in ancestry and economic development could be related. The first is that as people move they bring a set of attributes with them which they then pass on to their children and these attributes affect the economic performance of a county. The second is that groups with specific attributes are more willing to move to a county with given characteristics. If these characteristics are time invariant, then we already control for them by including fixed effects in our estimation. However, it could also be that ancestries with certain endowments may be more willing to move

[2]Where we have historical data that is comparable over time, such as for country-of-origin GDP and and human capital, we are careful to associate to each group of immigrants the historical characteristics of the country of origin at the time of emigration. Moreover, in some specifications we allow for the importance of the ancestral characteristics to decay over time to reflect the changes that occur during the process of social and economic integration in the US.

[3]For example, immigrants' experience of political institutions in the country of origin may matter at the state or federal level. Furthermore, cultural attitudes, such as trust, may impact development both directly and indirectly through their effect on the functioning of local institutions and the choice of growth enhancing public goods such as education. In addition, cultural attitudes themselves may be the results of the development of historical institutions in the country of origin [82].

in response to economic shocks. For example, more trusting groups may be more willing to move to a new area or away from family following the opening up of new economic opportunities.

To make progress understanding the mechanism through which changes in ancestry may affect economic development, one needs to isolate variation in ancestry that is not caused by contemporary shocks to economic output. To do so we move to a dynamic model of county per capita GDP to recognize that the effects of ancestry are likely to be distributed over time and to remove serial correlation from the residuals. When the residuals are not auto-correlated, the past distribution of ancestries, possibly augmented by their growth at the national level, is not related to county level contemporary shocks to GDP and can be used as an instrument for the ancestry composition today. Given the centrality of the assumption of the nature of the residuals, it is essential to test for serial correlation in the estimating equation.[4]

We pursue an identification strategy based on this idea, both by instrumenting our ancestry-weighted endowment variables in dynamic models with fixed county effects and also by relying on GMM approaches to deal with endogeneity issues in short dynamic panels [59, 14] both in a single and bivariate equation context. Our results suggest that the evolution of ancestry composition has a significant effect on county per capita GDP. Moreover, while there is evidence that shocks to county GDP help to predict ancestry composition, the effect is quantitatively small. Instead, it appears that the dominant mechanism is for changes in ancestry to have large effects on economic development that peak after two to three decades, and are long lasting. The rich time pattern of the effect of ancestry composition reinforces the value of having a panel at our disposal.

Finally, we provide evidence that suggests that the groups immigrants and their

[4]Our approach builds on the strategy used in the immigration literature (see, for instance, Card [32], Cortes [35], and Peri [72]), but with greater attention paid to the serial correlation properties of the residuals, mostly overlooked in this literature. See section 2.5.5 for a full discussion.

descendents encounter matter as well. Fractionalization, a measure of the diversity of ancestries, is positively associated with local development, whereas cultural fractionalization is negatively associated with it. Increases in the diversity of origin are good for growth as long as the overall cultural attitudes are similar.

The structure of the paper is as follows. In the next section we review the related literature. In Section 3, we describe how we build up the stock measure of ancestry by county from 1850 to 2010 based on census micro-samples. We also discuss the evolution of the distribution of the stock of ancestry by county for major immigrant groups. In Section 4, we outline the construction of GDP per capita at the county level. More details on the construction of our ancestry mapping and our measure of county GDP is contained in detailed data appendices. Section 5 contains the econometric results, while Section 6 concludes.

2.2 Related literature

Our results provide novel evidence on the fundamental and recurring question of whether the US acts as a "melting pot," quickly absorbing new immigrant groups, or whether immigrant groups maintain distinct identities in at least some dimensions.[5] The significance of our measure of ancestry in explaining local economic development provides further evidence against a pure assimilationist view and in favor of approaches that emphasize the persistence, at least in part, of cultural, institutional, or human capital traits across generations. If immigrants were quickly and fully integrated and homogenized into the United States, then it would be very difficult to make sense of the importance of the ancestry composition of a county, especially with

[5]Following the seminal contribution by Glazer and Moynihan [51], many authors have argued that the view of the immigration experience as a process of quick assimilation into the US society is inadequate. For a review of the theoretical contributions see Bisin and Verdier [23]. For recent empirical evidence on the persistence of cultural traits beyond the first generation see Borjas [27], Antecol [13], Giuliano [49], Fernández [42], Fogli and Fernández [44], and Giavazzi, Petkov, and Schiantarelli [48]. On whether immigrants assimilate as individuals or communities, see Hatton and Leigh [56].

regard to groups that arrived long ago.

Our work is closely related to the growing literature on the importance of history for contemporary economic development, as well as studies on migration and its consequences. Recent work has emphasized the importance of institutions and culture in shaping economic outcomes over the long run.[6] As we have argued, there are serious challenges in identifying the causal effects of culture or institutions on economic outcomes since they are likely to be co-determined.[7] The availability of panel data is a distinguishing feature of our work since it allows us to better distinguish the characteristics of a place from the attributes of the people who live there and to address the potential endogeneity of ancestry composition in a dynamic context.

Our paper is also related to the rich literature on the effect of migration on economic outcomes in the United States, as well as work examining the determinants and importance of ethnicity and ethnic diversity.[8] Since ethnicity in the United States

[6]See the comprehensive review by Spolaore and Wacziarg [79] of the evidence on the role of history in economic development, on the fundamental causes of growth and on the relative importance of institutions, culture, and human capital. On the importance of of the ancestral composition of current populations see Spolaore and Wacziarg [78], Putterman and Weil [74], Comin, Easterly, and Gong [34], and Ashraf and Galor [15]. On the importance of culture see Putnam, Leonardi, and Nanetti [73], Guiso, Sapienza, and Zingales [53], Guiso, Zingales, and Sapienza [55], Guiso, Sapienza, and Zingales [54], Nunn and Wantchekon [69], Alesina, Giuliano, and Nunn [9] and the review by Fernández [43]. On the role of institutions across countries see Knack and Keefer [61], Acemoglu, Johnson, and Robinson [3], Acemoglu, Johnson, and Robinson [4], Acemoglu, Johnson, and Robinson [2], and Albouy [6]; see Michalopoulos and Papaioannou [64] for the role of institutions at the ethnic level; and Banerjee and Iyer [16] and Dell [38] for the impact of within country institutions in the past. For the relationship between culture, institutions and economic performance see Tabellini [81], Tabellini [82], and the review by Alesina and Giuliano [8]. On human capital see Barro and Lee [19] and Barro and Lee [20], Gennaioli et al. [47] and Glaeser et al. [50] on the relative role of human capital versus other factors. A separate literature has argued for the importance of geography see Diamond [40] and Bloom and Sachs [25].

[7]A recent literature has examined regions within many countries to help control for unobservable country-specific effects. See, for instance, Tabellini [82] and Gennaioli et al. [47].

[8]The literature on the effect of immigration is very large. Goldin [52] and Hatton and Williamson [57] provide evidence from the age of mass migration. On later migrations, see Borjas [28] for an early review. See also Card [31], Altonji and Card [12], Card [32], Borjas [29], Ottaviano and Peri [70], Ottaviano and Peri [71], and Peri [72]. On the relationship between ethnic diversity, on the one hand, and outcomes such as growth, public goods provision, education, employment, political participation, or conflict see Easterly and Levine [41] for cross country evidence; Alesina, Baqir, and Easterly [7] Cutler and Glaeser [36], and Alesina and La Ferrara [11] for evidence within the US; and Miguel and Gugerty [65] for Kenya. Ashraf and Galor [15] focus on the relationship between genetic diversity and economic development at the cross country level, while Alesina, Harnoss, and Rapoport [10] present cross country evidence on the effect of birthplace diversity. Ager and Brückner

generally reflects a belief about shared ancestry [90], ancestry and ethnicity are closely related. The immigration literature typically focuses either on the characteristics and outcomes for the *flow* of immigrants or on their effects on labor market outcomes of the residents in the short term. Our focus is instead on the *stock* of ancestry and whether the attributes that immigrants brought with them and may pass on to their children affects outcomes for all residents.

In many ways, our work builds on Putterman and Weil [74] who show that not accounting for the large population movements across countries since 1500 undervalues the importance of culture and institutions. Putterman and Weil [74] reconstruct the shares of a given country's ancestors today who came from other countries since 1500 and examine the importance of past history, as modified by migration flows, on current outcomes. Taking into account these flows enhances the ability of measures of early technological or institutional development to explain present outcomes. They conclude that in the cross-section of countries today what matters is not only the characteristics of the country, but also the characteristics of the populations that inhabit it. Our work differs from Putterman and Weil [74] because of our focus on local as opposed to country-level development, and for our use of panel data.

2.3 Ancestry in the United States

The variable at the center of our analysis is an Ancestry Vector (AV), which records our estimate of the countries of origin of the ancestors of a given county's population. We build the AV based on census questions which ask every person the state or country where she was born. From 1880 to 1970 the census also asked for the place of birth of the person's parents. We construct the AV iteratively using the more detailed information that is available from the census, and starting as far back as possible. For

[5] examine the effect of first generation immigrant flows on fractionalization and polarization within the US. Putterman and Weil [74] are the only ones that focus on diversity of attributes (as opposed to ethnic diversity) in a cross country setting.

first generation immigrants or their children, the ancestry is straightforward since we know exactly where they came from. If the parents come from two different countries or states, we assume that they contribute equally to the ancestry of their children. For example, the child of German and Irish parents is half German, half Irish. If the parents are born in the US, we assign the child the common ancestry vector among 20-30 years olds in the child's birth year in the state of birth of the parents. The AV for each period therefore depends on the AV in the past, since internal migrants bring their ancestry with them when they move from state to state and pass it on to their children. Accumulating this information over time for a geographic area, the AV gives, in expectation, the fraction of the people in a given area whose ancestors come from a given country. Therefore, the AV is not just the fraction of first generation immigrants as in Ager and Brückner [5], but instead keeps track of the ancestry of everyone, accounting for internal migration, age structure of the population, and local variations in where people from different countries originally settled. We give details for how we construct ancestry in the US in Appendix 2.6.

We can construct ancestry at the county level until 1940. Starting in 1950, the census only reports data for somewhat larger county groups, whose definition changes slightly over time. Because of this aggregation, our analysis centers on the 1154 county groups that allows us to maintain a consistent geographical unit of analysis from 1850 to 2010. The Data Appendix provides additional details. We continue to use county to refer to county groups, except where the specific number of groups is important.

Since both the contributions of African Americans and the legacy of slavery are so central to understanding ancestry in the United States, our analysis includes race. The census recorded racial characteristics since 1850. We allow for distinct ancestries within racial groups, and so recent Nigerian immigrants or immigrants from the West Indies, for instance, are distinct from African Americans who are descendents of former slaves. We emphasize that any finding we make regarding African Americans cannot distinguish African culture and institutions from the brutal history of slavery before the Civil War, and the cultural, economic, and political repression that continued for more than a century following Reconstruction.

While nativity was a central concern in the early censuses, other distinctions within country of origin, such as religion or regional origin within a country, were not generally recorded. Therefore, we cannot distinguish sub-national groups, even though the distinctions between them may be very important. For example, many Russian migrants were Jewish, but since we cannot distinguish these migrants, all Russians are recorded as a single group. Similarly, the census does not distinguish among the African countries of origin of the slave population in 1850.

2.3.1 Ancestry in the US over space and time

There have been immense changes in the United States in overall ancestry and its geographic distribution since 1850. Our ancestry measure is representative at the county level and can be combined to give a representation of ancestry in the US as a whole or any sub-region. Since any attempt to construct ancestry at a national level that did not start with the micro-samples and did not keep track of the internal migration and local population growth would be deeply flawed, we believe our estimates are the first consistent estimates of the stock of ancestry over time for the United States at both the national and county level.

American ancestry has become increasingly diverse. Figure 1 illustrates this growing diversity by showing the shares of the groups that make up more than 0.5% of the population for 1870, 1920, 1970 and 2010. The descendents of the original English settlers still made up more than half of the population in 1870, but 1870 is the last decade that they were in the majority. African Americans represented a little over 10% of the population. The Irish population had swelled from a recent wave of migrants, and a large wave of new German immigrants had increased the already substantial German population from colonial migrations. Descendants of immigrants from Scotland and the Netherlands made up most of the remaining population.

Successive waves of immigration, starting particularly in the 1870s, rapidly transformed the ancestral makeup of the United States. Older ancestral groups were still expanding, but not nearly as fast as the newer groups, and so, in a relative sense, the older groups declined substantially. The share of descendants from England fell continuously and rapidly until the 1920s when the borders were largely shut for a generation. Similarly the share of African Americans fell, not because their overall numbers declined, but because other groups entered. The new migrants were more diverse than is commonly recognized, with large groups from southern Europe (particularly Italy), from eastern Europe (particularly Poland and Russia), from northern and central Europe including the Austrians and Germans, and from Scandinavian countries such as Sweden, Norway, and Denmark.

After 1920, immigration slowed substantially until the 1960s, and so changes mostly represent internal differences in population growth and demographic structure. Starting in the 1960s, new groups from Mexico, Central America, and South America started to arrive. Immigrants from Asia arrived as well. By 2010 the United States had become much more diverse with substantial populations from countries in Asia, Europe, Africa, and Central and South America. Of particular note, the share of Irish ancestry in 2010 implies that there was more than three times the number of people of Irish descent in the United States than in Ireland in 2010. Despite the relatively small total migration from England, due to relatively rapid population growth there are around the same number of people of English descent in the United States as there are people in England.

Although the overall evolution of diversity of the United States is notable, its geographic diversity is even more interesting. Figures 2 and 3 show the ancestry shares across the United States for select groups in 1870, 1920, 1970 and 2010. Of course, it is possible to construct such maps for all groups in every decade, but some groups are too small or too concentrated to appear on a map. We show six groups that are historically important or that can be seen visually on a map: African Americans, Germans, Irish, Scandinavians, Italians, and Mexicans. The maps tend to visually emphasize large and sparsely populated areas, and therefore, miss the rich diversity of the East Coast and its cities. We combine Norway and Sweden, whose inhabitants settled distinct areas, in order to make the Scandinavian homeland more visible.

Groups tend to settle together and then slowly spread out. Internal migration has continuously reshaped the ancestral geography of the United States. For example, one can observe the German presence in New York, around Milwaukee and Pennsylvania, and the subsequent spread to the entire Midwest and West, as well as the the heavy German migration to Texas. The original settlement and diffusion of Scandinavian immigrants in the upper Midwest and West is also notable. The Irish, initially concentrated in the cities of the Northeast, dispersed widely throughout the entire US. Italians, who initially settled in New York and Boston, spread to the Northeast but not far beyond, although they retain a presence in California, and a smaller one around New Orleans. Curiously, in 1870 the Italians and Irish made up a large fraction of some counties in the West which had very low populations, implying that relatively small shifts in immigrants can produce large changes in an area's ancestry composition.

The Great Migration of African Americans from the South to the cities throughout the country can be clearly seen by comparing 1920 in Figure 2 to 1970 in Figure 3, although since the maps do not depict cities well, the importance of the Great Migration is less obvious. African Americans are still highly concentrated geographically, and have not experienced the slow diffusion that characterizes the descendants of the Germans and Irish.

By construction, our Ancestry Vector (AV) is an attempt to measure something that could in principle be measured and known exactly: the fraction of the people in a county who come from or are descended from people who came from a given country of origin. While ancestry, as we define it, is objective, ethnicity and race are generally considered social constructs [67]. The concept of ethnicity is continually evolving as groups define themselves and are defined by other groups. Ethnicity not only changes over time, but need not be the same concept across the country even at a given time. The social construction of ethnicity does not make it any less powerful, but is necessarily an endogenous measure, responding to circumstances, rather than something than can explain other outcomes on its own.

Ancestry is not the same as ethnicity, although the two are clearly linked. Instead, we view ancestry as one of the inputs used to construct ethnicity. Indeed, in the United States, it appears to be the primary input [90]. Our measure of ancestry is highly correlated with self-reported ethnicity or ancestry in the 2000 census. Across counties in 2000, the correlation between the fraction that say they are of Irish ancestry in the census and the AV is 0.79; for Italians it is 0.91; for Germans 0.89; for Mexicans (who are often first generation) 0.98; for Norwegians 0.95; and for Swedish 0.92 (combined, Swedish and Norwegian have a correlation of 0.96 with the combined AV). For African-American the correlation is 0.99. English ethnicity is the most complicated since there is no longer much self-identification of English ethnicity, but when we include those who report themselves to be "American" the correlation is 0.93.[9]

[9] In the 2000 census, only 5.9% self-report an English ethnicity, while 7.2% give their ethnicity as "American," 19.1% do not report, and 1.4% report "White/Caucasian." Combining all of these other categories with the English and British self-reported ethnicities, there is a 0.93 correlation between our measure of English in the AV and the ethnicities reported in the census. One interpretation of this evidence, consistent with the constructivist approach to ethnicity, is that the dominant ethnicity is English and so all other ethnicities are defined as different from English. Then many whose ancestry is English do not think of themselves as having an ethnicity since they have the dominant ethnicity.

2.4 County GDP from 1850-2010

To understand the impact of ancestry on economic performance, we construct a county-level measure of GDP per capita. Starting in 1950 measures of income per person are available at a county level. Prior to 1950, however, the census only recorded limited information on manufacturing and agriculture output at a county level. While these measures may be useful for comparing rural counties, as in the study of national banks from 1870-1900 in Fulford [45], they are inadequate for comparing urban areas where many immigrants settled. The problem is that if some groups disproportionally settled in urban areas where physical output measures systematically underestimate output by ignoring services, then we will underestimate the contribution of these groups. We therefore need to engage in *county* income accounting to recreate a measure of gross domestic product at a county level. To our knowledge this measure is unique in including services as well as manufacturing and agriculture at a county level. The full details for how we construct this measure of county-level GDP are in appendix 2.6, but we describe it briefly below.

Using information on manufacturing inputs in each county, we construct the nominal value added in manufacturing. The census recorded agricultural output at a county level, but not intermediate inputs. We use historical aggregate statistics at the national level on total output, intermediates and value added in agriculture to obtain a measure of value added in agriculture at the county level, assuming that the ratio of value added to total output in agriculture is the same in each county.

Services are the most difficult to value. We use the employment and occupation information collected by the micro-samples from the census for each year to construct employment by broad service category (trade, transportation and public utilities, finance, professional services, personal services, and government). We then calculate nominal valued added per worker in each service category based on national accounts. Our choice of the broad service categories is driven by the availability of value-added estimates that are comparable for long periods. We then multiply nominal value added per worker at the national level by the county-level employment in each category. This approach allows New York City, with a substantial service sector composed of finance, to have a much higher income from services than a small rural county where services might be mostly employed servants. Since we are using national value added, however, a lawyer in New York City has the same value added as a lawyer in the rural county. We follow the same procedure used for services to obtain value added in mining and construction. Excluded from our measure is any value from the existing housing stock, although new housing is captured through construction employment.

The census reports personal income at the county level starting in 1950, and no longer reports manufacturing and agricultural output in the same way. Using the overlap in 1950 between our measure of nominal GDP by county and income per capita in each county from the census, we construct a ratio of GDP to income at a county level. We apply this county-level ratio to the income series from 1960 to get an estimate of GDP. Effectively, we use the growth rate of personal income at the county level to approximate the growth rate of county-level GDP. We then calculate GDP for the same county groups used in constructing the Ancestry Vector. Finally, we convert nominal GDP to real GDP using the price deflator from Sutch [80]. In our analysis we will always allow for common year effects which absorb any common changes such as in national prices, but we include state-year effects in some specifications which absorb any state-specific changes in the GDP deflator.

Our goal is for each decade to create a measure that correctly captures the relative GDP per capita of different counties for the period of 1850-2010. Throughout this analysis we include time effects to absorb overall temporal variation. Yet our measure does surprisingly well at capturing aggregate changes. Figure 4 shows real GDP per capita as constructed by Sutch [80], which includes services, and our measure of county GDP summed over all counties and divided by population. Figure 4 suggests that our measure is a good approximation of the level of aggregate output and captures the change over time. Part of the reason for this close relationship is that the construction of the historical GDP at the national level relies on many of the same sources we have used at the county level such as the national estimates of manufacturing and agriculture output.

Figure 5 illustrates the importance of including services rather than simply using the more readily available output numbers for manufacturing and agriculture. The figure shows the share of value added using our measure for each industry. Even in 1850, services represented around 20% of value added and its share grew rapidly. Moreover, the value added from services tended to be highly concentrated. When we map the share of services in the local economy the share is frequently above 70% for a highly urban area, which can be surrounded by rural areas where the share is less than 30%. Figure 5 also shows that by 1950 our measure matches the sectoral shares in the National Income and Product Accounts nearly exactly (and shows similar trends before that).

2.5 Does ancestry matter and why?

Combining our measure of the ancestry makeup of each county with our measure of county income, we ask whether ancestry matters for local economic development and which attributes brought by the immigrants from the country of origin play an important role. What is crucial about this exercise is that, unlike most other studies of ethnicity or ancestry, we have at our disposal a panel of consistent data. The availability of panel data allows us to evaluate the association between ancestry composition and economic development controlling for time invariant county characteristics. We start by asking whether the evolution in ancestry composition is significantly related to changes in county GDP. We then examine which characteristics of the country of origin help to explain this association, develop summary measures of the endowments brought by immigrants from the country of origin, and assess their correlation with local economic development.

Even after controlling for fixed county effects, there remains the potential for endogeneity issues in assessing the effect of ancestry on development if people move in response to economic shocks in addition to time-invariant county characteristics. To address this concern, we propose an instrumental variable strategy based on the past distribution of ancestries. The absence of auto-correlation in the error process of the GDP equation is essential for this strategy to be justified and this motivates the importance of allowing for a rich dynamic specification, and of testing for serial correlation.

Throughout the analysis, we limit the sample to 1870-2010 for two reasons: (1) the US Civil War (1861-1865) changed the economic landscape, making comparisons between the pre-war and post-war period difficult; and (2) the iterative construction means that in 1870 the ancestry vector is based on more decades of micro-sample information.

2.5.1 Is ancestry composition associated with economic development?

We begin by investigating whether ancestry is correlated with local economic development in the context of a fairly unrestricted econometric model that allows the effect of each ancestry to be captured by a different coefficient. Our Ancestry Vector (AV) for a given county c and time t, is an estimate of the share of that place's population whose ancestors came from a particular country-of-origin ancestry a out of all possible ancestries A. Denote these shares by π_{ct}^{a} and note that they sum to one in each county by definition. In the text, we continue to use "county" for the county groups that are our unit of analysis. We start with a series of estimates of the effect of ancestry on log county GDP per capita y_{ct} of the form:

$$y_{ct} = \theta_c + \lambda_t + \sum_{a=1}^{A} \alpha_a \pi_{ct}^a + \gamma X_{ct} + \epsilon_{ct}, \tag{2.1}$$

which include county fixed effects θ_c and year effects, λ_t, and allow each ancestry to have its own effect α_a. Some specifications include additional controls X_{ct} such as population density to reflect time-varying urbanization rates, the lagged dependent variable, and measures of education. In more general specifications we will also allow for state-specific period effects λ_{st}, for county-specific trends, and for the lagged dependent variable. We normalize the ancestry effects by setting the coefficient on the English to zero.[10] The remaining coefficients can then be interpreted as whether replacing the English with that ancestry is associated with a change in GDP per capita. Our basic question is whether, even after controlling for observables and unobservables, the individual ancestry coefficients are different from zero.

The results of many variations of equation 2.1 are shown in Table 1. The first set of regressions in columns 1 through 3 of Table 1 do not have variables other than the fraction of each ancestry and different combinations of county, year, state effects, and county trends. The table shows the F-statistic for the joint test that all α_a are zero (each ancestry matters equally for GDP). We also separately test the hypothesis that all ancestries other than African American and Native American are zero to examine whether the results are purely driven by race. Below each F-statistic we report its p-value. They are all zero to more decimal places than can fit in the table.

Every form of the estimation, therefore, strongly rejects that ancestry does not matter, in the sense of not being associated with economic development. All estimates include county fixed effects, so the fixed characteristics of the place of settlement is controlled for. We can also ask whether regional trends—which might reflect evolv-

[10]Since very small ancestries cannot be precisely estimated, we include only the ancestries that make up at least 0.5% of the population in 2010, which accounts for 93% of the population.

ing factors, such as industrial structure, that may be related both to county GDP and ancestry composition—may affect our answer. However, the inclusion of state-specific period effects or county-specific trends leaves the significance of the ancestry composition intact. Our conclusion that ancestry matters is also robust to the adding county GDP in the previous period $y_{c,t-1}$ as a regressor. One might be concerned that ancestry matters only because it reacts to current shocks, yet ancestry matters even when we include it only at a decade lag. We will address this issue more at length in Section 4.5. The last several columns also include other possible explanatory variables such as population density and county-level education (measured first by literacy and then, after 1940, by average years of education). These variables represent potential channels why ancestry may be related with economic development. For example, some groups may tend to put more emphasis on education than others. Similarly, an increase in density may reflect a higher level of urbanization of the county, resulting in a differential attraction for different immigrant groups. The ancestry coefficients continue to be significant even after including these controls, and so ancestry matters beyond its relationship to education or urbanization.

2.5.2 Why is the association significant? Correlating the ancestry coefficients with country-of-origin characteristics.

We next examine whether the coefficients on the ancestry shares are related to characteristics of the country of origin. We divide the analysis into four broad categories: past economic development, institutions, social capital or culture, and human capital. Together with geography, these categories are the fundamental drivers of economic growth that have been proposed in the literature. Geography of the country of origin is necessarily left behind when migrating, and so can only express itself indirectly through what immigrants bring with them. The main limiting factor in the analysis is the availability of information for a broad range of countries over different time periods. Unlike our data on ancestry and county GDP, which we have carefully constructed based on micro data to be consistent across time and space, the cross-country data, particularly in the distant past, is not always available or reliable.

Immigrants arrived at different times and we would like to capture what immigrants brought with them by the conditions in their country of origin at the time of immigration. Doing so requires knowledge of the conditional density of immigration over time so that, for example, the Irish coming in the 1850s reflect a different experience than the Irish in the 1890s, both of whom are different from the Italians in the 1910s. Our ancestry measure captures very well the stock of people whose ancestors came from a country of origin. Since it is a stock, however, changes in it reflect both increases from migration (external and internal), and also natural changes from births and deaths. We therefore turn to immigration records that contain the number of migrants arriving from different countries starting in the 1820s [39] at a national level. Before that, we create an approximate density of arrival times for the stock of migrants based on Daniels [37]. The full procedure is described in Appendix 2.6. With a density of arrival times, we can construct country-of-origin measures that are weighted by the time of arrival. For example, we calculate the difference between log GDP per capita in the country of origin and log GDP in the US at the time of arrival $(y^a_\tau - y^{US}_\tau)$. For a given ancestry, the arrival weighted log GDP is then:

$$\tilde{y}^a_t = \sum_{\tau=0}^{t} (y^a_\tau - y^{US}_\tau)(1-\delta)^{t-\tau} F^a_t(\tau) \tag{2.2}$$

where $F^a_t(\tau)$ is the arrival density of group a up to time τ, which is is 0 for $\tau > t$, and δ is the rate of depreciation of the importance of origin GDP. Of course, this procedure is only possible if we observe country-of-origin measures that change over time. For arrival-weighted variables we consider the endowment of the country of origin relative to its value in the United States on arrival. We use the relative value because, for example, we want to take into account that the original English settlers came from a country that was poorer in real terms in the 1700s than the countries of some of later immigrants, but the English were much closer to the production frontier at the time.

The ancestry effects appear to be closely related to economic conditions in the country of origin as measured by GDP per capita in 1870, or historical GDP weighted by the arrival density in Figure 6. The relationship between the ancestry effect and measures of country-of-origin GDP is positive both for the mainly European ancestries that were important sources of immigration flows before 1924 (see Figure 1) and for all large ancestry groups.[11] We think of GDP in the country of origin as a summary measure of all of the cultural, institutional, and human capital elements that lead to economic success at a given time. Migrants from an origin where these elements are present may have brought whatever mix is important for success with them.

However, we want to go beyond GDP of the country of origin as a synthetic measure of the endowment brought by immigrants to the US. In the bottom row of Figure 6 we plot the relationship between the ancestry coefficients and different measures of institutions at the national level. For institutions we use state history from Putterman and Weil [74] and the difference in political participation from the United States, weighted by time of arrival, using the measures of historical political participation created by Vanhanen [88].[12] State history reflects how long a particular state has had centralized government in 1500 and shows a strong positive association

[11] The slope coefficients are estimated using Weighted Least Squares to down-weight the ancestries that are less precisely estimated. We use analytic weights defined as the inverse of the estimated standard deviation for each ancestry coefficient. The relationship is similar using other measures of country-of-origin GDP including GDP in 2010 and by allowing some degree of depreciation of arrival GDP.

[12] Our choice of institutional variables is largely driven by availability. Measures of executive constraints from Polity IV do not have coverage for key countries going far enough back. The version produced by Acemoglu, Johnson, and Robinson [2] only covers select European countries.

with the ancestry coefficients. Political participation is only positive for the mainly European ancestries before 1924. Political participation, however, may not reflect the differing experiences of immigrants. Political participation was low for most countries with large migrations before 1924, and the institutional experience of Italian peasants from its south might have been very different from the Swedish immigrants, even if neither group could vote. Moreover, while country-of-origin institutions may affect the design and functioning of federal or state institutions, which we control for in the regression through time and county fixed effects, national institutions in the country of origin may be a poor proxy for the ability to develop local institutions and make them work effectively.

Immigrants also brought with them a set of cultural attributes from the mother country that can affect their ability to function productively in the area where they settle. If those attributes are passed down, at least in part, to their descendents, this would contribute to explaining the significance of the ancestry vector. We focus on those values and beliefs that facilitate cooperation, which are often referred to as "social capital" and have been at the center of previous investigations [55, 82]. To measure cultural attributes we use the World Value Survey which asks a representative sample of respondents in numerous countries a wide variety of questions about their attitudes and beliefs. Optimally, we would want a measure of the culture at the time of departure, but these surveys are available for a large number of countries only starting in the 1980s or 1990s. For recent surveys to tell us anything about past culture, one needs to assume that the relative ranking of countries in more recent decades captures, albeit imperfectly, their relative position in earlier times. This would be true, for example, if some cultural attitudes are fixed or very slow changing, or if they responded to common factors that made them move at a similar pace in different countries. Moreover, one may also want to allow for county-of-origin regional differences in cultural attitudes. However, the census does not provide information on immigrants' region of origin. We combine the surveys since 1981 and use the answer to several questions that Tabellini [82] and others have proposed might be important for economic development: generalized trust (Trust), tolerance and respect for others as an important quality that children should have (Respect), obedience as an important quality in children (and possibly a negative characteristic in a world requiring independence (Obedience), and a feel of control over one's life as an inverse proxy for a fatalism (Control). We will also experiment with measures of thriftiness (Thrift).[13] Following Tabellini [82], we construct the principal component at the individual level of Trust, Obedience, Respect, and Control as a summary measure of cultural values important for cooperating with others.

We plot the relationship of the coefficients of the Ancestry Vector with Trust, Obedience, the principal component of culture, and Thrift in Figure 7. The coefficients are positively and significantly associated with Trust, the principal component of culture, and Thrift, and negatively and significantly associated with Obedience. The correlation with Respect and Control is weak, and so we do not show them separately, but will include them later in a more parsimonious approach.

Figure 7 also shows the ancestry coefficients' relationship with two measures of education: (1) the ratio of the immigrants' education to the overall education in the United States at the time of arrival based on information on literacy and, later, on years of education contained in the census (see Appendix 2.6 for a detailed discussion); and (2) the ratio of the average years of education in the country of origin relative to the United States at the time of arrival using the data in van Leeuwen and van Leeuwen-Li [87]. The education of migrants weighted by arrival density has a positive relationship with ancestry. The ratio of the years of education in the country of origin relative to that of the US is positively related to the ancestry coefficients for the ancestries before 1924, but shows only a small relationship for all ancestries.

[13] The World Values Survey data and variable construction are described in details in the data appendix section 2.6.

The relatively weak relationship with average years of education in a country of origin may be because the human capital of the immigrants is different from the average, or because differences in human capital rapidly disappear in a new setting. Of particular note is the difference between the education level of recent immigrants, such as Indians, and the lower average level of education of their countries of origin.

2.5.3 A parsimonious parametrization of ancestry composition

In this section we examine the association between ancestry composition and economic development in a more parsimonious manner by assuming that the effect of each ancestry is proportional to some attribute of the country of origin. More specifically, we take some characteristic z^a for country-of-origin a and define:

$$z_{ct} = \sum_{a=1}^{A} \pi_{ct}^{a} \mathrm{z}^{a}. \tag{2.3}$$

We can think of z_{ct} as the expected or predicted value, across countries of origin, of the endowment of a given characteristic z_{τ}^{a} for county c at year t, where the italics denote the endowment variable weighted by the ancestry vector, and upright case letters the endowment characteristic itself.[14] For example, take the simplest form of country-of-origin level of development, the Log GDP per capita in 1870 and form its ancestry-weighted value *Log GDP per capita in 1870.* Since the GDP in 1870 is constant for any given country, its ancestry weighted value varies only because the ancestry composition varies over counties and over time. We can think of it as offering a prediction of county income based on the incomes in 1870 of the country of origin of the county's population. Similarly, our measures of culture, which come only from

[14] Putterman and Weil [74] form a similar construct at the country level in 2000 for state centralization in 1500 and years since the introduction of agriculture, using population shares adjusted for migration flows since 1500.

recent surveys, vary only because of the ancestry composition in a county.

Some characteristics, such as the GDP in the country of origin at the time of arrival, vary both with time and ancestral composition. In this case, we form the z_{ct} variable using the ancestry-weighted average in equation 2.3, but allow the country-of-origin characteristic z_t^a to vary over time. We construct z_t^a by weighting the difference between the country-of-origin characteristic and the United States using the density of arrival times up to time t as in equation 2.2. We also construct some variables as ratios of the country-of-origin and the United States at the time of arrival.[15]

Our typical regression asks how well we can predict county GDP per capita using the ancestry composition and country-of-origin characteristics, and so takes the general form:

$$y_{ct} = \theta_c + \lambda_{st} + \beta z_{ct} + \gamma X_{ct} + \epsilon_{ct}, \tag{2.4}$$

where we include county group (θ_c) and state-year effects (λ_{st}) or common year effects. In some specification, z_{ct} will be a vector of the ancestry-weighted values of the endowment of several characteristics. Note that, implicitly, we are imposing the restriction that the ancestry coefficient in the unrestricted model is proportional to one or more elements of the endowment vector. Given the more parsimonious representation of the effects of ancestry, we will be able to experiment more fully with the dynamic specification of the equation by including a richer lag structure for the dependent variable and for the ancestry-weighted endowment z_{ct}. Moreover, since the ancestry vector contains multiple elements, we can construct more complex functions that reflect other aspects of the endowment distribution, such as fractionalization in the characteristics of the country of origin.

[15] We form the migrant-education to US-education ratio, and country-of-origin education to US education ratio in this way. The formula for ratios is: $\mathrm{z}_t^a = \sum_{\tau=0}^{t} (\mathrm{z}_\tau^a / \mathrm{z}_\tau^{US})^{(1-\delta)^{t-\tau}} F_t^a(\tau)$ where $F_t^a(\tau)$ is the arrival density of group a up to time τ, and δ is the rate of depreciation of the importance of that characteristic. This formula gives the average ratio of country-of-origin characteristic by time of arrival. When the depreciation rate is greater than zero, the ratio converges to one as the time of arrival gets further away, and so the immigrant group converges to the US.

Changes in ancestry composition and economic development

Table 2 shows a series of regressions of the form of equation 2.4 where each estimate is from a separate regression. For each ancestry-weighted variable we present three specifications, each of which include county fixed effects: (1) with year effects, (2) with state-year effects, (3) with state-year effects and including the fraction African-American, Native American, and the log population density. Including state-year effects allows each state to evolve independently over time and so only relies on variation within state. Since much of the variation in the effect of ancestry is likely to be felt across regions, including state-year effects removes much of the variation, but ensures that the estimates are not driven purely by differential regional trends. We allow African Americans and Native Americans to have an unrestricted coefficient since the information at the country-of-origin level for African Americans and Native Americans is necessarily speculative.[16] We include population density to allow the urban-rural composition of a county to change over time. Of course, if density grows at the same rate for all counties then its effect is completely captured by the county fixed effects and common year effects. We discuss the last three columns of Table 2 later.

The coefficient on the ancestry-weighted *Log origin GDP/US on arrival* is positive and significant at the 1% level in column 1 with just fixed effects, as well as in column 2 with both fixed effects and state-year effects, but is insignificant in column 3 with the additional controls. Using the estimate in column 2, a change in the composition of a county so that the *Log origin GDP/US on arrival* is one percent higher is associated with a 0.53% increase in the county's current GDP per capita. Since the estimates include county fixed effects, this estimate is identified as the composition changes over

[16] Where available, we assign the values of Ghana, a West African country that was at the heart of the slave trade, to African Americans, and typically use overall US values for Native Americans. The results are nearly identical if we also allow those with African ancestries from the West Indies to have their own independent effect as well.

time, not just from the cross-section. The results are similar in terms of significance when using the ancestry-weighted *Origin-GDP-to-US ratio* or *1870 GDP*.

Ancestry-weighted *State History in 1500* from Putterman and Weil [74] captures the familiarity with centralized state institutions and shows a pattern of effects on county GDP similar to those of the origin GDP measures. The effect is significant and positive in all specifications, except the one with state-year effects and the additional controls.[17] Ancestry-weighted *Political participation* as of the time of arrival (measured as the difference between the fraction eligible to vote in the country-of-origin and the US weighted by the arrival density) does not predict county GDP, except in the specification with only common year effects, and has a negative coefficient in some specifications. Since few large origin countries had a widespread franchise at the time of migration in the nineteenth and early twentieth century, the fraction of people voting may not well capture differences in institutions or political participation. The role of the endowment of human capital is less robust and it depends upon how it is measured and upon the exact specification, although it is mostly positive when included without controls.

Measures of cultural attitudes towards working with others, such as the ancestry-weighted variable *Trust*, are strongly related to higher county income. *Trust* is positive and significant at the 1% level in all specifications. Since our measure of trust from the World Values Survey is the fraction of the population in a country of origin who report that other people can generally be trusted, the coefficient suggests that an increase in the mix of ancestries that increases *Trust* by one percentage point (0.01) is associated with an increase in the income of a county by 2.6%.

The important role of generalized *Trust* is possibly due to its ability to capture and summarize those cultural characteristics that enhance the capacity to cooperate,

[17] The state history variable is constructed as an index varying from 0 to 1. So a 1 percentage point (0.01) increase in the index brings approximately the same increase as a 1% (0.01) increase in 1870 GDP. We use the Putterman and Weil [74] measure version 3 with a depreciation of 5% of state history in the past.

sometimes called social capital. These characteristics affect the functioning of local institutions, but may also capture the experience of good institutions in the mother country and the ability to transport them to the areas where immigrants settle, as good and effective institutions may foster the creation of trust. For this reason, Trust is likely to capture the effect on economic development of both good culture and good local institutions of the country of origin.

Ancestry-weighted *Obedience* has a precisely estimated and negative effect in three out of the four specifications. *Respect* and *Control* display positive coefficients that are marginally less precisely estimated. *Thrift* is positively and very significantly related to local development in three out of four specifications. Following Tabellini [82], we have formed the principal component of Trust, Control, Respect, and Obedience from the individual data, and then taken the average across the respondents of the principal component for each country. The ancestry-weighted principal component is positively and significantly associated with county GDP in all specifications.

Rich ancestries in poor places

Perhaps surprisingly, over the broad sweep of US history since 1850, people from high-income countries tend to live in lower income counties on average. Column 4 in Table 2 show that the coefficients on our ancestry-weighted variables most often take the opposite sign when fixed effects are not included. This pattern holds for *Log origin GDP on arrival*, for example, which is positive in column 1 with fixed effects and negative in column 4 without them (state-year effects are included to sweep out time varying state differences).

What explains this negative correlation, which is not what one would expect if prosperous areas attract prosperous people? The primary driving force behind this correlation is the historical legacy of settlement, particularly among the English. While the English are a large portion of much of the US, they are disproportionally present in rural areas in the poor South and Appalachian states which received little migration after their first settlement. Later migrants, such as the Italians or Irish, while poor when they arrived, went to cities and prosperous areas, especially in the Northeast. Finally, the Great Migration of African Americans shifted them from the poor rural South to growing urban areas.

The differences between the estimates that use the variation over time within each county and those that rely mostly on on the cross-sectional variation suggest that the availability of panel data is very important for understanding the effects of ancestry. Much empirical work on culture or ancestry cannot distinguish between the effect of the place and of the people that live there. The negative cross-sectional relationship between *Trust* or *Log origin GDP* and county GDP is likely specific to the settlement patterns in the United States and what part of the frontier was open when a large migration occurred or where a group was forcibly resettled. However, the point that estimates based on cross-sectional variation do not disentangle the effects of factors inherent in a place is more general.

2.5.4 What matters most?

In Section 2.5.3, we examined country-of-origin characteristics in isolation, with the goal of showing several elements of the endowment vector brought by immigrants are associated with per capita county level GDP. But which component of the endowmentis most strongly associated with local economic development? As we have discussed, the panel nature of our data allows us to address this issue controlling for a rich set of unobservables by including county fixed effects and state-year effects. Doing so necessarily removes any effect of national or state institutions and of their evolution. Similarly, we cannot directly estimate whether there is a “founder” effect of the groups who first settled a county since such an effect is absorbed by the fixed effect.

With these caveats in mind, Table 3 combines a selection of the most important measures from Table 2 to examine which measures remain significant once they are included together as explanatory variables. We use the ancestry-weighted variables *Trust*, *State History*, the *Migrant Education-to-US* ratio at time of arrival created by census records, and *Thrift*.[18] Since many important differences appear across states rather than within them, we show the results both with common year effects, and with state-specific year effects. Finally, since the country-of-origin endowments used for African-American and Native Americans are speculative, we included in some specifications the fraction of each of these groups, as well as the population density to allow for differences between urban and rural areas.

The effect of culture, as measured by ancestry-weighted *Trust*, is robustly significant and about the same size across all columns, while the other possibly important variables are not. *Thrift* is also significant, but only in the specification with state-period effects. *State History* is significant without state effects, but not with them. Culture may summarize the role of both social capital and the quality of local institutions in the country of origin, as we have argued before. Conversely, the experience of a centralized state represented by *State History* may be less relevant in capturing the development and functioning of local institutions, and any effect it has on state or national institutions is absorbed by the state-year and fixed effects.

Puzzlingly, the ratio of education of the migrants to the US education at the time of arrival has either an insignificant or negative and significant coefficient when including state-year effects. This relationship does not depend on the speed of depreciation of the difference (δ), and also holds using the country-of-origin years of education as well. By itself, arrival education is mostly positively related to county GDP in Table 2. The negative relationship may come from colinearity between the education and the other included endowment variables.

[18]We obtained very similar results using the principal component of culture instead of *Trust*, but report the results for *Trust* since it is more straightforward to interpret.

Including the fraction of African Americans and Native Americans still leaves the coefficient of ancestry-weighted *Trust* significant and of about the same size. The values we assign in constructing the endowments for these groups are necessarily imprecise, and it is important to point out that the results are not coming just from these groups. West Africans today have low trust as measured by the World Values Survey, at least partially as a consequence of the slave trade [69]. The long-term consequences for trust on the descendents of those actually enslaved may be even worse. While we report the coefficients on the fraction African Americans and Native Americans, since the groups also appear within each of the ancestry-weighted variables the coefficients are not informative about the groups themselves.

The size of the coefficients matters as well as their statistical significance. The interquartile range across counties for *Trust* is 0.064, for *State History* it is 0.095, and for the ancestry-weighted migrant education ratio at the time of arrival it is 0.081. Moving from the 25th percentile to the 75th percentile county in *Trust* raises GDP per capita by nearly 25.5%, using the estimated coefficients reported in column 1. The effect is of similar size across all specifications. A similar change for *State History* is associated with a 6.9% increase in county GDP per capita. For migrant education, a change from the 25th percentile to the 75th is associated with an statistically insignificant increase in GDP per capita of 2.3%, using the results in column 1, or a decrease of 15%, using the results in in column 2. *Trust*, therefore, is the most robust, statistically significant, and economically important correlate of local economic development.[19]

[19] In the next section, we will construct instruments for these variables and consider the importance of allowing for a dynamic specification by including lags of county GDP. While we mostly focus on examining just one variable at a time, when we include multiple endowment variables we reach the same overall conclusions in the dynamic model with instruments and fixed effects as in this section: *Trust* is highly significant with a sizable coefficient, *State History* is less significant but still matters, while the *Migrant Education-to-US* ratio at the time of arrival is insignificant and with a coefficient close to zero.

2.5.5 Sorting and endogeneity

The previous sections have documented a robust association between ancestry and income. In this section we examine the possible mechanisms underlying this relationship. The association could come from two sources: (1) when people with certain characteristics move to a county, its GDP changes, or (2) people with certain characteristics are attracted to a county whose GDP is changing. It is worth noting that there is only a reverse causality problem if people move immediately in response to shocks. If it takes a decade for them to move then, if the error term in the GDP equation is not serially correlated, there is no simultaneity bias. Moreover, even if people move immediately, the direction of any bias in estimating the effect of ancestry on GDP is ambiguous. For example, it could be that a booming county disproportionately attracts immigrants who are poorer, since they are the ones with greater incentives to move. The cross-section results shown in the fourth column of Table 2 supports this observation that people from poorer countries end up in richer counties on average. A counter argument is that the most mobile people may be those with the highest education and geographically diverse social networks.[20]

The estimates in the previous sections allow for county fixed effects. The fixed effects removes and controls for all fixed unobserved characteristics of a place. In trying to identify the effect of ancestry composition on local GDP, it is not a problem, for example, if the poor immigrants tend go to cities with ports that require manual laborers, as the presence of a port is largely fixed. Similarly, if Norwegians go to places in the Upper-Midwest whose cold ecology they are familiar with, the fixed effect removes climate and geography. As we have shown in Section 2.5.3, it is extremely

[20]Note that the problem with selection is not that the poor, or rich, within each ancestry are the ones that are more likely to move if ancestries are equally affected, for instance, because they have the same income distribution.. Instead, the problem is that ancestries with specific characteristics may be more mobile on average. For example, suppose ancestries with low trust are more willing to move since they have lower attachment to a local community. Since trust is positively correlated with local development, but low trust ancestries are more likely to move to booming counties, the within estimates will tend to underestimate the impact of trust on local development.

important to control for county fixed effects since people from richer countries tended to settle in relatively poorer counties. Yet, the fixed effect estimates do not address the possible correlation between shocks to county level per capita GDP and ancestry composition.

In this section, we propose possible strategies to identify the effect of ancestry composition on economic development. We construct an instrument for the Ancestry Vector and the ancestry-weighted endowment variables using the past distribution of ancestries, augmented by the national growth rates, building on the basic strategies of the recent immigration literature.[21] We first instrument for the ancestry-weighted endowment variables in the model with fixed effects, including two lags of the dependent variable. Then we examine more fully the issue of the dynamic specification of the model and address the endogeneity issues in the context of short panels [59, 14], starting from a single equation framework. Finally, we model explicitly both county GDP and ancestry-weighted endowment variables in a bivariate panel vector auto-regression and present estimates of the impulse response functions, based on a Cholesky decomposition of the residuals, under different assumptions on the ordering of the variables. The absence of autocorrelated residuals is essential for our identification strategy and this requires the specification of rich enough dynamic models and testing for serial correlation in the estimating equation.

We conclude that, while there is some evidence that there is an attraction that draws people of certain characteristics to booming counties, the ancestry composition matters in a causal sense for local economic development even after accounting for this attraction. The effect is significant, sizable, and long lasting. We focus on the

[21]See, for example, Cortes [35] and Peri [72]. Peri [72] allows for a dynamic specification of the estimating equation by including the lagged dependent variables. They build on Card [32], who estimates a static model, although he briefly discusses the importance of lack of serial correlation in the estimating equation. A related strategy is also used in the local development literature to instrument for labor demand shocks. See Bartik [22] and Blanchard and Katz [24]. Although the absence of serial correlation in the residuals is an essential condition for the use of the past distribution of immigrants as an instrument, this literature often fails to conduct such tests.

effects of ancestry-weighted *Trust*, since it appears to have the most robust role, but also show results for the *Log origin GDP/US on arrival* in the appendix as a summary measure of the potential economic endowment of immigrants.

Instrumenting for ancestry and expected endowments

Immigrants tend to go where there are already immigrants from their country [21]. Growth of native groups similarly occurs in places where there are already populations of that ancestry since it takes Germans to make Germans. We build on these observations to create an instrument for ancestry based on the stock of ancestry in the past. This approach is similar to using lags of the ancestry-weighted variables as instruments, but brings in information for the overall growth of ancestries at the national level.

We start with the population $P^a_{c,t-1}$ of ancestry a in county c at time $t-1$ and construct its predicted value at time t if in each county the population grew at the national rate for each ancestry, g^a_t, to obtain $\tilde{P}^a_{c,t} = P^a_{c,t-1}(1+g^a_t)$. Summing over all the ancestries we can obtain the predicted growth rate of the total population in each county, $\tilde{P}_{c,t}$. The projected share of ancestry a's population in each county $\tilde{\pi}^a_{c,t}$ is then:

$$\tilde{\pi}^a_{c,t} = \frac{\tilde{P}^a_{c,t}}{\tilde{P}_{c,t}} = \pi^a_{c,t-1}\frac{1+g^a_t}{\sum_{a=1}^{A}(1+g^a_t)\pi^a_{c,t-1}}. \tag{2.5}$$

Note that $\tilde{\pi}^a_{c,t}$ does not use any county specific information from decade t. If there is no serial correlation in the error term of the GDP equation, then $\tilde{\pi}^a_{c,t}$, or simply $\pi^a_{c,t-1}$, can be used instead of $\pi^a_{c,t}$ to construct an instrument for the ancestry-weighted endowment variables. The absence of serial correlation in the local GDP equation is essential for this identification strategy to be valid. We therefore include past values of GDP and test whether there is any evidence of residual serial correlation. We also make the very reasonable assumption that no single county plays a dominant role in attracting people of a given ancestry.

As an intermediate step, we first show the effect of including two lags of county GDP in the second to last column of Table 2 (marked DYN FE for dynamic fixed effects). Since the regression now includes lags of county GDP, the reported coefficients are the effect of a change in the endowment within a decade. The sum of the lags of county GDP are generally around 0.6, indicating that the long-run effect of a permanent increase in *Trust,* for example, is around 2.5 times larger than the short-run effect.[22]

The last column of Table 2 (denoted IV DYN FE) shows the results of using the predicted shares $\tilde{\pi}^a_{c,t}$ to construct an instrument for each expected endowment variable in equation 2.3 in the dynamic equation that includes two lags of the log county income to remove serial correlation. In all cases, including two lags is sufficient to remove serial correlation using the Arellano and Bond [14] test based on differences of the residuals. For reasons of space, we report only the tests for the specifications using *Trust* in columns 6 and 7 of Table 4, and using *Log origin GDP/US on arrival* in columns 6 and 7 of Table A-1. The first stage regressions suggest that our instrument has strong explanatory power for the corresponding ancestry-weighted endowment variables.[23]

In all cases in which it was significant in the static specification, the coefficient of the ancestry-weighted endowment variables remains significant in the dynamic specifications, whether it is instrumented or not. The estimates of the impact effect with the instrument are in general slightly larger than those for the dynamic fixed effect results. The long-term effects of a permanent change are again around 2.5 times

[22]The long-run effect, in a single equation context, is $\alpha/(1-\rho_1-\rho_2)$ where α is the coefficient of each ancestry-weighted endowment variable, and ρ_1 and ρ_2 are the coefficients on the lags of county GDP. Column 6 in Table 4 shows the full estimates for *Trust*, while column 6 in in Table A-1 show the same results for *Log origin GDP/US on arrival.* The coefficients of the lagged dependent variables in each regression are typically very similar. Using the values for *Trust*, to get the long-run effect multiply the coefficients in the DYN FE column by 2.4=1/ (1-0.525-0.054).

[23]For instance, the t-statistic for the first stage instruments constructed using $\tilde{\pi}^a_{c,t}$ has P-values that equal zero to the fourth decimal point. Most of the explanatory power is due to the variation in $\pi^a_{c,t-1}$ since replacing $\tilde{\pi}^a_{c,t}$ with $\pi^a_{c,t-1}$ in constructing the instruments has nearly the same first stage significance and very similar second stage results.

larger than the short-term effects. Some of the anomalies observed before disappear; in particular, now ancestry-weighted *Migrant education/US* at arrival has a positive and significant sign as does *Arrival political participation.* We will discuss further the dynamic effects of changes in ancestry-weighted endowments in the next section.

We have also examined the effect of including the average log GDP of each county's neighbors in the preceding decade in a specification that is otherwise the same as the IV dynamic fixed effects results in column 6 to allow for possible spatial correlation. The results are essentially identical, and therefore we do not report them separately. The coefficient on the past neighbor's GDP is generally small, typically below 0.01, and mostly statistically insignificant.

Instrumenting for ancestry in short dynamic panels

The instrumental variable results presented in the previous section rely on including the lagged dependent variable to remove serial correlation. With a relatively short panel (T=15), including the lagged dependent variable with fixed effects can generate inconsistent estimates [68]. In this section, we address both this issue and the problem of endogenous migration by using the GMM approach to the estimation of short dynamic panels with large N proposed by Holtz-Eakin, Newey, and Rosen [59] and Arellano and Bond [14]. The basic idea is not to use the within transformation, but other transformations, such as first differencing or forward orthogonal deviations, that allow one to use lagged values of the regressors or other variables as instruments.[24] Note that using lagged values of the ancestry-weighted variable as instruments is identical to using lagged ancestries in the construction of the instrument when the country-of-origin characteristic is not time varying, like Trust. In addition, we estimate a bivariate panel vector auto-regression (VAR) for log county GDP and

[24]The forward orthogonal deviation transformation subtracts from the value of a variable at time t the forward mean (and rescales the results appropriately). This transformation has the property that if the original errors are i.i.d., they maintain this characteristic after the transformation.

ancestry-weighted *Trust* that allows us to examine the extent that shocks to county GDP attract migrants of a certain type. We continue to focus on ancestry-weighted *Trust* as an example because it seems to be the variable most robustly correlated with county GDP, but include the results for *Log origin GDP/US on arrival* as a useful summary measure of the endowments brought by immigrants in the appendix.

Table 4 shows a series of GMM estimates of the effect of the ancestry-weighted *Trust* on county GDP per capita (Table A-1 in the appendix shows the same table for *Log origin GDP/US on arrival*). Column 1 estimates the effect using orthogonal deviations to remove the county fixed effect, while column 2 uses the first difference transformation. Appropriately lagged values of the regressors are used as instruments with the precise lags used indicated in the table. In both cases we test for serial correlation in the first differences in the error term using the Arellano and Bond [14] test for serial correlation of the residuals in differences. In first differences one expects first order serial correlation if the error term in the level equation is white noise, but not second-order serial correlation. Second order serial correlation would invalidate the use of once-lagged variables as instruments with orthogonal deviations or twice-lagged variables as instruments with first differences. With two lags of county GDP, we do not find evidence of second order serial correlation, which is necessary for the validity of our instruments.[25] Moreover, the test of overidentifying restrictions (Hansen test) does not suggest model misspecification in any of the equations. In column 3, we include multiple lags of *Trust* as well. While the individual coefficients change size, their sum is nearly identical, and so the long-run effect of a change in *Trust* is nearly the same. In column 4 we include as an additional instrument the one constructed in the previous section based on the past stock of ancestry and the

[25]Note that our instrumenting strategy can also deal with the issue of measurement error in the ancestry-weighted variables. The lack of second order serial correlation in differences suggests that there is no substantial measurement error component in county GDP or a moving average component in the ancestry variable. Had we found such components, they could have been dealt with by further lagging the instruments.

growth rate of each ancestry at the national level in equation 2.5. The results are nearly identical to column 1 which means that the constructed instrument does not add much additional information relative to simply using a lag of the *Trust* as an instrument.[26]

For comparison, columns 6 and 7 show the results of estimating the same dynamic model with two lags of county GDP, using the within transformation but no instruments in column 6, and our constructed instrument in column 7. The sum of the coefficients on the lagged dependent variables is somewhat larger in the GMM estimates that with the fixed effects, as one would expect in relatively short panels [68], but the difference is small. More importantly, the coefficients on the effect of ancestry-weighted *Trust* remain highly significant. Note that, although the impact effects differ, the long-run effect of a permanent change in *Trust* (defined as 5.14=1.347/(1-0.624-0.114)), using the GMM results of column 1 of Table 4 is very similar to the long run effect of a permanent change in *Trust* in the fixed effects estimation with two lags of county GDP in column 6 (5.20), and in the fixed effect estimation of the same model when *Trust* is instrumented in column 7 (5.63) using the past distribution of ancestries from Section 2.5.5. The estimated coefficient of *Trust* in the static fixed effect model of Table 2 (2.5) is in-between the GMM estimates of the short and long-run effects in the dynamic model, and is closer to the impact effect. It is also very close to the estimated impact effect of the dynamic fixed effect model, with or without instruments.

Finally, we examine the co-evolution of county GDP per capita and ancestry-weighted *Trust* in columns 8 and 9 of Table 4 using a bivariate panel vector autoregression. This approach allows county GDP to affect *Trust* as well as for *Trust* to affect county GDP and makes no structural assumptions beyond the number of lags. While the previous columns deal appropriately with the potential endogeneity of

[26]Including a one decade lag of the average neighboring counties' log GDP as an additional regressor leaves the results unchanged. Its coefficient is miniscule and not significant.

Trust, they do not explicitly model its evolution. Instead of estimating the structural model for county GDP, as in columns 1-7 of Table 4, we now estimate the reduced form of the model for both log county GDP and *Trust*. The coefficient of the first lag of *Trust* is again highly significant in the GDP equation. County GDP also has an effect on *Trust* in column 9. Indeed, when we test for Granger Causality we strongly reject both that *Trust* does not Granger cause GDP and that GDP does not Granger cause *Trust*, with p-values very close to zero. However, the effect of GDP on *Trust* is very small.

We consider the co-evolution explicitly by calculating the impulse responses functions of log county GDP and *Trust* obtained from a Cholesky decomposition under two different assumptions about the ordering of the variables: (1) that county GDP affects *Trust* only with a lag, and (2) that *Trust* affects county GDP only with a lag. Since it takes people time to move in response to a boom, we think that the first assumption may be more reasonable. The impulse responses for a one standard deviation shock to log county GDP and *Trust* are shown in Figure 8 (for *Log origin GDP* see appendix Figure A-1). The overall shape of the impulse responses are very similar for both decompositions. The short-run response is sizable and significant (either immediately or after one period), peaks after four periods and then slowly declines. For instance, when *Trust* is assumed to respond to GDP only with a lag, a one standard deviation shock to *Trust* leads to an increase in GDP of 1.5 percentage points on impact, peaking at somewhat above two percentage points after four decades.. The effect is significant and large (around 1.5 percentage points) even after ten decades. The reverse effect of a shock to county GDP on *Trust* is statistically significant but it is always small (note the different scale of the vertical axes for the *Trust* and GDP responses). For instance, it peaks at 0.002 or 0.004 (depending upon the ordering of the variables), which is a rather small number given that 90% of the observations of *Trust* vary between 0.22 and 0.40.

2.5.6 Ancestry and diversity

Until now we have examined the average of the attributes people in a county might have received from their ancestors. However the *diversity* of ancestries may be as important as the weighted average of those attributes. In this section, we conduct an initial exploration of this issue in the context of the static model with fixed effects. We use several measures of diversity. One is the standard fractionalization index that measures the probability that any two individuals chosen from a population will not be of the same group:

$$frac_{c,t} = 1 - \sum_{a=1}^{A} (\pi_{ct}^{a})^2.$$

Recent work has generalized this index by allowing it to incorporate measures of distance (for reference, see Bossert, D'Ambrosio, and La Ferrara [30], who generalize early work and provide an axiomatic treatment). We define a measure of similarity based on the difference of some country-of-origin measure z between group j and group k as $s_{ct}^{jk} = 1 - |z^j - z^k|/r$ where $r = \max_{j\in\{1\ldots A\}} z^j - \min_{j\in\{1\ldots A\}} z^j$ is the range of values that z can take. As two groups become more similar along the z dimension, their similarity approaches one. Then a generalized fractionalization index is:

$$frac_{c,t}^{w} = 1 - \sum_{j=1}^{A}\sum_{k=1}^{A} \pi_{ct}^{j}\pi_{ct}^{k}s_{ct}^{jk}$$

where the w stands for a "weighted" fractionalization.[27] The standard fractionalization index is just the weighted fractionalization index when members of different groups are assumed to be completely dissimilar ($s^{jk} = 0$ for $i \neq j$). We show results based on fractionalization weighted by country-of-origin Trust, but obtain similar

[27]Note that the fractionalization index could also be defined using measures of dissimilarity between groups j and k. If $d_{ct}^{jk} = |z^j - z^k|/r$ then $frac_{c,t}^{w} = \sum_{j=1}^{A}\sum_{k=1}^{A} \pi_{ct}^{j}\pi_{ct}^{k}d_{ct}^{jk}$ since the sum over the AV is 1. Although the discussion assumes a fixed x^j for each ancestry, the country-of-origin measure can change over time as well. For example, it is possible to use the density of arrival weighted country-of-origin GDP to calculate the fractionalization at any given time. The double sum over ancestry makes weighted fractionalization somewhat complicated and computationally intensive to calculate weighted fractionalization over the full county-decade panel.

results using fractionalization of origin GDP.

In Table 5 we report the results obtained when we include measures of fractionalization and Trust weighted fractionalization using the fixed effects estimates of the static equation 2.4 when ancestry-weighted *Trust*, *State History* and the *Migrant-education-to-US* ratio are all included. An increases in county diversity of country-of-origin as captured by fractionalization is associated with an increase in county GDP per capita. An increases in Trust weighted fractionalization is associated, instead, with a decrease in GDP. The coefficient on the level of ancestry-weighted *Trust* is very similar to the estimates without fractionalization (see column 1 of Table 3). Since fractionalization and weighted fractionalization are both indices that vary from 0 to 1, the estimated effects are large: an increase in the Trust fractionalization by one percentage point (0.01) decreases county income by 2.7%.[28] The estimated effects of *Trust*, fractionalization, and Trust fractionalization are robust to many different specifications such as including state-year effects, the fraction of Native Americans and African Americans, population density, and county education levels. The positive impact of fractionalization and negative impact of Trust fractionalization does not come just from diverse and high income cities and is not just a racial effect.

These results capture two different views of diversity. The positive effect of fractionalization is consistent with the notion that it is beneficial for people with new skills and ideas to come into a county, particularly if these complement the skills and ideas of the existing population. Moreover if they bring different tastes, the newcomers may open up new opportunities for trade. Yet if those new groups are substantially different along important dimensions such as trust, this may create conflict and lead to a decrease in the ability to agree on growth enhancing policies at the local level. One

[28]The mean fractionalization across all county groups is 0.73, with an interquartile range of 0.215, while for the fractionalization of Trust the mean is 0.155 and the interquartile range is 0.105. Going from the 25th to the 75th percentile for fractionalization is associated with a rise in GDP per capita of 25%, while going from the 25th to the 75th percentile of Trust fractionalization reduces GDP per capita by 29%.

can imagine, for example, that a low-trust group moving into a high-trust area may not only bring down the average trust level (as captured by the ancestry-weighted *Trust*), but also make the high-trust group less willing to cooperate.

These results help make sense of a tension in the literature that examines ethnic diversity. In the cross-section, both across countries [41] and within them [7, 65, 36] ethnic diversity is related to lower output growth or investment in public goods. Yet diversity can have positive consequences. For example, Alesina, Harnoss, and Rapoport [10] present cross country evidence of a positive relationship between birthplace diversity and output, TFP per capita and innovation. Ashraf and Galor [15] find that the relationship between genetic diversity and country level economic development is first increasing, then decreasing, resulting in an interior optimum level of diversity. Ager and Brückner [5] demonstrate that increased fractionalization of first generation migrants in the United States is positively associated with output, while a tendency towards polarization—when there is an even division between two groups—is negatively associated with output. Putterman and Weil [74] find that the Standard Deviation of state history generated by the post-1500 population flows is positively related to the income of countries today.

Given the evidence that fractionalization has both positive and negative effects, and that its effects overall may be non-linear [15], in columns 5-8 of Table 5 we include the square of fractionalization and Trust weighted fractionalization, allowing the effect to be non-linear. The square of fractionalization has a consistently negative effect, indicating that the positive marginal effect of increased fractionalization is decreasing. Increasing diversity in an already diverse place has a smaller positive effect than in a homogenous place. The square of Trust fractionalization has a positive effect, suggesting that the negative marginal effect of Trust fractionalization gets smaller the more diversity in Trust there is. Increasing the diversity of Trust has a larger negative effect in more uniform societies. The quadratic form implies that there is potentially an optimal level of diversity and worst level of Trust diversity. The maximum and minimum, however, fall very close to the limits of the range of diversity of our counties; while diversity has a non-linear effect, we do not find that it has u-shaped effect within the very diverse United States.[29]

2.6 Conclusion

Using micro-samples from the US census since 1850, we have mapped the ancestral distribution of population of US counties, and combined it with consistent estimates of county level GDP per capita. This panel has allowed us to assess whether the endowments of people's ancestors are related to local economic outcomes. The changing ancestry composition of US counties is significantly associated with their economic success, even after controlling for county fixed effects, common or state-specific year effects and other time varying observable county level factors. The cultural, institutional, and human capital endowments that migrants brought from their country of origin explain this association. We find that cultural variables reflecting values and beliefs about cooperation tend to play the most robust role relative to other factors. We address the potential endogeneity of ancestry due to geographical sorting through an instrumental variable strategy in a dynamic setting and find that changes in ancestry-weighted characteristics of the country of origin affect local economic development. The effectsD are sizable, significant, and long lasting.

The diversity of the characteristics of the country of origin are important as well. Our results suggest that ancestry fractionalization is positively related to economic development. However, measures of the fractionalization of the cultural endowment brought by immigrants is negatively related to county level GDP. It matters not only

[29]For a quadratic $ax + bx^2$ the maximum or minimum occurs when $x = -a/(2b)$. The optimal fractionalization (using column 5) is 0.99, while the least valuable Trust fractionalization is 0.37. The 90th percentile of our county groups is 0.88 for fractionalization and 0.26 for Trust fractionalization, and so the maximum and minimum fall at the very top end of possible values.

where you came from, but also whom you came in contact with once you arrived.

The complex mosaic of ancestry in the United States has changed profoundly over the past and it is still evolving as new migrants enter and people move internally. Our novel data set on the stock of ancestry and GDP has allowed us to provide new evidence on the relationship between ancestry composition and economic development. However, this is just the start; the multifaceted role of ancestry diversity and its relationship with economic outcomes deserves a deeper look, and many more issues can be investigated using our data. For instance, how are inherited values and beliefs modified by surrounding groups? How are group identities such as ethnicity formed from the building block of ancestry? And what are the mechanisms through which the cultural, institutional, and human capital endowments of immigrants affect social and economic development? We leave the answer to these and other questions to future work.

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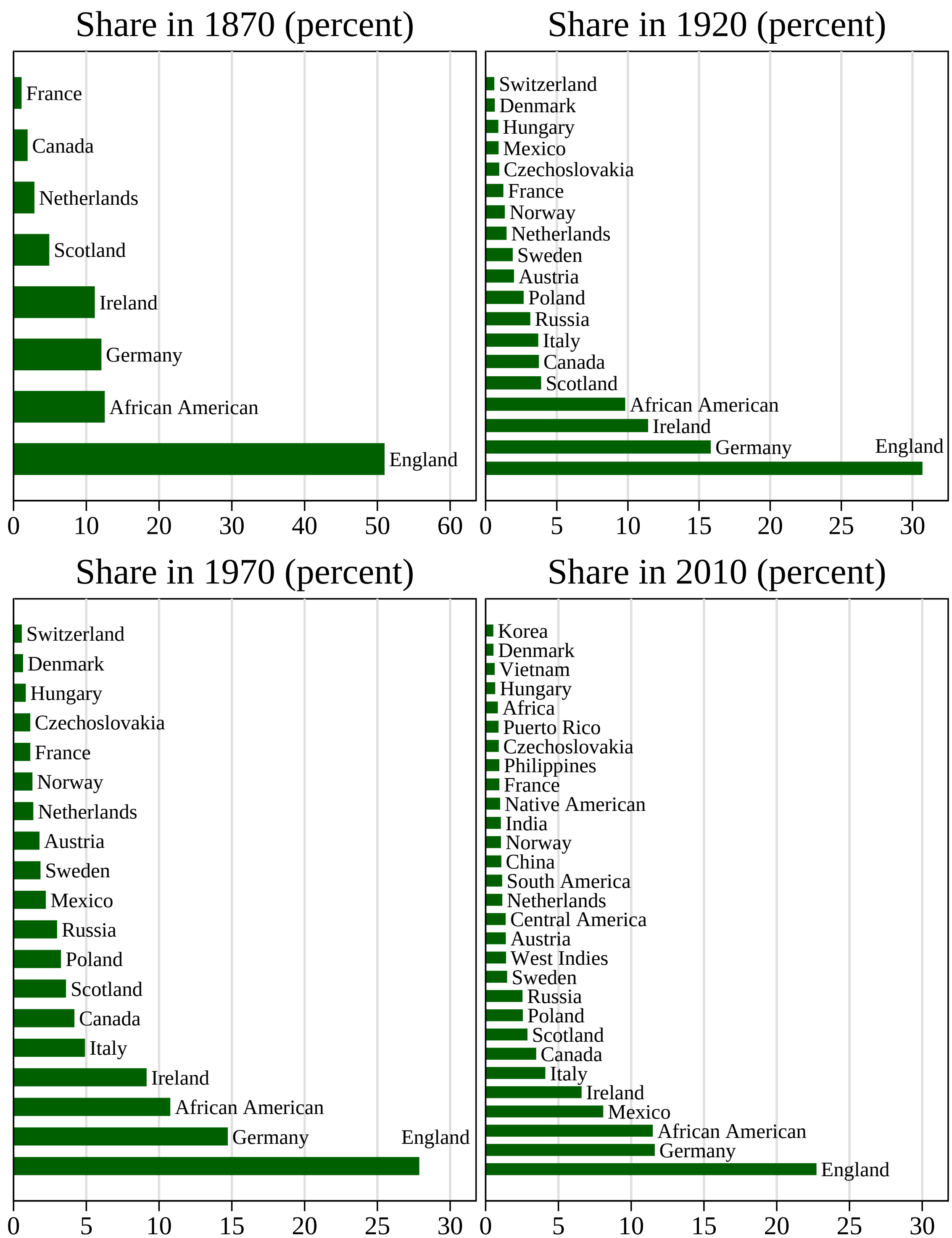
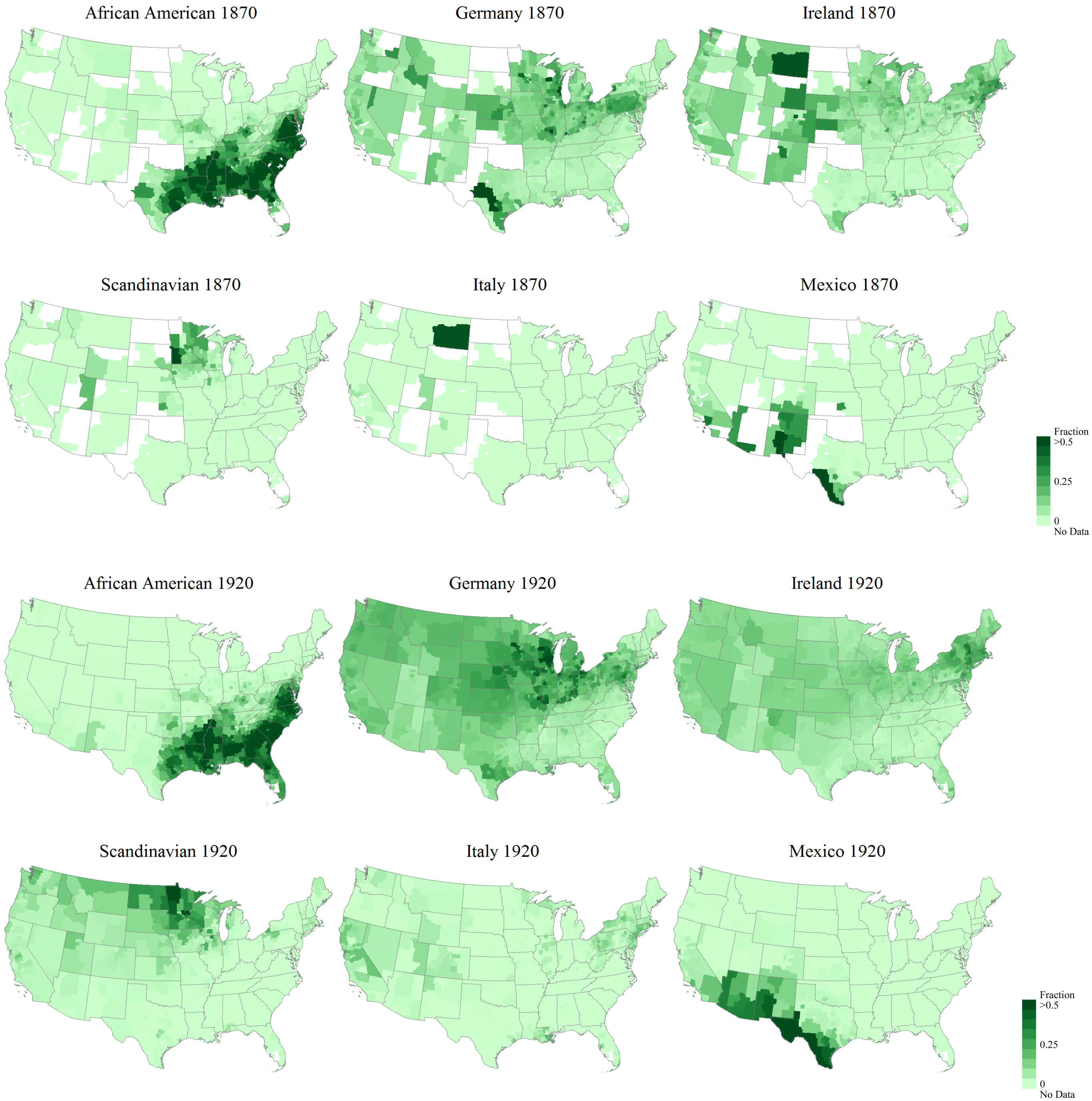
Figure 1: Ancestry share in the United States: 1870, 1920, 1970, and 2010



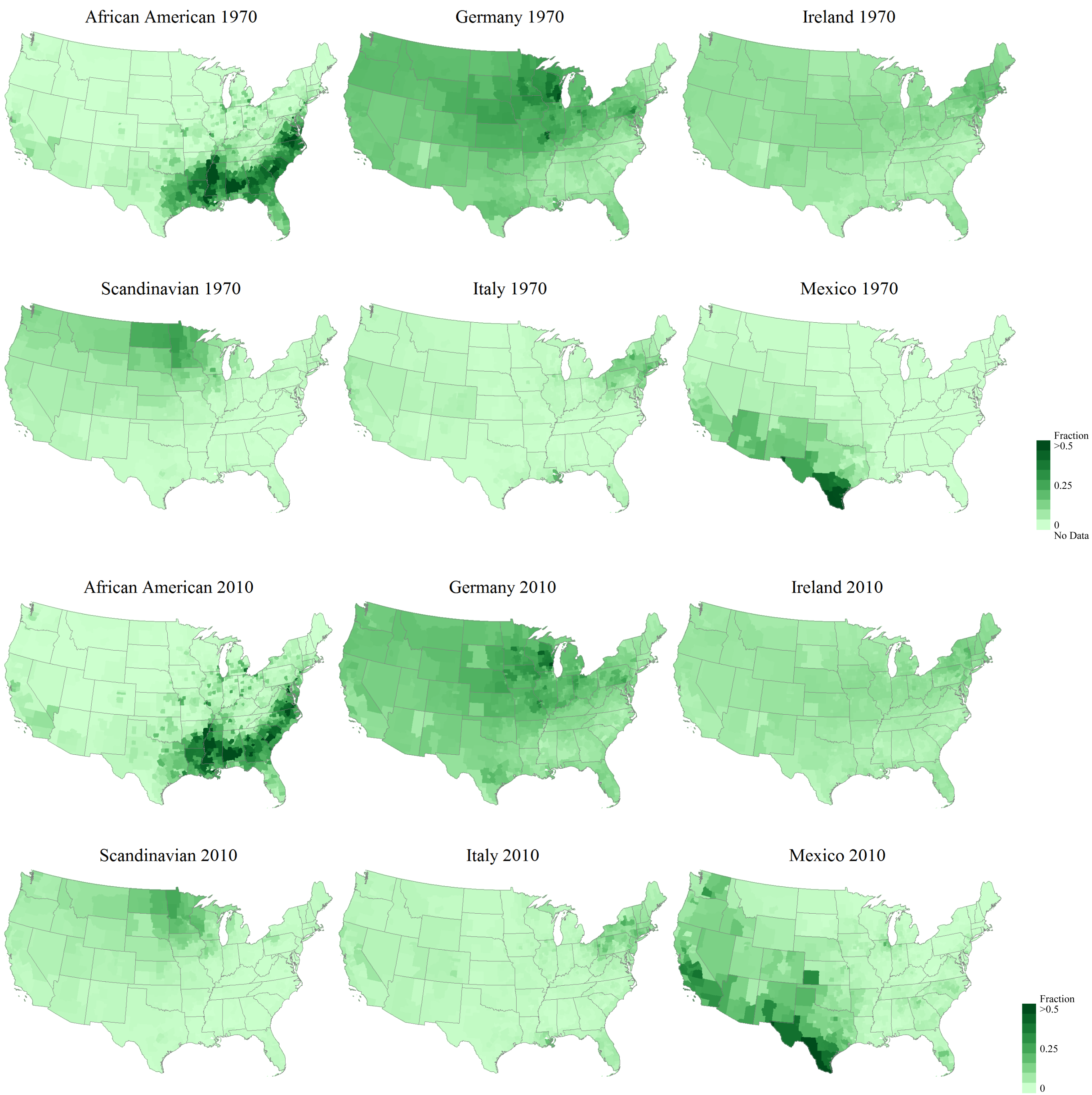
Notes: Shows the aggregate ancestry shares in the US for ancestries with greater that 0.5% of the population. Ancestry shares are created by summing the share in each county weighted by county population in each year. See Section 2.3 and Appendix 2.6 for the ancestry construction.

Figure 2: Select ancestries in the United States: 1870 and 1920



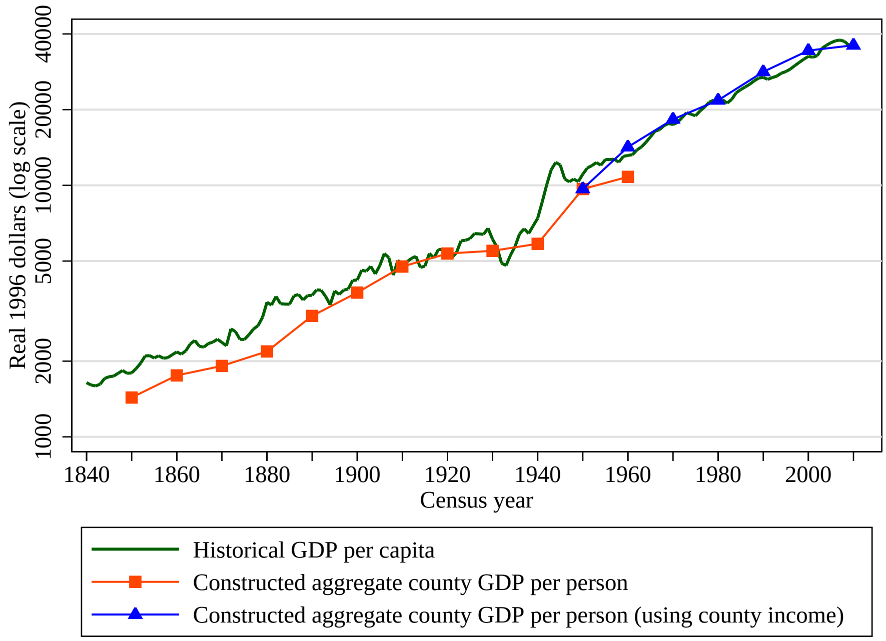
Notes: Scandinavian is the combined Norway and Swedish ancestries. See Section 2.3 and Appendix 2.6 for the ancestry construction.

Figure 3: Select ancestries in the United States: 1970 and 2010



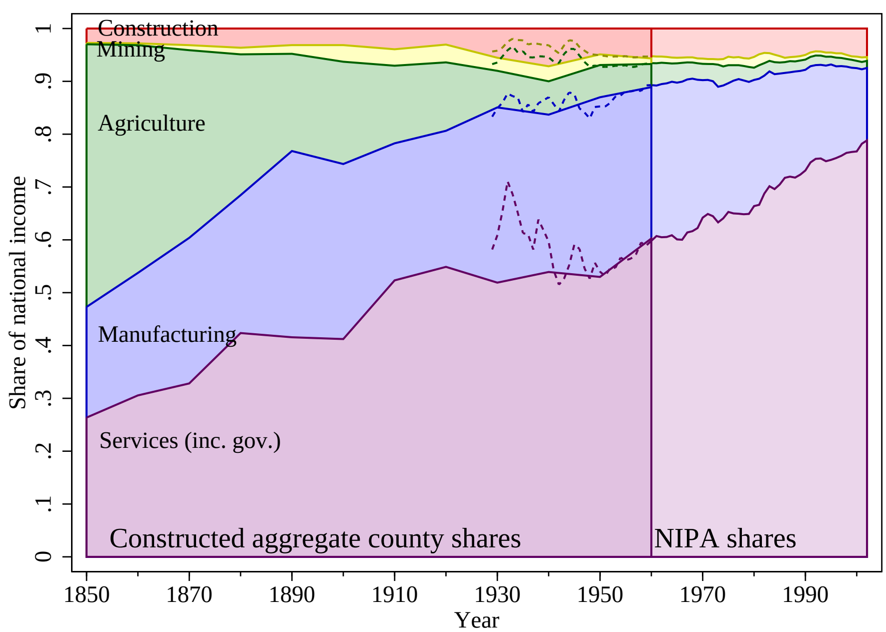
Notes: Scandinavian is the combined Norway and Swedish ancestries. See Section 2.3 and Appendix 2.6 for the ancestry construction.

Figure 4: GDP and aggregate county GDP per capita: 1840-2010



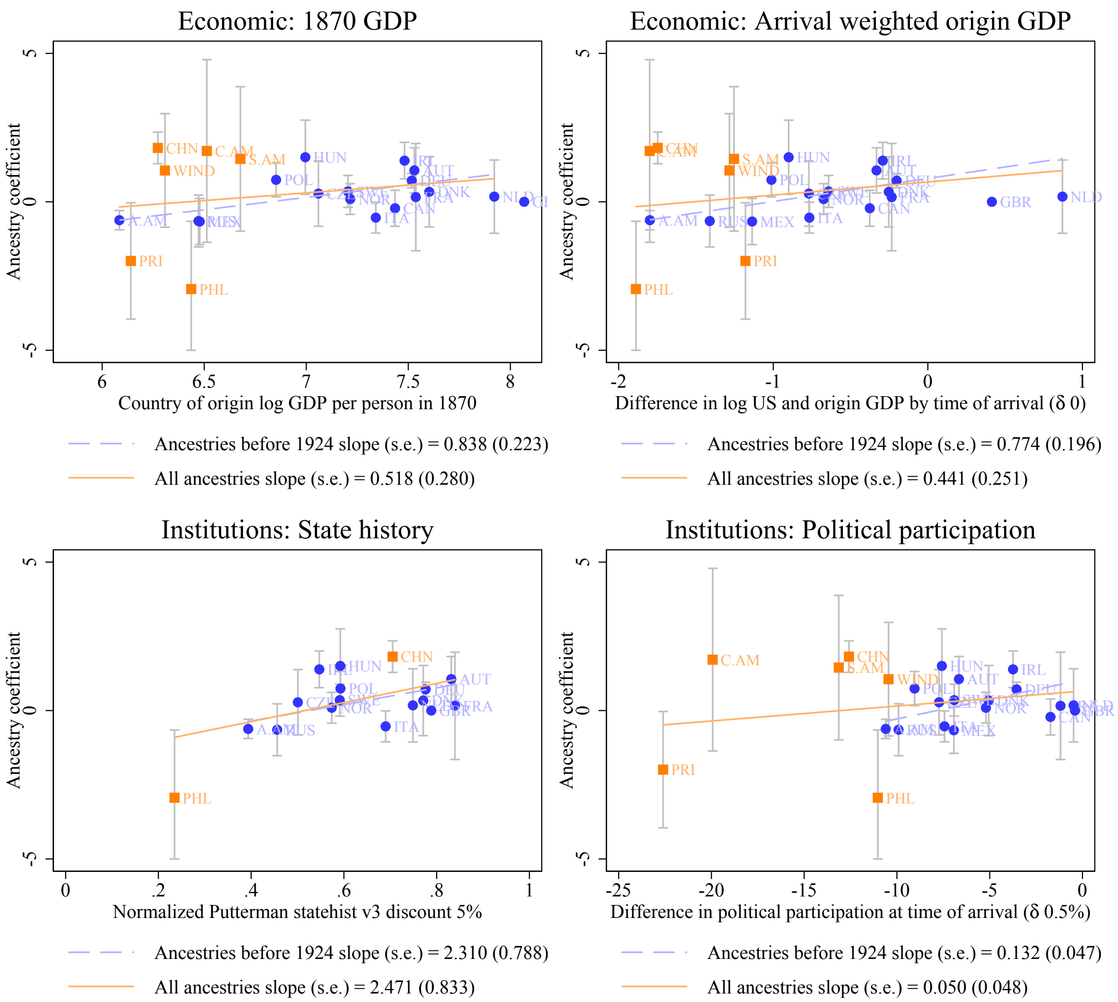
Notes and sources: Historical GDP per capita from Sutch [80]. The constructed aggregate GDP per capita and aggregate county income per capita are created by totaling the county measures for each year then dividing by population.

Figure 5: Constructed sectoral shares 1850-2010



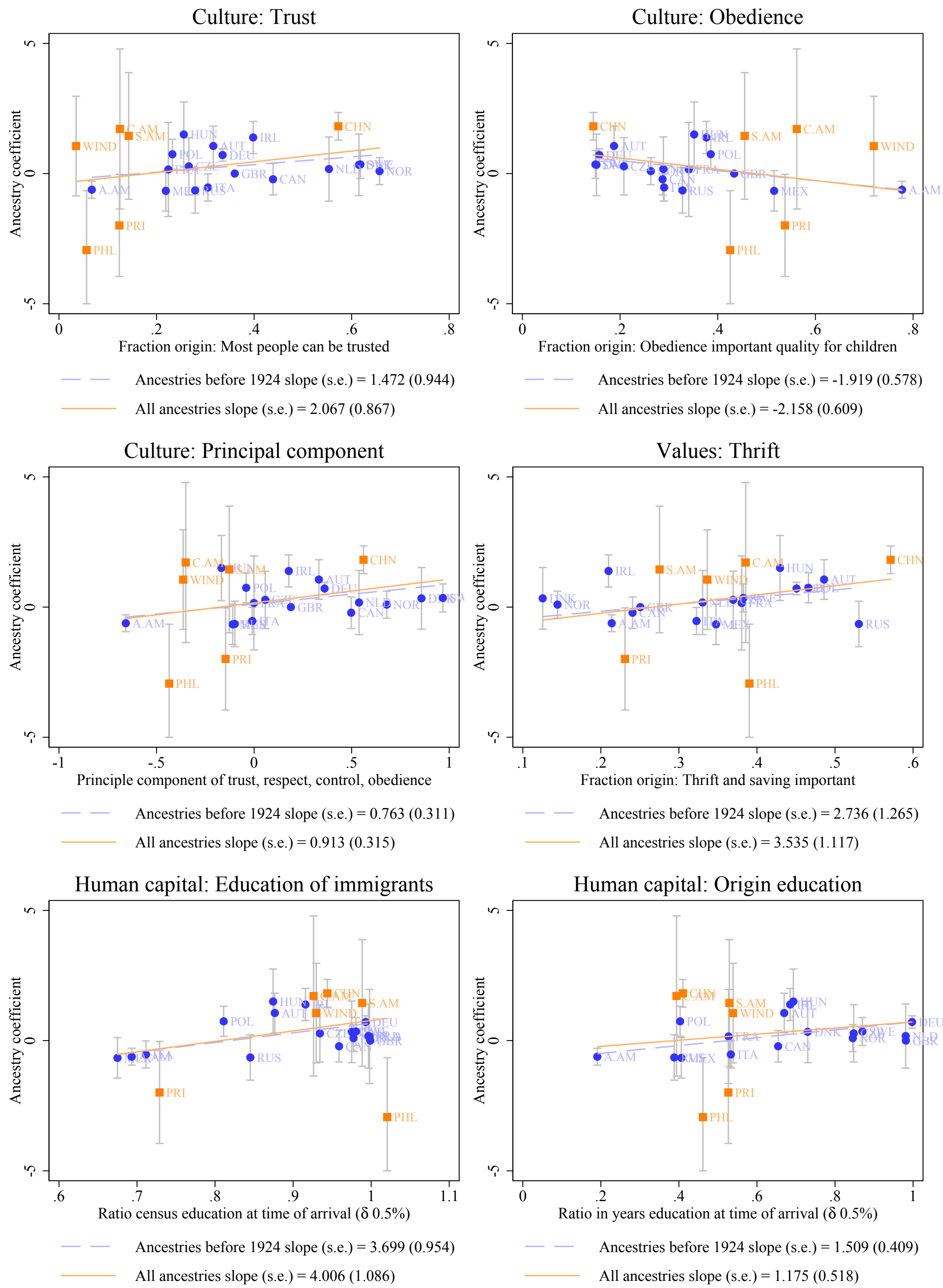
Notes: The shares from 1850 to 1960 are based on our estimates of county GDP totaled over all counties. The National Income and Product (NIPA) shares on the right are the dashed lines in 1929 and the overall shares after 1960 and are based on Carter [33].

Figure 6: Ancestry and country of origin: Economic and Institutions



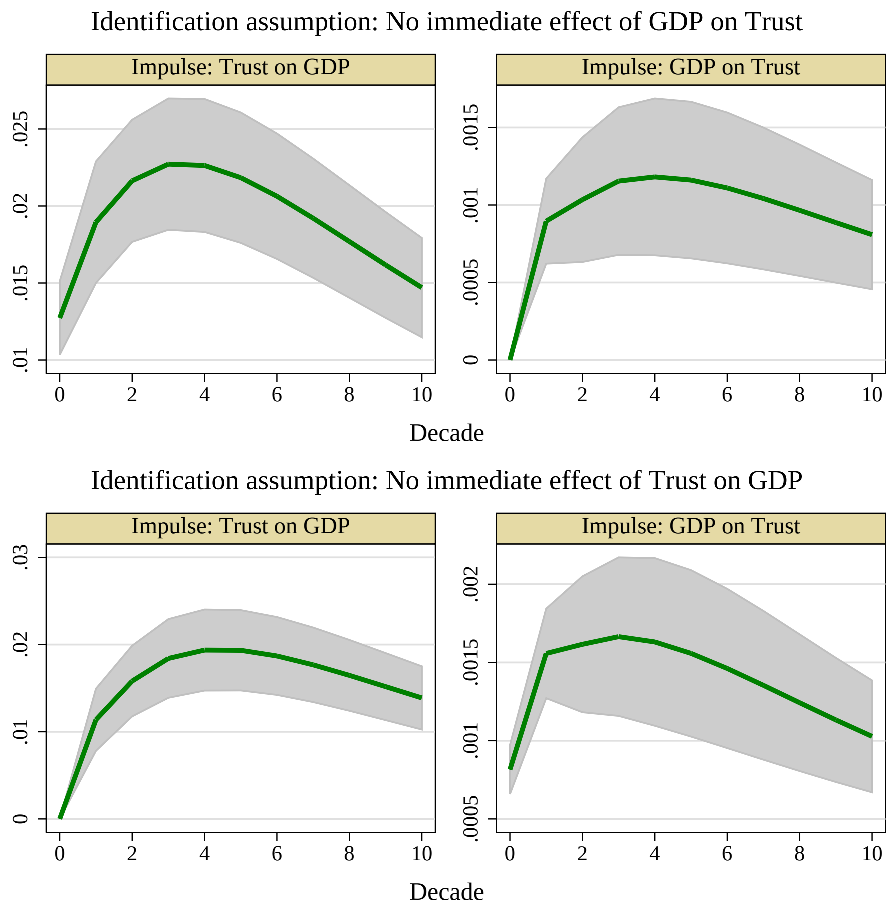
Notes: Shows the relationship between economic variables in the country of origin and the coefficients estimated for large ancestry groups on log county GDP per capita including fixed effects in equation 2.1. The construction of origin GDP is described in Appendix 2.6. Arrival density is based on author calculations from Department of Homeland Security [39]. State History is from Putterman and Weil [74] and excludes origins that were heavily settled by migrants (the Americas). We use their version 3 with a discount of 5%. Political participation is the percent that could vote in national elections [88], taken as the difference between that group and the US political participation, weighted by the time of arrival with a depreciation rate of 0.2%.

Figure 7: Ancestry and country of origin: Social capital, culture, and human capital



Notes: Shows the relationship between cultural variables in the country of origin and the coefficients estimated for large ancestry groups on log county GDP per capita including fixed effects in equation 2.1. The questions are based on the World Values Survey, see appendix 2.6. Human capital is the difference between years of education in origin and US at the time of arrival. Years of education from van Leeuwen and van Leeuwen-Li [87]. Arrival density is based on author calculations from Department of Homeland Security [39].

Figure 8: Impulse response of log county income and ancestry weighted trust



Notes: Shows impulse responses corresponding to columns 8-9 in Table 4 estimated together as a panel VAR using pvar [1]. The impulses are calculated using two Cholesky decompositions: (1) No immediate effect of GDP on TRUST, but TRUST can immediately affect GDP, (2) No immediate effect of TRUST on GDP, but GDP can immediately affect TRUST. The size of the impulse is the standard deviations of the residuals in each equation. Shaded areas are the 95% confidence intervals based on Monte Carlo simulation.

Table 1: County GDP per capita and individual ancestries

Dependent variable	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
	Log(County group GDP per capita)								
Log(GDP p.c.) at t-1				0.401***	0.254***				0.381***
				(0.00653)	(0.00700)				(0.00674)
Literacy							0.555***	0.463***	0.321***
							(0.0335)	(0.0332)	(0.0342)
Years education							0.0718***	0.0314***	0.0234***
							(0.00454)	(0.00481)	(0.00421)
Log(density)								0.0896***	0.0292***
								(0.00395)	(0.00382)
F(All ancestry =0)	136.5	53.86	26.14	33.85	13.27	14.52	46.47	51.91	30.54
p-value	0	0	0	0	0	0	0	0	0
F(non-AA anc. =0)	80.27	45.12	23.62	20.78	12.04	12.07	42.98	43.15	20.96
p-value	0	0	0	0	0	0	0	0	0
State X Year	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
County group trends	No	No	Yes	No	Yes	Yes	No	No	No
Lag Ancestry	No	No	No	No	No	Yes	No	No	No
R^2 (within)	0.962	0.972	0.979	0.980	0.984	0.981	0.972	0.973	0.980
R^2 (between)	0.517	0.632	0.00872	0.831	0.0446	0.0265	0.703	0.769	0.881
Observations	18,444	18,444	18,444	17,295	17,295	17,404	18,216	18,207	17,061
County groups	1,151	1,151	1,151	1,151	1,151	1,151	1,151	1,148	1,148

Notes: The F-tests test the joint hypothesis that all ancestries (except English, the excluded group) are jointly zero. The Non-AA F tests whether all ancestries except African Americans and Native Americans are jointly insignificant. All regression contain fixed effects for year and county group. *** p<0.01, ** p<0.05, * p<0.1.

Table 2: County GDP per capita and country-of-origin characteristics

Ancestry weighted	Log(County group GDP per capita)					
Variables	Each cell from a separate estimation					
One at a time	FE	FE	FE	NO FE	DYN FE	IV DYN FE
Log origin GDP/US	0.223***	0.532***	-0.101	-0.255***	0.279***	0.327***
on arrival	(0.0547)	(0.0478)	(0.0683)	(0.0714)	(0.0220)	(0.0116)
Origin GDP/US ratio	0.113**	0.646***	-0.328***	-0.441***	0.343***	0.428***
on arrival	(0.0555)	(0.0728)	(0.0888)	(0.121)	(0.0322)	(0.0186)
1870 GDP weighted	0.304***	0.735***	-0.111	-0.343**	0.363***	0.430***
by county AV	(0.0817)	(0.0745)	(0.116)	(0.143)	(0.0315)	(0.0177)
Migrant education/US	-0.151	1.215***	-1.676***	-0.784*	1.170***	1.305***
ratio at arrival	(0.195)	(0.169)	(0.296)	(0.397)	(0.103)	(0.0501)
Origin education/US	0.411***	1.144***	-0.462**	-0.484**	0.646***	0.743***
ratio at arrival	(0.120)	(0.141)	(0.184)	(0.188)	(0.0627)	(0.0304)
State history in 1500	0.968***	2.281***	-0.474	-0.870***	1.183***	1.482***
	(0.234)	(0.248)	(0.310)	(0.272)	(0.118)	(0.0601)
Arrival political	0.0104	0.0631***	-0.0371***	-0.0419***	0.0310***	0.0356***
participation	(0.00720)	(0.00673)	(0.0126)	(0.00898)	(0.00224)	(0.00146)
Trust	2.524***	4.254***	1.573***	-0.801**	2.190***	2.425***
	(0.430)	(0.394)	(0.538)	(0.398)	(0.186)	(0.0792)
Obedience	-2.175***	-2.944***	-2.894***	-0.607**	-1.522***	-1.584***
	(0.216)	(0.293)	(0.391)	(0.269)	(0.129)	(0.0541)
Respect	-0.532	4.379***	-2.474***	-5.196***	2.538***	3.568***
	(0.543)	(0.961)	(0.683)	(1.927)	(0.469)	(0.235)
Control	-0.687***	-0.289	-0.275**	-0.779***	-0.249***	-0.203***
	(0.139)	(0.206)	(0.129)	(0.101)	(0.0701)	(0.0356)
Principal comp.	0.946***	1.505***	1.035***	-0.230*	0.787***	0.860***
culture	(0.137)	(0.134)	(0.194)	(0.129)	(0.0564)	(0.0271)
Thrift	3.781***	1.935**	2.113***	3.449***	1.401***	1.414***
	(0.506)	(0.868)	(0.426)	(0.892)	(0.291)	(0.146)
Observations	16,713	16,713	16,704	16,713	14,419	14,393
Year X State FE		Yes	Yes	Yes		
Other controls			Yes			
Lags of county GDP					Yes	Yes
Count group FE	Yes	Yes	Yes	Yes	Yes	Yes
County groups	1151	1151	1151	1151	1151	1151

Notes: Other controls include the fraction African American, the fraction Native American, and the log population density. All regressions include county group effects and either state-year or state and year effects and errors are allowed to cluster at the state level (except in the IV regressions). All independent variables are constructed at the county group level by weighted country-of-origin characteristics by the ancestry vector as in equation 2.3. The Dynamic Fixed Effects column includes two lags of Log county GDP. In the IV column, the instrument is the variable constructed using ancestry based on settlement patterns in the past, and each regression includes two lags of the dependent variable. *** p<0.01, ** p<0.05, * p<0.1.

Table 3: County GDP per capita and combined country-of-origin characteristics

Dependent variable	Log(County group GDP per capita)								
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Trust	3.980***	4.303***	3.259***	2.636***	3.842***	4.005***	3.370***	2.951***	5.420***
	(0.500)	(0.655)	(0.746)	(0.798)	(0.476)	(0.590)	(0.788)	(0.825)	(0.519)
State history	0.724**	0.540	0.626*	0.136	0.634*	0.124	0.632*	0.0579	0.351
in 1500	(0.325)	(0.352)	(0.350)	(0.263)	(0.340)	(0.319)	(0.346)	(0.261)	(0.332)
Migrant educ./US	-0.283	-1.883***	-0.337	-1.908***	-0.181	-1.676***	-0.286	-1.748***	-0.979***
ratio at arrival ($\delta = 0$)	(0.206)	(0.243)	(0.203)	(0.239)	(0.223)	(0.251)	(0.215)	(0.243)	(0.294)
Thrift					0.946	2.514***	0.396	1.573***	-2.081
					(0.620)	(0.389)	(0.627)	(0.396)	(1.944)
Log pop. density			0.0343*	0.0589***			0.0340*	0.0556***	
			(0.0179)	(0.0113)			(0.0182)	(0.0112)	
Frac. African American			-0.411	-0.969***			-0.313	-0.656**	
			(0.323)	(0.309)			(0.317)	(0.325)	
Frac. Native American			0.586***	0.524**			0.603***	0.616***	
			(0.214)	(0.215)			(0.219)	(0.216)	
Observations	16,713	16,713	16,704	16,704	16,713	16,713	16,704	16,704	16,536
R-squared	0.962	0.973	0.962	0.974	0.962	0.974	0.962	0.974	
State X Year FE	No	Yes	No	Yes	No	Yes	No	Yes	No
Instrument	No	No	No	No	No	No	No	No	Yes
County groups	1151	1151	1148	1148	1151	1151	1148	1148	1151

Notes: Italics indicate the variable is ancestry weighted at the county group level as in equation 2.3. All regressions include county group effects and and standard errors are allowed to cluster at the state level.. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: GMM estimates of the dynamic effects of ancestry weighted Trust

	Single equation GMM					FE	IV	Bivariate VAR	
Dependent	Log(County group GDP per capita)							GDP	*Trust*
Variable	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Trust	1.347***	1.630***	4.552**	1.387***		2.190***	2.425***		
	(0.204)	(0.390)	(2.204)	(0.198)		(0.0680)	(0.0792)		
Decade lag			-2.609		1.271***			1.276***	0.807***
Trust			(1.832)		(0.222)			(0.226)	(0.0258)
Two decade lag			-0.182		0.0225			-0.0108	0.0486**
Trust			(0.200)		(0.168)			(0.152)	(0.0218)
Decade lag	0.624***	0.608***	0.595***	0.626***	0.637***	0.525***	0.520***	0.591***	0.00643***
log county GDP	(0.0178)	(0.0273)	(0.0305)	(0.0179)	(0.0165)	(0.00767)	(0.00786)	(0.0192)	(0.00105)
Two decade lag	0.114***	0.0705***	0.112***	0.110***	0.110***	0.0540***	0.0493***	0.0943***	-0.00157**
log county GDP	(0.0122)	(0.0154)	(0.0116)	(0.0116)	(0.0118)	(0.00700)	(0.00707)	(0.0115)	(0.000698)
Long-run effect	5.14	5.07	6.01	5.25	5.11	5.20	5.63		
Observations	13,268	13,257	13,211	13,268	13,227	13,268	13,242	13,223	13,223
County groups	1,147	1,147	1,147	1,147	1,147	1,147	1,147	1,147	1,147
Add. Inst				Past			Past		
Transform	FOD	FD	FOD	FOD	FOD	FE	FE	FOD	FOD
GMM instruments	1/2	2/3	1/3	1/2	1/2			1/2	1/2
AB AR(1) in diff.	0	0	0	0	0	0	0		
AB AR(2) in diff.	0.146	0.240	0.207	0.233	0.291	0.134	0.0748		
Hansen over id.	0.938	0.889	0.892	0.491	0.323				

Notes: Italics indicate the variable is ancestry weighted at the county group level as in equation 2.3. All regressions include year effects and remove county group fixed effect either by Forward Orthogonal Deviations (FOD), First Difference (FD) or Fixed Effect (FE). The lags of the instruments are reported in the table under GMM instruments. All endogenous variables have the same instruments. AB AR(1) and AR(2) report the p-values of the Arellano and Bond [14] test for serial correlation in first and second differences. The Hansen over id. reports the p-value for the Hansen test of over-identifying restrictions when the equation is over-identified. The Additional Instrument is the past ancestry augment with national level ancestry growth as discussed in Section 2.5.5. Columns 1-5 are estimated in Stata as single equation GMM using xtabond2 with the collapse option [75], column 6 is estimated using the within estimator, column 7 the within estimator and two stage IV, while columns 8-9 are estimated together as a panel VAR using pvar [1]. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: County GDP per capita and diversity

Dependent variable	Log(County group income per capita)							
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
Trust	2.075***	2.832***	3.126***	2.758***	2.154***	2.821***	2.504***	2.238***
	(0.442)	(0.452)	(0.598)	(0.579)	(0.407)	(0.454)	(0.687)	(0.590)
Fractionalization	1.153***	1.350***	1.402***	1.242***	3.718***	2.453***	3.927***	3.246***
	(0.185)	(0.180)	(0.248)	(0.248)	(0.762)	(0.638)	(0.727)	(0.556)
Trust weighted	-2.791***	-2.304***	-3.286***	-2.295***	-4.979***	-1.546*	-4.751***	-1.424
fractionalization	(0.481)	(0.357)	(0.503)	(0.410)	(1.168)	(0.858)	(1.246)	(0.879)
State history	0.227	0.000957	0.632*	0.125	0.174	-0.0398	0.378	-0.156
in 1500	(0.321)	(0.281)	(0.356)	(0.263)	(0.343)	(0.286)	(0.372)	(0.256)
Migrant educ./US	-0.161	-1.645***	-0.0746	-1.567***	-0.446**	-1.672***	-0.434*	-1.735***
ratio at arrival ($\delta = 0$)	(0.190)	(0.212)	(0.222)	(0.199)	(0.204)	(0.225)	(0.220)	(0.219)
Fractionalization^2					-1.882***	-0.905**	-2.038***	-1.735***
					(0.558)	(0.426)	(0.583)	(0.431)
(Trust weighted					6.793**	-2.130	5.788**	-1.623
fractionalization)^2					(2.673)	(2.294)	(2.810)	(2.245)
Observations	16,713	16,713	16,704	16,704	16,713	16,713	16,704	16,704
R-squared	0.964	0.974	0.965	0.975	0.965	0.975	0.965	0.975
State X Year	No	Yes	No	Yes	No	Yes	No	Yes
County group FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other Controls	No	No	Yes	Yes	No	No	Yes	Yes
County groups	1151	1151	1148	1148	1151	1151	1148	1148

Notes: Italics indicate the variable is ancestry weighted at the county group level as in equation 2.3. All regressions include county group effects and standard errors are allowed to cluster at the state level. The creation of fractionalization and weighted fractionalization is described in section 2.5.6. Other controls include the fraction African American, Native American, and log population density. *** p<0.01, ** p<0.05, * p<0.1.

Appendix for:

Does It Matter Where You Came From? Ancestry Composition and Economic Performance of US Counties, 1850 - 2010

Scott L. Fulford, Ivan Petkov, and Fabio Schiantarelli

Not for publication

Constructing the Ancestry Vector (AV)

The AV for those who are not African American or indigenous

Approach for 1790-1840 when information is limited. The first census in 1790 collected some information by state on "nationality" but none of the censuses until 1850 collected such information. We use the 1790 census to create the initial state level nationality vector. The census did not collect nationality information again until 1850, so for the initial step we simply allocate the AV for each year between 1800 and 1820 based on the nationality in 1790. One nationality in 1790 is "Hebrew" although it is very small in all cases. We combine Hebrew with German.

From 1820 to 1830 and 1830 to 1840 the government started collecting information on immigrants, their country of origin and the state where they moved [18]. We use these values to update the 1790 ancestry vector to account for the immigration flows during these two decades.

Approach for 1850, 1860, 1870, 1980, 1990, and 2000 when no parent data exists, but we have individual data on nativity. Starting in 1850 the census asked the country of birth for those born outside the United States and the state of birth for those born within. Samples from the records have been collected and digitized and are stored in the Integrated Public Use Microdata Series (IPUMS) collected by Ruggles et al. [76]. For most years the sample was 1 in 100 but larger samples (5%) exist for some years and we use those where possible.

For each person in the microsample, we create an ancestry vector. The person receives a one for the place of birth if he or she is from that foreign country. Starting in 1880 the census also recorded the place of an individuals parents. We describe how we use this information below. Without the parent information, for non-immigrants we use the demographic structure attributing to an individual the AV for the age group between 20 or 30 in the place of birth at the time of her birth. Using those who are 20-30 year older means we attribute to a person the AV of the age group most likely to be her parents. For a non-immigrant who lives in the same state as she was born, we attribute to her the AV for those who were 20-30 in the county where she lives now as of the closest census to her birth. This age group is in their most fertile years and so are the most likely to be her parents. We give non-immigrants who have moved the AV for 20-30 year olds from their state of birth as of the closest census to their birth.

During a period of rapid immigration keeping track of the changing demographics matters. For example, consider someone who was 30 years old in the 1870 census and was born in Suffolk county, Massachusetts which contains Boston. We would not want to give a large probability that she had an Irish ancestry, since there was not yet a large Irish presence in 1840. On the other hand, a 10 year old in 1870 would be much more likely to have an Irish ancestry The combination of more Irish, and more Irish in the 20-30 age group makes Irish ancestry more likely. We create the county average over all individuals to give AV for county and state in that year, as well as the the AV for those age 20-30 (the "parent" AV). Since we have only state level variation until 1850, 1860 is the first year where the parent AV will differ by county. In later years as we move forward with additional microdata, counties become increasingly diverse.

Approach for 1880 to 1970 using parent nativity. From 1880 to 1970 the census also collected information on the birthplace of the parents of each person in the census. We use the same procedure when only the individual birth place is known for the parents, and then give the individual one half of each parent's AV. So $AV_i = 0.5AV(Mother_i) + 0.5AV(Father_i)$. For the foreign born parents we assign them an AV with 1 for the country of birth and zero elsewhere. For native parents, we assign the parent the AV for the age group 20-30 in each parent's state of birth in the closest census of birth. If the parent is born in the same state the individual is living in now, we assign the parents the county AV for those 20-30 in the birth year. It is common for both parents to be from the same country, in which case the AV is just 1 in the country of origin of both parents.

Approach for 1890 when no individual data exists. Because a fire wiped out all of the individual level 1890 records, we have to use aggregate data published by the census for this year. The NHGIS [66] has collected county level information for a wide range of variables in a number of census years, including 1890, from the published census volumes. These record the place of birth of the foreign born population. For each county the AV is: $AV(\text{County}) = (\text{Fraction Foreign}) * AV(\text{Foreign Born}) + (\text{Fraction Native}) * AV(\text{Natives})$.

Forming the non-immigrant AV is more difficult, since the place of birth is only available at the state level. We use the demographic structure by state in 1880 aged by 10 years to assign weights for birth years—the fraction of the native population born closest to the 1880 census, the 1870 census and so on. Then we assign the native AV over all states as the double sum over state s birthplace (BPL) and year of birth for each age group d:

$$AV(\text{Native born in state}_j) = \sum_{s=1}^{S} \sum_{d=0}^{D} f_{s,j} f_{d,j} AV(s, \text{birthyear of } d)$$

where $f_{s,j}$ is the fraction of the native population in state j born in state s and $f_{d,j}$ is the fraction of birth group d in state j as constructed from 1880.

Approach for 1940. The 1940 census introduced for what appears to be the first time supplemental questions that were asked to only a subset of the population. We will use the question about ancestry in the supplement. The Public Use Microdata Sample then took a sample from the people who answered the supplemental question and their households. Since that would tend to over-sample large households, they first sampled people who had been selected to answer the supplemental question, and then selected the households of that person with probability equal to the inverse of household size. It is an elegant solution since it gave a representative sample of the entire population and ensured that every household had one person who had answered the supplemental questions. The procedure means that selecting only those who have answered the supplemental questions is no longer representative. We use the sample weights to adjust for the sampling procedure.

African Americans and indigenous peoples

Race is a very important and sensitive issue in the US, and the evidence suggests that it is not nearly as fixed a concept as is sometimes believed. Since we are primarily interested in the relationship that culture and institutions have with economic outcomes, forced migration and slavery are one potential source of a particular set of culture and institutions. We therefore treat self-identified "black" and "white" as non-mixing groups which contains separate ancestries within them. Within "blacks" we then distinguish between the descendants of ancestors who were brought from Africa as slaves—whom we refer to as African American—and later African migrants from countries such as Nigeria or "black" migrants from the Caribbean. African Americans represent by far the largest group.

Treating the combined African ancestries as a separate non-mixing group ignores many complexities of race in America, but we think it is closer to capturing the experience of race in US history. In the long and racist history of the United States, the societal rules have tended to make "black" an absorbing state and actively worked to prevent intermarriage. The rape of slave women was widespread [62, pp. 124-5], and so many African Americans are the partially descendants of slave holders. Yet children of "black" mothers were still considered "black" and were still slaves [58]. After the Civil War, interracial marriage was still illegal in 17 states in 1967 when the US Supreme Court struck down anti-miscegenation laws [60, p. 62]. Such laws had the unseemly consequence that made it legally necessary to define who was prohibited from marrying whom by virtue of their "blood" [77]. The strictest rule held that "one drop" of blood of African ancestry made someone "black," although the enforcement was not universal and less strict rules also existed [60]. Partly as a consequence of this history, intermarriage between "blacks" and "whites" were uncommon until very recently. Intermarriage among all races represented just 3.2% of marriages in 1980 and 8.4% in 2010 [89]. Further, intermarriage is not necessarily a problem in constructing aggregate county ancestry if the children of mixed race couples do not systematically report themselves as one race or the other.

Similar to African Americans, we treat Native Americans as their own ancestry group. Partly due to the legacy of forced settlement into reservations, some counties have a large presence of Native Americans. They are not always recorded well in the early censuses. Where possible, we take self-identified natives as their own ancestry group and assume no mixing. Except for counties with reservations, they are typically a small portion of the population, so this assumption is not particularly important.

On mixing

Our procedure does not distinguish between complete ancestry mixing and the full separation of ancestries that share the same geography. For example, in a population half German and half Irish, the second generation will have an AV half German and half Irish whether or not all of the Germans marry Germans and all of the Irish marry Irish or there is inter-marriage between Irish and Germans. The AV is thus the appropriate estimate of the expected ancestry of any individual from that population, but does not provide a measure of cultural mixing, only of co-location. For African Americans the use of race assumes that they are fully African American.

Aggregation and PUMAs

To protect anonymity, from 1950 onwards the microdata does not typically give counties for the individual records. Usually there is some geographic identifier that combines several counties, although in 1960 only state level information is available. We therefore use the somewhat larger units available in each year to update the county level, but maintain the county as the basic unit of observation. The basic idea is that counties within a group will have a different history and different AV from when we can fully identify them from 1940 and earlier. The new information from each post-1940 census is the same within each group but is applied to an already existing AV. Finally, we aggregate the constructed county level data up to the 1980 Public Use Micro Areas (PUMAs) since these are the most consistently used areas after 1950. In keeping with the terminology starting in 1950, we refer to these somewhat larger aggregates as county groups.[30]

[30]See `https://usa.ipums.org/usa/volii/tgeotools.shtml` for a description of the geographic identifiers used over time.

Constructing county GDP

County manufacturing and agricultural value added 1850-1940

The census recorded for each county the total value of agricultural output and the value of manufacturing output and costs of inputs. We construct nominal value added of manufacturing by subtracting the cost of inputs from the total output. In 1850, the census did not collect manufacturing inputs. We use the average of the 1860 and 1870 county level ratio of outputs to inputs in manufacturing to create inputs. This approach assumes that at a county level the same ratio of inputs to outputs is used in 1850 as in 1860 and 1870.

For agriculture during this period the only local measures that exist are of output, not value added. No good measure at the county level exists of the costs of inputs in agriculture over a long period. Agriculture does have intermediate inputs such as fertilizers as well as agriculture inputs used in the production of other agricultural outputs such a feed corn for cattle and seed. To account for these inputs, we construct a national measure of the ratio of value added to total output by subtracting intermediate inputs from total agricultural output using series K 220 -250 from U.S. Census Bureau [86]. While intermediate inputs were small early on at about 6% in 1850, increasing to nearly 12% by 1900, by 1940 they were nearly 40%. Adjusting for intermediate inputs hastens the relative decline of agriculture after 1900. We apply the ratio between nominal value added and output at the national level to the value of county level agricultural output to obtain an estimate of agricultural value added at the county level.

The census did not collect manufacturing data in 1910, although estimates of it exist at a national level. To create county level manufacturing, we interpolate between 1900 and 1920 using the national growth in manufacturing value added and allocating growth to each decade in the same way we allocated growth in services so that manufacturing value added grows in each decade in each county at the same rate it does at the national level.

Using county employment 1850-1940 to construct value added in services, mining and construction

The micro-samples of the decadal census collect information on the occupation codes of the individuals. We allocate the occupations to correspond to the broad NIPA categories, and so create a measure of the total workers employed in a give industry in each decade. Then we create county level measures of services value added by multiplying county level employment for each service category (trade, transportation and public utilities, finance, professional services, personal services, and government) by the national measure of value added per employee,the construction of which is detailed below. We follow the same procedure for construction and mining.

There are several important difficulties with creating county employment: occupations change over time and some occupations such as legal services that may be classified as a service for an individual are part of manufacturing value added when performed for a manufacturing firm.

In addition, the sexism and racism inherent in the early censuses poses additional difficulties. In 1850 women were not coded as having an occupation. While many women did work solely in domestic production, some women were employed outside the home. Similarly, in 1850 and 1860, slaves were not listed as having an occupation. While both slaves and women were enumerated for political purposes, we do not have information on their occupation. Many, but not all, of the slaves would have been employed in agricultural production, either directly or indirectly so we are not missing their output entirely, only undervaluing the skilled services they did provide.

Since the physical census records from 1890 were largely destroyed by fire, there is no micro-sample from 1890. We linearly interpolate for each county the employment by industry category in 1890 using 1880 and 1900.

Measures of services, mining, and construction at the national level 1850-1960

The construction of value added for services, mining and construction varies by sub-period depending on the information available

Value added per worker by services category 1840-1900. Gallman and Weiss [46] construct measures of services value added and employment for eight categories at a national level from 1840 to 1900: trade; transportation and public utilities; finance professional services, personal services, government, education, and "hand trades." Hand trades are composed of smithing, shoe repair, and tailoring. These activities are technically manufacturing (they are constructed by hand or *manus*), but by the time formal national accounts were constructed in the 1950s had become part of services. Since the census includes output from the hand trades as manufacturing, we exclude them to avoid double counting. Combined with the Gallman and Weiss [46] estimates of the labor force in each category, we create a measure of the value added per worker.

Value added per worker by services category 1930-1960. The National Income and Product Accounts [83] break down by industry the product (p. 104) and "persons engaged in production" (p. 122) which includes full time employees, part-time employees, and the self-employed. Since the census samples we use at the county level do not distinguish between full and part-time work or self-employment, the broad measure best matches the county data we use. We use the equivalent tables in United States Department of Commerce [84] to construct nominal value added per person engaged in production for the post-war period.

Constructing value added for services in 1910 and 1920. No estimates connect the Gallman and Weiss [46] and United States Department of Commerce [83] estimates of services value added by category. Since our goal is to correctly capture the relative value of different services, and their relationship to other productive activities, we interpolate the national value added of service categories in 1910 and 1920 based on 1900 and 1930. Since both prices and real activity increased rapidly over the period, the interpolation method matters. Linear interpolation, for example, is not a good choice because overall growth rates differ by decade. Linear interpolation of current dollar values between 1900 and 1930 tends to overstate growth from 1910 to 1920 since overall real GDP grew faster from 1900 to 1910 than 1910 to 1920 while prices grew faster from 1910 to 1920. So we first convert value added by each service category to real values using the GDP price deflator from Sutch [80]. Then we allocate growth in each decade in each service category from 1900 to 1930 to match the growth of real GDP per capita 1900 to 1930.[31] Note that we do not require the growth in service categories to be the same (some categories had almost no real growth over the period), only that where there is growth the proportion that takes place between 1900 and 1910 be the same as for overall growth. We finally obtain nominal quantities of (national) service value added for 1910 and 1920 by multiplying by the GDP price deflator from Sutch [80].

Value added for construction and mining. We use the values of mining and contract construction from the National Income and Product Accounts in 1930 and 1940 to construct national value added per worker. From 1880 to 1920 we also use the estimates of Wright [91] for mining. From 1850 to 1870 we use the ratio of the value added per worker in mining to the value added in transportation in 1880 times the value added per worker in transportation in 1850, 1860, and 1870. This approach assumes that the value added in transportation and mining grow at the same rate from 1850 to 1870. An important part of the value of mineral and fuel extraction comes

[31] Let y_{1900} be real national GDP per capita in 1900. Then a fraction $f^{y}_{1910-1900} = (y_{1910} - y_{1900})/(y_{1930} - y_{1900})$ of that growth took place between 1900 and 1910. We assume the same fraction of growth in each service category took place between 1900 and 1910. So for some service category s we observe value added per person y^{s}_{1900} and y^{s}_{1930} then we calculate $y^{s}_{1910} = f^{y}_{1910-1900} * (y^{s}_{1930} - y^{s}_{1910})$.

from transporting it to populated areas. Transportation value added per worker grew at close to the same rate as overall national product per person during the period. Our approach for construction is similar but involves even stronger assumptions. Construction value added per worker before 1930 is simply its ratio to national income per person in 1930 and 1940. This approach assumes that construction value added grows at the same rate as the national economy, and that employment in construction is a good measure of the distribution of construction activity. Construction is a relatively small component of GDP—it composed only 5% of national product in 1950 and our estimates suggest it was smaller before that—and this approach puts a reasonable value on construction.

Income per capita 1950-2010

Starting in 1950 official statistics report measures of personal income per capita at the county level. We combine the county level income data from the County Data Books [85] with the county income from the census in 1980, 1990, 2000, and the combined 2008-2012 American Community Survey collected by Minnesota Population Center [66]. In 1950, the census only reported median household income at the county level, while in other years we have mean income per person. To account for this discrepancy we multiply the 1950 median household income by the mean income to median income ratio in 1960 for each county. This approach is exactly correct if growth from 1950 to 1960 was entirely mean shifting, leaving the distribution unchanged, and family sizes did not change.

County output 1950 and 1960

Starting in 1950, the census micro-samples no longer report the current county of residence so it is no longer possible to construct county employment shares by industry. The City and County Databooks [85] provide measures of employment in 1950 and

1960, as well as manufacturing and agricultural products sold.

The manufacturing values in the the Databooks are reported as value added in 1947, 1954, 1958, and 1963. Rather than taking the linear average, which misses the rapid growth during the period, we take the average growth rate in each county from 1947 to 1954, and use the county specific growth rate for three years starting in 1947. We use the same method to update 1958.

The agriculture values in the Databooks give the total value of farm products sold in 1950 and 1959 which we use to construct agriculture in 1960 by multiplying the county value by the nominal national increase in the total output in agriculture from 1959 to 1960 in series K 220-239 in U.S. Census Bureau [86]. Since these values do not include farm products consumed by farm households, we adjust both for value added and consumption using series K 220-239 in U.S. Census Bureau [86]. Own consumption was slightly more than 6% of total farm output in 1950. Of much larger importance is the value of intermediate inputs which were close to 40% of total output in 1950.

The Databooks report "Mining Industries Employees" in 1939 which we use for 1940 without adjustment, and 1958 and 1963 which we apply to 1960 by taking the county specific linear average. The Databooks report a value added measure of mining in 1963, but we continue to use the employment based measure for consistency with earlier estimates.

In 1950 and 1960, the Databooks report the employees in construction; manufacturing; transportation and public utilities; wholesale and retail trade; finance, insurance, and real estate; and overall employment. The reporting in the Databooks for some counties is problematic, since some counties have more employment listed in a given category than overall. To create a less error filled employment variable, we take the larger of civilian and total employment (total employment is not always larger). Personal and professional employees are only reported in 1950, and government employees only in 1970. We use overall employment to construct a residual government and personal employment in 1950 and 1960 by subtracting out the other categories and setting the residual to zero if it would be negative. The residual in 1960 contains both government and personal services, we divide between them using the fraction of personal in personal and government services in 1950.

With employment totals we find a value added of services using the same method as for 1940 and earlier. Using Tables 6.1B for national income by industry and 6.8B "Persons engaged in production" in United States Department of Commerce [84] gives an average product per employee per industry which combine with employment by industry in each county to create a measure of value added by county by industry.

Combining income and output measures

From 1850 to 1960 we have created something close to GDP per capita for each county. Starting in 1950 we have an income based measure from the census. These two measures are not the same; in each decade from 1950 to 2010, the sum of county aggregate incomes from the census is less than GDP from the national accounts. Income leaves out a number of categories such as owner occupied rent that are included in GDP. A a county level, moreover, income, which can include profits from activities elsewhere, need not be the same as a measure of the gross domestic product produced in a county. We use the overlap of our income measure and GDP measure in 1950 to combine the two series to create a measure of GDP per capita over the entire time period. We use the ratio of GDP to income in 1950 and update using the county income after that. Effectively, we use the growth rate of personal income at the county level to approximate the growth rate of county level GDP after 1950. Some counties have GDP-to-income ratios that are extreme because the constructed value of county GDP is low. We replace the five counties with a GDP-to-income ratio less that 0.3 with their state average ratio.

Finally, we deflate our constructed measure of county level nominal GDP by the GDP deflator in Sutch [80], updated using Bureau of Economic Analysis tables on GDP and the GDP deflator.

Creating a density of arrival times

Immigrants arrived at different times and we would like to reflect what immigrants brought with them by the conditions in their country of origin at the time of immigration. Doing so requires knowledge of the conditional density of immigration over time so that, for example, the Irish coming in the 1850s reflect different experiences than the Irish in the 1890s, both of whom are different from the Italians in the 1910s. Our ancestry measure captures very well the stock of people whose ancestors came from a country of origin. Since it is a stock, however, changes in it reflect both increases from migration, but also natural changes from births and deaths. We therefore turn to immigration records that contain the number of migrants arriving from different countries starting in the 1820s [39] at a national level. In 1850 we create a density of arrival times for the stock of migrants in 1850 based on Daniels [37]. The division is appropriately coarse given the limited information, and so only divides between arrivals in 1650, 1700, 1750, 1800, and 1850. For example, we allocate all of the Netherlands arrivals to 1700, and divide the English migrants to between 1650 and 1750 to reflect the later migration of lowland Scots and Scotch-Irish. Using our ancestry vector and county population, we create a stock of total population of ancestry a in time t: P_t^a. The immigration records then record the number of migrants I_{t+1}^a from country a over the decade from t to $t+1$. The density $F_t^a(\tau)$ gives the density of arrival times τ of the descendents of the population of ancestry a at time t (which is by definition 0 for all $\tau > t$ since it is a conditional density). We update it based on immigration records using:

$$F_{t+1}^a(\tau) = \frac{(P_{t+1}^a - I_{t+1}^a)F_{t+1}^a(\tau) + I_{t+1}^a 1(\tau = t+1)}{P_{t+1}^a}, \tag{2.6}$$

where $1(\tau = t+1)$ is an indicator which is one if $\tau = t+1$. This formula updates the density at t by the fraction of new migrants between t and $t+1$ compared to the total stock. For example, the density changes only slightly for the English between 1880 and 1890, despite more than 800,000 migrants because the stock is so large, while the 1.4 million German immigrants significantly shift the arrival density of Germans because of the smaller stock.

We modify this approach slightly for smaller immigrant groups. Immigration records group some countries together and information is not available for all countries. We assign the density of arrival times to similar countries, or from the overall group. For example, we assign the arrival times of "Other Europe" in the immigration records to Iceland. However, the total migration from all of "Other Europe" is larger than our estimates of the population descended from Iceland migrants in most years. We assume that the arrival of migrants is proportional to the larger group (or similar country), and scale the number of migrants so that the population implied by the immigrant records is no larger than the population implied by the census records. In particular, define a projected population that would come from immigration and natural increase from growth rate g:

$$\hat{P}_t^a = \sum_{\tau=t}^{-\infty} (1+g)^{t-\tau} I_\tau^a.$$

$\hat{P}_t^a$ is the population that would occur if all immigrants came and then grew in population at growth rate g. Then define:

$$\omega^a = \max_t \frac{\hat{P}_t^a}{P_t^a}$$

as the maximum ratio of the projected population based on the (too large) immigration records and the population descended from group a. We then define the scaled immigration of the particular group as $\hat{I}_t^a = I_t^a / \omega^a$ which scales the number of migrants to the overall population of that group.[32]

[32]The procedure is slightly more complicated for small countries where measurement error in either

Austria-Hungary and its constituent countries pose a special problem. At least some Czech and Slovak migration (which are record together as Czechoslovakia) appears to be part of the Austrian migration in the immigration records since our ancestry calculations suggest a substantial Czechoslovakia presence from 1900 to 1920, while the immigration records show few migrants. Similarly, Poland was divided among Austria, Hungary, Germany, and Russia in the decades ending in 1900, 1910, and 1920 during a period of peak migration. We assign a fraction of Austrian migration to Czechoslovakia, and a portion of German, Hungarian, and Russian migration to Poland. The fractions are approximate based on the relative populations in 1910.

Several groups have a special set of arrival times that are more or less by assumption. We assign African Americans an arrival of 1750. Significant groups of Native Americans are first counted in the census or forced to move to new areas after 1850. We assign them an "arrival" of 1840, acknowledging that giving an indigenous group an arrival time is problematic, but think of it as representing an approximate density of the start of substantial contact with other groups, with all of its many, often negative, consequences. Puerto Rico similarly represents a complicated situation since Puerto Rican's have been US. citizens since 1917, but the data used to track Puerto Rico the same way as the rest of the US counties is only sporadically available. We allocate a small mainland migration in 1910 and a much larger one in 1960 to match the ancestry population totals.

While the density is approximate it still provides very useful information that matches immigration narratives. For example, the 2010 density gives the average decade of arrival for each ancestry living in 2010. Most Irish are descended from immigrants who arrived in the 1840s, with substantial populations in the 1850s and

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our measure based on samples from the census, or immigration statistics can produce very large ω^a. We define ω^a as the maximum ratio of projected to census population when the census population is at least 100,000. If the ancestry never reaches 100,000, we still use the overall maximum. Finally, if this procedure produces an immigration flow larger than our projected population, we set the density equal to 1 in that year.

1860s, but few afterwards compared to the large population. Based on these calculations, more people of Chinese ancestry are descended from people who migrated from 1860 - 1880 than the second wave of Chinese migration from 1970-2010. Far more migrants came later, but the early migrants had already established a population which grew over time and which we track geographically with the census calculations. Other Asian migrants have come mostly since 1970, except the Japanese who are mostly descended from early migrants.

Constructing country of origin measures

Origin Country GDP

This section briefly details how we fill in the gaps left in origin country GDP per capita in the Bolt and van Zanden [26] update of Maddison [63]. Some crucial countries of origin are not available for all dates going back although some information is available. We fill in missing data by making reasonable assumptions about the likely relationship within other countries or the same country on surrounding dates. The most important of these is Ireland which did not obtain independence until 1921, and has only spotty estimates of income separate from the United Kingdom. We use the ratio of Irish to UK GDP in 1921 to fill in dates from 1880 to 1920, and the ratio of Irish to UK in 1870 to fill in dates before that. While this approach will clearly miss Irish specific events such as the potato blight, our goal is to get the relative incomes appropriately.

Little information is available for countries in Africa. Ghana, a British colony, has estimates in 1913 and 1870 and yearly starting in 1950 (Ghana was the first African country to achieve independence in 1957). We linearly interpolate between 1870, 1913, and 1950, but since the value in 1870 is close to subsistence (439 in 1990 $) we set 1850 and 1860 to 439.

The West Indies is a birthplace for a substantial portion of the population in some areas early on. We use the post-1950 Maddison numbers for the Caribbean. We take the ratio of the Caribbean to Jamaica between 1913 and 1950 when there are no overall Caribbean numbers listed, interpolate between years 1900 to 1913, and again use the ratio of Caribbean to Jamaica between 1900 and 1870, and again prior to 1870.

Latvia, Lithuania, and Estonia have some early migration (small overall). They are combined where there is data on them separately, but we use the ratio with overall Eastern Europe to go back earlier.

Puerto Rico has a special status. It has been a US possession since 1898, and after 1950 there was significant migration to the mainland. We treat Puerto Rico as a separate ancestry recognizing its distinct culture. The ancestors of Puerto Ricans appear to be a combination of Spanish, Africans brought as slaves, and a mix of other immigrants. We assign Puerto Rico its own GDP after 1950, but before that give it the Caribbean GDP adjusted for the Puerto Rico-to-Caribbean ratio in 1950.

The Pacific Islands (a birthplace in the census) as well as American Somoa represent a similar problem to Puerto Rico. We create a Pacific Islands (including Somoa) GDP per capita by taking the ratio of Fiji and Indonesia in 2010 (source: World Bank, 2010 International $PPP) and using the Indonesian GDP going back in time.

We create Latin America GDP before 1870 as the ratio of Argentina, Brazil, and Colombia in 1870 times their average before that. Mexico is always separate, so Latin America excludes Mexico as an ancestry.

Israel is complicated in the past since it had substantial migration to create the modern state. We assign the Lebanon GDP to Israel/Palestine before 1950. Note that Jewish migration from Europe to the US is measured as the country of origin in Europe.

Afghanistan has the India GDP in 1870, and its own after 1950.

For smaller countries (with comparably small migrations) where information is missing we assign them to a comparable larger country. We assign Lichtenstein, Monaco, and Andorra the French GDP; San Marino, Vatican City, Malta, and Cyprus the Italian GDP; Gibraltar the Spain GDP; Lapland n.s. the Finland GDP. All of Eastern Europe n.s., Central Europe n.s., Eastern Europe n.s., and Southern Europe n.s. get the Eastern Europe overall GDP.

Culture Measures from the World Values Survey

We construct measures of several cultural attitudes from the European Values Survey and the World Values Survey. We use an integrated version of the survey that combines both sources and utilized each of the six waves available between 1981 and 2014. The cultural endowment is inferred from the answers to six survey questions:

Trust: A measure of generalized trust is estimated from the responses to the question: "Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?" We calculate the proportion of the total respondents from a given nationality that answer that "most people can be trusted." An alternative response to this question is that one "can't be too careful."

Control: As a measure of the attitude towards one's control over personal circumstances we use the answer to the question: "Some people feel they have completely free choice and control over their lives, while other people feel that what they do has no real effect on what happens to them. Please use this scale where 1 means "none at all" and 10 means "a great deal" to indicate how much freedom of choice and control you feel you have over the way your life turns out." In particular, we take the average response by nationality for all countries in our dataset.

Respect, Obedience, and Thrift: To measure the attitude toward authority and towards saving behavior we use the following question from the survey: "Here is a list of qualities that children can be encouraged to learn at home. Which, if any, do you consider to be especially important? Please choose up to five." There are 17 possible qualities listed. We estimate the proportion of people by nationality that respond that "tolerance and respect for other people" is important to measure Respect and the proportion of people that respond that "obedience" is important to measure Obedience. To measure the importance of saving we estimate the proportion of people that respond that "thrift saving money and things" is important.

Holiday: To measure the attitude towards leisure we use the response to the question: “Here are some more aspects of a job that people say are important. Please look at them and tell me which ones you personally think are important in a job?” Similarly to the questions regarding important qualities in children this question has 18 different aspects. We use the fraction of people that respond that “generous holidays” is an important aspect in a job to proxy for the attitude towards leisure.

Following Tabellini [82] we also form the first principal component of the combined attitudes Trust, Control, Respect, and Obedience at the individual level, and then take the average of the principal component for each country.

Immigrant Education

In this section we describe how we measure immigrant education, attempting to capture the human capital compared to the United States at the time, of the immigrants when they arrive. Combined with the density of arrival times, the measure of new immigrant education gives an average arrival weighted education.

The census records the birthplace, so we know the education of immigrants, but does not record the year of arrival. For example, although the census records the Italians who were in the US. in 1910, we do not know which of them arrived between 1900 and 1910. We make the assumption that recent migrants are those who were born in a foreign country and are between 20 and 30 as of the age census. Most of the large waves of migration were primarily among young people, although some migrants brought their families and so came as children. Taking the 20-30 year olds thus mixes some people who came recently with some who may have come as children and so received an their education in the United States. In 1850 we assign the literacy of the 30-40 years olds migrants to the 20-30 year olds migrating in 1830-1840. For 1890 when the census micro-samples were destroyed we assign the literacy of the 30-40 year olds in 1900. For African Americans we use the education level as of 1900 since there were rapid gains in literacy after the civil war which slowed after 1900. For Native

Americans we use the literacy levels as of 1900 which is the first year that Native Americans are recorded extensively.

The micro-samples from the census record the education as well as the birthplace. Before 1940 the census only records literacy, while after that it records years of education. Since we want to create a measure that captures the average relative education of migrants, we must combine these disparate measures so that we can compare the relative education of later migrants with early ones. We take the ratio of the 20-30 migrant literacy for each ancestry to the non-migrant US education of 20-30 year olds before 1940, and use years of education starting in 1940.

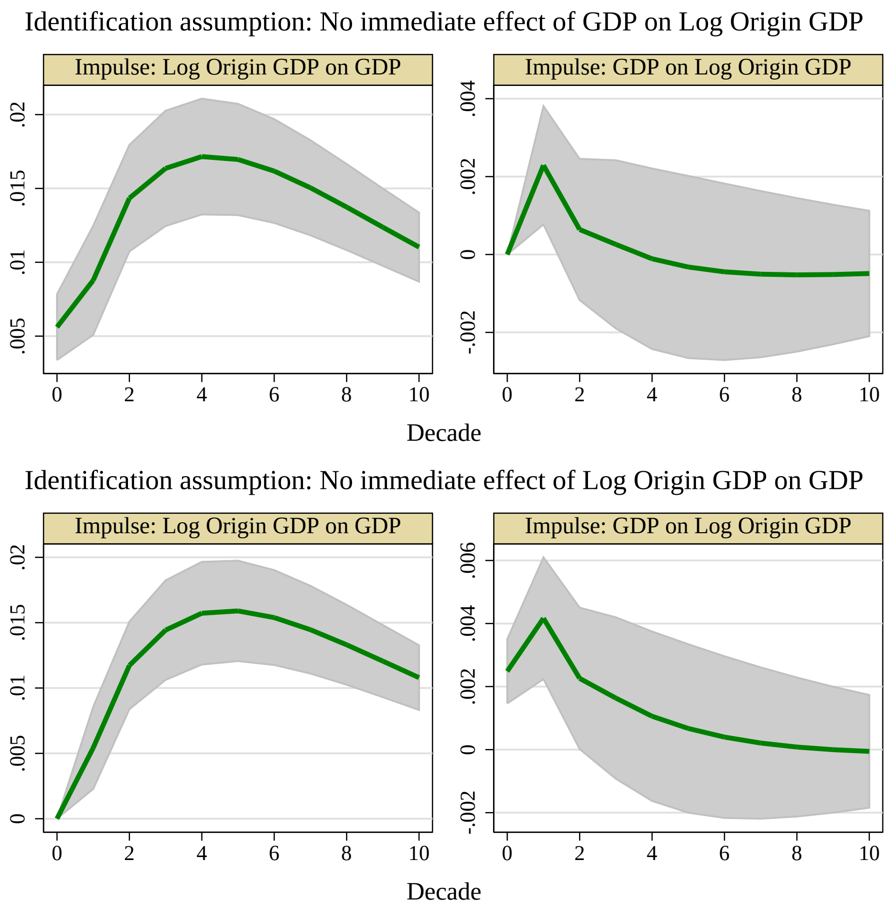
With no adjustment this procedure assumes that the ratio of years of education is the same as the ratio of literacy. Rather than make this strong assumption, we instead adjust the literacy ratio so that it gives the linear prediction of the years of education ratio. To do this we take the demographic groups that are age 30-40, 40-50, and 50-60 in 1940 for whom we observe their education, and compare the literacy of the same ancestry groups who were 20-30, 30-40, and 40-50 in 1930. Regressing the ratio of each age-ancestry groups years of education to the US (measured in 1940) on the same ratio for literacy (measured in 1930) then gives a prediction of how the ratio to US literacy converts to the ratio to US years of education on average. We use this prediction to adjust the literacy ratios before 1940.

Table A-1: GMM estimates of the dynamic effect of ancestry weighted arrival origin GDP

	Single equation GMM					FE	IV	Bivariate VAR	
Dependent	Log(County group GDP per capita)							GDP	*Origin GDP*
Variable	[1]	[2]	[3]	[4]	[5]	[7]	[7]	[8]	[9]
Log origin GDP/US	0.226***	0.159***	0.107	0.225***		0.279***	0.327***		
on arrival	(0.0244)	(0.0390)	(0.137)	(0.0243)		(0.00995)	(0.0116)		
Decade lag			0.0286		0.106***			0.0869***	0.755***
Log origin GDP			(0.108)		(0.0286)			(0.0282)	(0.0203)
Two decade lag			0.0729***		0.0860***			0.0706***	0.0802***
Log origin GDP			(0.0242)		(0.0226)			(0.0212)	(0.0167)
Decade lag	0.622***	0.644***	0.632***	0.626***	0.633***	0.548***	0.541***	0.598***	0.0163***
log county GDP	(0.0165)	(0.0230)	(0.0166)	(0.0163)	(0.0152)	(0.00760)	(0.00775)	(0.0172)	(0.00586)
Two decade lag	0.126***	0.0828***	0.116***	0.123***	0.116***	0.0701***	0.0669***	0.105***	-0.0175***
log county GDP	(0.0114)	(0.0139)	(0.0113)	(0.0110)	(0.0111)	(0.00702)	(0.00709)	(0.0111)	(0.00463)
Long-run effect	0.90	0.58	0.83	0.90	0.76	0.73	0.83		
Observations	13,268	13,257	13,211	13,268	13,227	13,268	13,242	13,223	13,223
County groups	1,147	1,147	1,147	1,147	1,147	1,147	1,147	1,147	1,147
Add. Inst				Past			Past		
Transform	FOD	FD	FOD	FOD	FOD	FE	FE	FOD	FOD
GMM instruments	1/2	2/3	1/3	1/2	1/2			1/2	1/2
AB AR(1) in diff.	0	0	0	0	0	0	0		
AB AR(2) in diff.	0.0215	0.535	0.122	0.0346	0.138	0.680	0.608		
Hansen over id.	0.00828	0.0345	0.752	0.0206	0.510				

Notes: Italics indicate the variable is ancestry weighted at the county group level as in equation 2.3. All regressions include year effects and remove county group fixed effect either by Forward Orthogonal Deviations (FOD) or First Difference (FD). The lags of the instruments are reported in the table under GMM instruments. All endogenous variables have the same instruments. AB AR(1) and AR(2) report the p-values of the Arellano and Bond [14] test for serial correlation in first and second differences. The Hansen over id. reports the p-value for the Hansen test of over-identifying restrictions when the equation is over-identified. The Additional Instrument is the past ancestry augment with national level ancestry growth as disused in Section 2.5.5. Columns 1-5 are estimated in Stata as single equation GMM using xtabond2 with the collapse option [75], column 6 is estimated using the within estimator, column 7 the within estimator and two stage IV, while columns 8-9 are estimated together as a panel VAR using pvar [1].

Figure A-1: Impulse response of log county income and ancestry weighted trust



Notes: Shows impulse responses corresponding to columns 8-9 in table A-1 estimated together as a panel VAR using pvar [1]. The impulses are calculated using two Cholesky decompositions: (1) No immediate effect of GDP on GDP1870, but GDP1870 can immediately affect GDP, (2) No immediate effect of GDP1870 on GDP, but GDP can immediately affect GDP1870. The size of the impulse is the standard deviations of the residuals in each equation. Shaded areas are the 95% confidence intervals based on Monte Carlo simulation.

Chapter 3

Culture: Persistence and Evolution

3.1 Introduction and Motivation

Learning how a person's values and beliefs are formed and transmitted from one generation to the next is the first step towards understanding the more general problem of how persistent a society's values and beliefs are – an issue on which there is abundant disagreement. Some contributions argue that values and beliefs are deeply rooted in the country or ethnic group to which a person belongs — being related for example to history or geography — and evolve slowly over time.[1] Others, instead, suggest that cultural attitudes can change rather quickly in response to changes in economic incentives and opportunities, in technology, and in institutions.[2] Both views of culture (slow versus fast moving) have truth in them, in the sense that while some cultural traits certainly go back to the distant past and affect today's economic and institutional outcomes, it is also true that many values and beliefs evolve in response to changes in technology, economic environment, and in political institutions.

[1]See Putnam (1993), Guiso, Sapienza and Zingales (2006, 2007, 2008), Tabellini (2008a,b), Alesina, Giuliano and Nunn (2013), Durante (2009), and Roland (2004). See Alesina and Giuliano (2013) for a recent review.

[2]See Gruber and Hungerman (2008), Alesina and Fuchs-Schuendeln (2007), Di Tella, Galiani and Schargrodsky (2007), Giuliano and Spilimbergo (2014), Fernandez (2011), Fehr (2009), and Bowles (1998).

An important distinction in understanding the process through which a person's values and beliefs are formed is that between "vertical" and "horizontal" transmission. Inside the family, parents shape their children's preferences balancing the desire to share common values with them, with the concern for teaching traits that will make it easier for their children to function in the social environment in which they will live: this is vertical transmission. But children are also exposed to the world outside the family and thus are subject to a process of social imitation and learning external to the family: this is horizontal transmission.[3] Two different models of cultural transmission are thus at work, as in the models of evolutionary biology[4]: vertical transmission, like genetic inheritance, tends to be relatively more conservative, giving rise to slow evolution of culture; horizontal transmission, as in an epidemic, may result in a rapid change in the number of people who adopt a new cultural characteristic particularly if it is attractive to the receiver. This can happen, not in historic time, but in the space of a few generations.

Thinking about these issues, it is reasonable to consider immigrants an ideal group to study. The incentives that give rise to vertical transmission could be particularly strong among immigrants, as early-generations immigrants may want their children to share some of the values that they, or their own parents, brought with them from their country of origin. But some of these inherited values may be at odds with the culture of the new country in which they are living, possibly hindering productive interaction with other groups, and may be modified by the social interactions in the new environment: horizontal transmission could thus also be particularly strong among immigrants.

In this paper we investigate the speed of evolution of a wide range of cultural attitudes for different generations of European immigrants to the United States. We

[3]The transmission that occurs from a member of the previous generation who is external to the family to a member of the present generation is often called oblique. We consider it as a part of horizontal transmission.

[4]See Cavalli-Sforza (1981) and (2001, ch.6), Boyd and Richerson (1985, 2005).

look at a variety of attitudes, rather than a single one because we surmise there is substantial heterogeneity across cultural traits and immigrant origins in the speed with which attitudes evolve across generations. We study the transmission of attitudes through four generations (a century) because it is possible that some attitudes may appear to be quite persistent within a couple of generations but change significantly by the fourth generation. We use data from the General Social Survey (GSS) to analyze the evolution of cultural attitudes about religion, family, gender, sexuality, cooperation, redistribution, etc., distinguishing between first, second, third and fourth (or higher) generations of European immigrants to the US. The focus on European immigrants is largely imposed on us by the availability of sufficient data for multiple generations distinguished by country of origin. We use data contained in 21 waves (the exact number varies across attitudes) of the GSS survey collected between the end of the 1970's and 2012. Although the GSS is far from being perfect, it is the only data source that allows a systematic investigation of the evolution of cultural values for *multiple* generations, *multiple* countries of origin and for *multiple* traits.

Immigrants provide a particularly useful laboratory for the study of the evolution of values and beliefs because, as mentioned above, their cultural attitudes are likely to bear the mark of the country from which they, their parents or their grandparents emigrated.[5] However, they are also influenced by their exposure to US society and its social, political, and economic institutions, often very different from those of the country of origin. They thus provide an interesting quasi-experiment for the effect on inherited cultural attitudes of a change in the economic and social environment. The conditions under which this leads to integration of immigrants or to the emergence of immigration clusters in which separate cultural traits persist has been debated in the theoretical and empirical literature.[6]

[5] See Fernandez (2008).

[6] See the seminal paper by Lazear (1999) on the incentives to and conditions for integration in heterogeneous populations and the inter-temporal extension in Konya (2005). Bisin and Verdier (2000), (2001) provide conditions under which heterogeneity in cultural values may be a stable

In order to provide some structure in discussing the results, we develop a simple model of socialization and identity choice. The model builds largely on the contributions by Bisin and Verdier (2001) on the choice of socialization by parents, and on Lazear (1999) and Konya (2005) for a child's choice of her cultural identity. Parents derive utility form the child retaining their original cultural trait, but also consider the possibility that this may hinder the child's ability to interact productively with the majority. The child plays an active role in the model and chooses her identity weighing the expected transaction gains from assimilation and a switching cost that partly depends upon the parents socialization effort, and which also contains a component that is randomly distributed across the population. Parents choose the optimal level of socialization taking into account of the child's optimization problem, knowing the distribution of the switching cost, but not the realization for their child. The model yields two possible type of equilibria: one with complete assimilation and another with the minority group not assimilating. The occurrence or not of assimilation, and its speed when it happens, depends upon a set of parameters that are likely to vary across different cultural traits and across countries of origin, such as the child's net transaction gains and the switching costs from assimilating, the utility benefit to the parents from the child maintaining the original trait, together with the costs of the socialization effort, and, finally, the discount factor parents apply to the child's utility.

In studying how a person's values and beliefs are formed and transmitted from one generation to the next, and whether or not they converge, we face a number of empirical challenges. First and foremost, immigrants, even from the same country of origin, differ, depending on when the first generation of the "dynasty" they belong to arrived in the US. Irish immigrants who arrived in the 1890s, for example, are clearly

equilibrium in an optimizing model of cultural transmission under imperfect parental empathy. See also Bisin, Topa and Verdier (2004), Tabellini (2008b), and Bisin and Verdier (2010) for a review. See also Guiso, Sapienza and Zingales (2008) for a model of transmission of beliefs, Fernandez (2013) for a model of beliefs formation, and Doepke and Zilibotti (2008) for a model of endogenous preference formation.

different, in terms of the values they brought with them, from post World War II first generation Irish immigrants. One has to account for this in empirical work, in order to separate convergence of values across generations of immigrants from convergence of values over time across countries of origin. For this reason we study the transmission of values and beliefs within a single dynasty, starting with first generation immigrants born before World War I. We follow the cohort of the children of this generation, and the cohorts of their grand children and of their grand-grand children.

Finally, one should not forget that our results are specific to, say, Irish immigrants and cannot be extended to all Irishmen, including those who never left Ireland, since emigrants are not a random sample of the population. We will discuss how selection issues within first generation immigrants, between those who decide to stay and those who return to the original countries leads to an underestimate or overestimate of the speed of change of culture.[7]

We are certainly not the first ones to analyze these issues[8]. However, most existing contributions focus on the *persistence* of cultural traits for *second* generation immigrants and on their effect on economic and social outcomes. For instance, Giuliano (2007) presents evidence that cultural heritage is important for living arrangements, Fernandez (2007) for female labor force participation, and Fernandez and Fogli (2009) for female labor force participation and fertility outcomes, all using US census data. Fernandez and Fogli (2006), using the GSS, finds results that are also supportive of an effect of the culture of the country of ancestry on fertility outcomes for US immigrants, although no distinction is made between second and higher generation

[7]The speed at which attitudes evolve may depend upon the community within which a person lives. Italians immigrants who were brought up in New York's Little Italy neighborhood are likely to lose their "country-of-origin" attitudes more slowly than Italians who settled in the mid-West. Sample sizes in the GSS do not allow us to address fully this issue. We will leave it for future research.

[8]Earlier contributions in the sociological literature use early waves of the GSS, and focus on the assimilation process of specific groups, such as Italian immigrants in Greeley (1974, ch.4) and Alba (1985, ch.6). The results in Greeley are based on a sample of males only. Both studies emphasize the change, as opposed to the persistence of cultural attitudes, but do not distinguish among different generations.

immigrants.[9] Exceptions, in the sense that they use generations beyond the second, are Antecol (2000) – who finds that culture matters for the gender gap in labor force participation, for both the first, second and higher generations of US immigrants, although less for the latter – and Borjas (1992) who shows that ethnic capital (measured as average ethnic-specific education, professional achievement or wages) has a greater effect on children's education, occupation and wages for both the second and the third generation, although the effect tends to be higher for the second.[10]

The paper has three main findings. First we provide evidence of heterogeneity across cultural traits in the speed with which they evolve across generations and converge to the prevailing norm. We document the persistence of family values (parental control on teenager's access to contraception, ease of divorce, and frequency of social events with relatives, the role of women in society at large and in politics), political views, and deep individual religious values (as reflected in the answers to questions regarding belief in the frequency of prayer and approval of prayer in public schools). As a result, the values of immigrants of fourth-or-higher generation still bear strongly the imprint of their ancestors, who migrated to the United States many decades earlier. We also show that attitudes towards cooperation (the trustworthiness, helpfulness and fairness of others), children's independence, and sexuality converge, instead, more quickly, as successive generations adapt to the norms of the new society in which they live. The same is true – namely relative fast convergence – for the frequency of attendance to religious services. The latter reflects the social dimension of the religious experience and behaves differently from the other slow moving per-

[9]See also Algan, Bisin, Manning and Verdier (2012) and associated authors for a study of the pattern of cultural and economic integration of immigrants in Europe, and how they differ by immigrant communities, religious beliefs and host countries. The empirical evidence is based on the European Social Survey, complemented by other data sources, and the focus is on the first and second generation's indicators of social and cultural integration (family arrangements, fertility, education, labor market outcomes, religion, language spoken, etc.).

[10]Rice and Feldman (1997) distinguish the level of civic attitudes for Italian immigrants on the basis of the number of grandparents born in the US and reach the surprising conclusion that the descendants of earlier immigrants are more likely to give *less* civic responses than the descendants of later immigrants.

sonal religious values mentioned above. Finally, results concerning cultural attitudes towards women's role outside the home imply a faster convergence of attitudes towards women in the workplace, such as the perceived cost of market work for the mother-child relationship, compared to attitudes about the general role of women in politics.

These results are largely consistent with one prediction of our simple model in the sense that faster convergence is observed for attitudes that are likely to generate larger transaction gains from assimilation, such as attitudes towards cooperation, compared to those for which transaction gains are likely to be smaller, such as the frequency of prayer and approval of prayer in public schools. Convergence is also slower for attitudes for which the utility gain to the parents from the child retaining the original trait is likely to be higher, such as some family values. Interestingly, the relatively faster convergence of attitudes towards women's work in the market, as opposed to their role in politics, can be explained by the large economic gains from having women participating in market work.

Our second important result is that time since the original immigration of the ancestors matters and that the results obtained studying higher generation immigrants differ from those obtained limiting the analysis to the second generation. Thus, finding that the attitudes of second generation immigrants still closely reflect those of the country of origin, does not imply *per se* that attitudes are very persistent. For instance, the beliefs that shape trust of second generation immigrant towards other members of society still bear strongly the mark of the country of origin and are different for immigrants from different countries of origin. However, such differences become smaller when one considers fourth or higher-generation immigrants.

Finally, we find that persistence is "culture-specific" in the sense that the country from which one's ancestors came matters in defining the pattern of integration (or lack thereof) with respect to the entire set of cultural traits. Moreover, the strength of the family in each country of ancestry and the degree of difficulty in learning English are (negatively) correlated with the fraction of attitudes for which we observe faster convergence. These results could also be interpreted in the light of our model: switching costs, for instance, are likely to be related to language proximity and to the strength of family ties. However, given the small number of countries involved, this results must be taken with a grain of salt.

The plan of the paper is as follows. In Section 2 we illustrate a simple model of parents' socialization and children's identity choice. In section 3 we discuss how we measure cultural attitudes in the GSS, how we define generations and ethnic origin, and which European countries (or groups of countries) we use in our analysis. In Section 4 we describe how we recover the country of origin effect for different generations, dynasties and time periods, while in Section 5 we illustrate our measure of cultural "convergence". In Section 6 we present and discuss our main empirical results. Section 7 contains several robustness checks and extensions. Section 8 concludes.

3.2 Why Persistence Can Differ Among Cultural Traits and Countries of Origin : A Model of Cultural Transmission

This section contains a simple model that will help interpret our main empirical findings, namely that different cultural traits may converge at varying speed, or not converge at all. Moreover, the dynamics of cultural convergence may differ across cultures i.e. in terms of our empirical work, across countries of origin. The model is based on the idea that a person's traits evolve through two parallel processes: vertical transmission within the family and horizontal transmission associated with social interactions outside the family. The model draws on the vast literature carefully reviewed in Bisin and Verdier (2011).[11]

The model is set up as follows. Assume there is one cultural trait in the population that can take two values: one associated with the minority, denoted by m and the other associated with the majority, denoted by M. Think of the two traits as representing, for instance, the attitude towards pre-marital sex, one of the attitudes whose evolution we study in our empirical analysis. Recent immigrants (the minority) might still carry their cultural attitudes of the country of origin, which could be quite different from those of the majority in the United States, the new social environment in which they live.

We normalize the population to 1 and assume that the initial size of the minority is q. Consider a second-generation immigrant belonging to the minority group. Personal attitudes are shaped by two forces: "vertical" transmission within the family and "horizontal" transmission from social interactions outside the family. Traits are first transmitted inside the family from parents to their children. As children interact with people outside the family, they may realize that the traits acquired from their parents are not ideal (in a sense that we shall make precise in a moment) for social interactions outside the family. For instance, if the norm in society (the norm of the majority) is that young people live together before deciding whether or not to get married, excluding pre-marital sex will make it more difficult for the child to find a partner and get married. However, breaking with a more traditional view of sexual morality may also generate a costly conflict with one's family, the more so the greater the parents' effort to educate the child.

We shall proceed in three steps. First we study the child's identity choice problem: what determines her decision whether or not to "assimilate", that is to abandon the minority trait and acquire the majority trait.[12] Building on Lazear (1999) and Konya

[11]See also Pichler (2010), Vaughan (2012), and Panebianco (2014).
[12]See also the seminal paper on identity choice by Akerlof and Kranton (2000), as well as Bisin et al (2011).

(2005), we assume that switching from the old to the new trait allows a minority member to interact more productively with the majority. However, it also generates a transaction cost in dealing with members of the minority. Moreover, abandoning the original family trait implies a utility cost for the child that, in part, depends upon the effort the parents have put in educating her. Then we shall go back and analyze the parent's socialization problem: parents prefer children with their own cultural trait and hence educate them to this trait, as in Bisin and Verdier (2001). The parent however also "empathizes" with her child, in the sense that she understands that the trait she is trying to transmit may hinder the child's opportunities in the new society. Her educational decision will balance these two incentives.

To keep the problem simple, we assume that each individual lives two periods. In the first period, after having been educated by her family, she interacts with others of the same cohort in society. In the second period she becomes the single parent of a child and decides how much effort to put in socializing the child to her own trait – for instance spending time teaching her ancestors' values. Finally, having analyzed the child's decision whether or not to assimilate, given the education received by her parent, we shall study how the size of the minority evolves over time, given that the cost of assimilation is distributed randomly in the population.

We show that there are two possible equilibria: one in which no child assimilates and the size of the minority group remains constant at the initial level, and one in which instead children assimilate and the minority trait eventually disappears from society. Which of these two equilibria occurs and the speed of convergence to the full assimilation equilibrium depends upon a set of parameters that capture the cost and benefits for the child and for the parent of assimilating or not, and that are likely to vary across cultural traits, and also across countries of origin.

3.2.1 The Child's Identity Choice Problem

The child's problem is a simple variant of Lazear (1999)[13]: V^i, ($i = m$ or M) denotes the surplus produced by a social interaction between two people both belonging to the same group–minority or majority. We assume that the two surpluses are identical ($V^m = V^M = V$), a simplifying assumption which is irrelevant for our results. The interaction between two persons with different cultural traits implies a loss. More specifically, $V(1-\theta^M)$ is the surplus produced by a social interaction between a person, whose parents belong to the minority and who has not assimilated, with another person belonging to the majority, with $0 < \theta^M < 1$. $V(1-\theta^m)$ is the surplus of the interaction between a person whose parents belong to the minority and who has acquired the majority trait, with another person from the minority, with $0 < \theta^m < 1$. We will assume that $\theta^M > \theta^m$ because it is plausible that the child of a minority parent retains some ability to interact with members of the minority even if she assimilates. There is no loss in the transaction when two people have the same trait, that is in this case the surplus is V. The proportion of the minority group in the population is $q < \frac{1}{2}$ (we omit the time subscript here to keep the notation light). $d(\tau, t_i)$ is the utility cost for a member of the minority for abandoning the parent's trait: it is increasing with the parent's socialization effort τ and also includes an additive stochastic component t_i that can be interpreted as the cost of learning the new (majority) trait, so that $d(\tau, t_i) = d(\tau) + t_i$, with $d(\tau)' > 0$. We assume t_i to be distributed randomly in the population according to the distribution function $G(.)$. The child knows t_i, while the parent does not observe it, but knows its distribution $G(.)$.

The child's meets at random individuals from the minority or majority groups with probability q and $1-q$ respectively. Following Lazear (1999) we assume that the child decides whether or not to assimilate at the beginning of the period, knowing the

[13]See also Konya (2005) for a dynamic extension.

probability of meeting a minority or a majority member, but before having actually met them. Her expected utility is therefore equal to $qV + (1-q)(1-\theta^M)V$ when the child does not assimilate, and to $q(1-\theta^m)V + (1-q)V - d(\tau) - t_i$ when she assimilates. Children are myopic, in the sense that they do not look ahead to when they will become parents. A child i assimilates if the expected gain from assimilation is higher than the expected gain from non-assimilation:

$$(1-q)V\theta^M - q\theta^m V - d(\tau) - t_i \geq 0 \tag{3.1}$$

Defining the cumulative density of t_i, with support $[\underline{t}, \bar{t}]$, the proportion of minority individuals that assimilate after a draw of t_i is given by:

$$G\left((1-q)V\theta^M - q\theta^m V - d(\tau)\right) \tag{3.2}$$

If $(1-q)V\theta^M - q\theta^m V - d(\tau) > \bar{t}$ the child will always decide to assimilate ($G(.) = 1$). If $(1-q)V\theta^M - q\theta^m V - d(\tau) < \underline{t}$ the child will never assimilate ($G(.) = 0$). When $\underline{t} \leq (1-q)V\theta^M - q\theta^m V - d(\tau) \leq \bar{t}$, the child will assimilate with some probability. Assume for simplicity that t_i is uniformly distributed on $[\underline{t}, \bar{t}]$. In this case the probability of assimilation and the proportion of minority individuals who assimilate is given by:

$$Prob\left(t_i \leq (1-q)V\theta^M - q\theta^m V - d(\tau)\right) = \int_{\underline{t}}^{(1-q)V\theta^M - q\theta^m V - d(\tau)} \frac{1}{\bar{t}-\underline{t}} dt = \frac{(1-q)V\theta^M - q\theta^m V - d(\tau)}{\bar{t}-\underline{t}} \tag{3.3}$$

3.2.2 The Parent's Socialization Problem

Each family is a single-parent family and produces only one child. As in Bisin and Verdier (2001) the parent can socialize the child at a cost $c(\tau)$, increasing in τ, and she derives utility $\varphi(\tau)$ if the child maintains the family trait, which occurs with a probability she can affect through her educational effort. The parent also cares about her child's utility and how it is affected by her actions that contribute to determining, through $d(\tau)$, the probability of assimilation, and, hence, how productively the child will relate with the majority (and the minority). The extent of empathy is described by β: for $\beta = 0$ the parent doesn't care about the child's utility and only cares about her wish that the child does not assimilate. We abstract from the components of the parent's utility that do not depend upon the costs and benefits of educating the child. Finally we also assume that the parent only cares about her immediate descendants.

Thus the parent maximizes her expected utility $w(\tau)$ given by:

$$\begin{aligned} w(\tau) \;=\; & -c(\tau) + \varphi(\tau) Prob(\text{no child assimilation}) + \\ & +\beta Prob(\text{no child assimilation}) \left[qV + (1-q)V(1-\theta^M)\right] \\ & +\beta Prob(\text{child asssimilation }) \left[q(1-\theta^m)V + (1-q)V - d(\tau)\right] - \\ & -\beta \int_{\underline{t}}^{(1-q)\theta^M V - q\theta^m V - d(\tau)} \frac{t_i}{\bar{t} - \underline{t}} dt_i \end{aligned} \tag{3.4}$$

Let us assume that $c(\tau) = \frac{c}{2}\tau^2$, $\varphi(\tau) = \varphi_0$, and $d(\tau) = d\tau$.[14] The parent's optimal socialization effort is determined by the following first order condition:

$$c\tau + \beta d \frac{(1-q)\theta^M V - q\theta^m - d\tau - \underline{t}}{\bar{t} - \underline{t}} = \frac{\varphi_0 d}{\bar{t} - \underline{t}} \tag{3.5}$$

The interpretation is simple: the left hand side is the marginal cost to the parent from varying τ, composed by the marginal direct socialization/education cost and by the expected change in the assimilation cost for the child, discounted by β (the parent's imperfect empathy parameter); the right hand side is the change in the expected direct benefit for the parent from non-assimilation. Solving for the optimal level of

[14] We could allow $\varphi_0 + \varphi_1\tau, \varphi_1 > 0$ but this would complicate the algebra without improving the intuition.

τ, τ^*, one obtains:

$$\tau^* = \frac{\varphi_0 - \beta[(1-q)\theta^M V - q\theta^m V - \underline{\mathrm{t}}]}{\frac{c(\bar{t}-\underline{\mathrm{t}})}{d} - \beta d} \tag{3.6}$$

For concavity of the objective function $\frac{\partial^2 w}{\partial \tau} = -c + \frac{\beta d^2}{\bar{t}-\underline{\mathrm{t}}} < 0$ and hence the denominator in (3.6) is positive. We assume that $\varphi_0 - \beta[(1-q)\theta^M V - q\theta^m - \underline{\mathrm{t}}] \geqslant 0$ to guarantee that the parent's effort is non negative. The comparative static for τ^* is intuitive. The parent's effort is increasing in φ_0, her benefit if the child does not assimilate. It is instead decreasing in c, the cost of the effort put into educating the child. It is also increasing in θ^M, the penalty for the descendant of a minority parent in interacting with members of the majority, if she holds on to the family trait, and decreasing in θ^m, the penalty for the descendant of a minority parent in interacting with members of the minority, if she adopts the majority trait. In the former case the benefit of assimilating for the child increases, while in the latter it decreases. A strong educational effort by the parent is thus a hindrance for the child, the more so the larger is θ^M and the smaller is θ^m. The empathic parent internalizes this and reduces her socialization effort the larger is θ^M and increases it the smaller is θ^m.

For given values of θ^M and θ^m, an increase in q has a positive effect on the parent's socialization effort because it decreases the probability of meeting a member of the majority, diminishing the expected penalty for descendants of minority parents associated with interacting with the majority (when not assimilated) and increases the cost of interacting with members of the minority (when assimilated). Note that our model does not display the "cultural sustainability property" of Bisin and Verdier (2001), whereby a minority parent makes a greater effort at socialization when q is small.

The effect on the parent's socialization effort of an increase in the total surplus from transactions is negative, as we have assumed that $q < \frac{1}{2}$ and $\theta^M > \theta^m$, so that the transaction net gains from assimilation are positive and the (partly) empathic parent takes this into account, therefore reducing τ^*. The effect of the parameter d, that captures the cost for the child of assimilating, and that depends on the parent's educational effort, is positive: the higher is d , the more effective is the socialization technology and this induces the parent to use it more intensely (increasing her effort). The effect of the discount factor β is ambiguous and the reason is simple: if β increases, it means that the parent gives more weight both the the child's net transaction benefits of assimilation $((1-q)\theta^M V - q\theta^m)$ and to the switching cost of assimilation $(d\tau)$. The first effect leads the partly emphatic parent to decrease τ^*, so that the child can reap those benefits; the second leads to an increase in τ^*. Hence the effect of β is ambiguous. Finally, for a given spread of the distribution, $\bar{t} - \underline{t}$, a decrease in $\underline{t}$, which generates a leftward shift of the distribution, decreasing its mean, but keeping the variance constant, is associated to a decrease in τ^*[15]: again, this is because the probability of assimilation increases, which increases the penalty for the child of dropping the family trait, a penalty that is greater the larger the parent's educational effort. Given $\underline{t}$, an increase in $\bar{t} - \underline{t}$ has the opposite effect by a similar logic.

3.2.3 Assimilation and Non-Assimilation Equilibria and Dynamics

Let us assume that that $\underline{t} \leq (1-q(0))\theta^M V - q(0)\theta^m V - d\tau^* \leq \bar{t}$, where $q(0)$ is the initial proportion of the minority group in the population, so that there is an incentive to assimilate for at least some members of the minority. In this case the

[15]Recall that the mean of the uniform distribution is $\frac{\bar{t}+\underline{t}}{2}$, while the variance is $\frac{(\bar{t}-\underline{t})^2}{12}$.

probability of assimilation evaluated at the optimal parent's effort, τ^*, is[16]:

$$G\left((1-q_t)\theta^M V - q\theta^m V - d\left(\frac{\varphi_0 - \beta[(1-q_t)\theta^M V - q_t\theta^m - \underline{\mathrm{t}}]}{\frac{c(\bar{t}-\underline{\mathrm{t}})}{d} - \beta d}\right)\right) \tag{3.7}$$

This is also the proportion of minority members in the population that assimilate. It is easy to see that this proportion is unambiguously increasing in V and θ^M, and decreasing in d, θ^m and q. This is the result of the direct effect of these parameters on *G (.)* and their effect through τ^*. The effect of the remaining parameters mimics the effect on τ^* with the opposite sign: the proportion of minority members that assimilates, increases in c and decreases in φ_0; the effect of the discount factor β is again ambiguous; for a given spread of the distribution, $\bar{t} - \underline{\mathrm{t}}$, a decrease in $\underline{\mathrm{t}}$, which generates a leftward shift of the distribution, decreasing its mean, but keeping the variance constant, is associated with an increase in *G(.)*; given $\underline{\mathrm{t}}$, an increase in $\bar{t} - \underline{\mathrm{t}}$, instead, decreases *G(.)*.

The decrease in the proportion of the minority between $t+1$ and t , $-(q_{t+1} - q_t)$ equals the proportion of the minority that assimilates between these two dates $G\left((1-q_t)\theta^M V - q_t\theta^m V - d\tau_t^*\right)$, times the size of the minority at t, q_t[17]:

$$\begin{aligned} q_{t+1} - q_t &= -\,G\left((1-q_t)\theta^M V - q_t\theta^m V - d\tau_t^*\right) q_t \\ &= -\,\frac{(1-q_t)\theta^M V - q_t\theta^m V - d\tau_t^* - \underline{\mathrm{t}}}{\bar{t} - \underline{\mathrm{t}}} q_t \end{aligned} \tag{3.8}$$

with τ_t^* defined in (3.6). Equation (3.8) represents the dynamics of the system when $\underline{\mathrm{t}} \leq (1-q_t)\theta^M V - q_t\theta^m V - d\tau_t^* \leq \bar{t}$. When $(1-q_t)\theta^M V - q\theta_t^m V - d\tau^* \leq \underline{\mathrm{t}}$ nobody

[16] If $(1-q(0))V\theta^M - q(0)\theta^m V - d\tau^* > \bar{t}$, the model would generate an uninteresting and implausible dynamics with instant full assimilation.

[17] Assuming that no member of the majority acquires the minority trait is equivalent to assuming that $q\theta^{m,M}V - (1-q)\theta^{M,M}V - d^M\tau^M < \underline{\mathrm{t}}^M$, where the superscript M (second superscript for the θ parameter) denotes the parameters for the majority. In other terms, for all members of the majority, the gain from more efficient transactions is exceeded by the combined costs of acquiring the minority trait.

assimilates, $G(.) = 0$ and $q_{t+1} - q_t = 0$. This observation allows us to determine the possible steady state equilibria (where $q_{t+1} - q_t = 0$) and their stability properties. Consider first the value of q_t, $\tilde{q}$, such that $(1-\tilde{q})\theta^M V - \tilde{q}\theta^m V - d\tau* = \underline{t}$ so that there is no gain from assimilation. For greater (smaller) values of q the net gain is negative (positive). It is easy to show that (see Appendix 2 for details on the dynamics and on the steady-state equalibria):

$$\tilde{q} = \frac{\theta^M V - \frac{\varphi_0 d^2}{c(\bar{t}-\underline{t})} - \underline{t}}{\theta^M V + \theta^m V} \tag{3.9}$$

Moreover, $0 < \tilde{q} < 1$. If $\widetilde{q} < q_0 < \frac{1}{2}$, then the initial proportion of the minority is an equilibrium because there is no net gain from assimilation. Recall that the equation of motion assumes that no member of the majority adopts the minority trait, which is reasonable if indeed we are dealing with a minority ($q_0 < \frac{1}{2}$). If $q_0 < \text{Min}(\frac{1}{2}, \tilde{q})$, the steady state equilibrium implies full integration ($q = 0$). The full integration equilibrium is locally stable with the minority in this case gradually shrinking in size. All this is summarized in Figure 1a and Figure 1b, where the steady state(s) and dynamics of the system are represented. The phase line is upward-sloping and convex and it intersects the 45 degree line at 0 and $\tilde{q}$. In Figure 1a we present the phase diagram for the case in which $\widetilde{q} < \frac{1}{2}$, so that two type of equilibria exist, one with full integration and one with no integration (associated, for instance, with an initial size of the minority equal to q_0^a and q_0^{na} respectively). In Figure 1b, we present the case in which $\tilde{q} \geq \frac{1}{2}$ so that only the full integration equilibrium exists. Finally, it is easy to see that $\tilde{q}$ increases, and hence the range of initial values of q_0 for which the full assimilation equilibrium occurs becomes larger, with the loss for a non assimilated person in her dealing with the majority, θ^M, with the size of the total surplus from the transaction, V, with the cost to the parents for the socialization effort, c, with an increase in $\bar{t} - \underline{t}$ for a given $\underline{t}$ (so that both its mean and variance increase). $\tilde{q}$ instead decreases with the penalty for an assimilated child of a minority parent from dealing with members of the minority , θ^m, with the effectiveness of the socialization technology, d, with the direct benefit to the parent of the child maintaining the original trait, φ_0, and with a shift to the right of the distribution of t_i (so that the mean increases for a given spread of the distribution). Note that the parent's discount factor, β, has no effect on $\tilde{q}$. This is because at $q = \tilde{q}$, the probability of assimilation is zero, so the second term on the left hand side of the first order condition for τ, equation (3.5), is zero, i.e. there is no expected cost for the parent from the child assimilating. As a result, at $q = \tilde{q}$, β does not matter for τ^* and, hence, for $\tilde{q}$.[18]

Summarizing, our simple model can help us to think about the different speed of convergence of various attitudes, as they are shaped by vertical and horizontal transmission. Cultural attitudes differ in the advantage that assimilation confers to the child in transacting with the majority and in the costs that assimilation implies for him, partly shaped by the parent's socialization effort. They also differ in the utility gain they imply for the parent when a child retains the minority cultural trait and in the cost that the parent's educational effort entails. Attitudes, such as trust, are likely to imply a large transaction gain for the child from assimilating. For other traits, such as deep religious attitudes, the transaction payoff from converging to the majority trait is likely to be smaller. Attitudes, such as those towards family values or

[18]In the model we have considered the decision whether or not to assimilate along a single dimension, that is a single attitude. The results however directly extend to the contemporaneous choice of more than one trait, provided we exclude interactions across attitudes. Assume there are two traits $a = 1, 2$, each one of them dichotomous, as we have assumed so far. Assume that costs and benefits are additive and that there is no interaction between the two trais, that is *socialization* $c(\tau_1) + c(\tau_2)$ costs for the parents are and direct socialization benefits are $\varphi(\tau_1) + \varphi(\tau_2)$. Assume that switching costs are also additive for the child, $d(\tau_1) + d(\tau_2))$, and, to avoid multivariate distributions, that the two stochastic terms t_1 and t_2 are independent. Finally assume that the net benefits associated with each attitude are $\theta_a^{M*}(1 - q_a)V_a - \theta_a^{m*} q_a V_a - d(\tau_a) - t_a$, $a = 1, 2$ again assuming lack of interaction. In this simple case the conditions for τ_1 τ_2 are identical to those we have derived and simply need to be indexed by $a = 1, 2$. Of course the model would be more complicated if we allowed for cross affects across attitudes, but this is not central to our paper and we leave this extension for future research.

gender roles, may imply large gains for the parents if the child maintains the minority trait, or a large cost for the child if he abandons her family's traditional values and beliefs. However, maintaining some of this traits or beliefs may come to a large cost for the child if they are not conducive to an active participation in the labor market. The model also suggests that patterns of integration may differ depending on the country of origin of each immigrant group because of cross country variation, for each cultural attitude, in the costs and benefits of integration. For instance, cross country variation in the strength of the family may be reflected in differences in the perceived benefit for the parents from the child not dropping the trait transmitted within the family. Similarly, the cost for the child of acquiring a new trait may differ across countries. We will use these insights in discussing the empirical evidence on the heterogeneity across attitudes in the speed of convergence of values and beliefs of successive generations of immigrants to the US, and how it varies across countries of origin.

3.3 Measuring Cultural Attitudes and Defining Generations and Country of Origin in the GSS

Our measurement of cultural attitudes is based on the General Social Survey (GSS). We use multiple (22) waves of the GSS, starting in 1978 and ending in 2014. Each wave includes a core set of questions that remains in the survey in each year in which it was conducted. This core includes personal information such as age, income, region of residence, and family origin, as well as information on personal views on a variety of topics such as family values, gender roles, religious beliefs, sexual behavior, cooperation, role of government, etc..

One of the advantages of the GSS is that it allows us to analyze a wide variety of attitudes over several generations of immigrants. We have selected the attitudes for which data were available over a relatively long span of time, up to three decades (or slightly more). For ease of interpretation, we have grouped attitudes (or questions) into several broad categories. The list of categories, variables, and coding choices is provided in Table 1. Group A deals with views on social life, social interactions, and cooperation. It includes questions about trustworthiness (*trust)*, fairness (*fair)*, and helpfulness of others *(helpful)*. Group B includes attitudes towards government intervention – should the government redistribute income (*eqwlth*), provide a safety-net for the poor (*helppoor*) – and overall political views (*polviews*). Group C surveys different religious attitudes such as the frequency of attendance to religious services (*attend*), the frequency of personal prayer (*pray*), the strength of affiliation with one's religion (*reliten*), the belief in afterlife (*postlife*), and the approval of prayer in public schools (*prayer*). Group D includes attitudes about family and children. Questions in this group elicit views on the degree of parental consent in teenage access to birth control (*pillok*), on the restrictiveness of divorce law (*divlaw*), on the co-residence of multiple generations (*aged*) – i.e. whether one approves of children living with their parents beyond a certain age, and on the frequency of evenings spent with relatives (*socrel*). Furthermore, this group includes views on preferred qualities in children such as obedience (*obey*) and independence (*thnkself*). Group E surveys views on gender roles. Participants in the GSS are asked to express their opinion concerning various statements describing the role of women in the labor market, in politics and at home: should a woman work even if the husband can support her (*fework*)?; can working mothers have a warm relationship with their children (*fechild*)?; women should take care of running the home while men run the country (*fehome*); women are not suited for politics (*fepol*). Group F reports views on legalized abortion for any reason (*abany*) or restricted to cases of risk for the mother's health, defects in the fetus, or rape (*abrisk*). Group G covers attitudes towards sexual behavior such as premarital sex (*premarsx*) and homosexual sex (*homosex*). Finally, Group H elicit views on whether social mobility is a result of hard work versus help or luck (*getahead*).

The premise of our study is that values and beliefs are formed in part as a result of one's upbringing, and in part through the influence of factors external to the family such as peers, institutions, and economic circumstances. Consequently, values and beliefs depend both on the country of origin of a person's ancestors, as well as on her generation (to be defined below). The country of origin is an important determinant of culture as it encodes the history of a people, encompassing past technological, economic, institutional and cultural environments. The generation of a person is important given that the temporal "distance" from the country of ancestry may be associated with a dilution of the original cultural trait because of exposure to a different set of economic and social opportunities, to different institutions, and cultural influences.

We consider the evolution of attitudes over multiple generations (up to the fourth). As a result, we are constrained by data availability to focus on immigrants to the US from a limited number of European countries and from Mexico. We focus on countries for which we have relatively numerous observations: Great Britain (GB), comprising England, Wales and Scotland, Germany, (GER), Poland (POL), Ireland (IRE), Italy (ITA) and Mexico (MEX). In addition we consider Scandinavian immigrants from Denmark, Norway, Sweden and Finland as a single group (SCA) on the basis of a relatively common cultural background.[19]

We define the generation to which an immigrant belongs following what is typically assumed in this literature. We define a person to be a first-generation immigrant if he/she was born outside of the United States. Immigrants are defined to be second-generation if they are born in the US and at least one of their parents is born abroad, and third-generation if they are born in the US, all of their parents are born in the US and at least two of their grandparents are born abroad. Lastly, a person is said

[19]For other Southern and Eastern European countries and for the French we do not have enough observations, given the estimation strategy we will adopt in this version of the paper.

to be of fourth-generation-or-more if he/she is born in the US, all his/her parents are born in the US and at most one grandparent is born abroad. With this definition the last category includes fourth generation immigrants as well as people of a higher generation who still declare a specific European country of origin. In defining the country of origin we use the answer to the question: "*From what countries or part of the world did your ancestors come?*". If more than one country is indicated, the respondent is asked: "*Which one of these countries do you feel closer to?*". 79% percent of the sample can identify a main country of origin affiliation. The definition could, in principle, be made tighter by limiting our analysis to respondents who indicate only one country. This, however, would reduce substantially the number of observations, as only 50% percent of the sample chooses just one country. Therefore we will not pursue this option here.

3.4 Recovering Country of Origin Effects for Different Generations, Dynasties and Time Periods

The way an individual perceives the world is shaped by the values and beliefs of his/her parents. The attitudes of one's parents are, in turn, shaped by their parents. This implies that an individual's ancestral origin is an important factor determining his/her values and beliefs. In order to capture the extent to which someone's country of origin impacts his/her attitudes, we estimate a Probit model which includes indicator variables for one's ancestry.[20] We allow the effect of ancestry to depend upon the temporal "distance" from the country of origin. This distance is measured by whether the immigrant is first, second, third, or fourth or higher generation. Moreover the

[20]Responses to each of the GSS questions are therefore re-coded to produce a binary outcome (see Table 1).

ancestry effect will depend upon the birth cohort of an individual, since the cultural heritage brought by immigrants and transmitted to their descendants depends upon when they left the mother country and came to the US (we will also assume a 25 year interval between cohorts). We allow the effect of the country of origin to depend on generation and cohort in a multiplicative fashion, imposing as little restrictions as possible on the data. We will use these effects to chart the evolution of attitudes within the only complete "dynasty" we observe in our sample. More precisely, we estimate the following Probit model:

$$Pr(y_t^i = 1) = \sum_{o \in O} \sum_{g \in G} \sum_{c \in C} \beta_{o,g,c} \left(I_{(Origin^i = o)} \times I_{(Generation^i = g)} \times I_{(Cohort^i = c)} \right) + (\theta X_t^i) \tag{3.10}$$

where y_t^i takes the value of 1 if a certain event has occurred for individual i in wave t. $I_{(\,.\,)}$ are indicator functions that take the value of 1 if the condition in the subscript is satisfied, 0 otherwise. The sums are defined over three different sets: set O includes all possible countries of origin as defined in Table 1; set G includes each of the four possible generations of immigrants; set C includes four groups of respondents – those born in the periods 1890-1914, 1915-1939, 1940-1964 and 1965-2000. The set of controls includes: income, education, mother's education, father's education, age, age^2, year-of-the-survey dummy, gender, number of children, marital status, work status, religion, regional indicators, and urbanization indicators. Clearly variables such as income and education may be related to the country of origin: immigrants and descendants of people from different countries of origin, may, for instance, attribute different importance to education. Yet, we prefer to define country of origin effects net of these factors, in an attempt to capture deeper cultural values and beliefs that go beyond personal characteristics and circumstances.[21] Consequently, the evolution of

[21] See also Algan and Cahuc (2007, 2010) and Giavazzi et al (2013). In our robustness section we

attitudes that this paper analyzes is not explained by changes in the level of education or income of immigrants over time. These individual controls are held constant when we compare changes of attitudes across different immigrants. Finally, note that we include survey-year effect common to all respondents to capture general variations of attitudes over time. Summarizing, the country-generation effect is based on the estimated value of $\beta_{o,g,c}$ with $o \in \{1,..,7\}$; $g \in \{1,..,4\}$; $c \in \{1890-1914, 1915-1939, 1940-1964, 1965-1990\}$.

Our sample includes responses of immigrants whose ancestors moved to the U.S. during different periods. For example, the ancestors of some of our respondents arrived with the large migration waves around the turn of the twentieth century, while the ancestors of others immigrated more recently. In order to avoid mixing dynasties of immigrants that started at different points in time, and hence brought with them different attitudes, in our empirical work we focus on the four generations of *the only full dynasty of immigrants observable in our data* – the one that starts with the first generation arriving between 1890 and 1914 and ending with the last generation being born after 1965. The attitudes of the first generation of this dynasty — the one arrived in 1890-1914 — is captured by $\beta_{o,1,1890-1914}$, those of the second generation by $\beta_{o,2,1915-1939}$, those of the third generation by $\beta_{o,3,1940-1964}$, and, finally, those of the fourth generation (or higher) by $\beta_{o,4,1965-1990}$. For some countries the GSS does not have many respondents who are both first generation and belong to the cohort of 1890-1914. In order to have enough observations for the first generation of each country, we assume that the first generation of the 1890-1914 cohort and of the 1915-1939 cohort are characterized by the same coefficient ($\beta_{o,1,1915-39} = \beta_{o,1,1915-39}$). In Table 3, part one, we report the frequency of observations for each country, generation and cohort for the respondents of the question of trust. In Panel B we summarize the frequency of observations for the dynasty on which we focus.

also experiment with a more minimalist list of controls, including only age, age squared, year of the survey, gender, religion, regional indicators, and urbanization indicators.

3.5 Measuring Convergence in Cultural Attitudes

In this section we illustrate how we measure and assess whether or not there is convergence in the cultural attitudes of different generations of immigrants towards the norm set by the more established and dominant groups. We start by calculating the deviation of the attitude of a given respondent from the average attitude of the respondents considered to represent the dominant culture. For each of the countries of origin we define

$$\widetilde{\beta}_{(o,g,c)} = \beta_{(o,g,c)} - \beta_{(ave,4,c)} \tag{3.11}$$

where $\widetilde{\beta}_{o,g,c}$ represents the difference of the country-origin effect, $\beta_{o,g,c}$, from the norm ($\beta's$ here denote estimated values). To capture the multi-cultural nature of the U.S., we assume that the "norm" is represented by the weighted average of the attitudes of the fourth generation (or higher) European immigrants from all European countries in our sample, $\beta_{ave,4,c}$. We calculate the appropriate weights by using information from the 2000 U.S. Census about the ancestral composition of the non-foreign born population across different cohorts. To examine the experience of immigrants from different origins for the dynasty starting in the 1890-1914 period, we focus on two relationships. First, we compare $\widetilde{\beta}_{o,1,1890-1914}$ to $\widetilde{\beta}_{o,2,1915-1939}$, i.e. how the distance from the norm of the first member of the dynasty compares to the distance from the norm of the succeeding member of the same dynasty. This relationship allows us to characterize the level of assimilation that occurs from the first to the second generation of immigrants of the same origin. We then compare $\widetilde{\beta}_{o,1,1890-1914}$ to $\widetilde{\beta}_{o,4,1965-1990}$. We use this relationship to capture how the particular attitude of descendants changes from the first generation all the way to the fourth generation, relative to the respective norms.[22]

[22]We can also analyze the process of convergence between the first and third generation by comparing $\widetilde{\beta}_{o,1,1890-1914}$ to $\widetilde{\beta}_{o,3,1915-1939}$. We choose to focus on evolution between the first and fourth

This methodology follows and extends the approach proposed by in Algan et al. (2012).[23] However, whereas they focus on the changes between the first and second generation, we analyze the evolution of attitudes over multiple generations. Most importantly, we keep the dynasty constant – only consider descendants of a "common original immigrant". This approach provides a rich, country-of-origin specific, picture of the process of cultural transmission, which is not contaminated by changes in attitudes of successive cohorts of immigrants.

It is useful to characterize the various patterns of convergence or non-convergence using a graph. Assume one plots the generation-1 deviation on the horizontal axis and the generation-4 deviation on the vertical axis (i.e. $\widetilde{\beta}_{o,1,1890-1914}$ and $\widetilde{\beta}_{o,4,1965-1990}$). We can partition the four quadrants in regions by drawing a 45 degree line and a 135 degree line going through the origin (see Figure 2a). Focusing on Quadrant I, with positive initial and final deviations from the norm, points between the x-axis and the 45 degree line represent *monotonic convergence from above*, in the sense that the deviation is larger in generation 1 than in generation 4, while those between the line and the y-axis capture *monotonic divergence from above.* Points between the (continuation of the) 45 degree line and the x-axis in Quadrant III represent *monotonic converge from below,* while points between the 45 degree line and the y-axis *monotonic divergence form below.* In Quadrant II, in which the difference relative to the norm is first negative then positive, the 135 degree line separates points of *divergent leapfrogging* (above it) from those representing *convergent leapfrogging* (below the line). Similarly, in Quadrant IV, where the difference from the norm is first positive and then negative, points below the (continuation of the) 135 degree line are points of *divergent regression* and those above the line are points of *convergent regression.* This graph is useful to understand how the pattern of convergence differs

generation in order to allow as much time as possible for attitudes to evolve further, beyond the change that occurs between the first and second generation.

[23]See, in particular, Figure 1.4 on p. 25.

for each cultural trait and each country.

We construct an overall index of convergence for each attitude by counting the proportion of countries that fall in the monotonic convergence from above or below, and in the convergent regression and leapfrogging regions. In other terms we are counting, in this case, the points *outside the hourglass* defined by the 45 and 135 degree lines through the origin that represent a decrease in the *absolute* value of the distance from the norm going from the 1^{st} to the 4^{th} generation. Alternatively, we can do this for the 1^{st} and the 2^{nd} generation. We define the proportion of countries within these convergent region as π_{45}.

The drawback of π_{45} is that it may not be a strict enough criterion. In particular it does not allow us to distinguish between slow-converging attitudes that feature country-generation effects close to the 45 degree line (or its reflection), and fast-converging ones clustered closer to the origin, along the y-axis. To this end, we define $\pi_{22.5}$ as the proportion of countries situated between the x-axis and the 22.5 degree line (or its reflection). In other terms, we are now squeezing the hour-glass from above and *count as convergent only those country-wave observations for which the absolute value of the distance from the norm in generation 1 has been cut at least in half by generation 4* (see Figure 2b). This is our preferred measure of convergence. One could use a somewhat tighter or looser criterion. As a robustness exercise, we will document in Section 7 that the ranking of attitudes obtained using the $\pi_{22.5}$ criterion is very similar to the one obtained when we require that the absolute value of the distance from the norm for generation 1 is cut by a third (π_{30}) or two thirds by generation 4 (π_{15}).

Note that this approach, particularly when using the π_{45} criterion, is related to *β convergence* as the latter focuses on whether the slope of the regression line of $\widetilde{\beta}_{o,4,1965-1990,}$ on $\widetilde{\beta}_{o,1,1890-1914}$ is between zero and one (so that the regression line lies in the *monotonic convergence* region). Yet, it is less parametric, less exposed to the influence of outliers, and it allows for convergent leapfrogging and convergent regression as well.

3.6 Results

In this section we present our results, using the definition of convergence based on the hourglass. We start by calculating the percentage of countries whose distance from the norm in generation four is less than half of the distance of their ancestor in generation one. We use this fraction to quantify the convergence that occurs in the particular attitude considered between the first and the fourth generation of the dynasty. We compare the convergence up to the fourth generation with that occurring between the first and the second generation. In this exercise we exclude Great Britain from the count because it plays a dominant role in defining the norm (with a weight of around 40%). After presenting the basic results, we will explore in the next section several robustness exercises and extensions, such as tightening or relaxing the convergence criterion, using a reduced set of controls in the Probit equation, and changing the definition of the norm.

Finally, we shall also present evidence on the changing strength of the relationship between attitudes in the country of origin and immigrants' attitudes across generations. In particular we want to see whether and how the cultural distance of various generations of immigrants from the mother country *increases* for different traits. This last exercise is different from but complementary to what we do in the core of the paper, with our focus on whether or not the cultural distance between succeeding generation of immigrants and the US norm *decreases* for various attitudes.

In Table 4 we report the percentage of countries for which the initial gap has been cut at least in half ($\pi_{22.5}$ denotes this proportion) either going all the way to the fourth generation or by the second generation. In the table we order the attitudes from the slowest moving (top rows) to the fastest moving (bottom rows) in terms of our convergence criterion, going from the first to the fourth generation. Table 5 presents the results by attitude *and* country. Attitudes are organized in categories which facilitates the assessment of convergence of *groups* of attitudes. Importantly, this table allows us to assess whether or not there are country specificities in the process of convergence.

A number of common patterns emerge. First, whether a cultural trait can be considered persistent or not crucially depends upon whether one considers the change between the 1^{st} and 2^{nd} or the 1^{st} and 4^{th} generation. This point is very important: stopping at the 2^{nd} generation, as the literature has typically done, would miss the greater convergence of a number of attitudes. These can be seen comparing the percentage of countries converging by generation four (column 1) and by generation 2 (column 2) reported in Table 4. In approximately three quarter of the cases the percentage of convergent observations by the 4^{th} generation is larger than for the 2^{nd} generation (in the remaining cases there is either no change or a slower convergence by the 4^{th}generation). When we focus on the average percentage of convergent cases for each group of attitudes, in all cases the percentage is larger for generation four compared to generation two (see the last columns of Table 5).

Focusing on the column of Table 5 for the average fraction of convergent cases by generation four, the ranking of *groups* of attitudes, from the slowest-moving to the fastest-moving are: Gender Role, Religion, Government and Politics, Family, Mobility/Success, Abortion, Cooperation, and Sexual Behavior. Note that the change in the proportion of convergent attitudes between the first and the second generation and the first and fourth generation is greater on average for the Cooperation and Sexual Behavior group. Moreover the 95% bootstrapped confidence interval does not include zero for Cooperation and, in this sense, we can reject the hypothesis of no change between the second and fourth generation. For the Sexual Behavior group the 95% confidence interval includes zero, but the 90% interval does not. The 95% confidence interval does not include zero also for the Family and Religion Group, but the change is smaller in size. It is even smaller and not significant for the remaining groups.

In terms of individual attitudes (see the first column of Table 4), the ones that converge more slowly by the fourth generation are those that describe some religious values such as prayer in public schools (*prayer*) and the frequency of personal prayer (*pray*), some family values and traditions concerning divorce, frequency of evenings spent with relatives and parental control on contraception (*divlaw*, *socrel*, and *pillok)* and views about the general role of women in society (*fehome:* the role of women is running the home, while men run the country) and the suitability of women for politics *(fepol).* General political views, and views towards the poor (*polviews* that distinguish conservative- from progressive-leaning individuals, and *helppoor*) also belong to this slow moving group. The next slowest group, in term of speed of convergence is mixed, containing views about women in market work (*fework)*, towards abortion without restrictions (*abany*) and the role of effort in getting ahead (*getahead*) [24]

Trust is among the fastest moving attitudes. It is the key attitude capturing cooperation. Interestingly, *trust* is one of the slow moving attitudes when one focuses on the change between the first and second generation. The group of fast-moving attitudes also contains attitudes toward children's independence (*thnkself and obey*), as well as homosexuality and abortion with restrictions (*homosex* and *abrisk*). The next fastest convergence group contains the remaining attitudes towards cooperation (*fair* and *helpful*), *fechild* (whether or not a child suffer when the mother works), attitudes towards premarital sex (*premarsx*), some religious attitudes (such as *attend*,

[24] Inglehart and Baker (2000), using the World Value Survey (WVS), suggest that economic development is associated with shifts away from absolute norms and values toward more rational, tolerant, trusting, and participatory ones. However, they argue that cultural change is path dependent and is affected by the broad religious and cultural heritage of a society. Notice that the values and attitudes that we identify as slow moving are considered by Inglehart and Baker (2000) as characteristics that distinguish preindustrial from industrial societies.

reliten and *postlife*) and *aged.* With regard to the latter, note that there is evidence that in the last decades there has been a return to a greater acceptance of sharing the home with grown children (see Fry 2014).

In conclusion, the summary convergence rates for groups of attitudes and for individual attitudes suggest that the slower moving ones are those connected with general gender views, general political views, and many (but not all) religious and family values. The fastest changing attitudes, instead, are those related to cooperation, sexuality, and children characteristics likely to determine their success in American society.

Lazear (1999) and Konya (2005), on which the child identity choice of our model is built, emphasize that cultural assimilation is more likely the greater the gain from sharing a cultural trait with the majority and the greater the inefficiency of not doing so. Cavalli-Sforza (2001) also suggests that a trait is more likely to spread horizontally if it is beneficial (see also Tabellini 2008b). Our simple model indeed captures and further clarifies this effect, allowing for a parents' socialization choice, as in Bisin and Verdier (2001). In our model the range of initial size of the minority for which full assimilation is the steady state equilibrium *and* the speed of assimilation in each period indeed increase with the net transaction gain.

This mechanism seems to be at work with many of our fast moving attitudes. For instance, there is much to be gained from sharing attitudes towards cooperation, as captured by *trust*, the fastest moving attitude: although there could be an initial gain from taking advantage of the trust of others, it is likely that the gain would be short-lived, followed by punishment if one is discovered cheating and not conforming to the social norm.[25] Moreover, even though the value attached to the ability of children to

[25]See Guiso, Herrera and Morelli (2013) on how cultural clashes between countries (including the dimension of trust) may lead to the choice of inefficient policies once the countries join a union, with an application to the policy response to the Greek crisis.. There is also an extensive literature on the role of schools in shaping attitudes towards cooperation. See, for instance, Algan, Cahuc and Shleifer (2013) on the effect of teaching methods on beliefs underlining cooperation, and the references there on the effect of the quantity of schooling on social capital. Note that in deriving

be independent, captured by *thnkself* and *obey,* are family attitudes, they affect the ability to profit from interacting with other members in a society, like the US, that greatly values independence. It is, therefore, not surprising to see that they are the *only* (very) fast moving family attitudes. The other family attitudes are instead more slow moving, which is fairly consistent with the spirit of our simple model.

Moreover, the fast convergence of views regarding the cost of women working in terms of the quality of the relationship with one's children can be explained by the large economic gains from having women participating in market work and the fact that generations of women have gradually learned about it.[26] Conversely, it is interesting that attitudes that have to do with women's general role in society and politics, relative to the home, move more slowly. Indeed many complex forces act on gender norms. Many authors (for instance, Goldin 2006 and Albanesi and Olivetti 2009) emphasize that technological innovations, structural change accompanying economic development, and medical improvements have had a powerful effect on gender roles in the labor market. Alesina, Giuliano and Nunn (2013), instead, find a persistent impact on gender norms today of the use of the plough as far back as a few millennia, even after accounting for the other factors mentioned above.

The fact that religious attitudes are on average slow to converge can be rationalized in terms of the less obvious net transaction gains that accrue from adaptation to the norm. However, it is not easy to explain why the speed of convergence of the belief in the after life (*postlife*) is greater than the one for the importance of personal prayer (*pray*), as they both capture deep religious attitudes. The fast evolution of *attend* and *reliten* by the 4^{th} generation is more understandable in terms of the model, as they are embodied or likely to be embodied in public manifestations of one's belief. These are also attitudes for which conforming to the norm may confer social benefits.

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the country-generation effects we control for education of the respondent and of his/her parents.

[26] In our model, we do not allow for learning, See, however, Fernandez (2013) for a model of belief formation in which it takes time for people to update their beliefs about the implications for children's welfare of women working outside the home.

Gruber and Hungerman (2008) find that changes in shopping hours had a large impact on church attendance and conclude that this validates economic models of religiosity that highlight the importance of economic influences, such as the opportunity cost of church-going for religious participation. On the issue of redistribution, our results are broadly in line with those of Alesina and Fuchs-Schuendeln (2007), who find that this attitude can change rather rapidly. They differ instead from those of Luttmer and Singhal (2011) who present evidence that such attitudes are rather "permanent". It is true, however, than most political views tend to converge relatively slowly.

An interesting question is whether the probability that a cultural attitude converges or not depends upon how spread out across countries is the distribution of the trait in the first generation. Here the arguments may go both ways. Large differences in the first generation may make a movement towards the norm more advantageous; on the other hand it may be more difficult to reduce the distance. In our results the median initial standard deviation of the seven faster moving attitudes is larger than the median standard deviation for the slower moving ones (.45 versus .20). The difference in the standard deviation suggests that an initial larger dispersion may lead to faster convergence.

Our results have implications for the debate between the views that emphasize the assimilation of immigrants, versus those that highlight the preservation of a separate identity, and for the question whether the melting pot metaphor is accurate for European immigrants to the US. Indeed, by the fourth generation, the majority of cultural attitudes of descendants of European immigrants has converged, consistently with *Assimilation Theory.* However, contrary to the prediction of that theory and consistently with *Multiculturalism,* descendants of immigrants from different countries of ancestry have maintained over several generations a degree of cultural distinctiveness along some traits. In other terms, the temperature in the melting pot was hot, but not uniform throughout, as one would expect given the model of cultural transmission we have developed that emphasizes the fact that the speed of convergence is likely to differ across various attitudes.

Are there interesting country specificities in the pattern of convergence? The bottom row of Table 5 reports the total number of convergent attitudes by country. Ireland and Germany are the countries with the highest number of cases in which attitudes converge over the entire sample period. Mexico is at the bottom with Poland, while Italy and Scandinavia occupy intermediate positions. An interesting question is which factors can explain the number of convergent attitudes by country. For instance, one would expect, on average, that in countries of origin in which the family is a weaker social institution, direct transmission would be relatively less important or effective. This is captured in our model by the parameters representing the benefit to the parent from the child maintaining the original trait and by the effectiveness of the socialization technology, embodied in the portion of the child's switching cost related to the parent's educational efforts. Indeed there is a positive and significant rank correlation ($r = .62$) between the number of convergent attitudes and the average of the family coefficients for different countries of origin for the 1^{st} generation (weighted by the size of the 1^{st} generation in each period), taken as a proxy for the weakness of the family as an institution in the country of ancestry. However, this is not the only factor. The ease to learn English may also matter in acquiring other cultural traits. In our model this is captured by properties of the distribution of the stochastic component of the child switching costs. As a proxy for the ability to acquire English proficiency, we use the average, for each country of origin, of the number of words (out of ten) of which 1^{st} generation immigrants can identify the meaning[27]. The correlation with the number of changing attitudes is also significant (the rank correlation coefficient is .67). Finally, the number of convergent attitudes by country is negatively correlated ($r = -.47$) with a measure of residential

[27] GSS includes a series of questions that identify the respondent's vocabulary ability.

segregation (See Borjas 1995)[28]. Although our model is silent on this issue as it does not include a residential choice, this is what one would expect since a neighborhood characterized by a high concentration of individuals from the same ancestry is likely to contribute to perpetuating the culture of the country of origin and to a slowing down of the process of cultural integration. All these results should be taken with a grain of salt given the small number of countries in our sample. The issue of how the composition of the neighborhood affects the evolution of attitudes at the individual level is a very important and interesting topic that we leave for future research.

3.7 Robustness and Extensions

In this section we discuss several robustness exercises. Are our results robust, for instance, to a change in the tightness of the convergence criteria in terms of the definition of the convergence region? Are they robust to the menu of controls included in the Probit model used to measure the country-generation-cohort effects or to changes in the definition of the norm to which attitudes converge? The answer to all these questions, as we shall see in the next sub-sections, is yes.

Finally, in the last sub-section we investigate an issue that is important, though not directly related to our main result. In the paper we have investigated the convergence to the dominant norm across generations of immigrants. A different but interesting question is how do such attitudes relate, for succeeding generations, to those of individuals who have not migrated and kept living in the country of origin? In particular, do we observe a weakening of the relationship as the temporal distance from the country of origin increases over generations?

These two issues are related, but different: convergence (non convergence) to the norm in the US does not imply nor is implied by an increasing distance (non

[28]More precisely, see Borjas (1995), Table 2. We use the measure based on the percentage of first and second generation immigrants in the neighborhood of the same ethnicity as a first-generation immigrants. Similar results are obtained using figures for the second generation.

increasing distance) from the culture of the country of origin. For instance, differences in attitudes across immigrants of distinct ethnicity (the issue investigated in this paper) could persist, and still the attitudes of immigrants could drift away from those prevailing in the country from which their ancestors came. Alternatively, one's cultural traits may remain close to those of the country of origin, but convergence to the norm across generations may be observed because over time values across countries become more similar. With this caveat in mind it is, however, interesting to present some evidence on the changing strength of the relationship between attitudes in the country of origin and attitudes of successive generations of immigrants.

3.7.1 Changing the Definition of the Convergence Region

In our baseline results we have measured convergence focusing, for each attitude, on the index we called $\pi_{22.5}$, which measures the proportion of countries that have cut the absolute value of the distance of generation 4 from the norm by at least half relative to generation 1. In Table A1 we present detailed results for the 4^{th} generation based on less or more stringent criteria for convergence: reducing that distance by any amount (π_{45}), by at least a third (π_{30}), and by at least two thirds (π_{15}). The (Spearman) rank correlation coefficients between the proportions of converging country-wave observations (by generation 4) in the baseline and those obtained using these alternative criteria are reported at the bottom of the table. All correlation coefficients with the ranking in our baseline case are very high (in excess of 80%). In other words the ranking of attitudes is robust to the degree of tightness of the convergence criterion and so are our general conclusions on the relative speed of convergence of different attitudes.[29]

[29] The Spearman rank correlation coefficient remains high for an even tighter convergence criterion, requiring that the original gap is cut by at least three quarters.

3.7.2 Reducing the Set of Controls in the Probit Equation

In Table A2 we limit the set of common controls to include only age, age squared, year of the survey dummy, gender, religion, regional indicators, and urbanization indicators. Income, education, mother's education, father's education, number of children, marital status, and work status are excluded. The income and education level of a respondent will surely influence his/her attitudes. But both income and education (as well as the rest of the excluded individual controls) can be viewed as an outcome of factors encoded in the country-of-origin fixed effects. The main results in the paper focus on the ancestral influence on attitudes that cannot be explained by variations in income, education, and etc.. In this section we allow for the ancestral influence to capture these changes in individual characteristics as well. Our conclusions are largely unchanged. The Spearman rank correlation coefficients with our original ranking is 0.97.

3.7.3 Changing the definition of the Norm

In Table A3 we return to our baseline specification and experiment with changing the definition of the norm. More specifically we choose as reference point the fourth generation descendants of immigrants from Great Britain. The rank correlation coefficient with our original ranking is 0.78 and our conclusions remain largely the same. This should not be surprising since descendants of British immigrants represent a large share (around 40%) of the immigrants who are fourth generation (or higher).

3.7.4 Immigrants' Attitudes and Attitudes in the Country of Origin

As we have remarked in the introduction to this section, the relationship between the attitudes of succeeding generations of immigrants and those of individuals who have not migrated and kept living in the country of origin is related, but distinct from the main question investigated in this paper. A weakening (non-weakening) link with the original culture is neither a necessary nor sufficient condition for convergence (non-convergence) to the US prevailing norm. However, it is a very interesting issue and one the literature has often addressed, as do in this section.[30] We measure attitudes in the countries of origin using the European Value Survey (EVS) and the World Value Survey (WVS) which ask largely identical questions, some of which coincide or, more often, are similar to those asked in the GSS and used in our baseline results. The match is very close for the questions regarding some of the cultural attitudes we have used in our empirical work, such as *trust, attend, postlife,* and *homosex,* and a fairly close (but not perfect) for *pray, thnkself, obey, divlaw, fechild, fehome, fework,* and *abany* (See Table A4). The match is not close for the remaining attitudes we have examined. We have pooled the EVS and WVS data for all the relevant countries for the periods matching those defined in our baseline model. In the first stage, for each of these periods, we have estimated the coefficient of country-cohort specific dummies in a Probit model for each attitude, controlling for age, age squared, gender, and marital status.[31] In the second stage, we have then associated these country-cohort-specific effects with the data in each GSS survey, so that each individual as been matched with the culture in the country of origin of the cohort she/he belongs to. We have then estimated the Probit models for each cultural attitude on the GSS data, as we did before, but replacing the period-origin-generation and origin-cohort dummies with the time varying and country specific cultural proxy obtained in the first stage, interacted with generation dummies. We continue to control for all the individual specific variables used before and for common year effects. Essentially, we are assuming that the country of origin and time specific movements in culture for US immigrants are proportional to the cultural proxy estimated in the first stage,

[30] See the discussion and references in the Introduction.
[31] The results that follow are not sensitive to the choice of the controls.

and that its effect may vary across generations. In particular, we are interested in assessing the significance of the generation-specific coefficients and whether the effect of the culture of origin decreases (or not) going from the 1^{st} to the 4^{th} generation.

The results are reported in Table 6. First, considering all attitudes, in seven out of twelve cases the coefficients of the culture of the country of origin for the first or second generation are significant. The association is closest for the attitudes that bear a close correspondence in the actual question surveyed. This emphasizes the fact that an imperfect match between the EVS-WVS and the GSS questions is likely to lead us to underestimating the strength of the association with the culture of the country of origin. Most interestingly, from our point of view, the value of the generation specific coefficients decreases in most cases as we go from the first to higher generations, implying a weakening of the effect of the culture of the country of origin, as one would expect. For instance, in the case of *trust,* the coefficient decreases from .48 to .23, .18, .11 as we go from the 1^{st} to the 4^{th} generation, and remains significant (or almost so) at conventional levels from the 1^{st} to the 4^{th} generations. A similar pattern is displayed by *attend, pray, thnkself, fechild*, and, to some extent, by *divlaw and homosex.* Five of the attitudes displaying this decaying pattern are in the top half of the distribution in terms of convergence speed, according to our preferred criterion.

3.8 Conclusions

Do cultural traits persist relatively unchanged over long periods of time, or do they converge rather rapidly to a country's prevailing norm? In this paper we have presented new evidence on this question by analyzing cultural attitudes of different generations of European immigrants to the US and we have provided a simple model to shed light and interpret the evidence on the speed of convergence.

We show that persistence is not the same across cultural traits. Some traits converge slowly to the prevailing norm: this is the case, for instance, of some family and gender values, political views, and deep personal religious values. Other traits, instead, show a faster pace of convergence: this is true, for example, for attitudes towards cooperation (the trustworthiness and helpfulness of others), children's independence, and attitudes towards sexuality, and also attitudes towards the effect of women's work on the child-mother relationship. Slow-moving attitudes are mostly the ones for which direct transmission within the family is likely to be more important and effective. Fast-changing ones are those for which the benefits of assimilation as a result of economic and social interactions are greater and the switching costs smaller.

Importantly, we show that one would not come to these conclusions if one limited the analysis to just the first two generations of immigrants, as the literature has so far mostly done. Focusing only on the first two generations biases the conclusion in favor of persistence. Finally, we show that persistence is "culture specific" in the sense that the country from which one's ancestors came matters for the pattern of generational convergence (or lack thereof).

The implication of our results for the debate about the "melting pot" is that the latter was certainly at work for European immigrants for many-cultural traits and beliefs. However, descendants of immigrants from different countries of ancestry have maintained over several generations a degree of cultural distinctiveness along some other traits. Thus, the temperature in the melting pot was hot, but not uniform throughout, as suggested by our model that emphasizes how the effectiveness and importance of the socialization mechanism by parents and of the benefits from assimilation for their children is likely to vary across attitudes and countries. In this last respect, our results also show that the overall pattern of convergence differs across countries of origin in a manner largely consistent with the model predictions.

Finally, one may ask whether the evidence provided in this paper has any relevance for the question concerning the likelihood of success of reforms designed to change practices within a country. Are such reforms doomed because a country's culture cannot be changed, or can they succeed because they can change cultural attitudes by altering incentives? This paper neither intends to, nor can provide an answer to this question. What we have shown, however, is that the large shock represented by the new social and economic environment faced by immigrants can eventually lead to a change in many cultural traits. We have also found that the process of change depends upon cultural characteristics of the country of origin, so that any answer is likely to be country specific. These issues could be fertile ground for future research.

Tables and Figures

Table 1: List of Attitudes: Groups, Abbreviations, Descriptions

Group A – Cooperation	trust	can people be trusted or cannot be too careful? (y=1 for yes if $x_{GSS} = 1$)
	fair	will people take advantage of you? (y=1 for no if $x_{GSS} = 2$)
	helpful	people are mostly helpful or looking out for themselves (y=1 for yes if $x_{GSS} = 1$)
Group B – Government/Politics	eqwlth	government should equalize income between poor and rich (y=1 for yes if $x_{GSS} < 5$)
	helppoor	government should improve the standard of living of the poor (y=1 for yes if $x_{GSS} < 4$)
	polviews	political views (y=1 for liberal if $x_{GSS} < 4$)
Group C – Religion	attend	frequency of religious services attendance (y=1 for less often if $x_{GSS} < 4$)
	pray	frequency of prayer (y=1 for less often if $x_{GSS} > 4$)
	reliten	intensity of religious affiliation (y=1 for not strong if $x_{GSS} > 1$)
	postlife	belief in life after death (y=1 for no if $x_{GSS} = 2$)
	prayer	approval of prayer in public schools (y=1 for disapprove if $x_{GSS} = 2$)
Group D – Family	thnkself	independence of a child is highly important quality (y=1 for important if $x_{GSS} < 3$)
	obey	obedience of a child is a highly important quality (y=1 for not important if $x_{GSS} > 2$)
	pillok	birth control available to teenagers without parental consent (y=1 for ok if $x_{GSS} < 3$)
	aged	approval of sharing home with grown children (y=1 for disapproval if $x_{GSS} > 1$)
	divlaw	should divorce be easier? (y=1 for yes if $x_{GSS} = 1, 3$)
	socrel	frequency of social evenings with relatives (y=1 for less often if $x_{GSS} > 3$)
Group E – Gender Roles	fechild	working mother can have a good relationship with children (y=1 for yes if $x_{GSS} < 3$)
	fehome	women should take care of running homes (y=1 for no if $x_{GSS} = 2$)
	fepol	women not suited for politics (y=1 for no if $x_{GSS} = 2$)
	fework	women should work even if husband can support them (y=1 for yes if $x_{GSS} = 1$)
Group F – Abortion	abany	approval of abortion for any reason (y=1 for yes if $x_{GSS} = 1$)
	abrisk	approval of abortion for health/defect/rape reasons (y=1 for yes if $x_{GSS} = 0$)
Group G – Sexual Behavior	premarsx	approval of premarital sex (y=1 for yes if $x_{GSS} = 4$)
	homosex	approval of same-sex sexual relations (y=1 for yes if $x_{GSS} > 2$)
Group H – Mobility/Success	getahead	work, help, luck as a source of social mobility (y=1 for work if $x_{GSS} = 1$)

Notes: The responses from the survey have been recoded to have a binary outcome. y denotes the indicator variable in the Probit. Variable abrisk does not exist in the GSS. $abrisk = abhlth \cap abrape \cap abdefect$. x_{GSS} denotes the numerical value of the answers to the GSS questions. Some allow for a gradation of response.

Table 2: Country Groups

Country Group	Countries
German origin (GER)	Germany
Polish origin (POL)	Poland
Scandinavian origin (SCA)	Denmark, Finland, Sweden, Norway
Irish origin (IRE)	Ireland
Italian origin (ITA)	Italy
British origin (GB)	England, Wales, Scotland
South European origin (MEX)	Mexico

Table 3: Number of Respondents for the Question on Trust by Origin, Cohort, and Generation

	Cohort 1890-1915				Cohort 1916-1940				Cohort 1941-1965				Cohort 1966+			
	Gen1	Gen2	Gen3	Gen4	Gen1	Gen2	Gen3	Gen4	Gen1	Gen2	Gen3	Gen4	Gen1	Gen2	Gen3	Gen4
GER	12	67	54	112	47	83	308	639	63	86	340	1,528	32	39	62	587
POL	13	40	3		15	89	60	15	25	29	203	75	7	8	21	68
SCA	10	58	12	4	12	74	127	71	16	28	179	295	6	3	21	124
IRE	7	29	25	106	12	57	161	508	26	44	230	1,115	11	19	51	483
ITA	19	48	2	1	38	186	75	13	36	80	380	157	8	34	78	202
UK	19	38	48	208	61	87	124	1,046	68	81	163	1,460	22	19	28	461
MEX	1	3		3	28	45	13	12	144	105	85	72	270	170	43	77

	Dynasty 1890			
	Gen1	Gen2	Gen3	Gen4
GER	59	83	340	587
POL	28	89	203	68
SCA	22	74	179	124
IRE	19	57	230	483
ITA	57	186	380	202
UK	80	87	163	461
MEX	29	45	85	77

Table 4: Convergence by Cultural Attitude: Comparing Generation 4 and 2

	Gen 4 $\pi_{22.5}$	Gen 2 $\pi_{22.5}$	(Gen 4 $\pi_{22.5}$ - Gen 2 $\pi_{22.5}$)
prayer	17%	17%	0%
socrel	17%	17%	0%
pray	33%	17%	17%
divlaw	33%	0%	33%
fehome	33%	33%	0%
polviews	50%	50%	0%
pillok	50%	33%	17%
helppoor	50%	67%	-17%
fepol	50%	33%	17%
fework	67%	50%	17%
abany	67%	83%	-17%
getahead	67%	83%	-17%
attend	83%	67%	17%
aged	83%	33%	50%
eqwlth	83%	33%	50%
fair	83%	17%	67%
fechld	83%	67%	17%
helpful	83%	33%	50%
reliten	83%	50%	33%
postlife	83%	50%	33%
premarsx	83%	50%	33%
trust	100%	33%	67%
abrisk	100%	83%	17%
obey	100%	50%	50%
homosex	100%	50%	50%
thnkself	100%	33%	67%

Notes: Percentage of country-wave observations for which the absolute value of the deviation from the norm has been cut at least in half between generation 1 and generation 2 or 4

Table 5: Convergence by Cultural Attitude and Country

		GER	POL	SCA	IRE	ITA	MEX	Total	Gen 4 $\pi_{22.5}$	Gen 2 $\pi_{22.5}$	$\triangle$	90% CI	95% CI
Group A - Cooperation	trust	1	1	1	1	1	1	100%	89%	28%	61%	(22%, 61%)	(17%, 61%)
	fair	1	1	1	1	1	0	83%					
	helpful	1	1	0	1	1	1	83%					
Group B - Government/Politics	eqwlth	1	1	0	1	1	1	83%	61%	58%	11%	(0%, 39%)	(-6%, 44%)
	helppoor	1	0	1	1	0	0	50%					
	polviews	0	1	0	1	1	0	50%					
Group C - Religion	attend	1	1	1	1	0	1	83%	60%	40%	20%	(7%, 40%)	(3%, 40%)
	pray	0	0	0	1	0	1	33%					
	reliten	1	1	1	1	1	0	83%					
	postlife	1	0	1	1	1	1	83%					
	prayer	0	0	0	1	0	0	17%					
Group D - Family	thnkself	1	1	1	1	1	1	100%	64%	28%	36%	(17%, 40%)	(14%, 47%)
	obey	1	1	1	1	1	1	100%					
	pillok	1	0	1	0	1	0	50%					
	aged	1	1	0	1	1	1	83%					
	divlaw	1	0	1	0	0	0	33%					
	socrel	0	0	0	1	0	0	17%					
Group E - Gender Roles	fechld	1	1	0	1	1	1	83%	58%	46%	12%	(-4%, 29%)	(-8%, 33%)
	fehome	1	0	1	0	0	0	33%					
	fepol	0	0	1	1	0	1	50%					
	fework	1	1	0	1	1	0	67%					
Group F - Abortion	abany	1	0	0	1	1	1	67%	83%	83%	0%	(-8%, 42%)	(-8%, 42%)
	abrisk	1	1	1	1	1	1	100%					
Group G - Sexual Behavior	premarsx	1	1	1	1	0	1	83%	92%	50%	42%	(.01%, 50%)	(0%, 50%)
	homosex	1	1	1	1	1	1	100%					
Group H - Mobility/Success	getahead	1	0	1	1	1	0	67%	67%	83%	-16%	(-17%, 50%)	(-17%, 67%)
		81%	58%	62%	88%	65%	58%						

Notes: The figures in the table represent the number of times we observe convergence for each country and each attitude. Convergence is achieved when the absolute value of the deviation from the norm has been cut at least in half between generation 1 and generation 4 ($\pi_{22.5}$ criterion). The last two columns report the bootstrapped 90% and 95% confidence intervals, based on 500 replications estimating the Probit equation, based on stratified sampling with replacement in the country-generation-cohort cells.

Table 6: The Impact of European Attitudes on US Immigrants across Generations

	$Cult_o \times I_{(g=1)}$	$Cult_o \times I_{(g=2)}$	$Cult_o \times I_{(g=3)}$	$Cult_o \times I_{(g=4)}$
trust	0.48	0.23	0.18	0.11
	(5.21)	(3.06)	(2.80)	(1.82)
attend	0.18	0.02	0.06	-0.01
	(4.12)	(0.54)	(2.73)	(-0.76)
pray	0.38	0.09	0.02	-0.02
	(3.81)	(1.27)	(0.35)	(-0.62)
postlife	0.07	-0.13	0.18	0.00
	(0.39)	(-1.24)	(2.57)	(-0.08)
thnkself	0.65	0.24	-0.06	0.02
	(4.15)	(2.19)	(-0.66)	(0.38)
obey	-0.15	0.13	0.05	-0.17
	(-0.77)	(0.74)	(0.47)	(-3.16)
divlaw	0.09	0.16	0.02	-0.01
	(0.99)	(2.13)	(0.35)	(-0.15)
fechild	0.28	0.09	0.05	0.06
	(2.25)	(1.17)	(0.81)	(1.32)
fehome	-0.19	0.10	0.14	0.03
	(-1.56)	(0.97)	(1.40)	(0.40)
fework	0.09	-0.02	0.02	-0.03
	(1.05)	(-0.25)	(0.28)	(-0.61)
abany	-0.01	-0.01	0.01	0.03
	(-0.13)	(-0.23)	(0.28)	(0.88)
homosex	0.12	0.12	-0.02	0.07
	(1.38)	(1.81)	(-0.42)	(1.50)

Notes: $Cult_o$ denotes the culture of the country of origin. Generation specific coefficients are reported. z statistics in parentheses.

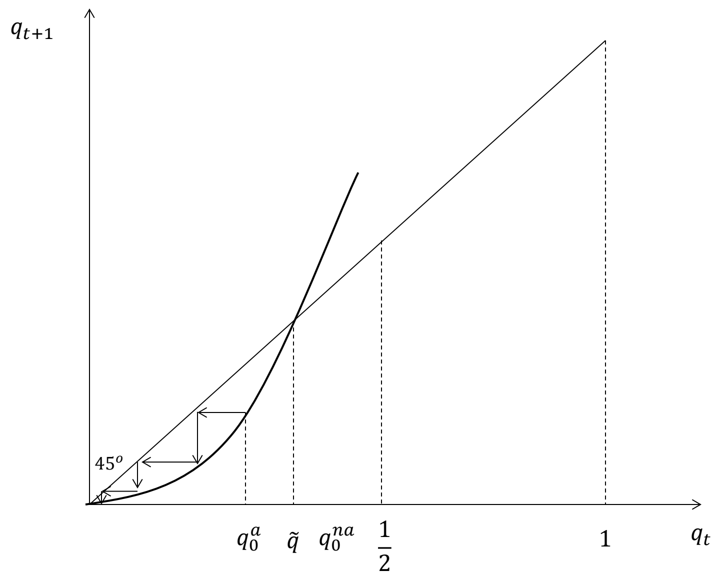

Figure 1a: Dynamics and Equilibria: Full Assimilation and Non-assimilation Equilibrium

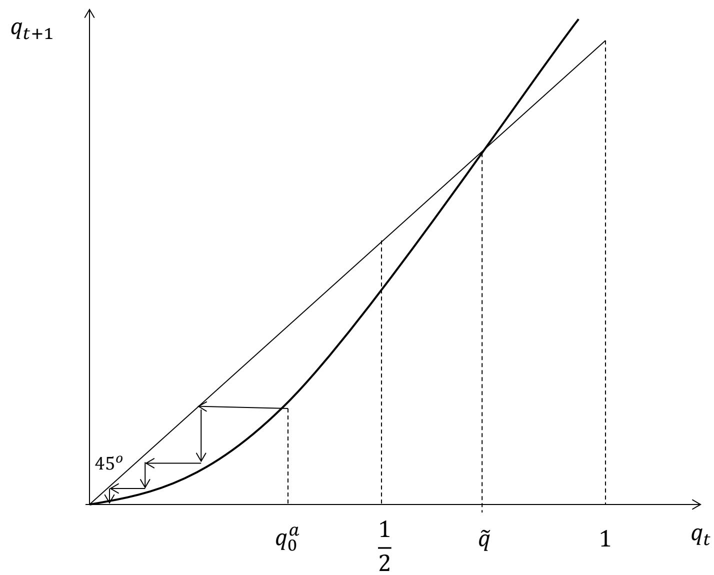

Figure 1b: Dynamics and Equilibria: Only Full Assimilation Equilibrium

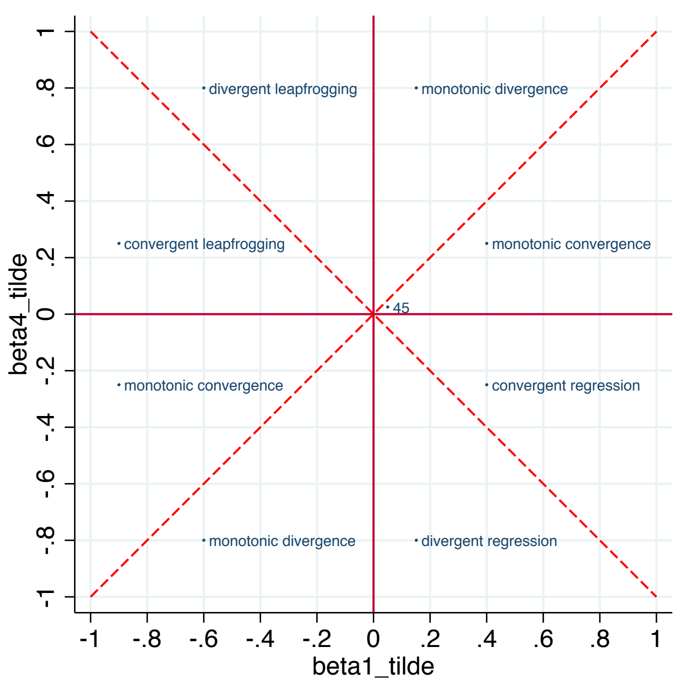

Figure 2a: Generational Convergence and Non-convergence Regions (by type)

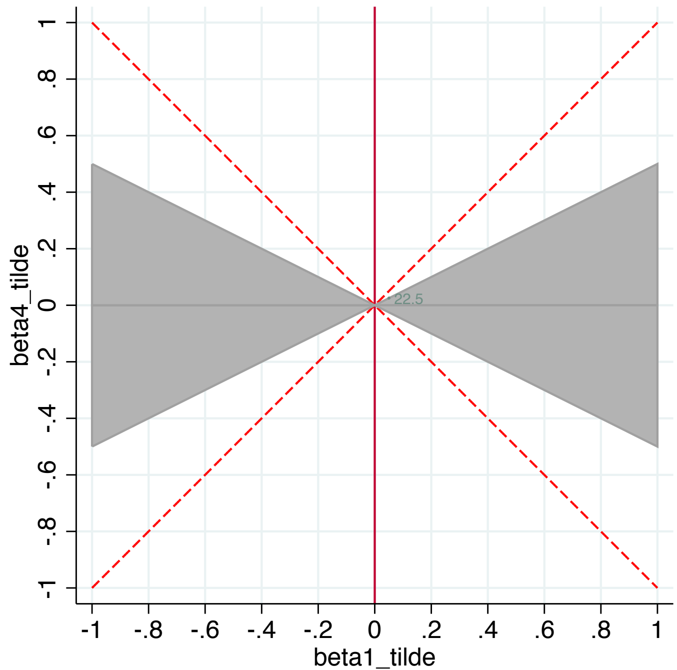

Figure 2b: Convergence Region Implied by the 22.5^o Cut-off Rule

Appendix 1

Table A1: Sensitivity of Convergence Across Different Criteria

π_{45}		π_{33}		$\pi_{22.5}$		π_{15}	
prayer	33%	prayer	17%	prayer	17%	divlaw	0%
fehome	33%	socrel	17%	socrel	17%	socrel	0%
polviews	50%	pray	33%	pray	33%	prayer	17%
socrel	50%	fehome	33%	divlaw	33%	polviews	33%
helppoor	67%	helppoor	50%	fehome	33%	pray	33%
pray	67%	polviews	50%	polviews	50%	fehome	33%
fework	67%	pillok	50%	pillok	50%	fepol	33%
getahead	67%	divlaw	50%	helppoor	50%	helppoor	50%
reliten	83%	fepol	67%	fepol	50%	helpful	50%
postlife	83%	fework	67%	fework	67%	pillok	50%
pillok	83%	abany	67%	abany	67%	eqwlth	50%
divlaw	83%	getahead	67%	getahead	67%	abany	50%
fechld	83%	attend	83%	attend	83%	premarsx	50%
fair	83%	aged	83%	aged	83%	homosex	50%
fepol	83%	helpful	83%	eqwlth	83%	getahead	50%
attend	83%	fair	83%	fair	83%	attend	67%
abany	83%	fechld	83%	fechld	83%	fework	67%
helpful	83%	eqwlth	83%	helpful	83%	fechld	83%
trust	100%	reliten	83%	reliten	83%	reliten	83%
aged	100%	postlife	83%	postlife	83%	trust	83%
thnkself	100%	premarsx	83%	premarsx	83%	fair	83%
eqwlth	100%	trust	100%	trust	100%	thnkself	83%
abrisk	100%	abrisk	100%	abrisk	100%	abrisk	83%
premarsx	100%	obey	100%	obey	100%	obey	83%
homosex	100%	homosex	100%	homosex	100%	postlife	83%
obey	100%	thnkself	100%	thnkself	100%	aged	83%

Rank Correlation

	π_{45}	π_{30}	$\pi_{22.5}$	π_{15}
π_{45}	1.00			
π_{30}	0.87	1.00		
$\pi_{22.5}$	0.84	0.95	1.00	
π_{15}	0.61	0.81	0.85	1.00

Notes: The table shows different orderings of the speed of convergence according to the percentage of country-wave observations for which the absolute value of the deviation from the norm in the first generation has been cut by any amount (π_{45}), by a third (π_{30}), by half ($\pi_{22.5}$), and by two thirds (π_{15}) by generation 4. The second table lists the rank correlations between the different convergence criteria.

Table A2: Limited Controls: Convergence by Cultural Attitude: Comparing Generation 4 and 2

	Gen 4 $\pi_{22.5}$	Gen 2 $\pi_{22.5}$	(Gen 4 $\pi_{22.5}$ - Gen 2 $\pi_{22.5}$)
prayer	17%	17%	0%
socrel	17%	17%	0%
pray	33%	17%	17%
divlaw	33%	0%	33%
fehome	33%	33%	0%
polviews	50%	50%	0%
pillok	50%	33%	17%
helppoor	50%	67%	-17%
fepol	50%	33%	17%
fework	67%	50%	17%
abany	67%	83%	-17%
getahead	67%	83%	-17%
attend	83%	67%	17%
aged	33%	83%	50%
eqwlth	83%	33%	50%
fair	83%	17%	67%
fechld	83%	67%	17%
helpful	83%	33%	50%
reliten	83%	50%	33%
postlife	83%	50%	33%
premarsx	83%	50%	33%
trust	100%	33%	67%
abrisk	100%	83%	17%
obey	100%	50%	50%
homosex	100%	50%	50%
thnkself	100%	33%	67%

Notes: This table replicates Table 4 using a limited set of controls. Percentage of country-wave observations for which the absolute value of the deviation from the norm has been cut at least in half between generation 1 and generation 2 or 4.

Table A3: UK Benchmark: Convergence by Cultural Attitude: Comparing Generation 4 and 2

	Gen 4 $\pi_{22.5}$	Gen 2 $\pi_{22.5}$	(Gen 4 $\pi_{22.5}$ - Gen 2 $\pi_{22.5}$)
prayer	0%	0%	0%
socrel	17%	17%	0%
fehome	17%	50%	-33%
divlaw	33%	0%	33%
fepol	33%	33%	0%
pray	50%	17%	33%
reliten	50%	50%	0%
postlife	50%	50%	0%
pillok	50%	33%	17%
helpful	50%	50%	0%
premarsx	50%	33%	17%
attend	67%	83%	-17%
eqwlth	67%	33%	33%
polviews	67%	17%	50%
helppoor	67%	50%	17%
fework	67%	50%	17%
abany	67%	83%	-17%
getahead	67%	67%	0%
obey	83%	50%	33%
fair	83%	17%	67%
homosex	83%	50%	33%
fechld	83%	67%	17%
abrisk	100%	50%	50%
trust	100%	17%	83%
thnkself	100%	50%	50%
aged	100%	50%	50%

Notes: This table replicates Table 4 using the attitude of the fourth generation of UK immigrants as a benchmark. Percentage of country-wave observations for which the absolute value of the deviation from the norm has been cut at least in half between generation 1 and generation 2 or 4.

Table A4: List of Matched Attitudes between the General Social Survey (GSS) and the European Values Survey/World Values Survey (EVS/WVS)

GSS	EVS/WVS Question Number	Description of EVS variable
trust	a165	Most people can be trusted (y=1 for yes if $x_{EVS} = 1$)
attend	f028	How often do you attend religious services (y=1 for less often if $x_{EVS} > 3$)
pray	f063	How important is God in your life (y=1 for less important if $x_{EVS} < 7$)
postlife	f051	Believe in life after death (y=1 for no if $x_{EVS} = 0$)
thnkself	a029	Important child qualities: independence (y=1 for important if $x_{EVS} = 1$)
obey	a042	Important child qualities: obedience (y=1 for not important if $x_{EVS} = 0$)
divlaw	f121	Justifiable: divorce (y=1 for yes if $x_{EVS} > 3$)
fechild	d061	Pre-school child suffers with working mother (y=1 for yes if $x_{EVS} > 2$)
fehome	d057	Being a housewife just as fulfilling (y=1 for no if $x_{EVS} > 1$)
fework	d058	Husband and wife should both contribute to income (y=1 for yes if $x_{EVS} = 1$)
abany	f120	Justifiable: abortion (y=1 for yes if $x_{EVS} = 10$)
homosex	f118	Justifiable: homosexuality (y=1 for yes if $x_{EVS} > 7$)

Notes: The responses from the EVS/WVS have been recoded to have a binary outcome. We indicate the correspondence between GSS and EVS/WVS and the original value(s) from the EVS/WVS that are matched with the recoded GSS variables. y denotes the indicator variable in the first stage Probit. x_{EVS} denotes the answer number to the EVS/WVS questions.

Appendix 2: Phase Diagram and Location of $\tilde{q}$

Re-writing equation (3.8) in the text, the dynamics of assimilation is determined by:

$$q_{t+1} = \left(1 - \frac{(1-q_t)\theta^M V - q_t\theta^m V - d\left(\frac{\varphi_0 - \beta[(1-q_t)\theta^M V - q_t\theta^m V - \underline{t}]}{\frac{c(\bar{t}-\underline{t})}{d} - \beta d}\right) - \underline{t}}{\bar{t} - \underline{t}} \right) q_t \tag{A1}$$

$$\frac{dq_{t+1}}{dq_t} = \left(1 - \frac{(1-q_t)\theta^M V - q_t\theta^m V - d\left(\frac{\varphi_0 - \beta[(1-q_t)\theta^M V - q_t\theta^m V - \underline{t}]}{\frac{c(\bar{t}-\underline{t})}{d} - \beta d}\right) - \underline{t}}{\bar{t} - \underline{t}} \right) + \left(\frac{\theta^M V + \theta^m V + \beta d \frac{[\theta^M V - q_t\theta^m V]}{\frac{c(\bar{t}-\underline{t})}{d} - \beta d}}{\bar{t} - \underline{t}} t \right) q_t > 0 \tag{A2}$$

$$\frac{d^2 q_{t+1}}{dq_t^2} = \frac{2c(\theta^M V + \theta^m V)}{c(\bar{t} - \underline{t}) - \beta d^2} > 0 \tag{A3}$$

Therefore the relationship between q_{t+1} and q_t (the phase line) starts at zero and it is increasing and convex. It intersects the 45 degree line also at $\tilde{q}$, where $\tilde{q}$ satisfies $(1-\tilde{q})\theta^M V - \tilde{q}V\theta^m V - d\tau^* = \underline{t}$,so that there are no gain from assimilation and $G\left((1-\tilde{q})\theta^M V - \tilde{q}\theta^m V - d\tau^*\right) = 0$. Our parametrization implies:

$$\tilde{q} = \frac{\theta^M V - \frac{\varphi_0 d^2}{c(\bar{t}-\underline{t})} - \underline{t}}{\theta^M V + \theta^m V} \tag{A4}$$

The numerator of the first line on the right hand side of (A4) is strictly positive, because we assume that $(1-q)\theta^M V - q\theta^m V - d\tau^* \geq \underline{t}$ which implies that $(1-q)\theta^M V - q\theta^m V - \frac{\varphi_0 d^2}{c(\bar{t}-\underline{t})} - \underline{t} \geq 0$. Hence $\tilde{q} > 0$. The numerator and denominator of (A4) also imply that $\tilde{q} < 1$. Therefore, $0 < \tilde{q} < 1$ as claimed in the text.

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