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Spillovers from Immigrant Diversity in Cities

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Abstract
Using comprehensive longitudinal matched employer-employee data for the U.S., this paper provides new evidence on the relationship between productivity and immigration-spawned urban diversity. Existing empirical work has uncovered a robust positive correlation between productivity and immigrant diversity, supporting theory suggesting that diversity acts as a local public good that makes workers more productive by enlarging the pool of knowledge available to them, as well as by fostering opportunities for them to recombine ideas to generate novelty. This paper makes several empirical and conceptual contributions. First, it improves on existing empirical work by addressing various sources of potential bias, especially from unobserved heterogeneity among individuals, work establishments, and cities. Second, it augments identification by using longitudinal data that permits examination of how diversity and productivity co-move. Third, the paper seeks to reveal whether diversity acts upon productivity chiefly at the scale of the city or the workplace. Findings confirm that urban immigrant diversity produces positive and nontrivial spillovers for U.S. workers. This social return represents a distinct channel through which immigration generates broad-based economic benefits.

Keywords: Immigrants, diversity, productivity, spillovers, cities
JEL Classifications: O4; R0; O18; F22; J61

1 Introduction

Since 1960, global flows of international migrants have more than doubled, alongside considerable growth in the mix of locations from which they hail (Özden et al., 2011). Much of this upswell of immigrant diversity is concentrated in cities in rich countries. In the U.S., in large metropolitan areas like New York and Los Angeles, nearly 40 percent of the population was born abroad, more than twice the national average; meanwhile, the Los Angeles Unified School District reports that more than 90 languages are spoken in its schools. London, Hong Kong and other large metropolitan regions report similar levels of foreign-born residents and immigrant heterogeneity.

This paper aims to determine whether this diversity affects worker productivity. Theory – drawn from psychology, organisational studies, urban economics, and economic geography – suggests a double-edged relationship rooted in externalities in production. On the positive side, country of birth is taken to signal distinctiveness in peoples' approaches to framing and solving problems. When a population contains a mix of such heuristics, it widens the scope of available solutions, while also providing opportunities to cross-pollinate ideas to produce innovations. Hence, diversity ought to generate spillovers that raise worker productivity. On the negative side, interaction and cooperation across birthplace-rooted differences can be more difficult, with the result that productivity in diverse contexts becomes inhibited.

Believing the relationship between diversity and productivity to operate at the metropolitan scale, empirical researchers have investigated these ideas in cities in the U.S., UK, EU15, Germany, and the Netherlands. Quite consistently, researchers find that cities that feature more diverse urban workforces have higher levels of wages, rents, and employment, suggesting positive spillovers from urban immigrant diversity (Ottaviano and Peri, 2006; Nathan, 2011; Kemeny, 2012; Bellini et al., 2013; Trax et al., 2012; Suedekum et al., 2014).

Of course, this is not the same as saying that immigrant diversity in cities is a direct cause of changes in productivity. The primary goal of this paper is to clarify the nature of this relationship, by addressing two major limitations of existing research. The first is that prior studies have largely not accounted for an array of individual-level sources of variation. Important among these are hard-to-observe characteristics like talent and motivation that are believed to play crucial roles in determining both productivity and worker locational choices. It is plausible that highly-productive workers are drawn to cities that happen to be immigrant-diverse; without accounting for such bias, we cannot be sure if effects ascribed to diversity in prior work merely reflect sorting rooted in unobserved human capital. The second limitation is that prior research has mostly ignored the role of workplace effects in shaping productivity. Many features of establishments ought to influence worker productivity, and the inability to account for these may introduce serious mismeasurement of the relationship of interest. Over and above this general point lies a specific concern: existing studies have not included measures of diversity in work establishments to complement measures at the urban scale. As a result, we do not yet un-

derstand whether any observed diversity effects operate within individual establishments, or whether they emerge from Jane Jacobs' "ballet of the good city sidewalk" (Jacobs, 1961, p.50).

To address these challenges, this paper exploits the U.S. Census Bureau's confidential Longitudinal Employer-Household Dynamics (LEHD) dataset, a uniquely comprehensive matched employer-employee dataset of U.S. workers and their work establishments. The version of LEHD used covers nearly all workers in 29 states, on a quarterly basis between 1991 and 2008. Our strategy is to focus on workers' multi-year work 'spells' held consistently within the same establishment and city. Leveraging the panel dimension of these spells, we examine how individuals' wages change in response to changes in the diversity in the cities where they live, as well as in the establishments where they work. We estimate a fixed effects model that accounts for stationary unobserved heterogeneity at individual, work establishment and city levels, thereby addressing bias from various sources, including sorting. One virtue of the data is the ability to measure changes in diversity not just in cities but also in establishments; this allows us to identify the specific contexts – either city or workplace – where any productivity-enhancing or -inhibiting effects may reside.

We find robust evidence that rising diversity in cities as well as establishments positively influences worker wages. These relationships hold after we address remaining endogeneity concerns by instrumenting for city and workplace diversity with lagged predictors, using the generalized method of moments fixed effects estimator. Results remain consistent in models focused narrowly on tradable activities, bolstering the claim that the link between diversity and wages reflects a productivity effect, rather than being driven by immigration-related quality-of-life factors. In our preferred specification (Table 2, Model 3), we find that, all else equal, a one standard deviation increase in city immigrant diversity is associated with a 5.8 percent increase in wages. At the same time, a one standard deviation increase in workplace immigrant diversity raises wages by 1.6 percent. The confirmation of city effects supports the existing scholarship, though city effects in the present paper are more modest than for approaches that have not accounted for sorting, workplace characteristics, and other hard-to-observe factors. And we contribute new evidence to suggest that diversity produces economic benefits not just on city sidewalks and streets, but also within work establishments.

Although this is a study of a specific country, the U.S. is a particularly useful case study for several reasons. First, it remains the primary global destination for immigrants, and it experienced a major increase in diversity as a result of the 1965 Immigration and Nationality Act. Second, among rich countries that display considerable immigrant heterogeneity, it offers a uniquely large and diverse urban system, with a relatively large number of cities at various size thresholds. Moreover, it has a famously mobile population; if sorting is to prove an important confounding factor, its effect ought to be particular strong in the U.S..

The remainder of the paper is organized in 5 sections. Section 2 reviews the theoretical and empirical literature motivating this study. Section 3 lays out the empirical approach. Section 4 describes the data. Section 5 presents results. Section 6 concludes.

2 Existing Literature

Much of the public debate and academic research on the economic impacts of immigration have focused on answering a question fraught with political and economic significance: how will growing flows of immigrants – and in particular relatively low-skill immigrants – affect job market outcomes of native-born workers (Borjas, 1994, 1995; Card, 2001, 2005)? This paper sets out to answer a different question: How might a labor force composed of immigrants born in a wide range of countries perform differently from one that is more homogeneous?

Considering this question, researchers have theorized and sought empirical support for a link between immigrant diversity and such outcomes as productivity, innovation, and entrepreneurship. While there is broad commonality in terms of the theoretical foundations relating diversity to each of these outcomes, empirical approaches have been varied.[1] The focus of this paper is on the relationship between diversity and productivity, and thus the remainder of this section reviews that strand of the literature.

There are a few channels through which immigrant diversity might influence economic welfare. One is that some individuals may have feelings about living and working in immigrant-diverse locations – for instance, they value the availability of a mix of ethnic restaurants, or, on the other hand they can feel uncomfortable being surrounded by people who have different habits and norms – and such feelings affect their utility by influencing their quality-of-life. Another channel is through production, in that direct interactions among individuals from diverse backgrounds can either augment or inhibit productivity. Theory for this latter possibility is derived from organisation-focused research spanning such fields as psychology, organizational studies, artificial intelligence and economics. On the positive side, theory suggests that the experience of having been born in a particular location shapes one's worldview (Hong and Page, 2004). It follows that, relative to more homogeneous sets of people, groups consisting of individuals from diverse birthplaces ought to contain an enlarged pool of available perspectives and heuristics. This heuristic diversity ought to improve problem solving in two ways. First, it will map out a larger proportion of the potential solutions available in the total problem space. Second, it will raise the likelihood of generating innovations by recombining ideas (Aiken and Hage, 1971; Nisbett et al., 1980; Hong and Page, 2001, 2004). On the other hand, researchers also argue diversity can inhibit productivity. A long line of studies find that diverse teams can find it hard to co-operate, with increased transaction costs from having to bridge cultural differences (Byrne, 1971; Van Knippenberg and Schippers, 2007; Harrison and Klein, 2007).

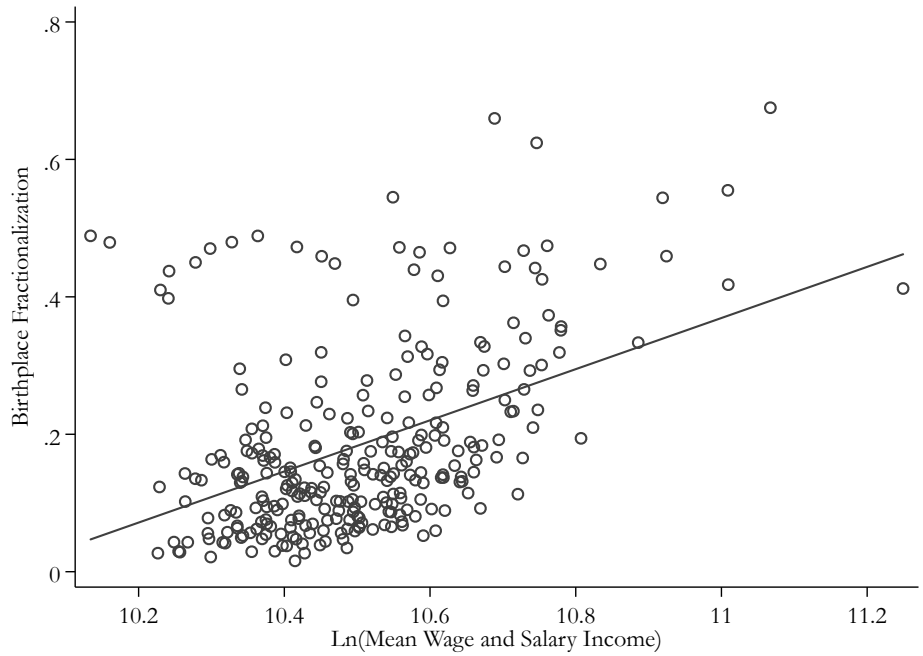
Although such arguments were initially made with individual organisations and work teams in mind, they also map neatly onto the urban scale. A wealth of theory and empirics suggests that the production of ideas is a phenomenon best understood as one in which interactions across organisations – whether formal partnerships or serendipitous, informal

[1] For a review of the links between diversity and all three outcomes, see Kemeny (2014). For a review more narrowly focused on innovation and entrepreneurship, see Kerr (2013).

exchanges – play an important role in innovation and economic performance; it is widely understood that such interactions have an important, though not exclusively local, urban character (Jacobs, 1969; Feldman and Audretsch, 1999; Jaffe et al., 1993; Storper and Venables, 2004). At this scale, it makes sense to think about diversity as potentially generating location-specific externalities – indeed they could be described as a specific form of social returns to human capital. Similar to the wealth of studies indicating local spillovers from education (for instance: Rauch, 1993; Moretti, 2004a,b), this paper, and ones like it, explores local spillovers from immigrant diversity.

Using public-use data from the 2007 American Community Survey (ACS), Figure 1 presents the motivating stylized fact: cities in which the average worker is highly paid also feature greater immigrant heterogeneity (measured using the generally accepted fractionalization index measured over birthplace). Researchers have sought to address a variety of substantive and methodological concerns in order to determine whether this simple bivariate correlation reflects an underlying relationship running from diversity to productivity.

Figure 1: U.S. Metropolitan Wages and Birthplace Fractionalization, 2007



Note: Data come from a 2007 1% public-use sample of the American Community Survey. Points on the scatter plot reflect actual city values for wages and diversity, whereas the solid line reflects the least squares fitted regression line. Fitted equation: Log (city average of annual wage and salary income) = 0.372(Birthplace Fractionalization) -3.724; R^2=0.194

Among these concerns is the possibility that diversity's effects may not be confined to the sphere of production. Though wages are broadly taken to signal productivity in production, diversity could also function chiefly as an amenity that (some) workers desire to consume. This has potential implications for factor prices, in terms of the wages workers earn, as well as the costs they face in the housing market, and relatedly, on their locational

choices. One influential approach to this issue is to consider potential productivity effects in conjunction with rents in a spatial equilibrium context. This has appeal, considering the fact that cities, much more so than nations, are highly porous entities where mobile workers make careful and complex choices about where they choose to live and work. Among urban economists in particular, it is commonly assumed that inter-urban differences in workers' real utility – a function of nominal wages as well as housing costs and location-specific amenities – ought to be driven toward equalisation by the mobility of workers (Rosen, 1979; Roback, 1982; Glaeser and Gottlieb, 2009). In the current context, this formalizes the idea that immigrant diversity could also shape welfare by influencing available amenities, which will likely be capitalized into housing costs. Empirical studies motivated by spatial equilibrium issues tend to jointly consider diversity effects on wages and rents, with the combined outcome suggesting whether diversity's chief effects are felt through the channel of consumption or production.

Empirical studies of this kind find a consistently positive and largely significant relationship between regional immigrant diversity and worker productivity. The seminal reference in the spatial equilibrium approach is Ottaviano and Peri (2006), who jointly test the relationship between diversity and wages and rents across U.S. metropolitan areas. They find that birthplace diversity is positively and robustly correlated with both wages and rents, indicating that diversity chiefly acts to raise productivity. Similar tests, in other advanced economies, across different time periods, and sometimes using various means of capturing amenities and productivity, similarly find a positive relationship suggesting that diversity has a positive influence on productivity (Nathan, 2011; Kemeny, 2012; Trax et al., 2012; Bellini et al., 2013; Bakens et al., 2013; Longhi, 2013; Ager and Brückner, 2013; Suedekum et al., 2014).[2]

Despite this consistent story, unresolved issues remain. Challenges in existing empirical work prevent confident statements about the relationship between diversity and productivity. Significant among these are unresolved issues relating to: sorting on unobservables; longitudinal dynamics; and establishment effects.

Sorting on unobservables refers to the idea that there may exist unmeasured characteristics that are related to both immigrant diversity and wages. Specifically, it could well be that diverse cities may also draw highly-skilled workers (skilled in ways that are not apparent from easily-measurable characteristics like educational attainment). Most of the models used assume that workers are homogeneous except for their birthplace. When observable characteristics are available in the data, studies often limit the group of workers to those with similar attributes. For example, Ottaviano and Peri (2006) consider the relationship between birthplace diversity and wages for white male native-born workers between the ages of 40 and 50. But their approach cannot address the likely scenario that, even among members sharing these observable characteristics, unobserved differences in preferences and abilities exist that affect both individual productivity and locational

[2]For a detailed review of the empirical literature on the productivity implications of urban immigrant diversity, see Kemeny (2014).

choices. Highly-productive workers may sort into high-diversity cities because they have particular preferences for the amenities related to diversity itself (Florida, 2002); alternately, such sorting could be part of a process by which workers match their abilities to places with a particular industrial mix or position on quality ladders (Combes et al., 2008; Kemeny and Storper, 2012; Moretti, 2013). In either case, estimates of the relationship between diversity and productivity may be biased upward.

To the best of our knowledge, in relation to spillovers from diversity, only one study has directly addressed this issue to date. Bakens et al. (2013) exploits an individual-level panel of wages and rents in Dutch cities, using a two step process first to separate individual-, sector-, and city-level contributions to wages and rents, and second to identify the importance of city diversity in the overall relationship between city-specific factors and wages. They find that observed and unobserved characteristics at the individual level account for most of the variation in wages and rents. And, although they find a positive relationship between city-level diversity and wages, coefficients on diversity are mostly insignificant, suggesting no real role for diversity in production. Though the Dutch context is particular (the entire national system of its cities can be fit into either the New York City or Los Angeles regional economy, in each case with considerable room and people to spare), the disjuncture between this finding and prior work highlights the potential importance of unobservable characteristics in determining how diversity may be related to economic outcomes of interest.

A second issue is that existing work has largely ignored the scale of the workplace. This is a problem in the general sense of failing to account for the ways in which characteristics of firms and individual establishments are important for understanding variation in productivity (Haltiwanger et al., 1999). But it also raises a particular issue in the context of spillovers from immigrant diversity: we have little understanding of the scale at which any productivity-augmenting interactions might be occurring. One strand of literature focuses the effects of heterogeneity in organisations and the work teams within them. Another considers regions to be the relevant containers bounding these interactions. But of course birthplace-diverse cities are likely to feature birthplace-diverse business establishments. Hence, what looks like a 'Jane Jacobs'-style metropolitan effect might properly be an organizational one; depending on study design, the reverse could also be true. Or there may be productivity effects operating simultaneously within organizations *and* at the metropolitan scale. Only a handful of articles seek to tease out these effects, by jointly modelling diversity at both scales. Trax et al. (2012) find that total factor productivity in German plants is positively and significantly related to diversity in both plants and cities. Nathan (2015) considers the influence of ethnic diversity in British cities and firms' top management teams, and finds mixed evidence that they are related to business turnover. More loosely related, Lee (2013) finds a small, positive relationship between the foreignness of UK firm managers (rather than their diversity) and firm process and product innovation, but he finds no significant effect of the share of foreign-born in the overall regional population. More work is needed to clarify the relationship between diversity and

productivity at these different scales.

A third challenge to the current empirical literature is the paucity of studies exploring longitudinal dynamics. Urban immigrant diversity varies across cities, but it also varies within them across time. If it is the case that diversity directly influences productivity, then shifts in diversity should be reflected in changes in productivity. Among the few studies addressing the potentially dynamic nature of this relationship, Longhi (2013) finds that the positive relationship between diversity in English Local Authority Districts and workers' wages found in cross-sections (consistent with much of the current research), disappears in panel estimates. This contrarian finding suggests the importance of examining this relationship in a dynamic framework.

3 Empirical Approach

Concerns about unobserved heterogeneity and longitudinal dynamics can be addressed by estimating models relating diversity and productivity over a large-N, large-T panel of individuals. Differencing the wages of individuals over time eliminates bias arising from unobserved heterogeneity, as long as relevant individual characteristics are stationary. By using panel data, one might also observe how diversity moves in relation to individuals' wages. To address questions of the scale at which productivity-enhancing may be occurring, data on individuals must be supplemented with information about the composition of each work establishment in which workers are employed.

With panel data on workers and their work establishments in hand, we employ an identification strategy that is similar to one used in recent research on local educational spillovers (Moretti, 2004a; Gibbons et al., 2013). Out of the set of all available workers, we focus on spells of 'stayers' – individuals that remain in their work establishment (and thus metropolitan area) for at least two years. As these workers are fixed in place, variation comes from the panel structure of the data, and more specifically from the shifts around these workers in the composition of the cities in which they live, and the establishments in which they work. In short, by observing the same individual in the same firm and city across time, we control for unobserved permanent individual, establishment, and city heterogeneity. This is represented in the following equation:

$$ln(w)_{ipjt} = d_{jt}\beta + +d_{pjt}\gamma + X'_{ipjt}\delta + E'_{pjt}\theta + C'_{jt} + \mu_{it} + \eta_t + \nu_{ipjt} \quad (1)$$

where, $ln(w)$ represents the log annual wages of an individual worker i in establishment p located in metropolitan area j at time t; d_{jt}, a key independent variable of interest, measures city-specific immigrant diversity, while d_{pjt} measures diversity at the level of the establishment; X' represents time-varying measures of worker-specific characteristics; E' describes a vector of dynamic employer characteristics; C' indicates time-varying city-specific characteristics, μ_{ipj} represents an individual-establishment-city fixed effect which simultaneously accounts for bias arising due to variation in permanent but unobserved

characteristics of individual workers, the establishments where they work, and the regional economies in which they live. At the individual level, such pertinent stationary unobserved heterogeneity could arise due to differences in such characteristics as innate ability, intelligence, or motivation. Among establishments, it could be driven by differences in such features as capital intensiveness or product quality. And at the level of metropolitan regions, differences in specialization, agglomeration, and other factors could be relevant, if hard to observe. η_t represents unobserved time-specific shocks that exert uniform impacts across all individuals, such as as business cycles; and ν_{ipjt} is the standard error term.

Applying the fixed effects estimator, equation (1) explores how an individual's productivity responds to changes in the level of immigrant diversity present in her metropolitan area, while it accounts for the major sources of spurious correlation that might bias estimates of the impact of diversity on wages produced using the standard approach.

Following the standard spatial equilibrium setup, one might seek to match a wage equation like (1) with a corresponding equation predicting rents. Yet related work on spillovers from education suggests a simpler approach. Acemoglu and Angrist (2001) and Moretti (2004a) argue that, in areas containing firms selling goods and services beyond their immediate locality, higher nominal wages must indicate higher average worker productivity. While firms in nontradable activities may reference local prices, traded-goods firms face national prices. If they paid higher wages with no compensating productivity advantages, firms would be forced to relocate to locations offering some form of compensating differential – whether in the form of cheaper land or higher quality-of-life.[3] Based on this rationale, models of diversity and wages like Equation (1), estimated over a population of firms that includes those engaged in tradable activities, can plausibly shed light on local productivity effects.

To capture the effects of diversity on worker productivity, the main identifying assumption to be satisfied is that the return on unobserved worker ability in their establishment and city is stationary over time, or at least that changes are uncorrelated with changes in city-specific diversity. As in Moretti (2004a), this return need not be general across higher-order categories, in this case establishments and cities.

4 Data

To estimate Equation (1), we use data from the U.S. Census Bureau's confidential Longitudinal Employer-Household Dynamics (LEHD) Infrastructure files, available in Research Data Centers of the Census' Center for Economic Studies. The LEHD program integrates administrative records from state-specific unemployment insurance (UI) programs with Census Bureau economic and demographic data, providing a nearly universal picture of jobs in the U.S. (McKinney and Vilhuber, 2011). The version of the data available for

[3]The spatial equilibrium hypothesis also requires satisfaction of demanding assumptions in this context, not least that worker preferences for diversity are homogenous.

this study covers 29 states between 1991 and 2008.[4]

Our strategy depends on being able to assign workers both to work establishments and to Metropolitan Core-Based Statistical Areas (CBSAs) that reflect economically-integrated urban regions.[5] We need to assign workers to cities in order to measure metropolitan immigrant diversity and decide who is in and out of the sample. We must also identify each individual's work establishment in order to produce establishment-level diversity measures, as well as other salient workplace characteristics. For workers in jobs at single-unit firms (firms with only one plant, outlet, or office), knowing the employer tells you the place of work, because there is only one possible location. However, for workers employed at multi-unit firms, knowing the employer cannot definitively reveal the place of work. About 30-40 percent of workers included in the LEHD data files work at multi-unit firms (McKinney and Vilhuber, 2011). To produce the Quarterly Workforce Indicators (QWI), LEHD researchers have built a file (the Unit-to-Worker file, or U2W) that, for each person employed in a multi-unit firm, provides ten work-unit imputations. Imputations are based on distance between workers' homes and establishment locations, and the distribution of employment across the establishments within the multi-unit employer, leveraging actual establishment–worker data which is available only for the state of Minnesota to generalize to the remainder of states (McKinney and Vilhuber, 2011, see Chapter 9). Because the place of work location structures much of the data processing necessary for our estimation strategy (building diversity measures; determining which workers are in and out of the sample; linking city and establishment characteristics to individual workers in the panel) using the multiple imputations is impractical. Instead, for each job in a multi-unit employer, we assign each worker to their most frequently imputed establishment (the mode), using random assignment in the case of ties.[6]

Once the multi-unit workers are assigned to a single establishment, we link variables stored in LEHD infrastructure files to individuals and their work places. Job spells (the starting and ending quarter and year for each worker-employer job) come from the Employment History File (EHF). Establishment location, total annual employment, and best NAICS industry come from the Employer Characteristics File (ECF-SEINUNIT). Worker place of birth, year of birth, sex, and race come from the Individual Characteristics File

[4]States used in our project: AR, CA, CO, FL, GA, HI, IA, ID, IL, IN, LA, MD, ME, MT, NC, NJ, NM, NV, OK, OR, SC, TN, TX, UT, VA, VT, WA, WI, WV.

[5]Throughout, we use the terms 'city', 'metropolitan area', and 'region' interchangeably.

[6]The quality of our city- and establishment-level diversity measures depends on assigning workers to the correct city in the state and the correct establishment within the employer. Looking across all jobs, the vast majority can only be assigned to a single city, either because they occur in single-unit employers or multi-unit employers where all the establishments are located in the same city. This raises our confidence that our diversity measures are based off workers who actually work in each city. With 30-40 percent of the workers in the LEHD data employed by multi-unit employers, if we got the assignment wrong in every case, our diversity measures would be meaningless. However, if we randomly assigned multi-unit workers to establishments, we estimate that we would get the city incorrect for less than 10% of workers. Using the most frequently multiply-imputed establishment, we estimate that the proportion of workers incorrectly assigned to a city to be much smaller than this upper bound. Furthermore, we have no reason to believe that there would be any non-random error related to birthplace that would systematically bias our diversity measures.

(ICF). Following a common practice in the literature, we limit the age range of workers to be over 16 and less than 66 years old. Together, these variables allow us to build annual city- and establishment-level diversity measures; generate person- and establishment-level characteristics; and to construct a panel of workers with multi-year job spells in a single location.

To construct metropolitan diversity measures, we first narrow our list of CBSAs to those that do not cross state boundaries with states unavailable to our project. Thus, although jobs located in Newark, NJ are included in our raw data, we drop them because they are part of the CBSA for New York City that also includes jobs in New York State and Pennsylvania, to which we do not have access. We do include CBSAs straddling multiple states to which we do have access, such as Texarkana in Texas and Arkansas. Our final sample includes 163 CBSAs.[7] With the list of CBSAs determined, we calculate several alternative measures of birthplace diversity based on all individuals in the LEHD data who worked in a CBSA in a given calendar year.

We measure establishment-level diversity measures by calculating many of the same measures as for cities, but for groups of workers in each establishment. The one crucial difference is that instead of weighting each person's contribution to birthplace diversity evenly (as we do in the city measures), we weight each person's contribution depending on how many quarters they work in a particular establishment. If they worked half the year in one establishment and half the year in another, then they count as half a person in the diversity measures of each establishment for that year.

Our analytical strategy relies on relating annual changes in wages with changes in the city and workplace diversity. To accomplish this we focus on people who remain in a single city and in a single establishment as others move in and out of both, changing the level of diversity around the stayers. Thus, our analytical sample includes many fewer people than those who contributed to the city- and establishment diversity measures, since we keep only workers with multi-year job spells in a single firm. Specifically, our analytical sample is a panel of individual workers, tracking their wages in a single job spell of at least two continuous years in one establishment. We also drop workers with extremely low wages, in keeping with the literature and restrict the sample to jobs at establishments with at least ten employees. And we drop workers who are simultaneously employed in multiple jobs, so that we can clearly identify the source of any establishment-specific diversity effects. For each worker, we track only their longest job spell in any city in our sample, so an individual only shows up in one establishment and one city in the panel, even if they have multiple job spells over their observed career that meet the two-year minimum.

[7] In fact, we estimated diversity measures for 232 CBSAs, however, our analytical sample was reduced by the inclusion of city-level measures of average education, derived from IPUMS.

4.1 Diversity Measures

Researchers commonly measure birthplace diversity using a Fractionalization index:[8]

$$Fractionalization_j = 1 - \sum_{r=1}^{R} s_{rj}^2 \tag{2}$$

where s is the proportion of residents in city j who were born in country r; and R is the number of different countries represented among residents of that city. The index nears zero as diversity decreases and its maximum value approaches one as heterogeneity increases; it is often described as measuring the probability that two randomly-drawn individuals in a location were born in different countries. The pervasiveness of this measure in diversity research is no doubt related to its simplicity, as well as its ability to capture both the breadth of countries from which individuals originate, as well as the sizes of these different country groups in a given location. This index was used to produce metropolitan immigrant diversity values used to generate Figure 1.

Because it is the most widely-used measure in the field, in much of the proceeding analysis, we estimate metropolitan as well as establishment-specific levels of diversity using the Fractionalization index, using the universe of LEHD-coded worker birthplaces in a metropolitan area or work unit.

For exploratory purposes, we also consider alternative metropolitan diversity indices, including an Entropy Index and an Alesina Index. These two indices are likely to produce measures that are correlated with the Fractionalization index, however each captures diversity in a somewhat different way, and none of these measures are clearly superior.[9] Entropy may produce a better gauge of diversity when groups are of dissimilar size (Taagepera and Ray, 1977); using the same variables and subscripts, the Entropy index is measured as:

$$Entropy_j = -\sum_{r=1}^{R} s_{rj} * ln(s_{rj}) \tag{3}$$

Alesina's index, derived in Alesina et al. (2013) is a decomposed component of a standard fractionalization index, with Equation (4) below representing diversity strictly among immigrants in a location (as opposed to natives as well as foreign born). The index is calculated as:

$$Alesina_j = \sum_{r=2}^{R} \Big[\frac{s_{rj}}{(1-s_1)} * (1 - \frac{s_{rj}}{(1-s_1)}) \Big] * (1-s_1)^2 \tag{4}$$

where s_1 is the share of native-born workers in the city population (with other subscripts as above), and the equation is indexed over all nonnatives ($r = 2$).

[8] This index has been used to capture a wide variety of categorical forms of diversity, including language, birthplace, race and ethnicity (see, for example, Taylor and Hudson, 1972; Easterly and Levine, 1997; Knack and Keefer, 1997; Ottaviano and Peri, 2006; Sparber, 2010).

[9] For deeper discussions of the relative merits of these and other indices, see Dawson (2012), Kemeny (2014), and Nijkamp and Poot (2015).

Following Ozgen et al. (2013), we additionally consider two measures in conjunction: the simple proportion of foreign born in the workforce, alongside a standard fractionalization index that is estimated over only the foreign born population. Like the Alesina index, this approach has the virtue of being able to tease out the extent to which effects arise due to the sheer presence of foreign-born, as distinct from their heterogeneity. Unlike a Fractionalisation index estimated over the entire population, the immigrant-only fractionalization measure will not be influenced by the single large group of native workers in each city and establishment. However, since it cannot account for the likelihood of actually meeting and interacting with those from other groups, estimates using this measure include the share of foreign born in all workers as a control.

4.2 Individual-level Measures

Our primary outcome of interest is an individual's annual earnings. Wage data in LEHD come from UI records, and are measured here in log form. The average annual earnings is a little over $35,000USD. Given our fixed effects approach, the other available individual-level information in LEHD cannot be directly included in estimation as controls. Nonetheless, this information is useful to describe our sample. As Table 1 describes, the average worker in our sample is 40 years old. Sixty-seven percent of the sample is white, 84 percent is native-born, and 47 percent is female. These characteristics closely match the broader U.S. economy. The average work spell in the sample lasts nearly 5 years.

4.3 Establishment-level Controls

In addition to workplace-specific immigrant fractionalization, we consider one time-varying establishment characteristic: employment. Employment is included since changes in aggregate workforce size can influence productivity. The average establishment in our sample employs 63 workers. In terms of other broad characteristics of our sample, Table 1 shows that six percent of jobs are held by foreign-born workers, while 35 percent of establishments are part of multi-unit firms. Nine percent of these units are chiefly engaged in manufacturing activities.

4.4 Metropolitan-level Controls

In addition to indicators of metropolitan birthplace diversity, a variety of city-level characteristics are included in the regression results that follow. Most importantly, in each model we include as controls measures of local externalities from scale and education. Measures of CBSA employment are included to capture the effects of agglomeration economies. To measure education levels, we estimate the annual share of each CBSA's workforce holding at least a 4-year college degree, using 5% public-use IPUMS extracts from the 1990 and 2000 Decennial Censuses, as well as 1% samples from each year of the 2001–2008 ACS

Table 1: Summary Statistics

Variable	Mean	Standard Deviation
Individual Characteristics		
Log Annual Earnings	10.48	0.637
Age	40.32	11.67
White	0.667	0.471
U.S. Born	0.840	0.366
Female	0.467	0.499
Spell Duration	4.970	3.304
Establishment Characteristics		
Birthplace Fractionalization	0.220	0.207
Foreign-Born	0.061	0.147
Employment	63.01	278.39
Multi-Unit	0.349	0.477
Manufacturing	0.091	0.287
City Characteristics		
Birthplace Fractionalization	0.180	0.129
College Share, All Workers	0.256	0.074
College Share, Natives	0.261	0.073
College Share, Immigrants	0.273	0.129
Employment (10,000s)	47.20	88.29
Birthplace Entropy	0.563	0.317
Birthplace Alesina	0.011	0.017
Birthplace Fractionalization, Immigrants	0.819	0.182
Share Foreign-Born	0.101	0.084
Race Fractionalization	0.433	0.137
Age Fractionalization	0.977	0.001
Individuals	33,550,000	
Establishments	1,193,000	
CBSAs	163	

(Ruggles et al., 2010).[10] Motivated by related work on other forms of heterogeneity (for example, Sparber, 2010; Østergaard et al., 2011), we use LEHD data to calculate additional diversity-based sources of externalities, based upon city-specific variation in age and race.

5 Results

Table 2 presents the main estimates of the relationship between birthplace diversity and wages. As described in Section 3, results are produced using fixed effects models on an annual panel of workers over the longest work spell over the study period (1991-2008).

[10]We use available data to interpolate across absent years (1991–1999) as in Moretti (2004b). Our measure of education is sourced in this way despite having annual, individual-level imputed values of schooling attainment available in LEHD, since we found that the latter are only moderately correlated (<0.4) with the more reliable values drawn from the Decennial and ACS.

Each model includes a single fixed effect that absorbs unobserved heterogeneity at multiple levels: worker, establishment, and city. Estimated equations also include year dummy variables that capture unmeasured shocks that are uniform across workers, plants and cities, but which vary over time. In the tables of results that follow, city-specific coefficients are listed first, followed by results for variables measured at the establishment level.

Table 2: Longitudinal Estimates of Immigrant Diversity Spillovers: Main Fixed-Effects Estimates

	Dependent Variable: Log of Annual Earnings				
	(1)	(2)	(3)	(4)	(5)
City Measures					
Birthplace Fractionalization	0.406***		0.375***	0.411***	0.390***
	(0.067)		(0.065)	(0.067)	(0.066)
College Share	0.164***	0.213***	0.162***	0.155***	
	(0.040)	(0.041)	(0.040)	(0.040)	
Employment	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Race Fractionalization				-0.043	
				(0.037)	
Age Fractionalization				2.091	
				(1.433)	
Native College Share					0.040
					(0.036)
Immigrant College Share					0.072***
					(0.009)
Establishment Measures					
Birthplace Fractionalization		0.079***	0.073***	0.073***	0.072***
		(0.008)	(0.007)	(0.007)	(0.007)
Employment	0.000*	0.000*	0.000*	0.000*	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Note: Standard errors in parentheses, corrected for clustering by establishment. $^{*}p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Estimated equation is (1). Year effects included in each model. Each model is estimated over 166,540,000 observations, nested in 33,550,000 individuals. Overall observation counts are rounded to the nearest 10,000 to ensure confidentiality.

Column 1 of Table 2 presents estimates of the relationship between wages and city-level birthplace fractionalization, controlling for the proportion of college-educated workers, and metropolitan and workplace employment. This model relates directly to the extant 'urban' literature, by considering the operation of the independent variable of interest at the city level only. At the same time, it improves upon prior work, chiefly by accounting for stationary unobserved heterogeneity at multiple scales, while also controlling for changes in wages that might be due to shifts in plant size. Estimates indicate a positive and significant relationship between city-level diversity and individual wages. As expected, control variables are all significant and positively related to wages. The coefficient on the share of college educated workers is extremely close to that reported by Moretti (2004b),

indicating that a one percent increase in the share of college educated workers in a city yields a wage premium of just over one percent. Overall, the model yields the insight that, all else equal, workers in U.S. cities featuring larger annual increases in birthplace fractionalization also experienced larger annual wage growth. This finding conforms to much of the prior work, while confirming that earlier findings were not fully driven by unobserved, sorting-driven worker characteristics, nor by unmeasured permanent features of either establishments or cities.

Column 2 of Table 2 presents estimates of a model where fractionalization measured at the establishment level is the primary predictor of interest, and where we disinclude city-level diversity. The coefficient on workplace diversity is positive and significant at a one percent level. Controls remain significant and consistent from the previous model. Interestingly, once exponentiated, the effect size of the share of college-educated workers in a metropolitan area is nearly identical to that found in Column 1 (1.24 percent for Column 2 where there is no measure of city diversity, versus 1.20 for Column 1 that includes such a diversity measure), further supporting the notion that immigrant diversity and education represent distinct channels for spillovers from human capital.[11] Column 3 presents our preferred estimates that includes diversity measured at both the city and establishment scales. When included in the same specification, metropolitan and workplace diversity each remain positively and significantly related to wages, though both coefficients are modestly smaller with the inclusion of the other. These results suggest that there are positive diversity impacts to be felt both from living in a more birthplace-diverse city, as well as from working in a more birthplace-diverse establishment.

The models in Columns 4 and 5 of Table 2 include some additional control variables of interest. Model 4 includes measures of forms of diversity not rooted in birthplace, to test whether immigrant diversity may not be capturing other aspects of heterogeneity that might be driving the result. Added diversity measures include fractionalization on the basis of race and age. The coefficients for race and age diversity in column 4 are not significant. Column 5 presents results in which the city-level measure of the proportion of college-educated workers is disaggregated to capture changes in the college share separately for native-born and immigrant workers. The rationale for this is to capture immigrant-specific stocks of human capital, in so doing ensuring that any effects ascribed to immigrant heterogeneity do not instead reflect changes in the stock of human capital specific to the immigrant population (cf., Hunt and Gauthier-Loiselle, 2010). Both native and immigration measures of education are positively related to wages, though only the coefficient on immigrant college share is statistically significant. Most importantly, the inclusion of these disaggregated education measures does not materially affect the direction, magnitude, or significance levels of the two main diversity coefficients of interest.

Table 3 reports estimates of variants of our preferred specification in which the we sub-

[11] Ideally, we would have liked to measure changes in human capital in establishments, not just in cities. However, our lack of confidence in the imputed LEHD education variable prevents us from doing so. Though imperfect, we take the continued significance of diversity and education at the city level to raise confidence regarding the importance of diversity at the establishment scale.

Table 3: Longitudinal Estimates of Immigrant Diversity Spillovers: Alternative City-Level Diversity Measures

	Dependent Variable: Log of Annual Earnings		
	(1)	(2)	(3)
City Measures			
Birthplace Entropy	0.161***		
	(0.025)		
Birthplace Alesina		1.703***	
		(0.225)	
Birthplace Frac: Immigrants Only			0.403***
			(0.036)
Immigrant Share			0.743***
			(0.084)
College Share	0.154***	0.140***	0.216***
	(0.040)	(0.043)	(0.041)
Employment	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)
Establishment Measures			
Birthplace Fractionalization	0.070***	0.071***	0.068***
	(0.007)	(0.008)	(0.008)
Employment	0.000*	0.000*	0.000*
	(0.000)	(0.000)	(0.000)

Note: Standard errors in parentheses, corrected for clustering by establishment. $^{*}p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Estimated equation is (1). Year effects included in each model. Each model is estimated over 166,540,000 observations, nested in 33,550,000 individuals. Overall observation counts are rounded to the nearest 10,000 to ensure confidentiality. Estimates produced using Stata's AREG command.

stitute several alternative measures of metropolitan immigrant heterogeneity for our main birthplace fractionalization measure. Column 1 of Table 3 reports estimates produced using the birthplace entropy measure. The coefficient on this measure of city diversity remains positive and significant at a one percent level, and as in previous models, the controls display the expected signs and statistical significance. In Column 2, we substitute the Alesina measure of metropolitan immigrant diversity. As in the previous model, city diversity enters as positive and significant, while the other results remain stable. Results from these two models suggest that the observed relationship between diversity and wages is not driven by the chosen approach to the measurement of city birthplace diversity. Indeed, based on coefficients in Table 3, effect sizes for a one standard deviation change in city diversity are approximately 5.5 percent for the entropy index, and 7.6 percent for the Alesina index – broadly in line with those found using the most commonly-used main fractionalization measure estimated over all workers. In Column 3, we report estimates distinguishing between the overall presence of nonnatives and diversity among those nonnatives, following Ozgen et al. (2013) and Nijkamp and Poot (2015). We find that, controlling for the proportion of foreign-born workers in the population, diversity among nonnatives is positively and significantly related to wages. The size of the coefficient

on diversity in this model very closely resembles results obtained using fractionalization estimated across the all workers.

Table 4: Longitudinal Estimates of Immigrant Diversity Spillovers: Selected Subsamples

	Dependent Variable: Log of Annual Earnings			
	(1) Large Plants	(2) Single-Unit Firms	(3) White Male Natives	(4) Manuf. Only
City-Level Measures				
Birthplace Fractionalization	0.362***	0.547***	0.502***	0.740***
	(0.071)	(0.089)	(0.079)	(0.170)
College Share	0.177***	0.214***	0.190***	0.226**
	(0.044)	(0.054)	(0.045)	(0.099)
Employment	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)
Establishment-Level Measures				
Birthplace Fractionalization	0.081***	0.079***	0.079***	0.114***
	(0.010)	(0.009)	(0.009)	(0.014)
Employment	0.000*	0.000	0.000**	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Observations (millions)	151.53	81.96	59.02	29.61
Individuals (millions)	30.38	16.66	11.34	5.49

Note: Standard errors in parentheses, corrected for clustering by establishment. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Estimated equation is (1). Year effects included in each model. Counts are rounded to the nearest 10,000 to ensure confidentiality. Large plants in Column 1 are those with at least 20 employees. Natives in Column 3 are white male workers born in the U.S.. Estimates produced using Stata's AREG command.

Table 4 presents estimates for specific subsets of the main sample. The models from which the results in this table are drawn are directly comparable to those found in Column 3 in Table 2, which includes measures of immigrant fractionalization at both city and work unit scales. Column 1 addresses potential concerns that measures of diversity may not be meaningful in very small workplaces. The estimates reported are produced over a sample of workers holding jobs in establishments that have at least 20 employees. Coefficients for city- and establishment-diversity remain positive and statistically significant at a 1 percent level, and are closely comparable to estimates for the entire sample. The coefficient for establishment birthplace diversity is modestly larger among these larger plants. Thus, there does not appear to be a substantial difference when we exclude smaller establishments from our sample.

Column 2 of Table 4 addresses potential bias arising from the way in which workers were assigned to establishments in multi-unit firms. As discussed in Section 4, for multi-unit employers, the data do not provide a direct link between the place of work and each employee, so to assign these workers to establishments and cities, we choose the mode of the multiple imputations provided. It is possible that this process incorrectly assigns workers to establishments, and to a lesser extent to cities; in turn, this could bias

measures of diversity, while also incorrectly relating other workplace characteristics to that particular worker.[12] To guard against bias from this source, we re-estimate Equation (1) solely for the subset of employees working for single-unit firms. For these workers, there is only one possible place of work, thus we are confident we have each worker placed among the correct co-workers in the workplace. The results show the same general result that increased diversity at both the city- and workplace-level is positively and significantly related to increased wages. Note that the coefficient for both levels of diversity is larger for these single-unit employers. However, these results raise our confidence that our process for assigning multi-unit employees to work locations is not spuriously driving results.

Column 3 in Table 4 estimates the relationship between diversity and wages for white, male native workers, in keeping with the main focus of much of the broader literature on the economic impacts of immigration. It is often contended that foreign-born workers displace and exert negative wage pressure on natives in the labor market, and especially native males. This subgroup has also been the focus of some diversity-specific work (for instance: Ottaviano and Peri, 2006; Kemeny, 2012). We would have liked to focus on less-skilled natives, however, absent reliable worker-level data on educational attainment, we focus on U.S.-born white male workers. As with all of the previous models discussed, the results indicate that city- and establishment-diversity are both positively and significantly related to worker wages. The coefficient on the measure of city diversity is considerably higher than for the overall labor force, suggesting that diversity yields a larger beneficial influence on the productivity of white native males.

Column 4 in Table 4 aims to address concerns that the observed positive relationship between diversity and wages may reflect the fact that diversity impacts wages indirectly by reducing quality-of-life. In a spatial equilibrium framework, a firm would be expected to compensate for this negative consumption amenity by raising worker wages, else workers would choose other locations. Since, due to data limitations, we cannot more directly capture the co-movement of changes in diversity and rents (the latter proxying for quality-of-life), we rely on the argument that changes in wages in a local economy that feature industries serving a national market must reflect changing productivity, otherwise the firms would be forced to relocate. Though Moretti (2004b) contends that the argument holds for wages if the local economy includes any national-serving or tradable products and services,in this model we interpret the point conservatively, and therefore limit our model to a subset of the labor market that is certainly facing national price competition: manufacturing. Column 4 presents results with the sample restricted to only workers in establishments classified within two-digit NAICS headings 31, 32 and 33. As in all of the previous models, city and workplace diversity emerge as positive and significant;

[12]Within the full set of misallocated workers, only a relatively small number would be incorrectly assigned to other cities , since many multi-unit firms have locations only within a single metropolitan area. Nonetheless, we sought to explore the robustness of our city-level, LEHD-derived diversity estimates by relating these to an analogous index produced using public-use IPUMS microdata. In the latter case, worker location is certain. For the year 2007, the two indices were very strongly correlated, with a coefficient of nearly 0.9. Hence, we believe that bias due to the misallocation of workers to cities is likely to be very small.

interestingly, coefficients for both are considerably larger than in the models that include all sectors, suggesting the possibility that variation in the nature of industries – whether rooted in needs for interaction or creativity or some other kind of work task – might be associated with systematic differences in the influence of diversity. The main point to be drawn from this model, however, is that it demonstrates that the positive relationship between diversity and wages holds among workers about whom we are most confident that increased wages reflect increased productivity. The inclusion of relatively long job spells in our sample (averaging nearly 5 years) supports this logic. It seems unlikely that firms could sustain so many years of inflated wages without a corresponding productivity increase.

Table 5: Longitudinal Estimates of Immigrant Diversity Spillovers: Two-Step Generalized Method of Moments FE IV Results

	(1) Log of Annual Earnings
City-Level Measures	
Birthplace Fractionalization	0.432***
	(0.144)
College Share	0.079*
	(0.046)
Employment	0.000**
	(0.000)
Establishment-Level Measures	
Birthplace Fractionalization	0.058***
	(0.013)
Employment	0.000**
	(0.000)
Observations (millions)	15.89
Individuals (millions)	3.24
Kleibergen-Paap LM (Underidentification)	1.5e+04
Kleibergen-Paap LM p-value	0.000
Kleibergen-Paap Wald F (weak identification)	2.0e+06
Hansen J (overidentification)	0.045
Hansen J p-value	0.8329

Note: Standard errors in parentheses, corrected for clustering by establishment. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Year effects included in each model. Estimates are run on a 30-percent random sample of individuals. Instruments used in this model are 3- and 4-year lags of city-level diversity, and 1-year lags of establishment-level diversity. Observation counts are rounded to the nearest 10,000 to ensure confidentiality. Estimates produced using Stata's XTIVREG2 command, with gmm2s fe options.

Though the empirical approach rooted in Equation (1) is aimed at addressing issues of worker selectivity into plants and metropolitan areas, additional endogeneity concerns could bias results. Though somewhat unlikely given the consistent findings reported thus far, unobserved productivity shocks at the level of the city or firm could be driving the

positive association observed in Tables 2-4. In Table 5, we seek to address remaining endogeneity concerns by instrumenting for diversity at the city and establishment level. Given the challenges of finding internal instruments in the spare LEHD data, especially at the level of the individual work establishment, we use lagged internal instruments implemented using the two-step generalized method of moments (GMM) fixed effects estimator. Specifically, the instruments are three- and four-year lags of city diversity, and a one-year lag of establishment diversity.[13] We opt for cluster-robust GMM because, given the nesting of individual workers inside establishments, this approach ought to produce more efficient estimates than conventional standard two-stage least squares (2SLS) (Baum et al., 2003). Producing GMM-FE IV estimates over the full sample proved to be far too computationally intensive. As a result, results presented in Table 5 represent estimates generated from a 30 percent random sample of individuals, covering spells for over three million workers. Kleibergen-Paap underidentification tests are passed, indicating the instruments can not be considered weak. As the estimating equation is overidentified, we may test for the joint orthogonality of the excluded instruments, using the Hansen J test statistic; results suggest that the instruments are independently distributed of the error process and that they are properly excluded from the model. Results in Table 5 broadly support the findings reported thus far. Diversity at the metropolitan scale is positively and significantly related to wages, as is diversity estimated at the establishment level. Coefficients for both key independent variables of interest remain fairly close to levels estimated using the standard FE model reported in Tables 2–4. Overall, the suggestion is that time-varying shocks do not explain the relationship documented elsewhere in the results.

6 Conclusion

This paper seeks to measure the potential productivity spillovers from immigrant heterogeneity in cities and within establishments in the U.S. We analyze job spells of workers remaining in a single establishment and city, exploiting variation over time to identify the impact of immigrant diversity. By doing so, the paper is able to improve upon prior work to clarify the diversity's effects in several concrete ways. First, the empirical strategy per-

[13] We experimented with an array of instruments before settling on those for which results are reported. Rejected instruments include 'substantive' city-level measures, such as an annual shift-share predicted diversity instrument that is especially common in cross-sectional studies of urban diversity (see, for instance, Ottaviano and Peri, 2006; Kemeny, 2012), and also used in some longitudinal work (Trax et al., 2012); as well as a measure of the proportion of refugees settled in a metropolitan areas in the overall population, drawn from The Refugee Processing Center, part of the U.S Department of State. Neither of these instruments passed tests of instrument under and overidentification (with the latter examined with the addition of lagged instruments to ensure having more instruments than potentially endogenous regressors, and the 'orthog' option in Stata's xtivreg2). A variety of lags were explored until ones were found that passed tests of both instrument strength and exogeneity. Because these are lags of potentially endogenous regressors, we were concerned that instruments may directly influence the dependent variable, instead of influencing wages exclusively through current-year diversity levels. For this reason we tested the exclusion restriction by estimating versions of Equation (1) that included these lags directly as independent variables. The instruments did not emerge as independently significant predictors of the outcome of interest, therefore providing support for their use.

mits us to account for selection and sorting dynamics between workers and locations in the wider national space economy. The strategy taken accounts not just for individual-level unobserved heterogeneity, but also stationary unobserved factors in cities and workplaces. Second, the use of panel data permits improved tracking of the co-movement of diversity and wages. Third, by considering diversity not just in cities but also in work establishments, this paper enhances our understanding of the scale at which diversity may influence worker productivity.

Results indicate that growing diversity in both American cities and in workplaces are associated with rising wages, and by implication, productivity. As a cities' diversity grows by one standard deviation, its average worker's wage is expected to grow by nearly six percent. A similar change in immigrant diversity in a worker's establishment also positively influences her wages, although by a smaller amount: 1.6 percent. These results are robust to the inclusion of a host of control variables; alternative measures of diversity; to narrower samples limited to workers in larger firms; single-unit firms; firms engaged in tradable activities; and to white native males; as well as to instrumental variables estimation using two-step GMM-FE.

Overall findings fit with those obtained by Trax et al. (2012) for German plants, which remains the only known paper that simultaneously considers the links between diversity and productivity at the scale of cities and workplaces. Like Trax et al. (ibid), we find positive effects at both scales; like them we also find that metropolitan diversity has a consistently larger influence on productivity than workplace diversity, though in the case of this paper the disjuncture between effects at each scale are considerably larger.[14] The fact that the relationship is stronger at a regional scale is surprising: though the mere existence of cities suggests external economies of scale, one might expect that much of the key problem solving to which theory suggests diversity may contribute occurs within the bounds of individual firms or plants. This challenging finding demands more research to push further our understanding of the economic value of Jacobs' 'sidewalk ballet.'

This paper provides new evidence of a channel through which immigration, and specifically the breadth of immigrant source countries, generates spillovers that improve the economic well being of firms and workers in America. As cities and workplaces become more immigrant diverse, workers on average enjoy higher wages. Further work should determine how this general effect may vary across labor market segments and industry types. And as with much of the research in this field, there is a need to complement this work with close studies that can better clarify the mechanisms through which the positive benefits of diversity emerge.

[14]Three key differences between the two papers should be noted: their paper studies plants; measures productivity using TFP; and measures diversity strictly over the non-native population.

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