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Abstract

Policymakers seeking to rezone urban industrial land often cite the need to attract or retain businesses that would otherwise locate in outlying areas or other regions. Yet, industrial land may still play an important role in the 21st century economy. This paper describes how industrially zoned land shapes the dynamics of business relocation and expansion in four San Francisco Bay Area cities. The analysis combines two unique datasets (the National Establishment Time Series and historic zoning maps) and uses multivariate analysis to examine the role of zoning in firm expansion, controlling for firm characteristics, industry, building characteristics, and location. Firm size plays the most important role, but the availability of industrially zoned land and large buildings also helps firms to expand. The paper concludes by outlining land use and economic development strategies that help cities target firms creating jobs on industrial land.

Introduction: The controversy over industrial land

Developers in strong market regions often pressure cities to rezone industrial land for residential and commercial use. In response, many cities have allowed conversion in exchange for the protection of key manufacturing areas. Others have opened up their industrial areas to a mixture of uses.

Rarely, however, is the decision grounded in an understanding of business dynamics, particularly rates of job creation on industrial land. In fact, economic development practitioners may not even participate in the land use decision-making process. Even if cities advocate preserving industrial land, they typically justify the decision not because of the need for job creation but because of the vital business functions of the industrial sector.[i]

What might a better understanding of business dynamics contribute to decision-making about industrial land? Understanding the relationship between firm expansion and type of city land can help policymakers use land conversion strategically to generate job growth. Such strategic targeting can also reduce the waste of taxpayer money on ineffective tax incentives (Peters & Fisher, 2004). Linking land use planning to economic development policy can create new synergies, for instance leading to economies of scale in infrastructure investment.

This article uses a unique database that links data on business job creation to the characteristics of the site where the business is located, including location, zoning, and building characteristics. It asks what is the role of zoning in business expansion and contraction, controlling for firm characteristics, physical and locational characteristics, business cycle, and industry sector? Within California, long one of the most dynamic state economies in the country, we focus on a strong market with an ongoing debate

about industrial land conversion, four cities of the East Bay subregion of the San Francisco Bay Area (Berkeley, Emeryville, Oakland, and Richmond). We find that a firm's initial size, in terms of both jobs and sales, is the most important predictor of change in jobs, but also that location in a manufacturing zone and building size matter.

We begin with an examination of the literature on business dynamics, industrial land conversion, and manufacturing trends. After a brief overview of methods, the article describes patterns of business startups, expansion, and relocations overall and then specifically on industrial land. We then look specifically at whether location in an industrial zone spurs or impedes employment growth. A conclusion offers policy implications.

Business dynamics and industrial land

Economic analysis is only as good as the underlying data. Our understanding of business dynamics has suffered from the inability to access and interpret reliable data on how businesses start, expand, contract, and die. Similarly, previous studies have had difficulty linking business data to zoning and land use patterns due to problems of cost, data quality, and data availability. The following looks at what we know about job creation and then examines the role of industrial land in the local economy.

Business dynamics

In theory, net new job growth (outside of the public sector and investment) may come from supply-side factors (lower costs of production), emergence of new markets, export expansion, and over the long-term, innovation and human capital endowments. But most of the studies about business dynamics

focus more on industry sector, firm size and firm age than land availability, due in part to the lack of reliable data on land occupancy and use.

Debates about business dynamics gained new momentum in the late 1970s as researcher David Birch began using establishment-level Dun & Bradstreet data to analyze how businesses create jobs (Birch, 1979, 1987). Birch found that small businesses (with 20 or less employees) created 66% of jobs in the U.S. between 1969 and 1976, attributing this dynamic to a high rate of business start-ups. His later work determined that the majority of job generation actually occurred among a small number of successful, larger firms, many of which were so-called "gazelles" (Birch & Medoff, 1994; Henrekson & Johansson, 2010).

Although Birch's general emphasis on the importance of small firms has, by and large, stood the test of time, his data and analysis missed several dynamics critical to job creation. First, these gazelles are not necessarily start-ups; in fact, the "high-impact" firms with rapid employment growth (in addition to revenue growth), accounting for most of private sector employment growth, tend to be older (on average, 25 years old (Acs, Parsons & Tracy, 2008). Second, net job growth is not closely related to plant size; high-impact firms exist across size classes (Acs et al., 2008; Davis, Haltiwanger, & Schuh, 1996). Third, large firms continue to play a significant role in the U.S. economy, with more stable growth potential, by providing the majority of jobs, paying the highest wages, maintaining higher success rates, and being more likely to adopt and implement technology (Harrison, 1994). Fourth, though firm births are particularly important for job creation, firm expansion yields the most net new jobs consistently over time (Neumark, Wall & Zhang, 2011). Establishments with fewer than 20 employees have the highest net new job creation rate, due to startup activity (Neumark et al., 2011).

Net new job creation may come not just from firm expansion or startups, but also relocations. Given the intense focus of policymakers and the media on business relocation, it is interesting to note how rare relocation actually is (Neumark, Zhang, & Wall, 2005; Brouwer, Mariotti, & Ommeren, 2004). Due to data constraints, just a few studies look specifically at business relocation dynamics. Studies of California business relocation have found that it plays a minor role in employment dynamics, responsible for just one percent of net new jobs (Kolko & Neumark, 2007; Neumark, Zhang & Wall, 2005). When firms do move, they don't move far, typically staying in the same cities, regions, and/or states (Chapple & Makarewicz, 2010). Firms rarely revisit the issue of their location: Imperfect information coupled with high sunk costs, social ties, and labor at the existing site, plus the costs for a site search, facilities move, and employee rehiring makes moving unattractive (Brouwer, et. al, 2004). The tendency of firms to stay in place makes inertia, not rational decision making, one of the most important location factors (Blair & Premus, 1993). When firms do move, it is typically due to external factors, such as mergers and acquisitions (Brouwer et al., 2004).

Industrial land and its role in the economy

In principle, zoning land to industrial use performs two different functions. Hierarchical zoning, separating lower (agricultural, industrial) uses from higher (commercial, residential), prevents the negative externalities associated with production from impacting less noxious uses. Further, it signals the types of physical and legal improvements that will be appropriate to maximize the land's productive capacity – i.e., the land's highest and best use (Heilbrun, 1974).

Of course, in practice, the idea that the market determines land use by the ability of different user groups to pay rent for the land is thwarted by the difficulty of changing zoning to respond to changing

market conditions. So industrial zoning may create inefficiencies by distorting the supply of land. For instance, as demand for industrial land declined in Philadelphia, planners did not rezone the land, impeding conversion and re-equilibration of the land market (Asabere & Huffman, 1991). Societal perceptions and biases also affect the rate of conversion: A study of New Orleans found that industrial land in predominantly White areas was faster to convert than that in minority neighborhoods (Frickel & Elliott 2008). Planners just reacting to developers rather than adopting a more comprehensive approach that analyzes the local economy may actually be enabling sub-optimal decision-making about industrial land conversion (Wolf-Powers, 2005).

Heikkila & Hutton (1986) use the term "exclusionary zoning" to refer to policies that preserve industrial zoning (typically in the urban core) by prohibiting higher uses despite market interest. This policy has costs in that it may mean inefficient use of resources, inhibition of industrial transition, and impacts on the local tax base in ways that are rarely made explicit. However, it may be appropriate to pursue exclusionary zoning under certain conditions, in particular (1) when the industrial district is economically viable, functioning as a business incubator or housing businesses linked to other local clusters; (2) when there is a high level of structural unemployment; or (3) negative externalities are an issue. Exclusionary zoning can not only keep rents low for businesses but also provides certainty to developers about city intentions. However, Heikkila & Hutton caution that it should not be implemented in the absence of a comprehensive industrial strategy and complementary policies such as infrastructure development and direct business incentives.

More recent work highlights the contribution of industrial areas and their activities to the regional economy: as job generators; providers of supplies and services, such as back-office functions or automobile repair, to businesses and households; and reservoirs of low-cost space that can incubate

startup businesses (Howland, 2011). However, critics continue to raise the issue of inefficiency, arguing that the external benefits of manufacturing in particular are not high enough to warrant the cost to the city of subsidizing the land, and slowing the relocation of these businesses to more appropriate areas may actually impede regional economic growth (Hills & Schleicher, 2011).

Industrially zoned land performs a role in the regional economy as a reserve of relatively low-cost land and large buildings with potentially flexible use: many industrial sites can accommodate not just production but also back-office functions, storage, loading, parking, and even research and development. They can also be subdivided when firms decrease in size. In contrast to more modern office buildings, this type of space offers firms the flexibility they seek in today's economy, with the ability to shift between vertical and horizontal organization, and to easily add or shed employees. This benefit augments the argument by Heikkila and Hutton (1986) about the conditions under which exclusionary zoning for industrial land is in the public interest.

In practice, exclusionary zoning for industrial use has existed in a few cities (most notably, Chicago and New York) since the 1980s, due to fears that demand from commercial and residential uses was displacing viable industrial businesses (Fitzgerald & Leigh, 2002). Some of these districts -- called Planned Manufacturing Districts in Chicago, Industrial Protection Zones in San Francisco – permit the mixture of uses in the districts, but limit land availability for non-industrial users.

Across the U.S., many municipalities and counties have recently undertaken studies of industrial land supply, typically in response to developer pressures to convert the land to residential, commercial, or mixed use. It is mostly the strong market regions that are re-evaluating how much industrial land they need.[ii] A recent review of over twenty such studies found three general concerns leading to industrial

land preservation: the recognition that industrial businesses (or more broadly, production, distribution and repair firms) support both the residential sector and other businesses, that they need to be located close by their customers, and that the availability of affordable land is key to maintaining these businesses (Dempwolf, 2010).

Policy recommendations for the preservation of industrially zoned land generally follow three tactics: regulation, incentives, and penalties. Regulatory changes include restricting the types of uses that can locate within a zone, instituting criteria for land conversion, and rezoning land. Incentives may include brownfield remediation or site assembly. Key among land assembly strategies is the industrial land trust or bank, an approach in which the public sector acquires industrially zoned land and leases it to qualifying uses; examples include the Marine Industrial Park in Boston, the Brooklyn Navy Yard, and the Cleveland Industrial-Commercial Land Bank (Hausrath Economics Group and Cambridge Systematics, Inc., 2004). Penalties include increased enforcement of zoning and building codes as well as impact fees or community benefits for non-industrial uses located in industrial zones.

More recently, advocates for the preservation of industrial land have drawn again on the argument first made by Cohen & Zysman (1987) that manufacturing matters. The relatively strong performance of manufacturing during the economic recovery has led some to advocate a new industrial policy (Pollin & Baker, 2010; Christopherson, 2011). As Christopherson (2011) argues, the recent resurgence of manufacturing – led in part by foreign investment -- is due largely to changing production costs (rising transportation costs, falling energy costs), a weak dollar, and competitive wages. Another line of argument lies in the rise of sustainable manufacturing, in particular the new viability of the waste conversion industry (Leigh, 2011).

Just one study explicitly examines the relationship between industrial land availability and firm expansion (Meigs & Wiles, 2010). A survey of 88 firms in the East Bay found that when businesses are expanding, office firms are more likely to move all operations to a larger site, while industrial uses either acquire more square footage at current site or increase their hours of operation. The major barriers to creating new jobs are labor costs, space costs, and access to capital.

Looking forward

Despite the plethora of evidence about the continued need for industrial land in the urban core (Dempwolf, 2010), little is understood about the relationship of industrial land to job creation. Industrial land studies have made the case that industrial jobs are closely related to other sectors, offer well-paying jobs, and benefit from a central location, but they tend to be descriptive in nature, i.e., fail to establish a causal link between industrial land designation and job creation or retention. Our understanding of job creation, particularly net new job creation, relies largely on analysis at the national and state, rather than municipal or neighborhood, levels. Part of the problem has been the lack of data, i.e., the inability of researchers to link changes in firm size to parcel-level zoning. But the overarching issue was raised by Heikkila & Hutton twenty-five years ago: cities fail to link their zoning to a comprehensive industrial strategy. The reasons for this are beyond the scope of this paper; the purpose herein is to show that we now have the tools to make this connection.

Methods and case selection

This study examines the four older core cities of the San Francisco Bay Area's East Bay: Berkeley, Emeryville, Oakland, and Richmond, with a particular focus on their industrial land, located near the

waterfront (see Figure 1). Because of its extensive industrial land, high land values, and conversion pressures, the East Bay is an extreme case study. Extreme cases are appropriate to study to uncover patterns and processes that are too subtle to be discerned in less extreme circumstances (Yin, 2009).

FIGURE 1 ABOUT HERE

While connected to the fortunes of the greater Bay Area, the East Bay early developed its own distinct and diversified economy, with strengths in transport, logistics, and manufacturing. Despite the decline and decentralization of goods-producing industries throughout the latter half of the twentieth century, cities like Oakland and Richmond still maintained high rates of growth and job creation, mostly through a rapid transition to a service economy with niches in health care and education, but also via steady employment in production, distribution, and repair industries. The East Bay weathered the dot com crash in the early part of this century better than most areas, attracting tech industry workers from San Francisco and the South Bay, and contributing to a local boom in construction and housing finance. This, in turn, put pressure on industrial land owners to convert prime areas along the waterfront to residential and office uses. However, the recent housing and economic crises have slowed overall development in the region.

This study relies on the National Establishment Time-Series database (NETS), a private-sector generated database that combines Dun & Bradstreet data on individual establishments into an annual time-series from 1990 through 2008. By providing data at the establishment level, rather than an aggregate geographic unit of analysis, it allows ready analysis of how individual establishments change over time. Shortcomings include costs, accuracy, and consistency over time (see Kroll, Lee & Shams, 2010 for a detailed discussion). Because year-over-year employment data may underestimate change due to

inconsistent record updating by Dun & Bradstreet, we use change in employment over a three-year period (as recommended by Neumark et al., 2005).[iii]

We constructed a database with detailed information on every business that has been located in the four cities between 1995 and 2008, which allowed us to look at job creation at all points of the business cycle.[iv] We linked this database to both 2005 parcel data from the Alameda and Contra Costa county tax assessor's office and zoning shapefiles from the individual cities.[v] To link the business to the parcel data, we used the latitude and longitude information contained in the NETS data to map the locations and movements of every establishment that has been in the East Bay between 1995 and 2008. Every year of a firm's life is thus connected to a particular location. This made it possible to identify and exclude data for years when firms were located outside the East Bay; for instance, if a firm started in Los Angeles in 2000, moved to Oakland in 2002, and then went back to Los Angeles in 2007, we only included its data for years 2002-2006. Because the database connects firm data with place-based information (zone, building square footage, etc.), it offers an unusually detailed profile of the economic activity in the East Bay industrial zones.[vi]

This paper uses ordinary least-squares (OLS) regression analysis to study the relationship between business expansion and place-based characteristics, including zoning. A variable representing business employment change is regressed on a variety of place-based characteristics and control variables. To account for the fact that many firms have not been present in the East Bay for the entire 13 year period, the regression was weighted by the number of years that each firm has been present in the target study area. In other words, if the firm above were in Oakland from 2002 to 2006, it would be represented in five different records, and thus count five times as much as a firm present for just one year. To control for this, i.e., to make our unit of analysis *firms* rather than *firm by year*, we weighted (in this example by

1/5, or 0.2). In order to capture business expansion, we created a dependent variable that measures the change in the number of employees over a three-year period. The sample only includes firms that existed in both the beginning and end year (in other words, it excludes firm births and deaths).

Table 1 describes the independent variables used in the analysis. From the NETS data, the database included firm age, number of jobs at the onset of the three-year period, and sales revenue at the onset of the three-year period. Each firm was located within a "neighborhood," with boundaries based loosely on policing districts. This control variable was used to capture heterogeneity across spatial communities, focusing specifically on the industrial zones. Each firm was also located within a municipal zone, a grouping of broad categories (industrial, commercial, residential, and open space/public land). Dummy variables at the 2-digit NAICS level represented industry sectors (aggregated into fewer categories for under-represented sectors in the East Bay).[vii] Dummy variables for each year allowed a time fixed effects analysis that in essence controls for the effect of the business cycle on the overall economy.

TABLE 1 ABOUT HERE

Variables representing aspects of the built environment are often collinear, meaning that they are highly correlated and often mutually reinforcing: e.g., a larger building is also likely to be a property with a higher assessed value. We examined multicollinearity by generating correlation matrices and variance inflation factors (VIFs) for each regression, and ensured that no VIFs exceeded a threshold value of 10. Because of multicollinearity issues, as well as incomplete data, we ended up excluding firm age and

including just two variables representing the physical property: building square footage and price per square foot.

In order to examine in more detail the differences between businesses that expand and those that contract, we then used discriminant analysis (calculated using SPSS statistical software). Discriminant analysis derives functions for these types of job change (based on the many independent variables discussed above) and assigns each firm to a group on the basis of its score. The overall score for each group is calculated by summing its weighted scores for each function, and weight is based on the percentage of the overall variation between job change categories accounted for by that discriminant function.

Discriminant analysis can be quite useful in social science and public policy research whenever the questions center on why phenomena are distributed into distinct groups or categories. As the name suggests, the methodology statistically evaluates factors that discriminate among two or more groups. It is similar in many respects to multiple regression, except that the dependent variable is structured around two or more discrete units much like logit or probit models. Discriminant analysis acts as confirmatory data analysis (Tukey, 1977), confirming pre-defined structures of the data. We define different groups based on known properties (in this case, change in employment), but not all properties are known. Discriminant analysis then helps us determine which characteristics most effectively describe and divide the groups.

Business Dynamics in the East Bay

Job creation can occur via business relocation into the area, new businesses starting up, or existing businesses expanding. Previous studies of California have found that the largest share of growth each year comes from startups (defined as businesses that started in the year for which job data is collected), followed by expansions; business relocations generate only a small share of growth (Chapple & Makarewicz, 2010; Neumark, Wall & Zhang, 2011). In the four East Bay Cities, the dataset indicated that there were 396,000 jobs in 46,300 firms in 2008, an increase of four percent in jobs and 39 percent in firms over 1995 (reflecting not only the increasing prevalence of small firms and startups but also the strengths and weaknesses of the NETS).[viii] Overall, 94 percent of firms have fewer than 20 employees, and 78 percent have fewer than 5 – rates slightly higher than the rest of the region and state. Over the period from 1995 to 2008, 55 percent (213,800) of jobs each year came from startups, on average – a higher concentration than in California as a whole. Firm relocations into the region (not including moves within the region) accounted for just 1.6 percent of all jobs (6,400), similar to the share found in the previous studies of California.

As noted previously, we use a three-year period to look at the role of firm expansions and contraction. According to the NETS data, most firms (78 percent) are static over any given three-year period, while 11 percent expand and 11 percent contract. Firm expansions accounted for 58,600 new jobs over every three-year period from 1995-2008, while contractions accounted for the loss of 41,100 jobs.

Comparing job creation via startups and expansions to the overall composition of the economy is instructive (Figure 2). Startups create jobs disproportionately in professional, scientific, and technical services, information, and management; retail; arts, entertainment and recreation; and other services. However, a disproportionate share of the jobs from firm expansion are in educational services, public administration, administrative services, and waste management; wholesale trade, transportation and

warehousing, and construction; professional, scientific, and technical services, information, and management; and manufacturing. Relocation brings jobs that are disproportionately in professional, scientific, and technical services, as well as manufacturing. Relative to the overall distribution of jobs, jobs from startups are disproportionately concentrated in residential zones (not surprisingly, as many firms start up at the place of residence), jobs from expansions in industrial and open space/public land zones, and jobs from relocation in industrial and residential zones (Figure 3).

FIGURE 2ABOUT HERE

FIGURE 3 ABOUT HERE

What is the relationship between zone and industry sector? If certain industries are concentrated in certain zones, then the role of zoning might just reflect changes in a particular industry. As shown in Table 2, industrial zones contain disproportionate shares of construction, manufacturing, wholesale, and transportation and warehousing firms, but otherwise look similar to the study area as a whole. Commercial zones most notably host concentrations of accommodation and food businesses, retail, and other services, while residential zones have concentrations of construction and professional service firms. Open space/public land house disproportionate shares not just of public sector establishments but also manufacturing, transportation and warehousing.

Shown in Table 3 are the descriptive statistics for firm and building characteristics in study area businesses. Average firm age is almost 14 years, and the average size is about 11 employees, with $1.3 million in sales. Buildings occupied by area businesses tend to be rather large, with an average of over 36,000 square feet; however, building square footage is reported for the entire structure, and there may be multiple occupants. Average price per square foot is $128 (in 2005 dollars), and the average age is 64 years (in 2005, so the average building was built before World War II).

Table 4 examines three characteristics of interest – three-year change in jobs and levels of jobs and sales in the initial year -- by zone, neighborhood, and industry. The majority (83 percent) of all businesses in the four cities are located in the commercial and residential zones, with just 14 percent in the industrial zones. Yet, businesses in these zones are much more likely to expand than those in other zones; over each three-year period from 1995 to 2008, they added an average of 0.72 employees, compared to 0.19 in commercial zones and 0.08 in residential zones. These businesses also start larger than their counterparts in other zones, except for open space/public land which includes many large public agencies.

TABLE 4 ABOUT HERE

Focusing specifically on the neighborhoods that contain industrial zones, Central East Oakland hosts almost one-fourth of all firms, followed by Fruitvale, West Oakland, San Antonio, and West Berkeley. Though neighborhoods like Port Richmond and Marina Bay have only a small share of firms, average firm size is considerably larger in these newer areas. In terms of three-year employment change, Emeryville and West Berkeley dominate, though they both average a gain of just one employee.

Overall, various types of service and retail firms dominate the local economy. However, it is the firms in wholesale, manufacturing, finance/insurance/real estate (FIRE), and administrative services and waste management that are most likely to expand.

The role of industrial land in firm expansion in the East Bay

To analyze further the role of industrial land in job creation via firm expansion, we look at change in firm size over three years as a function of various factors. Specifically, this analysis first uses OLS regression

to statistically test the significance of location in an industrial zone while taking other firm, building, and place characteristics into account. Table 5 shows the results for two models, one that looks at industrial zones relative to all other types of zones, and the second examining industrial, residential, and open space/public land zones relative to commercial zones. Though the models are highly significant, the *R*-squared of .124 suggests that these variables do not by themselves explain job creation; it is likely instead that factors internal to the firm such as liquidity or mergers and acquisitions play a critical explanatory role. Several variables, including firm size (measured in terms of both employees and sales), building square footage, and zoning, are highly significant in predicting employment change.[ix,x] However, despite controlling for industry sector, neighborhood, and year, none of these variables are significant.

TABLE 5 ABOUT HERE

Whether viewed in comparison to all types of zoning (Model 1) or just commercial zoning (Model 2) industrial zoning positively affects employment change. Being located on industrially zoned land results in 0.89 more jobs created relative to other zones, and 0.88 more jobs relative to just commercial zones. Regardless of industry sector, neighborhood, firm characteristics, and building characteristics, industrial zones seem particularly nimble at facilitating firm expansions.

But more than anything, firm size matters: in other words, the smaller a firm is in terms of employment at the initial point in time, and the larger its sales, the more likely it is to expand. For every additional job in a firm, the firm contracts by 0.07 jobs over three years, while for every million dollars in sales, the firm expands by 0.17 jobs. The inverse relationship between firm employment and sales suggests an interesting possibility, that it is the firms with high sales but low employment that tend to expand, while

those with both high sales and employment are more static or actually losing jobs. (Because of the possibility of interaction between these two variables, the model specification included an interaction variable as well, that was also highly significant with a slightly positive effect on jobs.)

In terms of building characteristics, total square footage is highly significant as a positive predictor of employment change. Perhaps the availability of space in a large building makes it easier for firms to add employees (confirming Meigs & Wiles 2010). However, price per building square foot is not significant.

Although the finding that smaller firms generate more new jobs confirms much of the research initiated in the 1980s, this analysis adds the finding that high sales levels matter too. But most importantly, these results suggest the importance of actual sites – location on industrially zoned land, regardless of neighborhoods, in a relatively large building. Because of data limitations, models developed in previous research have omitted this variable. Still, to improve the explanatory power of this model, it will be important to devise methods to incorporate other omitted variables, such as activities internal to the firm (changes in management), age of firm, age of building, building type, and startup status.

Using a discriminant analysis allows more precise differentiation among the factors that distinguish three types of firms: those that grew, those that remained static (0 employment change) and those that declined in size. By providing a distinct analysis for each of the three groups, it overcomes one shortcoming of the OLS regression method, which is predicting outcomes for a dependent variable that is dominated by static firms. Because multicollinearity and missing values are not an issue in discriminant analysis, it also allows examination of variables that could not be included in the OLS regression, including building age, firm age, and the professional services, information and management sector.

Two functions, both highly significant, differentiate among the three types of employment growth patterns (Table 6). To determine the relative importance of the independent variables in predicting the dependent, we look at function coefficients, which serve the same purpose as beta weights in multiple regression (Table 7). Overall, the model predicts 53 percent of the observations, with accurate results for 56 percent of the static group, 48 percent of the job gainers, and just 25 percent of the job losers. Firms growing in employment score particularly high on Function 1, which is associated positively with number of jobs in the initial year, firm age, and location in an industrial zone and in West Berkeley; Function 1 is negatively associated with location in a residential zone and building age. Firms losing jobs were also associated with Function 1, but not as strongly as firms gaining jobs. That both types of employment change were associated with Function 1 suggests that some variables are particularly salient in explaining volatility, whether in the form of job gain or loss. Job loss was positively correlated with Function 2, which is associated positively with firm age, jobs in the initial year, location in a residential zone, and building age, and negatively with location in an industrial zone and West Berkeley. Firms that neither grew nor shrunk in size were not strongly associated with either function.

TABLE 6 ABOUT HERE

TABLE 7 ABOUT HERE

We can use the structure matrix to look at the highest correlations between the functions and the variables to help explain employment growth, or in some cases, volatility (Table 8). In general, the results confirm the findings of the regression analysis, with the role of zoning standing out -- a positive relationship with industrial or commercial zoning, and a negative relationship with residential zoning. Other important variables include firm age (positive), building age (negative), and location in West

Berkeley (positive). Many of the variables that were either excluded from or insignificant in the regression analysis emerge as important here (including firm age, location in a commercial zone or West Berkeley, and building age). While these factors may not explain firms that remain static, they do help to differentiate firms that are changing rapidly, particularly those that are expanding.

TABLE 8 ABOUT HERE

Function 2 has considerably less explanatory power (explaining just 15 percent of the variance), but is useful in that it explains not just firm volatility but job loss in particular. Age of firm is by far the most important (and positive) variable, followed by employment in the initial year. That a firm's initial employment is positively correlated with both Function 1 and Function 2 suggests that it may work best to explain volatility generally, i.e., larger firms are associated with both job gains and losses. The regression analysis yielded a coefficient for firm employment that was negative but very small, perhaps reflecting this complex relationship.

The discriminant analysis provides several important findings that complement the regression analysis. First, some of the factors that are associated with job gain are also associated with job loss (perhaps contributing to the low explanatory power of the regression model). For economic developers, this suggests that in picking high probability winners to attract to our cities, we risk also choosing firms that are likely to lose jobs. Second, the analysis provides new information on the role of firm and building age, which were excluded from the regression model (due to missing data issues). The firms that expand are more likely to be older and to locate in younger buildings. The discriminant analysis also helps identify the contribution of other variables. For instance, the neighborhoods of West Berkeley, Marina Bay, and Emeryville are positively associated with Function 1, predicting volatility. Further research

should explore why certain industrial neighborhoods are more dynamic; these may not have been significant in the regression due simply to insufficient sample size. Further, sectors like professional services and manufacturing that did not contribute to the regression also perform strongly here, suggesting complex relationships with job change.

Conclusion and Policy Implications

This analysis examined business dynamics in the East Bay urban core, showing that zoning, particularly industrially zoned land, plays a significant role in firm expansion. While startups, as low-overhead home-based businesses, benefit from the ability to locate in residential zones, firms that expand – whether in production, distribution, and repair or information-based services – benefit from the ability to spill into available space in large buildings. Industrial zones seem to facilitate this slightly more effectively than commercial zones, perhaps because they have more of the "flex" space that allows firms to grow and shrink readily.

Though every region presents a unique context, several key variables here act to develop a construct for the role of industrially zoned land that will be valid in other regions with similar characteristics (proximal similarity). Specifically, this is an extreme case study in terms of its strong market, centrally located industrial land with conversion pressures, aging industrial buildings, and disproportionate share of small businesses, so these results are likely generalizable to other strong market regions with centrally located, older industrial districts and concentrations of small businesses. The different models consistently capture a role for industrially zoned land alone, controlling for other characteristics, essentially validating its importance in business dynamics. This resonates with numerous studies of other strong market regions experiencing pressure for land conversion in their older industrial cores, which help provide external validity to the empirical work presented here. However, more research is

needed, not only case studies to confirm these findings, but also models that help us understand the role of available industrial land in startups and relocations as well.

These results suggest a role for policymakers in retaining existing firms that are likely to grow, more than fostering startups and attracting new businesses from other areas. Although startups produce a disproportionately large share (55 percent) of new jobs, the results of the two multivariate analyses suggest that we have some tools to identify businesses that would like to expand and will be successful in doing so. Startups are volatile, turnover is rapid, and sole proprietorships may never add jobs. Likewise, though firm relocation into the region significantly affects employment growth, the share of net new jobs from relocation is just over one percent. Helping businesses grow in place – even though these findings suggest they will also be volatile -- is the safest bet.

If industrially zoned land is important to job creation via firm expansion, then it is important to link land use planning to a regional economic strategy. To target firms that are expanding, policymakers need to identify competitive local sectors and then locate the specific firms that are most likely to create new jobs – well established firms with 10-20 employees (relatively large in this context of the core of older central cities). The trick for policymakers will be to identify the businesses with latent potential for expansion, i.e., those with high sales relative to their employment.

The next step will be to determine the appropriate type of assistance. Previous work on this region (Meigs & Wiles, 2010) found through a business survey that industrial businesses seek more assistance with zoning and environmental regulations, while others are more concerned with access to capital or improving the built environment. Expanding in an industrial zone may entail permitting processes from

several different agencies, regulating building, zoning, environmental quality, and health. Businesses would benefit from streamlining and coordinating regulatory processes across agencies.

Spatially targeted programs may also facilitate business growth in certain areas. Though there is evidence that enterprise zones in California do not create jobs (Kolko & Neumark, 2009), enterprise zones may facilitate much needed access to capital particularly for capital investment and equipment.

Although this paper did not specifically examine the effects of policies to preserve industrial land, the analysis does have clear policy implications for cities deciding whether to retain their industrial zoning. Industrially zoned land contributes to the regional economy by providing flexibility, specifically, offering a reserve of relatively large sites that accommodate uses from storage to R&D. Some cities, while preserving their land as industrial zones, open it up to a broad list of users. For instance, San Francisco defined production, distribution and repair broadly to include new media businesses and even advertising. In the face of competition for land from higher rent-paying office uses, rents will escalate beyond the means of some of the firms that are contributing more jobs to the economy. Cities facing issues of structural unemployment may want to be more selective in the uses allowed to locate on industrial land in order to ensure that these expanding firms can stay. Alternatively, cities in strong market regions may want to devise less controversial tools for preserving industrial land, such as industrial land trusts.

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Figure 1. Four East Bay cities in the study area, with industrial zones.

Figure 2. Jobs by Industry Sector in the East Bay: Startups vs. Expansions

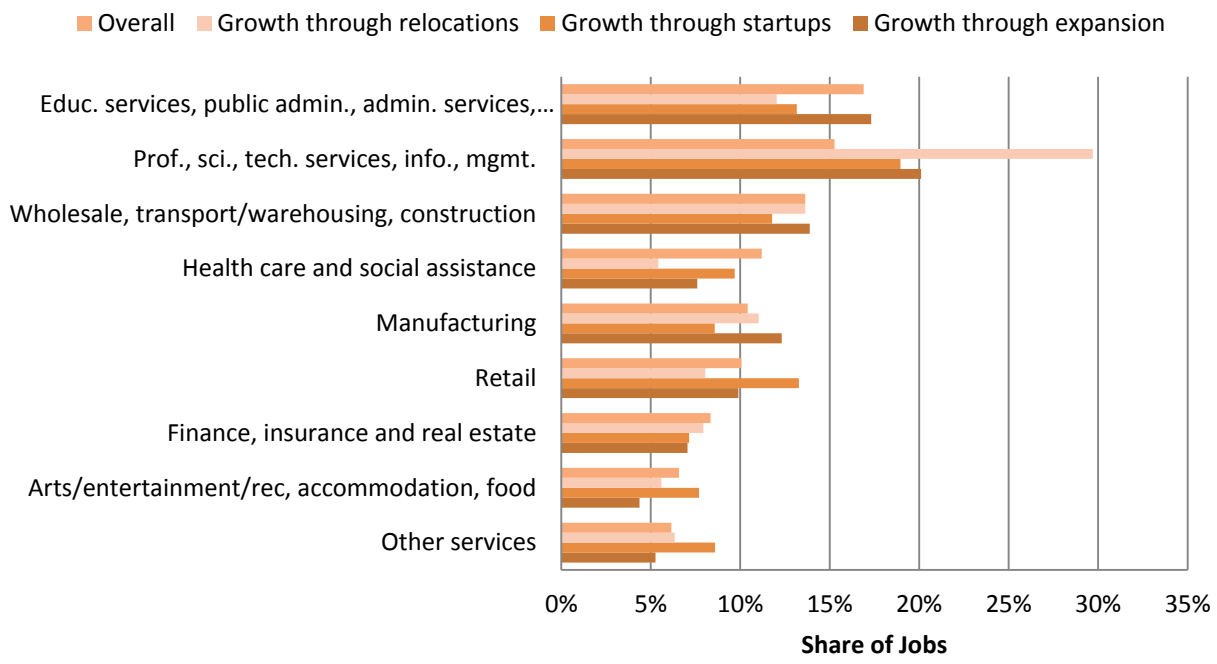

Figure 3. Jobs by Zone in the East Bay: Startups vs. Expansions

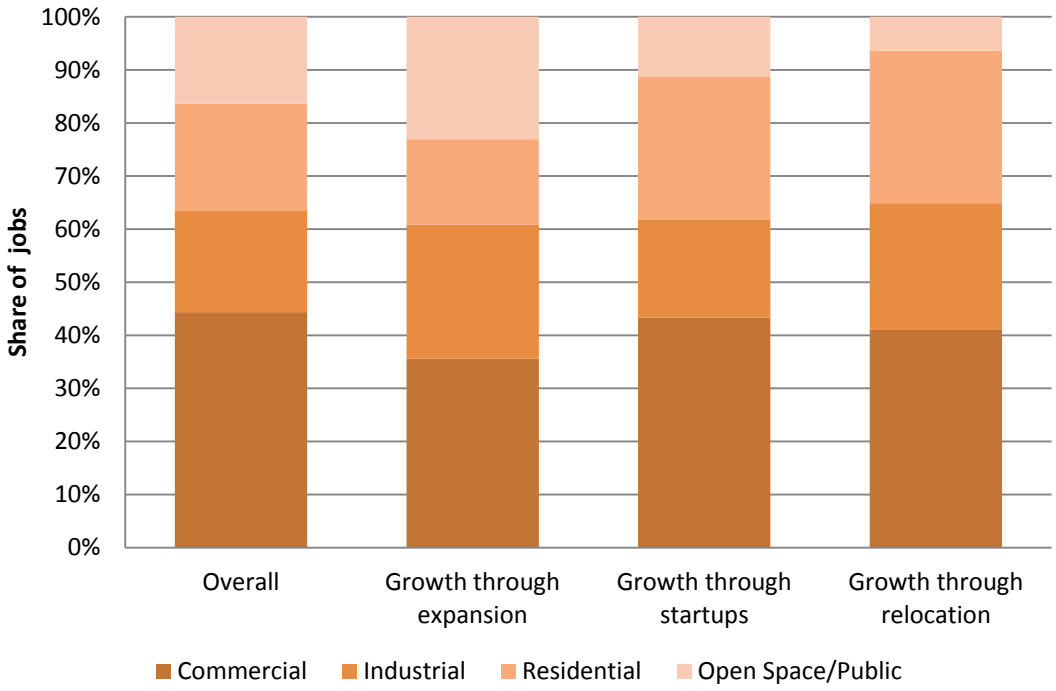

Table 1. Variables in the multivariate analyses.

Variable	Description	Source
Firm employment, year 1	# of jobs at this location at the onset of the 3-year period	1995-2008 NETS
3-year employment change	Change in number of employees, current year-3 years ago	1995-2008 NETS
Firm sales, year 1	Sales revenue at the onset of the 3-year period	1995-2008 NETS
Firm age	Number of years in business	1995-2008 NETS
Industry sector	14 dummy variables representing industry at the 2-digit NAICS level	1995-2008 NETS
Neighborhood	9 dummy variables to reflect the industrial neighborhood in which the firm is located	Shapefile based on 2010 municipal police districts**
Zone	Dummy variable to reflect location in a commercial, manufacturing, residential or other zone	2008 municipal zoning shapefiles
Building square footage	Total building square feet for the parcel on which the firm is located	2005 County Assessor's parcel data
Building age	Age of primary building on the parcel	2006 County Assessor's parcel data
Year	Final year of employment change (current year)	1995-2008 NETS

Table 2. Industry sector by zone, East Bay businesses 2005-08.

Sector	Industrial		Commercial		Residential		Open		Total	
	#	%	#	%	#	%	#	%	#	%
Accommodation and food	209	2%	1,752	6%	573	2%	41	3%	2,575	4%
Administrative services and waste management	596	6%	1,755	6%	2,740	10%	121	8%	5,212	8%
Agriculture, mining, and forestry	23	0%	51	0%	79	0%	1	0%	154	0%
Arts, entertainment and recreation	153	2%	431	1%	651	2%	47	3%	1,282	2%
Construction	792	8%	1,034	4%	2,249	8%	105	7%	4,180	6%
Educational services and public administration	161	2%	642	2%	800	3%	109	7%	1,712	2%
Finance, insurance and real estate	731	7%	2,570	9%	1,848	6%	110	7%	5,259	8%
Health care and social assistance	308	3%	3,020	10%	2,901	10%	120	8%	6,349	9%
Manufacturing	1,466	15%	1,566	5%	1,787	6%	131	9%	4,950	7%
Other services	880	9%	4,446	15%	3,580	12%	122	8%	9,028	13%
Professional services, information, and management	1,965	20%	5,538	19%	6,581	23%	330	22%	14,414	21%
Retail	1,337	14%	5,471	19%	3,651	13%	194	13%	10,653	15%
Transportation and warehousing	481	5%	377	1%	625	2%	54	4%	1,537	2%
Wholesale	796	8%	691	2%	613	2%	34	2%	2,134	3%
Total	9,898	100%	29,344	100%	28,678	100%	1,519	100%	69,439	100%

Table 3. Firm and building characteristics, East Bay businesses, 1995-2008.

Variable type	Variables	# of Firms	Mean	S.D.
Firm characteristics	Firm employment (year 1)	29,701	10.8	84.7
	Firm sales (year 1)	29,479	$1,271,094	$34,028,184
	Firm age	29,125	13.7	16.9
Building characteristics	Total building square footage	53,502	36320	124076
	Price per square foot (2005$)	52,952	$128	$199
	Building age	35,023	64.2	28.1

Table 4. Employment change and firm size by zone, neighborhood, and sector, East Bay businesses, 1995-2008

Variable type	Variables	# of Firms	Three-Year Employment		Employment in Year 1		Sales in Year 1	
			Mean	S.D.	Mean	S.D.	Mean	S.D.
Zone	Industrial zone	9,313	0.72	27.19	15.64	51.62	$2,130,726	$28,226,126
	Commercial zone	27,408	0.19	32.51	11.96	113.18	$1,514,304	$47,281,069
	Residential zone	26,840	0.08	13.73	6.55	46.50	$530,820	$6,414,230
	Open space or publicly owned land zone*	1,411	-0.07	47.36	25.27	105.61	N/A	N/A
Neighborhood	Central East Oakland	4,751	0.30	29.24	14.10	54.74	$1,493,654	$6,821,249
	Emeryville	2,275	1.14	23.39	16.46	67.00	$2,555,569	$22,871,904
	Fruitvale	3,307	0.03	8.35	7.71	28.50	$680,059	$3,030,639
	Marina Bay	511	0.14	33.53	21.79	56.27	$2,681,786	$7,814,116
	Port Richmond	35	-0.26	12.73	31.32	82.53	$6,358,028	$14,950,537
	Richmond Annex	1,192	-0.32	11.80	8.90	44.92	$821,699	$4,380,105
	San Antonio	2,979	0.05	7.24	8.25	43.57	$900,423	$17,638,721
	West Berkeley	2,568	0.59	13.65	10.63	31.24	$1,240,548	$4,732,305
	West Oakland	3,178	0.28	28.35	12.45	50.25	$1,378,346	$5,162,202
Sector	Accommodation and food	2,408	0.01	12.43	13.62	38.54	$499,663	$1,714,391
	Administrative services and waste management	5,040	0.48	16.42	8.74	33.33	$592,277	$2,244,666
	Agriculture, mining, and forestry	148	-0.92	27.86	12.31	54.53	$892,528	$3,159,164
	Arts, entertainment and recreation	1,238	0.25	8.19	7.40	22.03	$593,660	$3,490,823
	Construction	3,888	0.24	8.70	7.40	22.45	$1,209,523	$6,694,421
	Educational services and public administration	1,632	0.13	85.82	49.60	186.60	$2,287,688	$8,919,639
	Finance, insurance and real estate	5,002	0.55	30.41	11.79	209.19	$3,745,504	$114,400,000
	Health care and social assistance	5,908	-0.07	21.26	12.35	91.07	$722,220	$6,080,564
	Manufacturing	4,590	0.58	21.05	15.37	49.85	$2,044,296	$15,640,030
	Other services	8,384	-0.05	8.88	4.96	16.72	$362,475	$4,258,616
	Professional services, information, and management	13,507	0.38	30.83	7.99	69.87	$850,392	$11,087,493
	Retail	9,731	0.25	10.91	7.36	33.61	$1,079,730	$8,796,003
	Transportation and warehousing	1,458	-1.25	60.58	31.91	145.39	$4,882,420	$35,585,560
	Wholesale	2,036	0.66	8.68	8.82	22.76	$2,701,227	$53,427,857

* Consists primarily of public sector employers; sales not included.

Table 5. Explaining change in firm size over three years

		Model 1				Model 2			
Variable type	Variables	Unstand-ardized coefficient	Standard-ized (beta) coefficient	t-stat		Unstand-ardized coefficient	Standard-ized (beta) coefficient	t-stat	
	Constant	0.46		1.35		0.67		1.84	*
Zone	Industrial zone	0.89	0.02	2.43	**	0.69	0.02	1.79	*
	Residential zone					-0.35	-0.01	-1.59	
	OS/PL zone					-0.19	0.00	-0.16	
	Commercial zone (omitted)								
Firm char.	Jobs in Y1	-0.07	-0.33	-21.97	***	-0.07	-0.33	-22.00	***
	Sales in Y1	0.00	0.40	11.41	***	0.00	0.40	11.40	***
	Jobs x sales in Y1	0.00	0.21	7.34	***	0.00	0.21	7.36	***
Bldg char.	Tot bldg sf	0.00	0.01	2.30	**	0.00	0.01	1.98	**
	Price/bldg sf	0.00	0.01	0.93		0.00	0.01	0.95	
Neigh	C.E. Oakland	-0.04	0.00	-0.10		-0.04	0.00	-0.09	
	Emeryville	0.51	0.01	0.79		0.54	0.01	0.83	
	Fruitvale	-0.14	0.00	-0.31		-0.13	0.00	-0.30	
	Marina Bay	-0.25	0.00	-0.21		-0.25	0.00	-0.20	
	Port Richmond	-0.57	0.00	-0.13		-0.56	0.00	-0.13	
	Richmond Annex	-0.41	0.00	-0.47		-0.37	0.00	-0.43	
	San Antonio	-0.22	0.00	-0.48		-0.18	0.00	-0.39	
	West Berkeley	-0.16	0.00	-0.32		-0.15	0.00	-0.30	
	West Oakland	0.12	0.00	0.24		0.17	0.00	0.35	
Year	1995 (omitted)								
	1996	0.02	0.00	0.04		0.04	0.00	0.08	
	1997	0.04	0.00	0.08		0.05	0.00	0.11	
	1998	0.19	0.00	0.41		0.20	0.00	0.43	
	1999	0.23	0.00	0.49		0.23	0.00	0.50	
	2000	0.21	0.00	0.44		0.21	0.00	0.45	
	2001	0.13	0.00	0.27		0.13	0.00	0.27	
	2002	0.19	0.00	0.40		0.18	0.00	0.39	
	2003	-0.17	0.00	-0.38		-0.18	0.00	-0.39	
	2004	-0.15	0.00	-0.33		-0.15	0.00	-0.34	
	2005	-0.28	-0.01	-0.66		-0.29	-0.01	-0.67	
	2006	-0.06	0.00	-0.15		-0.06	0.00	-0.15	
	2007	-0.03	0.00	-0.08		-0.04	0.00	-0.10	
	2008	-0.02	0.00	-0.04		-0.04	0.00	-0.08	
Sector	AccoFood	0.10	0.00	0.19		-0.02	0.00	-0.04	
	AdminWaste	0.05	0.00	0.11		0.07	0.00	0.15	
	AgMineFor	-1.20	0.00	-0.62		-1.18	0.00	-0.61	
	ArtsEntRec	-0.34	0.00	-0.46		-0.32	0.00	-0.43	
	Construction	-0.34	-0.01	-0.75		-0.29	0.00	-0.66	
	EducGovt	1.03	0.01	1.34		1.05	0.01	1.36	
	FIRE	-0.29	-0.01	-0.71		-0.34	-0.01	-0.82	
	HealthSocial	0.05	0.00	0.14		0.03	0.00	0.08	
	Manufacturing	0.34	0.01	0.79		0.33	0.01	0.77	
	OthServices	-0.41	-0.01	-1.22		-0.46	-0.01	-1.35	
	Retail	-0.19	0.00	-0.59		-0.25	-0.01	-0.77	
	TranWarehouse	-0.60	-0.01	-0.79		-0.58	0.00	-0.76	
	Wholesale	-0.09	0.00	-0.16		-0.11	0.00	-0.20	
	ProfInMgt (omitted)								
*** p = .00, ** p < .05, * p < .10		N = 22,166 R^2 = .124, Sig. = .000				N = 22,166 R^2 = .124, Sig. = .000			

Table 6. Discriminant functions at group centroids.

3-year change in employment	Number of Cases	Function 1	Function 2
3-year job loss	8,024	0.318	0.188
Static	78,207	-0.078	-0.003
3-year job gain	9,216	0.380	-0.142

Table 7. Standardized Canonical Discriminant Function Coeefficients.

Variable	Function 1	Function 2
Firm employment (year 1)	.289	.431
West Berkeley	.237	-.244
Building age	-.206	.018
Residential zone	-.581	.281
Industrial zone	.254	-.244
Firm age	.255	.739

Table 8. Discriminant function-variable correlation matrix.

Variable Name	Function 1	Function 2
Residential zone	**-0.795**	0.271
Industrial zone	**0.605**	-0.345
Commercial zone	**0.449**	-0.069
Building age	**-0.371**	0.033
West Berkeley	**0.371**	-0.326
Total building square footage	**0.198**	0.032
Marina Bay	**0.152**	-0.074
Emeryville	**0.115**	-0.068
Prof. services, info. & mgt.	**-0.098**	-0.082
Manufacturing	**0.096**	-0.040
Firm sales, year 1	**0.083**	0.078
Open space/public land zone	**0.081**	-0.013
Wholesale	**0.075**	-0.038
Admin. services & waste mgt.	**-0.065**	-0.033
Accommodation and food	**0.055**	-0.014
San Antonio	**-0.050**	0.008
Construction	**-0.049**	0.013
West Oakland	**0.048**	-0.025
Port Richmond	**0.044**	-0.008
Fruitvale	**-0.036**	0.006
Education & public admin.	**-0.035**	0.035
Transport. & warehousing	**0.031**	0.005
Retail	**0.029**	-0.015
Arts, entertainment & rec.	**-0.027**	0.020
FIRE	**0.025**	0.021
Richmond Annex	**0.004**	0.001
Firm age	0.384	**0.750**
Firm employment, year 1	0.427	**0.478**
Other services	0.057	**0.104**
Health care & social assistance	-0.033	**0.065**
Agriculture, mining & forestry	0.012	**0.041**
Price per building sf	-0.025	**-0.029**
Central East Oakland	-0.001	**-0.011**
Function significance	***	***
Percentage of variance explained	84.8	15.2

[i] See, for instance, Los Angeles Mayor's Office of Economic Development, Industrial Development Policy Initiative for the City of Los Angeles Phase I Report (2004); San Francisco Planning Department, Industrial Land in San Francisco: Understanding Production, Distribution & Repair (2002).

[ii] A recent web scan (see http://communityinnovation.berkeley.edu/industrial-land-report.html) found studies in over 30 cities, including (as of 2009) includes nine jurisdictions in California (Los Angeles, Milpitas, Morgan Hill, Napa County, San Francisco, San Jose, Santa Clara, and Sunnyvale); the major cities of Baltimore, Boston, Charlotte, Chicago, Denver, Minneapolis, New York City, Portland OR, Seattle, Vancouver and Langley BC, and Washington DC; and miscellaneous other places such as Lee County, Florida; Ames, Iowa; Harford County and Prince Georges County, Maryland; East Fishkill, NY; Kirkland, WA: Arlington County, VA; and the states of Maryland, Oregon, and Rhode Island.

[iii] When Dun & Bradstreet representatives do not obtain updated information on firm employment in a given year, they use the employment figure from the previous year.

[iv] The choice of time period was also dictated by the years for which we could obtain clean data.

[v] The City of Berkeley had not digitized its zoning layer, so we drew it manually. Zoning boundaries were accurate as of 2008. For the purposes of this analysis, we assume that they reflect zoning in place in the late 1990s. We argue that this is not an unreasonable assumption because cities are slow to change their zoning boundaries, and even slower to change broad designations (e.g., from industrial to residential as opposed to from industrial to mixed use).

[vi] Even after cleaning the NETS data, many errors remain. For example, the latitudes and longitudes provided by NETS data are not accurate within five yards – meaning that, when mapped in ArcMap, a point may be located near but not within the parcel where the business is actually located. We attempted to control for this by joining points to parcels based on the shortest distance, but the remaining inaccuracies require the built environment variables to be interpreted as block-level trends. Finally, because county parcel data does not have complete information for all parcels, not all built environment variables are available for all of the businesses in the NETS database.

[vii] The NETS database provides both NAICS and SIC codes for each business, simplifying time series analysis.

[viii] The NETS database not only underreports employment change but also may overreport firms by neglecting to remove them from the database when they die.

[ix] Standardized coefficients are provided to allow the reader to compare the magnitude of the effect of different variables.

[x] Because sales had a non-linear relationship with job growth (jobs did not), the initial model included a quadratic term for this. Howeer, this created a collinearity problem and did not change any of the model results (in terms of coefficient direction and significance). Thus, it was excluded from the final model.